International Journal of Food and Agricultural Economics
ISSN 2147-8988
Vol. 1 No. 2 pp. 53-64

TECHNICAL EFFICIENCY IN AGRICULTURAL PRODUCTION AND ACCESS TO CREDIT IN WEST BENGAL, INDIA: A STOCHASTIC FRONTIER APPROACH

Arindam Laha
Department of Commerce, The University of Burdwan, Burdwan, West Bengal, India, Pin-713104, Mobile no: +919474601525, E-mail-arindamlaha2004@yahoo.co.in

Abstract

Access to credit significantly influences land leasing decisions, and thus ultimately has a significant implication on ensuring efficiency in agricultural production. This paper attempts to examine the instrumental role of credit in ensuring efficiency in the context of West Bengal agriculture by disaggregating the analysis for two mutually exclusive groups: bank customers and non-bank customers. Empirical analysis based on Stochastic Frontier Analysis confirms that farming households having access to formal credit are, in general, practicing cultivation more efficiently by channelizing credit in the utilization of agricultural inputs. In addition, contractual arrangements and operated farm size are found to be significant determinants of observed variation of technical efficiency estimates in case of bank customers. In the context of higher probability of access to credit in case of fixed rent tenants and large farmers, it can be argued that farmers having access to credit achieved a higher efficiency level by adopting the improved technology in agricultural production. Thus an access to institutional credit would provide an incentive to the farmers to adjust the operational land by the mechanism of tenurial contract so as to bring about efficiency in agricultural production.

Key Words: *Tenurial Contracts, Rural Credit Market, Technical Efficiency, Stochastic Frontier Analysis.*

1. Introduction

In the context of developing economy, the provision of agricultural credit at a subsidized rate of interest is considered as the precondition in the process of transformation of rural agrarian economy. It is held that utilization of modernized agricultural inputs by relaxing credit constraint would improve productivity of agriculture, which has far-reaching implications on ensuring sustainable livelihood of traditional farmers. In other words, the adoption of modern cultivation practice by appropriate resource allocation is expected to overcome technological barriers persist in traditional mode of cultivation. However, channelizing credit in the resource utilization may not automatically ensure the full potentiality of output in agriculture. Hence “the notion of technical efficiency in production arises” (Taylor et al, 1986a, p.111). In fact, Schultz’s “poor but efficient” hypothesis argued that merely a provision of agricultural credit at subsidized rate may not be effective in achieving higher technical efficiency in the context of limited investment opportunities in agriculture. Several attempts have been made in the literature to test the implications of subsidized credit programmes on efficiency of traditional agriculture (Taylor et al, 1986a, 1986b; Rao, 1970).

In the presence of imperfect credit market in developing economy, the land rental market acts as an institution to adjust the differences in the access to rural credit (Jaynes, 1982; Eswaran & Kotwal, 1986; Narayan, 2001). An asset poor farmer can overcome credit constraint by interlinking sharecropping contract with the provision of credit. Contrary, under rental arrangement, the extent of lease in land is bound to decline with credit constraint. Thus the strategy of sustainable agricultural development warrants effective institutional reforms in the land leasing and rural credit market so as to adopt improved practices in agricultural production with a given technology. In this context, the government of West Bengal made a special drive to reform both the markets in the early eighties, which eventually set the path of high growth of agricultural output in the state (Saha & Swaminathan, 1994; Banerjee et al, 2002). The government decided to act as a facilitator to ensure institutional credit flow by using their sharecropping certificates as collateral (Bandopadhyaya & Krishnaji, 1982; Kohli, 1987; Choudhuri & Pal, 1993; Saha & Saha, 2001; Banerjee et al, 2002). Several empirical studies also observed a substantial improvement in the number of sharecroppers accessing institutional credit relative to pre-*Operation Barga*[1] period (Bhaumik 1993; Saha & Saha 2001; Bhattacharya, 1996). In this backdrop, this paper examines the implications of access to credit on technical efficiency in production by comparing estimated technical efficiencies between two mutually exclusive groups: bank customers having an access to formal financial institutions, and non-bank customers who are financially excluded or served by informal financial institutions. The difference in the level of technical efficiency of bank customers and non-bank customers would ultimately enable us to identify the role of formal credit in explaining the differences of technical efficiency. In order to shed some lights on this issue in the context of West Bengal agriculture, this paper presents micro-empirical evidences by using primary field survey observations of 203 farmer households in Raina I block of Burdwan district, West Bengal. A multi-stage sampling technique is followed to select the ultimate sample units of farm households: in the first stage, four villages (Saktia and Anguna as developed villages with channel irrigation and Dhamash and Boro as underdeveloped villages with rain-fed agriculture) are selected purposively, and in the second stage, stratified sampling technique is followed to select the farm households covering landless agricultural labourers, marginal farmers (less than 2.5 acre), small farmers (2.5-5 acre), medium farmers (5-10 acre) and large farmers (above 10 acre).

