Analysis on Technical Efficiency of Hybrid Maize Production in District Mirpurkhas, Sindh

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Abstract

In order to analyze the technical efficiency of hybrid maize production in Mirpurkhas district of Sindh province, a survey was carried out during the year 2014-15. Empirical model for the total production of maize on farms was used and approximated by Cobb-Douglas production function involving various production associated factors. Technical efficiency for maize farms in sample area was 0.48 and most of the farms were technical inefficient below 0.50. The values of overall technical efficiency maize farmers ranged from 0.177 to 0.980. This implies that there is significant scope to increase efficiency levels. The frequencies of technical efficiencies indicated that sample farmers were categorized in three efficiency groups with low (<90%), medium (90-95%) and high (>95%) efficiency and assessed that 90 percent of the maize farms had low efficiency (<90%) and remaining 10 percent were highly efficient (above 95%) in district Mirpurkhas. The poor technical efficiencies imply that the soil quality, inadequate canal water, insect pest and poor extension services could be the causes of this low efficiency. There is significant scope to increase efficiency levels and extension services should be used to increase the technical efficiencies of the inefficient farms. A decline in overall technical efficiencies may be due to a complex of factors and increase in the rate of diffusion of technology and optimal farm management practices encouraged by extension services and programs should increase the technical efficiencies of the inefficient farms in the study area.

Keywords: *hybrid maize; inefficient; farms; Mirpurkhas; Sindh*

1. Introduction

Maize grain is a vital nourishment grain and delivers a variety of items as crude material for multi items and quality increases. It contributes 2.1 percent to the worth included agribusiness and 0.4 percent to GDP. Territory under maize crop has diminished to 1130 thousand hectares in 2014-15, demonstrating a decline of 3.3 percent over a year ago's region of 1168 thousand hectares. The creation of maize harvest remained at 4.695 million tons amid 2014-15, demonstrating 5.0 percent diminish in the course of the most recent year generation of 4.944 million tons. The generation diminished because of decline in range sown. Amid 2014-15, the gram beat, one of the significant heartbeats developed in rainfed ranges on minimal grounds recorded generation of 484 thousand tons against the creation of 399 thousand tons amid the same period a year ago, saw a development of 21.3 percent because of expansion in territory and great climate condition. The creation of Bajra, Jawar, Rapeseed and Mustard and Barley saw diminish in its generation by 14.3 percent, 13.4 percent, 9.9 percent and 9.0 percent, separately amid 2014-15 when contrasted with the same period a year ago. The diminishing underway is because of lessening in range sown (GOP, 2015).

Maize is a standout amongst the most potential oats become all around, and is the third after wheat and rice altogether sustenance grain generation. Because of its high versatility and profitability, the development of maize spread quickly around the world and right now it is being delivered in many nations of the world. In India as well, maize is developing as the third most vital product, after rice and wheat. Maize was customarily developed as staple nourishment, fundamentally for family unit utilization, however its interest for food and mechanical uses has

expanded quickly in the later past. In our nation, more than 50 for each penny of maize produce is being utilized as creature food (Singh *et al*., 2003).

Maize being the most noteworthy yielding grain crop on the planet is of critical significance for nations such as Pakistan, where quickly expanding populace has officially out stripped the accessible sustenance supplies. In Pakistan maize is third imperative oat after wheat and rice. Maize represents 4.8% of the aggregate trimmed territory and 3.5% of the estimation of farming yield. The mass (97%) of the aggregate generation originate from two noteworthy areas, KPK, representing 57% of the aggregate range and 68% of aggregate creation and Punjab contributes 38% land with 30% of aggregate maize grain creation. Almost no maize 2-3% is created in the area of Sindh and Sindh. Additionally an extremely developing and high yielding segment of maize, the spring maize range and generation in Punjab is not represented , which covers around 0.070 million ha with around 050 million tons of maize grain being delivered. (Shah, 2014). Hence, there is have to examine the generation and specialized effectiveness of the half and half maize so as to prescribe approach prospects for its manageability.

