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Do Farm Service Centers Improve Technical Efficiency of Chickpea Growers in Karak District, Khyber Pakhtunkhwa – Pakistan

Khuram Nawaz Sadozai[1], Rizwan Ahmad[2], Fida Muhammad Khan[3], Amjad Ali[4], Tajala Ahmad[5] & Shah Fahad[6]

[1] *Associate Professor, Department of Agricultural & Applied Economics, Faculty of Rural Social Sciences, The University of Agriculture Peshawar, Pakistan. Email: ksaddozai@aup.edu.pk*
[2] *Director Planning & Development (P&D), The University of Agriculture Peshawar, Pakistan*
[3] *PhD Scholar, Department of Agricultural & Applied Economics, Faculty of Rural Social Sciences, The University of Agriculture Peshawar, Pakistan*
[4] *Assistant Professor, Department of Agricultural & Applied Economics, Faculty of Rural Social Sciences, The University of Agriculture Peshawar, Pakistan.*
[5] *Research Fellow, ACIAR Pulses Project, Department of Agricultural & Applied Economics, Faculty of Rural Social Sciences, The University of Agriculture Peshawar, Pakistan*
[6] *Research Scholar, Department of Agricultural & Applied Economics, Faculty of Rural Social Sciences, The University of Agriculture Peshawar, Pakistan*

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Corresponding Author:
Khuram Nawaz Sadozai
Email: ksaddozai@aup.edu.pk

ABSTRACT

The central theme of this research endeavor was to assess the impact of Farm Service Centers (FSCs) on the technical efficiency of chickpea growers in District Karak, Khyber Pakhtunkhwa. Data were collected from chickpea growers, including both members and non-members of FSCs. Primary data were gathered from 120 chickpea growers in three villages of Karak district namely Meerzal Banda, Alam Gulkhel Banda, and Zariwaal Banda by using a multistage stratified random sampling technique. A Stochastic Frontier production function was applied to estimate technical efficiency. The results of the Stochastic Frontier Model indicated that most variables were statistically significant. The mean technical efficiency was calculated at 80%, suggesting that chickpea growers could improve their production by 17%. It is recommended that farmers may be supported with new technologies and essential inputs by the government, as these were significant contributors. Furthermore, Farm Service Centers should enhance their services and provide basic inputs at reasonable prices.

Introduction

The agriculture sector makes a substantial contribution to Pakistan's economy, accounting for approximately 24 percent of the country's Gross Domestic Product (GDP). However, the share of agriculture in the GDP of the country is significantly decreased over the period of time (GOP, 2020-21). Pakistan benefits from diverse climatic conditions, enabling the cultivation of various crop species across the country. Globally, around 170 countries grow pulse crops, with a recent estimated production of approximately 77.474 million tons. India, the leading producer, contributes an estimated 19.98 million tons.

Chickpea (*Cicer arietinum*), the world's third most significant food legume, has a limited genetic base due to its single lineage and self-pollinating nature. Chickpea varieties are categorized into two main types based on seed size, shape, and color: Desi, with small seeds, and Kabuli, with larger seeds. Chickpea is cultivated in tropical, subtropical, and temperate regions; the Kabuli type thrives in temperate areas, while the Desi type is primarily grown in semi-arid tropical regions (FAO, 2014). Chickpeas are mainly cultivated in sandy, rain-fed areas, and their production relies heavily on rainfall timing and distribution. Timely rains in Barani (rain-fed) areas play a crucial role in improving crop yields.

Pakistan ranks 19th globally in pulse production, with an estimated 688 thousand tons. In 2013-14, the total area cultivated for chickpea was around 4.4 thousand hectares, producing approximately 3.6 thousand tons at an average yield of 818 kg/hectare. The total area under Masoor (lentil) was 18 thousand hectares, with a production of 81 thousand tons and an average yield of 445 kg/hectare.

Farm Service Centers (FSCs) were established in Khyber Pakhtunkhwa (KP) in 2007 as a provincial government initiative to enhance agricultural services and support for farmers. These centers provide resources, technical assistance, and modern agricultural inputs to improve the efficiency and productivity of small and registered farmers. FSCs are equipped with crop inputs (seeds, fertilizer), mechanization resources, and a revolving fund designed to offer farmers subsidized rates for agricultural inputs. The primary focus of these centers are to offer technical backstopping and supply crop inputs to farmers. This research study aims to assess the effect of FSCs on the technical efficiency of chickpea growers in District Karak.