2. Nature of Tenurial Contract and Its Linkages to Alternative Sources of Credit

Tenancy is considered to be one of the oldest institutional devices evolved in order to facilitate distribution of land holdings in agriculture. The extent of tenancy is observed to be around 52 percent in our survey area, i.e., 106 farm households out of a total surveyed population of 203 households were involved in land lease market (Table 1). The conventional image of a land lease market is the stylized characteristics in our survey area where a large number of small leassees, mainly landless and marginal farmers, lease in from a small number of big lessors.However, heterogeneity of tenurial contracts, as a striking phenomenon in Indian agriculture, is also observed to be an intrinsic characteristic of our

[1] The government of West Bengal initiated *Operation Barga* (a land reform programme) in 1978 to provide property rights to sharecroppers. The successful implementation of the programme in West Bengal reflects an unparallel history created in reforming property rights in India.

surveyed villages. Coexistence of fixed rent tenancy, pure sharecropping and cost sharecropping[2] are widely used practice of tenurial cultivation. Fixed rent tenancy is considered as the widely used tenurial practice (34.90 per cent) and it is followed by pure sharecropping (22.64 per cent) and cost sharecropping (8.49 per cent). A significant 33.49 per cent of tenant households are involved in both fixed rent and sharecropping contracts.

Table1. Size-class Classification of Tenurial Contracts of the Surveyed Households

Types of contracts	Classification of farmer households					
	Landless	Marginal	Small	Middle	Large	ALL
Fixed rent tenancy	10 (28.57)	24 (41.38)	1 (11.11)	1 (33.33)	1 (100.00)	37 (4.90)
Pure sharecropping	6 (17.14)	13 (22.41)	4 (44.44)	1 (33.33)	0 (0.00)	24 (22.64)
Cost sharecropping	5 (14.29)	4 (6.90)	0 (0.00)	0 (0.00)	0 (0.00)	9 (8.49)
Both fixed rent and sharecropping	14 (40.00)	17 (29.31)	4 (44.44)	1 (33.33)	0 (0.00)	36 (33.96)
Total	35 (100.00)	58 (100.00)	9 (100.00)	3 (100.00)	1 (100.00)	106 (100.00)

Source: Field Survey 2006-07
Note: Figure in the parenthesis indicates the percentage share of tenant household belonging to a specific tenurial contract and a particular category of households.

Coexistence of multiple contracts can be explained meaningfully by the access to agricultural credit. In fact, existing theoretical conceptualization and empirical evidences suggest that "an increase in the availability of formal credit leads to a shift towards rental contracts, whereas in the absence of availability of institutional credit, a tenant is often compelled to depend on landlord to fulfill his/her credit requirements" (Laha & Kuri, 2010; Shaban, 2000). Testing of such proposition in the light of empirical evidences requires a two way classification on the basis of sources of credit and types of tenurial contracts (Table 2). Sources of credit are divided into three broad sources: institutional, landlord and informal lenders other than landlord. In reality, households have many sources of availability of credit. For simplicity of analysis, all sources of credit are assumed to be mutually exclusive in the sense that coexistence of many sources of credit is ruled out. If a particular tenant is getting credit from institutional sources, then all other sources of credit are not taken into consideration. Again a tenant, with no access from institutional sources of credit but getting credit from both landlord and other informal sources, is recorded have an access of credit from landlord only. An informal source other than landlord is recorded as the source of credit of a tenant only if neither institutional source of credit nor loan from landlord is viable alternative to him. In the table nearly 49 percent of the fixed rent tenants are observed to have access to institutional credit. Thus being a bank customer, a fixed rent tenant can use the rental market to equilibrate ratios of non-marketable or imperfectly marketable inputs to ownership land holdings. It also found that cost sharecroppers are

[2] While fixed rent contract usually involves a fixed rental payment, in cash or kind, the sharecropping arrangement rests on sharing of harvested produce in a predetermined basis. Sharing of crop is often determined by sharing of input costs by the landlords. Under cost sharing arrangement, the landlord usually shares the cost of factor of production usually in the same proportion as output share.