Ordinarily, the effectiveness levels are low when contrasted with the global per section of land efficiency: doubtlessly, a percentage of the variables contributing towards the low profitability are crazy. This wastefulness is likewise termed as specialized wastefulness built up its idea. Comprehensively talking, specialized wastefulness is the inability to deliver most extreme yield from a given level of inputs (Basnayake and Gunaratne 2002). This efficiency has two parts: specialized and allocative. Specialized efficiency is the capacity of a firm to create a maximal yield from a given arrangement of inputs or it is the capacity of a firm to use as unobtrusive inputs as could be allowed for a given level of yield. The previous is called info arranged measures and the last is known as yield situated measures of specialized effectiveness. Profitability can be in wrinkled through more productive usage of assets of ranchers and inputs with current innovation. In this study, efficiency of maize makers of District Chiniot is assessed. Interrelationship between efficiency level and different firm particular components gives valuable approach related data. Primary goal of the study is to figure the specialized effectiveness and determinants of wastefulness of maize producers (Hassan, 2004).

For the most part the homesteads with the same assets are creating diverse per section of land yield, as a result of administration wastefulness. The insufficient or no part of augmentation administrations, poor right of section to credit, occupant development, low efficiency rate, poor interchanges offices, and long separation from business sectors describe wasteful ranches. At present yield level is still up to some degree lower than the capability of our current assortments. Primary limitations to improve maize profitability are unfavorable climate conditions, inaccessibility of information at legitimate time, imperfect plant thickness, late sowing, lacking manure use, deficient water supply, weed infestation, bug bother assault and the determination of unsatisfactory cultivars under a given arrangement of situations. Subsequently, an agriculturist's capacity to build his salary and efficiency level is obliged by various components of which numerous drop out of his control (Tahir *et al.,* 2008). A large portion of the proportions or efficiency components examined as yet are required during the time spent investigation of the records. Their motivation, all in all, is to show a solid or feeble point in the association or operation of the business and to point out the particular stages or edges of the business where more noteworthy administrative consideration is required. What's more, there are different proportions that are regularly utilized as a part of a more broad investigation. They manage the relationship in the middle of expenses and returns, relationship of capital speculation to pay, and the rate of action or turnover of the capital. Taken a toll proportions are midpoints and their extents reflect physical generation efficiency.

Therefore, the present study has been planned to analysis the technical efficiency of maize in district Mirpurkhas of Sindh province with aims to the following objectives:-

2. Objectives

1. To study the profile of hybrid maize growers in the Mirpur Khas district Sindh.
2. To estimate the return to scale of hybrid maize growers.
3. To identify issues and suggest policy recommendations.

3. Methodology

The technical efficiency of maize production in Mirpurkhas district of Sindh province were investigated during the year 2014-15, using empirical model for the total production of maize on farms, likely to be approximated by

Cobb-Douglas production function involving various production associated factors. The main purpose of this chapter is to describe the sampling procedure, sample size and method of data collection. This chapter consists of different sections such as: provides as insight into the study area, discusses the selection of the study crop, sampling techniques applied and sample size, questionnaire development and its pre-testing, variables in the analysis study, difficulties faced by the researcher during data collection and the limitations of the study.

3.1 Overview of the Research Area

The study was conducted in the mixed cropping system of different talukas of district Mirpurkhas of Sindh province. The district of study has unique history and it was the largest district of the province. Later, the district has been divided into three districts, namely Mirpurkhas, Umerkot and Tharparkar.

3.2 Sampling Procedure

Mirpurkhas district has three talukas i.e. Mirpurkhas, Kot Ghulam Muhammad and Digri. A four stage sample design was used for collection of information from the field. First stage units were talukas, second stage units were union councils, third stage units were villages and fourth stage units were farmers. Stratification at the first stage was done by taluka, two union councils were selected from each taluka. Of these six union councils, two villages were selected from each union council and five randomly selected farmers were selected from each village. Thus, categorically a balanced, representative stratum from three talukas of the district was finalized to a size of 100 respondents. For managing the last stage sampling unit i.e. farmers, a list of farmers in each selected village was prepared and necessary information was obtained regarding, name of the farmer, area owned, area rented in/out, area share cropped in/out, ultimate operational farm holding and their location on the water course. The list of farm respondents in each selected village served as frame for sampling. Sample was stratified according to farm size and classified as different farm sizes. In all 100 farmers were selected from the twelve villages, 5 farmers from each village, keeping in view the composition of farm size in the selected villages and their location on the water course.

3.3 The Questionnaire

The questionnaire for the survey was designed to illicit for details about maize operations on the farms in the study area. Information concerning, farm size (acres), source of irrigation, age, education etc. were collected. The output and input data were obtained on per farm and per acre basis in the survey.