Justification of the study

Pulses are among the lucrative crops in the southern districts of Khyber Pakhtunkhwa. However, due to the low yield of these crops, pulse growers are discouraged from cultivating pulses. Additional factors, such as the absence of a support price for pulses, high labor requirements, and reliance on conventional agricultural practices, also compel farmers to switch to other crops. Despite this scenario, Karak district continues to produce chickpea as a major crop. Although pulse growers fetch less profit margin as most of the harvest is sent directly to pulse mills in Punjab province, chickpea cultivation still occupies a significant area in Karak district. Furthermore, due to inadequate crop management practices, growers are not technically efficient enough to achieve optimal yields. Therefore, this study aims to identify the main constraints faced by pulse growers and to estimate the technical efficiency of both registered and non-registered pulse growers in the study area.

Specific Objectives of this research study

The major objectives are mentioned below:

To compare technical efficiency of chickpea crop of member and non-members of farm service center in research area.

1. To identify the inefficiency factors that affects the efficiency of chickpea production.
2. To propose recommendations on the basis of findings of this study.

Hypotheses

1: $H_{o:}$ The Technical Efficiency of Farm Service Center (FSC) Farmers growing chickpea is different from Non-FSC Farmers.

$H_{I:}$ The Technical Efficiency of Farm Service Center (FSC) Farmers growing chickpea is similar to Non-FSC Farmers.

2: H_o Crop management skills of FSC and Non-FSC Farmers are affecting the efficiency of the chickpea growers.

H_l Crop management skills of FSC and Non-FSC Farmers are not affecting the efficiency of the chickpea growers.

Data & Research Methodology

Material and methods cover the major analytical framework of the research, that how the research methodology is formulated and which econometric as well as statistical tools have been employed for the research study? The research methodology designed for this research endeavor is highlighted as follow:

Universe of the study

The study has been conducted in district Karak of Khyber Pakhtunkhwa, Pakistan. District Karak is chosen because of its soil and weather which is most suitable for Chickpea crop. Another reason for selection of district Karak is that it's ranked as 1^{st} in chickpea production in Khyber Pakhtunkhwa.

Sampling design and sample size

Sampling Frame

The list of pulses growers who are member and non-member of Farm Service Centers (FSC) has been obtained from the Agriculture Extension department of District Karak. This list has been considered as the sample frame of this research endeavor. Furthermore, the required sample design and size has been made from this sample frame.

Sample Size Determination

Minimum sample size has been determined by using the Solvin formula. It's a random sampling technique used to determine minimum sample size given below.

It is computed as $n = N / (1+Ne^2)$…………………… (1)

Where;

n = no. of samples

N = total population

e = error margin (standard confidence level is 90% to 95%).

$n = N/1+Ne^2$

$n = 200/1+200(0.05)^2$

$n = 120$

By putting these values in (eq1) 120 chickpea respondents were estimated as sampled chickpea farmers.

Sample Design and Data Collection:

Primary data has been collected from the sampled farmers by using a multi-stage sampling technique. In the first stage of sampling district Karak has been selected purposely which is tremendously producing Chickpea crop. Three villages namely Meerzal banda, Alam Gulkhel and Zariwal Banda has been selected from district Karak in the second stage of sampling. Thirdly Minimum sample size and of selected samples has been estimated by applying Stratified Multistage Sampling Technique and sample size of members and non-members were equally selected from all the villages After calculating the minimum sample size in the fourth stage farmers has been selected through proportionate allocation sampling techniques (Cochran, 1977).

$n_i = n*N_i/N$

Whereas;

n_i = Number of respondents in ith village

$_i$ = Number of villages in the research area (i= 1, 2, 3)

n = Total sample size

N_i = Total number of respondents in i^{th} village

N = Total number of respondents in the research place

n_1 (Meerzal banda) = 80/200 * 120 = 48

n_2 (Alam Gulkhel Banda) = 50/200 * 120 = 30

n_3 (Zariwal Banda) = 70/200 * 120 = 42

Table 1: Proportional allocation sampling technique

Villages	Total farmers	Sample size	Member	Non-member
Meerzal Banda	80	48	24	24
Alam Gulkhel Banda	50	30	15	15
Zariwal Banda	70	42	21	21
Total	200	120	60	60