heavily dependent on landlord for necessary production and consumption credit. Nearly 56 percent of them were borrowed from landlord in the planting season. Thus it can be argued that the smaller the tenant's wealth the more profitable it is for the landlord to specify a cost sharing contract. However, no general conclusion can be drawn in case of pure sharecroppers. In the dataset, we have found neither landlord, nor any formal credit institution is the major source of credit for pure sharecropper. In fact, various informal sources other than landlord have found one of the important sources of credit for pure sharecroppers. It is followed by institutional credit which financially included 37.5 percent of pure sharecroppers into its network.

Table 2. Classification of the various sources of credit under alternative tenurial contracts

Types of contract	Sources of credit			
	Institutional	Landlord	Informal sources other than landlord	Total
Fixed rent	18 (48.64)	10 (27.03)	9 (24.33)	37 (100.00)
Pure sharecropping	9 (37.50)	5 (20.83)	10 (41.67)	24 (100.00)
Cost sharecropping	2 (22.22)	5 (55.56)	2 (22.22)	9 (100.00)
Both fixed rent and sharecropping	17 (47.22)	16 (44.45)	3 (8.33)	36 (100.00)
Total	46 (43.40)	36 (33.96)	24 (22.64)	106 (100.00)

Source: Field Survey 2006-07

3. Materials and Methods

Measurement of technical efficiency of farmers has long been the research interest among agricultural economists. The mode of agricultural production is often observed to be inefficient in technical sense, i.e., efficient frontier locus (representing maximum output) are remaining infeasible with a given set of agricultural inputs. In estimating technical efficiency two distinct approaches are generally followed: Data Envelopment Analysis (DEA) based on mathematical programming estimation and Stochastic Frontier Analysis based on econometric estimation. In the measurement of stochastic frontier production function, the plausibility of measurement errors and other noise in the data are considered (Coelli et al, 2002).

A two stage stochastic frontier approach is used in this paper, where, in the first stage, stochastic production function along with farm level technical efficiencies are estimated, and in the second stage, the determinants of such efficiency levels are identified. Maximum Likelihood Estimation technique is used in the first stage to estimate stochastic frontier production function. In such estimation procedure, the choice of variables is determined by Omitted and Redundant variable tests. The analysis is carried out separately for bank customers comprising of 196 holdings cultivated by 140 households and the group of non-bank customers comprising of 107 holdings cultivated by 63 households. The stochastic frontier production function model is specified as:

$$lnY_i = \beta_0 + \beta_1 lnLABB_i + \beta_2 (HL/LAB)_i + \beta_3 lnTFB_i + \beta_4 lnMIB_i + \beta_5 IRRI_i + \beta_6 LOAN_i + (V_i - U_i) \quad (1)$$

where ln represents the natural logarithm (i.e. to base e)

$\beta_{i(i=1,2,.....,6)}$ represents parameters that needs to be estimated in this model

Y_i represents yield of production measured in equivalent to rice (in quintal). Here $i = 1,2,............,N_j$, where N_j denotes the number of households having an access to credit, i.e., bank customers, j=B; and non-bank customers, j=NB, groups.

$LABB$ represents number of labour (both family and hired) used per bigha[3].

HL represents number of hired labour utilised.

TFB represents total amount of fertilizer used per bigha, (measured in Rs.)

MIB represents total amount of maintenance input[4] used per bigha, (measured in Rs.)

$IRRI$ = 1 if the cultivated land has an irrigation facility and 0 otherwise.

$LOAN$ = 1 if the household is observed to be financially included (whether formal or informal) and 0 otherwise.

V represents random error component which is outside the control of the farmer.

U represents measure of one sided inefficiency component.