3.4 Pre-Testing

According to Casley and Kumar (1988) a newly constructed questionnaire should be pre-tested on a few pilot respondents in order to identify weaknesses, ambiguities and omissions before it is finalized for the survey itself. Pre-testing provides an opportunity for the researcher to improve the questionnaire by adding something which they feel is missing or by deleting something which is unwanted or changing something that is not clear to the respondents. In this study, a comprehensive questionnaire was established and pre-tested in sample areas. As a result of the pre-testing some minor changes were made. The interviews were conducted in the local language. In some cases, the farmers were not available at the first visit; therefore, the interviewer had to pay a second visit to these respondents.

3.5 Estimation Method

Cobb-Douglas production function was used to find out the responsiveness of dependent variable (yield) to independent variables (fertilizer, animal labor, human labor, water application, pesticide application, number of plowing, weeding, farmyard manure, seed rate application and other inputs for maize crop. Following is the conceptual regression model to study relationship between yield and input factors.

According to Heady and Dillon (1960), the Cobb-Douglas function provides:

a)   An adequate fit of the data.

b)   Computational feasibility.

c)   Sufficient degree of freedom to allow for statistical testing.

Cobb-Douglas function in the study was in the form as follows:

$$Y_i = \beta_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9$$

Where,

Y = Dependent variables (yield)

X_1 = Fertilizer use

X_2 = Animal labor use

X_3 = Human labor use

X_4 = Seed rate application

X_5 = Number of plowing

X_6 = Pesticide application

X_7 = Water application

X_8 = weeding

X_9 = farmyard manure

β_0, β_1, β_2, β_3, β_4, β_5, B_6, β_7, β_8, β_9 are the parameters, which describe the way of function, behave.

For estimating the model, it has been transformed into log linear form by entering log to both sides of equation.

$$LogYi = \beta_0 + \beta_1 logX_1 + \beta_2 logX_2 + \beta_3 logX_3 + \beta_4 log X_4 + \beta_5 logX_5 + \beta_6 logX_6 + \beta_7 logX_7 + \beta_8 logX_8 + \beta_9 log X_9$$

The data were collected through field survey. The sample of 60 respondents from each cotton, wheat and sugarcane growers was selected through cluster sampling technique. Data were collected from growers by means of questionnaire, designed for the purpose. Data so collected were tabulated analyzed and interpreted in the thesis.

3.6 Data Limitation

In the study area, a considerable number of farmers were illiterate and many do not keep records of the inputs and outputs. This study suffers from weaknesses associated with the survey interviews when data accuracy depended heavily on the respondent's ability to recall past information and to answer the survey questions accurately. Such efforts were minimized by re-interviewing the farmers in case of any inconsistencies. However, some errors and discrepancies are unavoidable in this kind of study, despite every precaution.

4. Results

The study was carried out during the year 2015 to analysis the technical efficiency of production in District Mirpurkhas of Sindh province Pakistan and to look into the estimate the return to scale of hybrid maize growers and identify issues and suggest policy recommendations.

4.1 Maize Crop

The data of descriptive statistics for maize crop in Mrpurkhas district. The data indicated that the average farm to road distance was 2.1 and the standard error was 0.369 kilometer and varied from 1 kilometer to 6 kilometers while the average area on which maize was grown on the sample farms was 12.95 and the standard error was 0.389 acres, but the area under maize varied from 2 acres to 54 acres. The average age level of the respondent farmers in the sample area was 37.1 and the standard error was 2.391 years, but the age of respondents varied from 22 years to 66 years.

The average level of education of the respondent farmers in the sample area was 5 and the standard error was 1.378 years of schooling, but a considerable number of farmers were illiterate being no schooling years as minimum level, while the maximum average level of education in the sample area was 14 years of schooling showing a considerable number of graduate respondent farmers. The data indicated that the average land rent per acre per annum in the sample area was 2725 with the standard error was 135.89 rupees, but the minimum level of land rent was 1500 rupees per acre and the maximum level of land rent per acre was 3500 rupees per acre Similarly, a land tax was being charged at an average level of 304 rupees per acre and all the respondent farmers in the sample area paid the same rate of land tax.