Source: *Author's Calculation*

Analytical frame work

Theoretical frame work

In developing countries, the efficiency of farms is very necessary objectives. Economist trying to get maximum output from given level of input (Battese and Coelli, 1995). The measurement of efficiency and productivity developed by the Koopmans and Debreu (1951) work, which was further explained by Farrell (1957). Farrell categorized efficiency into technical efficiency, allocative efficiency and economic efficiency. Technical efficiency shows the differences in production of farmers. It's actually measured the gaps that exist among farmers actual production and the production that a farmer can produced from given inputs. The allocative efficiency represent the ability to produce a given level of output using cost minimizing input ratios and combination of technical and allocative efficiency is called economic efficiency (Khan and Ghaffar, 2013).

Model specification

Stochastic frontier production function

Stochastic frontier production function was independently proposed by Aigner, Lovell and Schmidt (1977) and Meeusen and Van den Broeck (1977). The functional form of stochastic frontier function is given as (Coelli *et al.* 1998; Battese (1992); Bravo-Ureta and Pinheiro (1997) and Coelli and Perelman (1999):

Y_i = $f(X_i\beta) + e_i$ i = 1, 2, 3………. n

Whereas,

Y_i = Output of chickpea for the ith farmer in kgs/acre

f = Suitable function such as Cobb-Douglas production function

X_i = Input used in production of chickpea in units/ha

β_i = Coefficient to be estimated

e_i = $v_i - \mu_i$

Whereas;

e_i = Composite error term

v_i = Random error having zero mean

μ_i = Non-negative truncated half normal

The first error component, vi, is assumed to be independently and identically distributed and symmetric. This error term represents the random effects, measurement errors, omitted explanatory variables and statistical noise. The second error component, $\mu i \geq 0$, is assumed to be independently and identically distributed with mean, μ, and variance, $\alpha^2\mu$, which is also known as farm specific factor, which has an association with the technical inefficiency of the farm and has a value between zero to one. (Khan, 2012)

Technical Efficiency

The farm specific technical efficiency can be calculated as;

TE = Y_i / Y^*

Whereas;

Y_i = Observed output of ith farm

Y_i^* = frontiers output of ith farm that can be achieved

TE_i = technical efficiency of ith farm that ranges between 0 and 1.

Where, 1 indicate most efficient farm and 0 indicate most inefficient farm.

Empirical Model

The empirical model of Cobb-Douglas functional form has been used for chickpea growers specified as;

$$\ln(Y) = \beta_0 + \beta_1 \ln x_1 + \beta_2 \ln x_2 + \beta_3 \ln x_3 + \beta_4 \ln x_4 + \beta_5 \ln x_5 + \beta_6 \ln x_6 + \beta_7 \ln x_7 + \varepsilon_i$$

Whereas;

ln = Natural logarithm
Y = output of chickpea
$\ln x_1$ = Seeds used (kg/acre)
$\ln x_2$ = Tractor hours per acre
$\ln x_3$ = Labor man days per acre
$\ln x_4$ = Urea in kgs per acre
$\ln x_5$ = FYM in kgs per acre
$\ln x_6$ = Number of irrigation per season
$\ln x_7$ = volume of pesticides and weedicides for one acre

D1 = dummy variable is equal to one if FSC members and zero otherwise
ε_i = error term and defined as $(v_i - \mu_i)$
v_i = Random error
μ_i = technical inefficiency error
β_o = constant term
β_i = regression coefficient of the i^{th} variable

Determinants of inefficiency

The technical inefficiency model based on Battese and Coelli (1995) was specified as;

$$\mu_i = \delta_o + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 + \omega_i$$

Whereas;

Z_1 = Age of the farmer
Z_2 = Farming experience of the farmer
Z_3 = Education of the farmer
Z_4 = Area under chickpea
Z_5 = Cost of Production
μ_i = Technical inefficiency error term
ω_i = Random error term
δ_i = Coefficient to be estimated

Estimation of Technical Inefficiency of individual Chickpea Farmers

For the estimation of technical efficiency of individual chickpea growers, the formula has been used.

$$TE_i = Y_i/Y_i^*$$

Whereas;

Y_i = Observed output of ith farm

Y_i^* = frontiers output of ith farm that can be achieved

TE_i = technical efficiency of ith farm that ranges between 0 and 1.

