Original Article

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Technical Efficiency in Cultivation of Pulses

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Abstract

Pulses contain more protein than any other grains and vegetables. Cultivation of pulses helps to maintain soil fertility through the nitrogen fixation. They are cultivated in many parts and consumed in all parts of the world. The main focus of this paper is to identify and compare the variables, which identify the yield of pulses for Large and Small farmers cultivating Black Gram (BG) and Green Gram (GG) in Tuticorin district, the study area. Multistage stratified random sampling technique has been adopted for the study. The proportionate random sampling technique has been adopted to select 150 each of Black Gram and Green Gram cultivating farmers from these 15 villages. The data relate to the month of November 2012. In the study area,out of 300 sample farmer's cultivations Black Gram (BG) and Green Gram (GG), 150 sample farms are under the category of Black Gram and remaining 150 sample farms come under Green Gram. It may be concluded from the analysis of Green Gram of pulses farmers, fertilizer was found to be a significant variable in the case of Large farmers. Whereas in the case of Small farmers, capital flows were the most important variable influencing the yield of pulses.

Keywords: Agriculture; Pulses; Small and marginal farmers; Yield; Multiple linear regression.

Introduction

Pulses production and consumption are important in maintaining food security. They occupy an important place in the human diet. Pulses contain more protein than any other grains and vegetables. Cultivation of pulses helps to maintain soil fertility through the nitrogen fixation.[1] They are cultivated in many parts and consumed in all parts of the world. Pulses are largely cultivated in dry-lands during the winter seasons. Pulses are grown on 22-23 million hectares of area with an annual production of 13-15 million tons (mt). India accounts for 33% of the world area and 22% of the world production of pulses.[2] The major pulse crops grown in India are chickpea, pigeon pea, lentil, moongbean, black gram, green gram, cowpea, urdbean and field pea. Due to stagnant production, the net availability of pulses has come down from 60 gm/day/person in 1951 to 31 gm/day/person in 2008. During 2009, India imported 4.32 million tones of various pulses, especially from the countries like China, Canada, Australia and Myanmar.[3] India is one of the exporters of pulses. The main focus of this paper is to identify and compare the variables, which identify the yield of pulses for Large and Small farmers cultivating Black Gram (BG) and Green Gram (GG) in Tuticorin district, the study area.

Methodology

Multistage stratified random sampling technique has been adopted for the study, taking Tuticorin district as the universe, the block as the stratum, the village as the primary unit and pulses cultivators as the ultimate unit. Tuticorin district comprises 12 blocks. Pulses are mainly cultivated in Kovilpatti, Vilathikulam and Oottapidaram which show more than 70 per cent of area under pulses in

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this district and hence the selection of sample villages restricted to these three blocks. Five villages in each block, which account for the highest area under pulses cultivation in the descending order of magnitude, were selected as the study unit for primary data collection. A list of pulses cultivators in the selected villages was obtained from the records of the Joint Director of Agriculture, Tuticorin. The proportionate random sampling technique has been adopted to select 150 each of Black Gram and Green Gram cultivating farmers from these 15 villages. The data relate to the month of November 2012.

Discussion and Analysis

In the study area,out of 300 sample farmer's cultivations Black Gram and Green Gram, 150 sample farms are under the category of Black Gram and remaining 150 sample farms come under Green Gram. In each crop, the sample farm can be divided into two group's namely small and marginal farmer based on area under Black Gram and Green Gram. For that, frequency tables were formed in each crop on the basis of area and its cumulative total was also worked out. The farms of less than 2 acres were grouped on marginal size and farms of more than or equal to 2-5 acres are grouped as small size. In the Black Gram, out of 150 sample farmers, 52 (34.67%) belong to marginal size and remaining 98 (65.33%) belong to small size. In the Green Gram, out of 150 sample farmers, 47 belong to marginal size and remaining 103 belong to small size.