The average number of plowing per acre given to maize area sown in the sample area by the farmers was 3.55 with the standard error was 0.788, but the number plowing varied from 2 to 5 per acre. The data indicated that the average weddings per acre given to cotton area sown in the sample area by the farmers was 3.20 and the standard error was 0.117 and the number of weeding varied from 2 to 4 per acre, the average number of irrigation per acre given to maize crop sown in the sample area by the farmers was 5.8 and the standard error was 0.137 and the number of irrigation varied from 5 to 7 per acre.

The average number of family labour plus permanent hired adult labour used on the sample farms was 2.3 persons per farm, but the number of family labour plus permanent hired labour varied from 1 as minimum number of laborers

to 7 as the maximum number of labourers per farm in the sample area. The average quantity of cotton seed per acre used for maize sowing in the sample area by the farmers was 6.50 with the standard was 0.917 kg, and the seed quantity varied from 5 to 10 kilograms per acre. It was further noted that the average quantity of DAP fertilizer per acre given to maize in the sample area was 0.85 and the standard error was 0.166 bags, varied from 0 to 2 bags per acre. The average nitrophos fertilizer per acre given to maize in sample area was 0.80 and the standard error was 0.117 bags, varied from 0 to 2 bags per acre, while quantity of urea fertilizer per acre given to maize crop in the sample area was 1.85 with the standard error was 0.082 bags per acre varied from 1 to 2 bags per acre. The average bags of nitrate fertilizer per acre given to maize in the sample area were 0.90 and the standard error was 0.123 bags per acre, varied from 1 to 2 bags per acre. The average quantity of pesticides per acre applied to maize in the sample area was 2.55 and the standard error was 0.114 liters varied from 2 to 3 liters per acre. The average production of maize yield per acre at the sample farms was 29.35 mounds, showing a minimum yield of 16 mounds, while the maximum yield of 40 mounds (Table-1).

Table 1. Descriptive Statistics for Assessment of Efficiency Level of Maize Crop Growers

Variables	Mean values	Stand Error	MinimumValue	Maximum Value
Distance from road (km)	2.1	0.369	1.00	6.00
Area of cotton (acres)	12.95	2.391	2.00	54.00
Age (Years)	37.10	2.391	22.00	66.00
Education (Years)	5	1.378	0	14
Land Rent (Rs/acre)	2725	135.893	1500	3500
Land Tax (Rs/acre)	304	0	304	304
Plowing (Number)	3.55	0.788	2	5
Weeding (Number)	3.20	0.117	2	4
Irrigation (Number)	5.80	0.137	5	7
Labours (Number)	2.90	0.323	1	7
Seed rate (kg/acre)	2.30	0.091	2	2.50
DAP (Bags)	0.85	0.166	0	2
Nitrophos (Bags)	0.80	0.117	0	2
Urea (Bags)	1.85	0.082	1	2
Nitrate (Bags)	0.90	0.123	1	2
Pesticides (Liters/acre)	2.55	0.114	2	3
Yield (Mounds/acre)	29.35	1.616	16	40

4.2 Estimates of Stochastic Frontier Production

The maximum likelihood estimates of the parameters of the stochastic frontier production function are obtained by using the computer programme, 'Frontier 4.1' developed by Coeli (1996). The parameter estimates are presented in Table-2 along with their standard errors and t-values.

The Cobb Douglas production function was found to be an adequate representation of the data, given the specification of the corresponding Translog Frontier Model. The value of coefficient for nitrogen application to maize variable is 1.33, indicates that one percent increase in the nitrogen increase the maize production by 1.33 percent. The value of coefficient for phosphorus variable is 1.34, denotes that one percent increase in the phosphorus increase the maize production by 1.34 percent, while coefficient value for potassium variable is 0.99, indicates that one percent increase in the potassium, increase the maize production by 0.99 percent. Coefficient value for pesticides variable is 0.93, indicates that one percent increase in the pesticides; increase the maize production by 0.93 percent and coefficient value for seed rate variable is 0.31 showing that one percent increase in the seed rate, increase the maize production by 0.31 percent. The coefficient value for sowing date variable is 1.39, indicates that one percent earliness in the sowing date, increase the maize production by 1.39 percent and coefficient value for seed quality variable is 0.38 showing that one percent improvement in seed quality, increase the maize production by 0.38 percent. The value of coefficient for irrigation numbers variable is 1.49 indicates that increase of irrigation, increase the maize production by 1.49 percent.