For the estimation of technical inefficiency of individual grower, the following formula was used.

$$TI_i = 1 - TE_i$$

RESULTS AND DISCUSSION

The major findings of this research study are described in this section. These estimated results are presented in the tabulated form by employing the descriptive statistics and econometric analysis.

Farming Experience of Chickpea Growers

Farming experience can elevate the crop management practices of the farmers with the passage of time. Usually, the more farming experience can result to précised panacea to various crop issues.

Owing to more experience farmer can handle the farm related problems by his/her own. Therefore, the respondents were asked about their farming experience. After computing the farming experience data, the mean value of farming experience of the sampled respondent was reported as 20.74 years having standard deviation 7.67. The mean farming experience of the respondents from Meerzal banda is 19.40 years ranging from 8 to 50 years with standard deviation of 7.95. However, the experience of the pulses growers in village Alam Gulkhel Banda was reported with mean value 20.50 years. Last but not the least the mean level of Zariwal Banda is found as 22.50 years with minimum 5 years and maximum 36 years and standard deviation is 8.12.

Table 2: Descriptive statistics of farming experience of sampled respondents

Village	Min	Max	Mean	S.D
Meerzal banda	8	50	19.40	7.95
Alam Gulkhekl Banda	6	32	20.32	6.94
Zariwal Banda	5	36	22.50	8.12

Source: *Survey Data, 2022-23*

Area under Chickpea Crop

Area under cultivation is the vital cog of any crop production. Well crop management by the grower can result in significant increase in crop yield. Though small cropped area is easy to manage but large area under cultivation with appropriate crop management practices can leads to lucrative output. The estimated results depict that an average area under cultivation in Karak district is 4.54 acres with minimum of 2 and maximum of 10 acres. Summary descriptive of each village is also illustrated in Table 3.

Table 3: Descriptive Statistics of Area under Cultivation:

Village	Min	Max	Mean	S.D
Meerzal banda	2	10	3.70	7.95
Alam Gulkhekl Banda	2	7	4.12	1.48
Zariwal Banda	2	9	5.82	1.43
Total	2	8.6	4.5	3.62

Source: *Survey Data, 2022-23*

Chickpea Farmers’ Attributes

Production efficiency can be affected by various variables such as age, household, education, number of male and female members in the household etc. Education has an important role in enhancing the efficiency of producers as found by previous studies Abdullai and Huffman (2000) as well as Owns *et al.* (2001). It is deemed that an educated farmer can efficiently allocate the given farm resources that subsequently leads to high crop production. The age of the farmers can play an important role, however age can contribute positively or negatively to the production. The aged farmers have generally more experience in crop production so they can enhance the crop yield. Household size can also significantly contribute the crop yield. Larger the size of household higher will be the number of members contributing in farming activities. The results reveal that the age of the farmer in the research area was reported with a mean value of 53.38 years and standard deviation of 14.18. Whereas, the education of the respondents ranged from 8 to 16 years with a mean of 11.37 years and standard deviation of 2.64. Results of study further showed that the standard deviation of household size is 1.57 with mean of 6.9 members. Household size was also determined as a part of demographic analysis which divulge that minimum number of male in the household were observed as 2 and maximum was 9 individuals with a mean computed as 4.56 members while the number of female ranged from 1 to 4 with a mean of 2.33 members.

Table 4: Summary Statistics of Farmer's Attributes

Attributes	N	Min	Max	Mean	Std. Dev
Age (in years)	120	24	84	53.38	14.18
Education (in years)	120	8	16	11.37	1.92
Male	120	2	9	4.56	1.27
Female	120	1	4	2.33	.639
Households	120	3	11	6.9	1.57