The Analytical Framework

The determinants of yield per acre for Large and Small farmers producing pulses are identified with the help of multiple linear regression models of Cobb-Douglas type.[4] Per acre yield is taken as the dependent variable and five factor inputs are included as independent variables. The regression model fitted was of the form.

$$Y=\alpha_0+\beta_1 \log X_1+\beta_2 \log X_2+\beta_3 \log X_3+\beta_4 \log X_4+\beta_5 \log X_5 +U \quad -- \quad (5.1)$$

where

Y = Per acre yield in kgs

X_1 = Human labour per acre (in Rs.)

X_2 = Bullock labour per acre (in Rs.)

X_3 = Fertilizer per acre (in Rs.)

X_4= Pesticides per acre (in Rs.)

X_5 = Capital flows per acre (in Rs.) And

U = Disturbance term

$$F = \frac{\Sigma e^2 - (\Sigma e^2_1 + \Sigma e^2_2) / k}{(\Sigma e^2_1 + \Sigma e^2_2) / n_1 + n_2 - 2k} \quad (5.2)$$

The structural difference between the two sample farmers, Small and large, was tested by using Chow's test.

where,

k = The number of parameters including the intercept term.

Σe^2 = Unexplained or residual sum of squares of the sample corresponding to both Large and Small farmers.

Σe^2_1 = Unexplained or residual sum of squares of the sample corresponding to Large farmers.

Σe_2^2 = Unexplained or residual sum of squares of the sample corresponding to Small farmers.

n_1 = Sample size of Large farmers and

n_2 = Sample size of Small farmers.

The 'F' test was carried out and if the computed value of 'F' was less than the table value of F at 5 per cent level of significance with (k, n_1+n_2-2k) degrees of freedom the null hypothesis that there was no structural difference between the two groups of farmers could be accepted. If there was a structural difference between the two groups, the test whether the difference occurs and at the interceptor at the slope level or at both had to be conducted by incorporating the dummy

variables at the intercept and slope levels in the regression model.

$$\log Y = \alpha_0 + \alpha_1 D + \sum_{i=1}^{5} \beta_i \log X + \sum_{i=1}^{5} r_j D \log X_i + u \quad \text{-------(5.3)}$$

The structural difference between the two groups of farmers was tested by using the regression model of the following form:

In the model (5.3) D was the dummy variable. The dummy variable D stood 0 for the Large farmers and 1 for the Small farmers.

Estimated Results of Regression Model For Black Gram

The regression model was estimated by the method of least squares for Large, Small and overall farmers cultivating Black Gram (BG) of pulses separately. The estimated results are presented in Table.

It is observed from Table 1, in the case of Large farmers, R^2 value indicated that about 79.45 percent of variations in yield were jointly caused by the five explanatory variables included in the model. Human labour and fertilizer was found to be statistically significant at 5 per cent levels. It indicated that one percent increase in these variables could increase yield by 0.3215 per cent, 0.3116 per cent, 0.1248 per cent and 0.3141 per cent respectively. It was also found that the human labour had a greater influence on the determination of yield, followed by the variable fertilizer. As per F-value, the fitted regression model was statistically significant at 5 per cent level.

As far as the Small farmers were concerned, all the five explanatory variables together accounted for nearly about 81.61 per cent variables in yield. All the five variables were positively related to yield. Human labour, fertilizer and capital flows emerged statistically significant at 5 per cent level, indicating the one percent increase in these variables could increase yield per acre by 0.3141 per cent, 0.2915 percent, 0.0919 percent and 0.3341 percent respectively. The impact of capital flow on yield of pulses was found to be higher in the case of Small farmers. The F-value showed that the estimated regression model was statistically significant at 5 per cent level.

In the case of overall farmers, the five independent variables jointly accounted for about 79.61 percent of the variations in the yield of pulses. All the five variables had a positive effect on the determination of yield. Input variables such as human labour,

Table 1: Estimated Regression Results for Large and Small Farmers Cultivating Black Gram

Variable	Parameter Estimates		
	Large Farmers	Small Farmers	Overall Farmers
Intercept	3.6511	2.8911	2.8516
Log X_1	0.3215* (3.9916)	0.3141* (3.4541)	0.3014* (2.9861)
Log X_2	0.0911 (0.0661)	0.0671 (1.0173)	0.0822 (1.0466)
Log X_3	0.3116* (3.7615)	0.2915* (2.9861)	0.2818* (3.1421)
Log X_4	0.1248* (2.8161)	0.0919* (3.1981)	0.1141* (3.1761)
Log X_5	0.3141* (2.7115)	0.3341* (4.0121)	0.3262* (3.9516)
R^2	0.7945	0.8161	0.7961
F- Value	28.4621	31.1621	31.4152
Residual Sum of Squares	0.092	0.088	0.265
No. of Observations	98	52	150

Figures in bracket represent t- value.
* Indicates that the co-efficients are statistically significant at 5 per cent level.