The parameters of stochastic production frontier are estimated by using *FRONTIER (version 4.1)* computer package. In the result, farm-specific technical efficiencies (i.e., the ratio of the observed output level of the farm to the output level produced by a fully efficient farm[5]) are also estimated, i.e., $T.E_i = \frac{Y_i}{f(x;\beta)} = \frac{f(x;\beta)e^{-u_i}}{f(x;\beta)} = e^{-u_i}$

In the second stage, the study used Censored Maximum Likelihood Estimation technique to identify the determinants of technical efficiency. In this estimation technique the farm-specific technical efficiency estimates are used as the dependent variable. In fact, this estimation technique is useful to consider the truncated nature of technical efficiency estimates that usually has a defined range in between 0 and 1. The specification of the empirical model is given by

$$T.E_i = \partial_0 + \partial_1 CONT1_i + \partial_2 CONT2_i + \partial_3 CONT3_i + \partial_4 OPRT_i + \partial_5 FRAG_i + \partial_6 FERTINT_i + \varepsilon \qquad (2)$$

where $\partial_i (i = 1,2,.....6)$ are the respective coefficients

$T.E_i$ represents the estimated values of technical efficiencies

$CONT1$ =1 if the plot is cultivated under fixed rent contract and 0 otherwise

$CONT2$ =1 if the plot is cultivated under pure sharecropping contract and 0 otherwise

$CONT3$ =1 if the plot is cultivated under cost sharecropping contract and 0 otherwise

$OPRT$ represents area of operated landholdings (in bigha)

$FRAG$ represents fragmentation index (i.e., the ratio of number of fragments into which the farm land is divided to the area of the owned land)

$FERTINT$ represents the extent of credit-input interlinkage (i.e., the proportion of the value of fertilizer obtained as credit to the total value of fertilizer used in cultivation)

[3] 2.5 bigha=1 acre= 4 046.856 4224 m^2 (by using relation to S.I units).

[4] The maintenance input includes the cost of seeds, plough, transportation, water and other input except labour cost.

[5] See Coelli et al (2002).

4. Empirical Result and Discussion

4.1 Estimation of the Stochastic Frontier Production Function

In the first stage, Cobb-Douglas specification of the stochastic production frontier is estimated by Maximum Likelihood Estimation technique. Table 3 represents the Maximum Likelihood estimates for the parameter of the production function separately for bank customers, non-bank customers and all households taken together. Overall, it can be suggested that all the input coefficients, except fertilizer, have their expected signs and no significant variation is observed in between the bank and non-bank customers.

Table 3. Maximum Likelihood Estimation Results of the Stochastic Frontier Production Function (All households, Bank customers and Non-bank customers)

Dependent variable: Yield of production in equivalent to rice (in quintal)				
Variable	Coefficients	All Households	Bank Customers	Non-bank Customers
		Estimate (t-ratio)	Estimate (t-ratio)	Estimate (t-ratio)
Intercept	β_0	2.1913 (13.5554)	2.2761 (12.640)	2.0428 (6.3688)
Total number of labour used	β_1	0.1861 (4.1104)	0.2166 (4.6372)	0.1767 (1.8137)
Hired labour to total labour used	β_2	-0.2103 (1.8377)	-0.2073 (-1.6898)	-0.2410 (-1.0258)
Total fertilizer used	β_3	-0.2086 (2.7348)	-0.2706 (3.3526)	-0.1408 (-0.8456)
Total maintenance input used	β_4	0.1184 (1.8683)	0.1450 (2.1782)	0.1020 (0.7434)
Irrigation	β_5	0.2242 (3.7202)	0.1514 (2.3705)	0.3292 (2.5304)
Loan availability	β_6	0.2336 (2.3882)	0.1873 (1.6637)	0.2473 (1.3874)
Sigma-squared	σ^2	0.7157 (9.3704)	0.4801 (7.2519)	1.0550 (5.1561)
Gamma	γ	0.8619 (26.9229)	0.8386 (12.0159)	0.8720 (20.9346)
Observations	N	303[6]	196	107

Source: Field Survey 2006-07

In case of all households, the positive and significant coefficients of irrigation and credit dummy variables indicate that overall production can be enhanced by exploiting the potentiality of irrigation and expansion of formal credit network among rural masses. The negative and significant coefficient of the ratio of hired labour to total labour suggests that family labour is more productive than hired labour. Like Coelli and Battese (1996), empirical evidences justifies that hired labour suffers from moral hazard problem in such an environment where labour-intensive operations required in paddy and potato cultivation. In

[6] The analysis is based on 303 holdings (or observations) cultivated by 203 farmer households.