Source: *Survey Data, 2022-23*

Major Variables used in the Model

Major crop's inputs are usually same with minor variation depends upon the need of the specific crop. Chickpea yield can be driven by various crops' input which includes Farm Yard Manure (FYM), Tractor Hours, Labor Days, Urea, DAP etc. In the present study the mentioned explanatory variables were considered as the reason for variation in chickpea yield. The minimum quantity of seed application by Chickpea growers was determined as 12.5 kgs while maximum quantity of seed used were 26.66 kg. An average value of Seed application was calculated from primary data as 15.89 Kgs. Crop management practices are usually rendered by Labours which can substantially affect the yield of chick pea. The number of labor employed ranges from 5 to 13 with a mean of 8.78 and had standard deviation of 2.64. The number of tractor hour ranged from 1 to 2 hour per acre with a mean of 1.03 hour per acre and had standard deviation of 1.22. The minimum amount of DAP applied were 0.12 bag (6 kg) per acre and maximum amount of bags were 1 bag per acre with mean of 0.34 bags per acre and had standard deviation of 0.14. The other chemical fertilizer applied by respondents to their crop ranged from 0.12 bag to 1 bag per acre and had standard deviation of 0.38 with a mean of 0.34 bag per acre. The quantity of farm yard manure applied by the respondents ranged from 0.33 to 2.5 trolley per acre with mean of 1.03 trolley and standard deviation of 0.46 as given in Table 4.

Table 5: Descriptive statistics of Major Variables

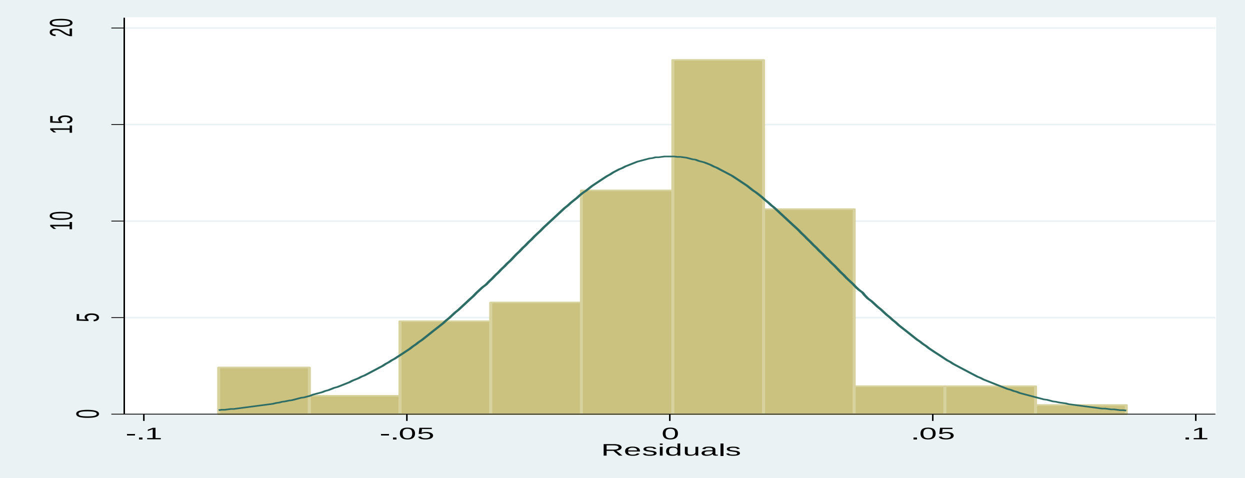
Major variables	N	Min	Max	Mean	Std. Dev.
Seed kgs /acre	120	12.5	26.66	15.25	2.64
Labor days	120	5	13	8.28	1.73
Tractor hours	120	1	2	0.82	1.22
Dap (bags/acre)*	120	.12	1	0.31	.14
Urea (bag/acre)	120	.12	1	0.32	.21
FYM (Trolly/acre)**	120	.33	2.5	0.90	.46
Pesticides	120	.17	1	0.40	.157

Source: *Survey Data, 2022-23* (*1 bag = 50kg, **1 trolley = 500kgs)

Econometric diagnosis

Normality test

To check the normality of the error term, histogram was constructed using Stata software. The output is given in figure 1. The distribution of the error term shows that the mean value was zero and the distribution was symmetric on both sides. This confirmed that the error term for the estimated Cobb Douglas model was normally distributed.



Test for Heteroscedasticity

Breusch-Pagan test was used to determine the heteroscedasticity problem in the given model. The resulted p value is given as follow:

Chi^2 = 0.84

P-value = 0.3583

The estimated p-value was found to be statistically insignificant that confirmed no problem of heteroscedasticity in data.