Table 2: Test for Equality of Parameters between Large and Small Farmers Producing Black Gram

Σe^2	Σe_1^2	Σe_2^2	(n_1+n_2-2k)	F	(6,138) at 1 per cent level	Inference
0.27	0.09	0.09	138	11.4	2.85	Structural difference exists between Large and Small farmers

fertilizers, pesticides and capital flow were found to be significantly related to the yield of pulses. It indicated that an additional percentage of use of these variables was capable of increasing the yield by 0.3014 per cent, 0.2818 per cent, 0.1141 per cent and 0.3262 per cent per acre respectively. Capital flows were found to be the most influential input on yield determination of pulses, followed by the variables human labour and fertilizer. The F-value showed that the overall regression model emerged statistically significant at 5 per cent level.

Thus it may be concluded from the analysis that the explanatory variables included in the model together explained about 79 to 81 per cent of the observed variability in the yield of pulses in the case of Large, Small and overall farmers. Human labour was found to be the most significant input influencing the yield of pulses in the case of Large farmers producing Black Gram. Whereas in the cases of Small farmers and overall farmers, capital flow had a greater influence on yield of pulses.

Test for Structural Differences

In order to examine the structural differences between Large and Small farmers producing Black Gram of pulses, Chow's test (2) was carried out. The results are given in Table 2.

From Table 2, the result of chow's test shows that the computed F-value (F) was higher than the table F-value and it was statistically significant at 1 per cent level. It indicates that structural difference existed between Large and Small farmers producing Black Gram.

Table 3: Tests for Stability of Intercept and Slope between Large and Small Farmers Producing Black Gram

Variable	Parameter Estimate	t-value
Intercept	2.9916	
Intercept dummy – D	0.0681	1.0148
$\log X_1$	0.3561*	4.3216
$\log X_2$	0.1142	0.0763
$\log X_3$	0.3141*	4.1921
$\log X_4$	0.0751	0.0991
$\log X_5$	0.3861*	3.6561
D $\log X_1$	-0.0421	-0.0062
D $\log X_2$	0.0492	0.0549
D $\log X_3$	-0.0261*	3.7516
D $\log X_4$	0.0564	1.0126
D $\log X_5$	0.0419	0.0783
R^2	0.8061	
F-Value	35.61	
No.of Observations	150	

* Indicates that the co-efficient are statistically significant at 5 per cent level.

Tests of the Stability of Intercept and Scope

In order to identify the factors causing structural difference between two groups of farmers producing Black Gram, dummy variables were incorporated both at the slope and the intercept levels in the regression model (3). The model (3) was estimated by the method of least squares and the results are given in Table 3.

It is found from Table 3 that in the case of

Table 4: Estimated Regression Results for Large and Small Farmers Cultivating Green Gram (GG)

Variable	Parameter Estimates		
	Large Farmers	Small Farmers	Overall Farmers
Intercept	2.1561	2.7661	2.1718
Log X_1	0.3161*(2.7716)	0.3162* (3.4161)	0.2961* (3.0461)
Log X_2	0.0431 (0.0613)	0.1141 (0.0913)	0.0791 (0.0769)
Log X_3	0.3218* (4.1931)	0.3145* (3.7916)	0.3019* (2.7962)
Log X_4	0.0761 (0.1121)	0.1015 (0.0049)	0.0999 (0.0481)
Log X_5	0.3162* (3.1260)	0.3162* (2.9861)	0.2945* (4.1142)
R^2	0.7861	0.8151	0.7919
F- Value	22.65	27.18	26.41
Residual Sum of Squares	0.036	0.039	0.219
No. of Observations	103	47	150

Figures in bracket represent t- value.
* Indicates that the co-efficient are statistically significant at 5 per cent level.