case of bank customers, estimated output elasticities with respect to labour, fertilizer and maintenance inputs are approximately 0.22, -0.27 and 0.15 respectively. On the other, the output elasticities for all these inputs are 0.18, -0.14 and 0.10 respectively for the non-bank customers. All other coefficients for bank customers are significant and have their expected signs. In contrast, for non-bank customers, only labour and irrigation availability significantly explain the variation in output. In the estimation of stochastic frontier production function, our particular interest is to examine the effect of access to credit (whether formal or informal) on the observed yield of production. The coefficient of credit dummy variable is found significant only in case of bank customers. Unlike non-bank customers, bank customers have the additional advantage of increasing the yield of production by using formal credit in the process of production. In fact, the utilization of credit is observed to have direct impact on the use of fertilizer and maintenance inputs in agriculture. The overall measure of inefficiency (as measured by the parameter γ) is estimated at 0.8619 (all households), 0.8386 (bank customers) and 0.8720 (non-bank customers). In general, empirical evidence suggests that non-bank customers are technically more inefficient compared to bank customers.

4.2 Analysis of Technical Inefficiency

The summary statistics of technical inefficiency estimates is presented in table 4. It can be pointed out that technical inefficiency of sample holdings ranged between 5.53 and 98.93 percent with an average of 38.90 percent. The wide range of technical inefficiency estimates suggest that, on average, the farmer households are able to exploit only 61 percent of potential output, and the remaining 39 percent of the production can be achieved by adopting the improved technology in agricultural production.

Table 4. Summary Statistics of Inefficiency Estimates

Statistic	Inefficiency percentage
Mean	38.899
Minimum	5.530
Maximum	98.928
Standard Deviation	16.511
Skewness	1.057
Kurtosis	1.335

Source: Field Survey 2006-07

The frequency distribution of inefficiency estimates suggests that majority of holding (70.63 percent) are subjected to 20-50 percent of technical inefficiency. Only 9 percent of total holdings are technically efficient in the range of above than 80 percent (Table 5). In other words, most of the holdings in our study area are found to be technically inefficient in production.

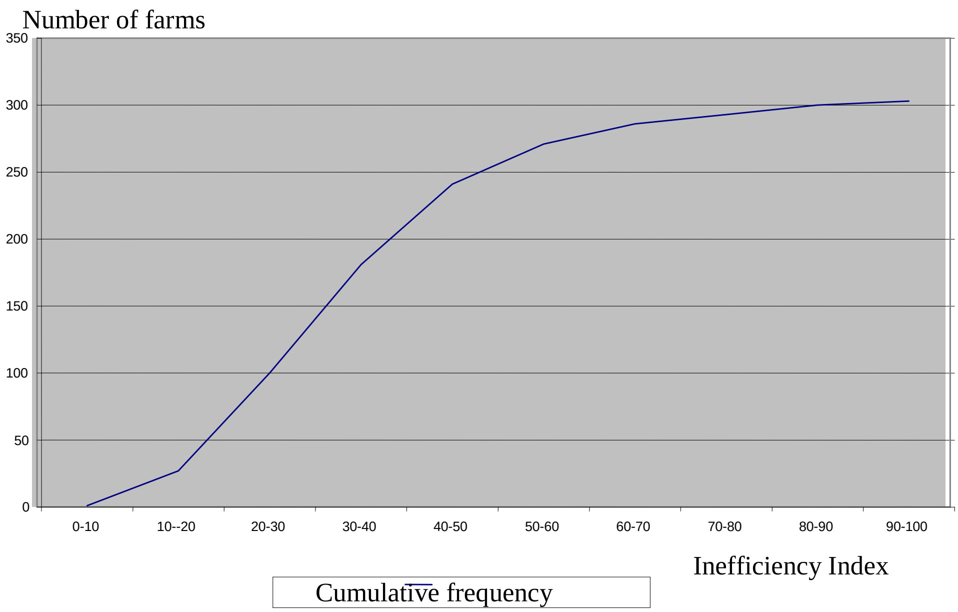
Table 5. Frequency distribution of sample holdings based on technical inefficiency

Technical Inefficiency (in percentage)	No of holdings	Percentage to total household
Below 10	1	0.3
10-20	26	8.6
20-30	73	24.1
30-40	81	26.7
40-50	60	19.8
50-60	30	9.9
60-70	15	5.0
70 and above	17	5.6
Total	303	100.00

Source: Field Survey 2006-07

The following figure 1 depicts the cumulative inefficiency distributions obtained the half-normal stochastic frontier model. The results are depicted with grouping made on interval size of 10.