Multicollinearity Test

VIF has been used to detect the problem of multicollinearity. For this the VIF for each explanatory variable was estimated and the results are given in Table 6. The results revealed that the variance inflation factor for all the variables was 1.86. As the calculated value is not exceeding 5 so there is no problem of multicollinearity in the present study. If the VIF value calculated more than 5 or 10 than there will be association between the explanatory variables Gujrati third edition, Pp 339).

Table 6: Estimates of Variance Inflation Factor

Variable	VIF	1/VIF
Seed/acre	1.69	0.591
Labor	1.88	0.532
Urea(bag)	2.49	0.401
Dap(bag)	1.96	0.511
FYM(trolley)	1.53	0.655
Tractor	1.06	0.944
Pesticides	1.37	0.727
Dummies	2.93	0.314
Mean VIF	1.86	

The Stochastic Frontier Analysis

Stochastic Frontier Analysis is a parametric approach used to estimate efficiency of any farm or firm. First step in analysis of efficiency in economic model is to estimate cobb-Douglas production function. The results obtained from frontier mirror that either the firm has achieved the maximum possible output with available set of inputs or working inefficiently. The frontier is considered as a gauge in estimation of technical efficiency and the deviation from frontier are used as a measure of technical inefficiency. Stochastic frontier analysis tells that how much the farm or firm deviates from the frontier. These deviations from the frontier are considered as the consequence of inefficiency and the factor that are not under the control of the individuals.

The maximum likelihood estimates of cobb-Douglas production function revealed that the significant economic variable were: seed, labor days, urea, and pesticides which implies that majority of the explanatory variables were significantly contributed to the chickpea production. It is evident that coefficient of most of the explanatory variables have positive sign and were in the line of economic theory. However the results for Farm Yard Manure and both chemical fertilizers i.e DAP and Urea has showed insignificance. The insignificant effect of these fertilizers might be their low use in the study area. The reasons for low use of these fertilizers could be that sampled farmers were not be able to afford the expenditure of DAP and urea. The low responsiveness of chickpea yield an increase in the amount of DAP and urea could be that some chickpea growers used them inappropriate quantity. As a result of this inappropriate application it is evident that in raising chickpea yield both the fertilizers had a negligible effect. In addition poor timing of application of both the fertilizers could be another contributing factor to an insignificant effect. The results are in accordance with the previous study of Ahmad (1998) and Kibara (2005). The coefficient of seed was .455 which showed that 1 percent increase in the seed amount keeping other things constant had enhanced the yield by .455 percent. The results illustrated that 1 percent increase in labor days keeping other variables constant had increased the chickpea yield by .107 percent. This situation underscores that the chickpea is labor intensive and high responsiveness than urea. Seed, labor days and pesticides are significant at 1 percent i.e ($P<0.01$). The coefficient of pesticides was .023 which revealed that 1 percent increase in pesticides application without any change in the other variables the yield had increased by .023 percent. The Elasticities sum of all the inputs was 1.861 i.e ($Ep>1$) which suggests that the farmers in the research area had the increasing return to scale. Increasing return to scale implies that if all the inputs involved increase by one percent the total input will increase but more than one present.

The variance parameter lambda (λ) is related with the goodness fit of stochastic production model and accuracy of the composed error term. The calculated value of lambda (λ) was 1.441 which is significantly diverse from zero showed that the employed stochastic production model was good fit and is properly measured the composite error term. The Gamma (Γ) parameter is obtained from the results is 0.81 which employs that inefficiency factors that are unexplained by the production function result 82 percent variation in stochastic production model as shown in Table 7.

Table 7: Maximum Likelihood Estimates

Independent variables	Coefficient	Std. error	t-ratio	Significance
Constant	-0.447	0.094	-4.75	0.000
Ln Seed	0.456	0.058	7.84	0.000
Ln labor days	0.1076	0.049	2.18	0.029
Ln Dap	-0.0144	0.0257	-0.56	0.575
Ln Urea	0.0737	0.0245	3.01	0.003
Ln FYM	0.0403	0.017	2.37	0.018
Ln Pesticides	0.0237	0.0184	1.29	0.198
Ln Tractor	1.174	0.029	39.42	0.000
Dummies	12.47	2.7l	4.49	0.000
Sum of elasticity of inputs	1.861			
Sigma v	0.019	.003		

Sigma u	0.038	.006		
Sigma2	0.002	.0003		
Lambda λ	2.036	.008		
Gamma($\Gamma = \lambda^2/1+\lambda^2$)	0.81			
Likelihood	294			

Source: Author's own estimation

Technical Inefficiency Estimates

The inefficiency parameter with positive sign shows that the technical efficiency is decreasing and the negative sign have direct relation of the parameter to efficiency. The age and the education have negative sign which showed that both the parameter have positively role in decreasing the inefficiency of the chickpea farmers. This Implies that education and age can increase the efficiency of chickpea growers while the Experience have no role in technical efficiency of study area. According to estimated result the coefficient of dummies was .039 i.e members are more significant as compare to non-members in the research area.