Large farmers, all the explanatory variable had a positive impact on yield per acre. Out of the five, three variables namely human labour, fertilizers and capital flows emerged statistically significant at 5 percent level. A percentage increase in these variables was capable of increasing yield by 0.3561, 0.3141 and 0.3861 per cent respectively. It is found that the human labour was the most influential variable in relation to yield, followed by fertilizer.

The Small farmers revealed that a structural difference was found due to the variable fertilizer. It indicates that an additional percentage of fertilizer was capable of increasing the yield of Large farmers by 0.3141 per cent and Small farmers by 0.288 [0.3141 + (-0.0261)] per cent. It is observed from the analysis that fertilizer had a greater effect on the yield of Large farmers than the Small farmers producing Black Gram. The F-value shows that the fitted regression model was statistically significant at one per cent level.

The dummy coefficient corresponding to the intercept is not statistically significant. It reveals that there is no difference between two groups of farmers with regard to technological change. It implies that the nature of technological change is neutral for both groups of farmers. It indicates that the yield curve of Large farmers had shifted neutrally in relation to that of Small farmers. In the slope dummy, the co-efficient corresponding to fertilizer emerged statistically significant. This implies that the structural difference between the two groups of farmers was caused with respect to the variable fertilizer.

Estimated Results of Regression Model for Green Gram

The regression model (1) was fitted by the method of least squares for Small, Large and overall farmers producing Green Gram (GG). The results are presented in Table 4.

It is inferred from Table 4 that in the case of Large farmers, R^2 value indicated that about 78.61 per cent of variation in yield were jointly caused by the five explanatory variables included in the model. Human labour, fertilizer and capital flows were found to be statistically significant at 5 per cent level. It indicated that one per cent increase in these variables could yield by 0.3161 per cent, 0.3218 per cent and 0.3162 per cent per acre respectively. It was also found that the fertilizer had a greater influence on the determination of yield, followed by the variables, human labour and capital flows. As per F-value, the fitted regression model was statistically significant at 1 per cent level.

As far as the Small farmers were concerned, all the five explanatory variables together accounted for nearly 81.51 per cent variation in the yield. Out of five variables included in the regression model, human labour, fertilizers and capital flows were found to be statistically significant at 5 per cent level. It indicated that one per cent increase in these variables could increase yield per acre by 0.3162 per cent, 0.3145 per cent and 0.3162 per cent respectively. The impact of capital flows on yield of pulses was found to be higher in the case of Small farmers. The F-value showed that the estimated regression model was statistically significant at 1 per cent level.

In the case of total farmers, the five independent variables jointly accounted for about 79.19 per cent of the variations in the yield of pulses. All the five variables had a positive effect on the determination of yield. Input variables such as human labour, fertilizer and capital flow were found to be significantly related to the yield of Green Gram. It indicated that on additional percentage of use of these variables, it was capable of increasing the yield by 0.2961 per cent, 0.3019 per cent and 0.2945 per acre respectively. Fertilizer was found to be most influential input on yield determination of Green Gram, followed by the variables, capital flows and human labour. The F-value showed that the overall regression model emerged statistically significant at 1 per cent level.

Conclusion

Thus, it may be concluded from the analysis of Green Gram of pulses farmers, fertilizer was found to be a significant variable in the case of Large farmers. Whereas in the case of Small farmers, capital flows were the most important variable influencing the yield of pulses.

References

1. Kannaiyan, S. Bioresources Technology for Sustainable Agriculture, Associated Publishing Company, New Delhi.1999; 422.
2. Maheswari R (1996), Seed Production Technology in Soybean under Rice fallow and Methods to Control seed detenoration in Soybean CV Col. (Glycine max L) Merrill, M.Sc., (Agri). Thesis, Tamil Nadu Agricultural University, Coimbatore.
3. FAO, 2008
4. Mahesh Chand, "On using Cobb-Douglas Production Function in Agriculture with Reference to India", ***Indian Journal of Economics.1967;*** 48(189)