Table 2. Maximum Likelihood Estimates for Parameters of Stochastic Frontier Production for Maize Farmers in Mirpurkhas District

Variable	Coefficient	Standard Error	T-value
Nitrogen	1.3386	0.0134	5.10
Phosphours	1.340	0.0423	3.68
Potassium	0.9991	0.0831	-0.00
Pesticides	0.9328	0.1348	-0.71
Seed rate	0.3186	0.0012	2.25
Sowing rate	1.3931	0.0562	3.68
Seed quantity	0.3834	0.09842	2.72
Irrigation	1.4950	0.0543	0.65

4.3 Technical Efficiency

Technical efficiency for maize growers is examined using stochastic production function approaches. The empirical application used farm-level data from different areas of district Mirpurkhas. Mean efficiency scores are invariant of the method of estimation under the assumption of constant returns to scale. On average the technical efficiency of irrigated maize farming in Mirpurkhas district was 0.48. Maize is the most important agricultural commodity in Mirpurkhas district of Sindh province, but not a single maize farm reached techncial efficiency of 1.0 and most of the maize sample farmers had technical efficiency below 0.50 (Table-3).

The comparative poor performance in terms of overall technical efficiency is in the southern and eastern regions of the district. This may be purely due to the differences in soil quality and inadquate availability of canal irrigation. Most of the south and east parts of Mirpurkhas district are tailends of canals and there is severe water shortage in these areas. However, in the weastern areas and north, the condition of canal water is satisfactory. The mean values of overall technical efficiency range from 0.177 to 0.980 (Table-3).

Table 3. Technical Efficiencies of Sample Maize Farmers Obtained Using the Cobb-Douglas Stochastic Frontier Production Function Model

Number of farms	Maize farms
1	0.508
2	0.177
3	0.763
4	0.267
5	0.570
6	0.252
7	0.228
8	0.562
9	0.449
10	0.166
11	0.697
12	0.354
13	0.291
14	0.273
15	0.515
16	0.980
17	0.534
18	0.968
19	0.383
20	0.669
Average	**0.480**

4.4 Frequencies of Technical Efficiencies

Factors under lying higher efficiency than the average of the sample could make interesting study. For this purpose, the sample farmers were categorized in three efficiency groups with low (<90%), medium (90-95%) and high (>95%) efficiency as indicated in Table-4. The above table exhibited that 90 percent of the maize farms in Mirpurkhas district fallen under the category of low efficiency (<90%), while zero sample farms producing maize in the Mirpurkhas district fallen in the category of medium efficiency (90-95%). However, two of the 20 farms producing maize fallen under the category of high efficiency (above 95%) and the percentage of the farms under this category remained 10 percent of the total sample farms producing maize in district Mirpurkhas.

Table 4. Frequencies of Technical Efficiencies for Maize Farmers in the Mixed Farming System of District Mirpurkhas

Range of technical efficiencies	Number of farmers	Percent
< 0.90	18	90.00
0.90 to >0.95	0.00	0.00
>0.95	02	10.00
Total	20	100.00

5. Conclusion and Suggestions

Analysis of technical efficiency for maize production in district Mirpurkhas of Sindh province concluded that there are significant possibilities to increase efficiency levels in maize production on average in Mirpurkhas district.

5.1 Suggestions/Recommendations

1) The poor technical efficiencies imply that the soil quality, inadequate canal water, insect pest and poor extension services could have had an influence on technical efficiency in the sample area.

2) There is significant scope to increase efficiency levels and extension services should be used to increase the technical efficiencies of the inefficient farms.

3) In addition, there exists a decline in overall technical efficiencies due to a complex of factors and increase in the rate of diffusion of technology and optimal farm management practices encouraged by extension services and programs should increase the technical efficiencies of the inefficient farms in the study area.

4) The government should announce the support price of maize crop on the basis. Quick and cheap transport and communication facilities should be provided to farmers at farm level. Farm to market, roads should be constructed by government

5) Good quality and high yielding varieties of seed should be supplied before sowing of maize crop in Pakistan.

6) Supplies of genetically improved and high quality seed needs to be insured by the government. There is a need to strengthen research activities.

7) Sindh Seed Corporation should produce hybrid varieties of seed in sufficient quantity to meet the increasing demand of farmers

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