Table 8: Inefficiency Estimates

	Coefficient	Standard error	t-ratio	P-value
Constant	14.959	10.50	1.42	0.015
Age	-0.179	0.061	-2.92	0.004
Education	2.480	0.322	7.72	0.000
Experience	-0.011	0.095	-0.12	0.902
Dummies	0.039	0.012	3.25	0.001

Technical Efficiency Indices

The results of descriptive statistics for technical efficiency are given in Table 8. The results of the study showed that the mean technical efficiency of the respondents of selected area was 93 percent with minimum range of 70 percent and maximum range was 99 percent. The mean technical efficiency of chickpea growers was 93 percent which needs to improve their production with available resources.

Table 9: Technical Efficiency indices

Observations	Min	Max	Mean	S.D
120	70	99	93	0.047

Technical Efficiency Spectrum Analysis of member and non-member of FSC

The different ranges of technical efficiency of members and non-members are illustrated in Table 10. The registered farmer's i.e members of Farm Service Centre fell in the range of 71 to 97 percent in which the technical efficiency of majority farmers were 86 to 90 percent and more than 90 percent. The technical efficiency of some of the farmers fell in the range of 71 to 75 percent and 76 to 80 percent. There were some of the farmers i.e non-members of Farm Service Centre have technical efficiency ranged from 60 to 85 percent in which the technical efficiency of most of the farmers were 60 to 65 percent and 66 to 70 percent while only 13 percent of the non-member farmers have the technical efficiency above 80 percent. The comparison of the efficiency scores between the members and non-members showed that the farmers which are the members of Farm Service Centre were highly technically efficient than the non-members.

Table 10: Frequency Distribution of Technical Efficiency

Efficiency score %	Member of FSC	Non-member of FSC	Total farmers
60-65	0 (0.00)	20 (33.33)	20 (16.66)
66-70	0 (0.00)	15 (25.00)	15 (12.5)
71-75	5 (8.33)	10 (16.66)	15 (12.5)
76-80	7 (11.66)	10 (16.66)	17 (14.16)
81-85	10 (16.66)	5 (8.33)	15 (12.5)
86-90	13 (21.66)	0 (0.00)	13 (10.83)
>90	25 (41.66)	0 (0.00)	25 (20.83)
Total	60 (100)	60 (100)	120 (100)

Conclusion

The major results concluded that the seeds and labor are two substantial significant Factors which can enhance the chickpea production by 0.456 and 0.107 percent when increase in one percent of each variable. The estimated study have further reinforced the irrational use of DAP and pesticides as their coefficient value is in negative sign which suggests that DAP and pesticides have inverse relation with chickpea production. This scenario can drop the chickpea growers into diminishing return to scale in the research area.

The study findings have supported that overall elasticity of all inputs is 1.86 which is greater than one which suggests that chickpea growers are running the first stage of production. Therefore, chickpea production can still be enhanced by increasing and proper management of available inputs. Among inefficiency factors, age and education of respondents in chickpea production were found highly significant in reducing the effect of inefficacy of the farmers.

Recommendations

1. Since most crop inputs significantly contribute to output, the government may make consistent efforts to ensure the timely availability of critical crop inputs such as seed, DAP and tractors for chickpea growers.
2. To enhance the technical efficiency of non-member FSCs farmers, efforts may be made to encourage their registration with the Farm Service Center, while registered farmers should increase their visits to the center.
3. The contribution of seed cost ranked as the highest input expense, accounting for 17.64% of total cropping costs, therefore, the concerned policy makers may consider providing seeds at subsidized rates to reduce this financial burden on farmers.
4. The government through the plate farm of these established Farm Service Centers may organize regular training programs on efficient resource utilization, modern crop management, and sustainable agricultural practices.

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