Figure 1: Cumulative frequency distribution of inefficiency index from stochastic frontier model



Measurement of technical inefficiency across alternative modes of cultivation suggests that the lowest level of technical inefficiency (0.349) is found under fixed rent tenancy. This is followed by owner cultivation (0.364), cost sharecropping (0.465) and pure sharecropping tenancy (0.490). Therefore, pure sharecropping and cost sharecropping arrangements are less technically efficient as compared to fixed rent and owner cultivation. Among three important tenurial contracts, other than owner cultivation, fixed rent tenancy is found to be technically most efficient followed by cost sharecropping and pure sharecropping arrangements. If we consider tenants as a group, then empirical evidence suggest that tenants are technically inefficient than owner farms.

Table 6. Estimated Technical Inefficiency Levels under Alternative Modes of Cultivation

Type of cultivation	Average technical inefficiency	No of holdings (in percentage)
Owner cultivation	0.364	154 (50.83)
Fixed rent	0.349	74 (24.42)
Pure sharecropping	0.490	45 (14.85)
Cost sharecropping	0.465	30 (9.90)
Tenant	0.415	149 (49.17)
All	0.389	303 (100.00)

Source: Field Survey 2006-07

Estimated technical efficiency measures of bank and non-bank customers suggest that, except middle farmer category comprising 5-10 acres of land, bank customers in all other size classes exhibits a higher level of technical efficiency compared to non-bank customers (Table 7). Thus access to formal credit play a significant role in achieving technical efficiency in agriculture.

Table 7. Estimated technical efficiency by farm size and access to credit

Operated land (in acre)	Bank customers		Non bank customers	
	Estimated efficiency	No of firms (in percentage)	Estimated efficiency	No of firms (in percentage)
Less than 2.5	0.648	86 (43.88)	0.554	90 (84.11)
2.5—5	0.667	51 (26.02)	0.535	8 (7.48)
5—10	0.619	43 (21.94)	0.659	8 (7.48)
Above 10	0.713	16 (8.16)	0.671	1 (0.93)
Total	0.652	196 (100.00)	0.569	107 (100.00)

Source: Field Survey 2006-07

4.3 Determinants of Technical Efficiency

Variation in the observed level of technical efficiency can be explained by several socio-economic determinants like contractual types, holding characteristics and availability of resources. Censored maximum likelihood estimators[7] are used to estimate the ∂ coefficients of the equation (2) specified in materials and methods. The results of the determinants of technical efficiency for all households in general and bank and non-bank customers in particular are summarized in Table 8.

[7] In Censored Regression Models, the dependent variable is only partially observed. When the dependent variable is censored, values of a certain range are all transformed to a single value. E-Views provide tools to perform maximum likelihood estimation of these models. For details, see Greene (2004), pp. 761-80.

Table 8. Results of the Determinants of Technical Efficiency

Dependent variable: Estimates of technical efficiency				
Variables	Coefficients	All Households	Bank Customers	Non-Bank Customers
		Estimate (Z-Statistic)	Estimate (Z-Statistic)	Estimate (Z-Statistic)
CONSTANT	∂_0	0.630*** (31.93)	0.655*** (25.26)	0.581*** (17.34)
CONT1	∂_1	8.18E-06* (1.76)	8.03E-06* (1.63)	5.14E-05 (1.01)
CONT2	∂_2	-0.129*** (-4.75)	-0.092*** (-2.61)	-0.159*** (3.82)
CONT3	∂_3	-0.106*** (-3.36)	-0.176*** (-3.91)	-0.075* (1.61)
OPRT	∂_4	0.001 (1.41)	0.001* (1.61)	0.003 (1.30)
FRAG	∂_5	-0.0006 (-0.09)	-0.008 (-0.71)	-0.005 (-0.51)
FERTINT	∂_6	0.012 (0.54)	0.009 (0.33)	0.020 (0.56)
Observations		303	196	107

Source: Field Survey 2006-07
Note: *** indicates significant at 1 percent, * indicates significant at 10 percent

Empirical results reveal the fact that the type of tenurial contracts influences the level of technical efficiency. Coefficients of the dummy variables defining pure sharecropping and cost sharecropping are negative, while the coefficient of the dummy variable defining rental contract is found to be positive. Except the coefficient of fixed rent tenancy for non-bank customers, all other coefficients defining contract types are found to be statistically significant. Thus sharecropping contract (whether pure sharecropping or cost sharecropping) are technically less efficient than owner cultivation. The fixed rent contract and owner cultivation for all households and bank customers are likely to be equally efficient in enhancing technical efficiency in agriculture. The empirical evidences thus reestablish our earlier observation that pure sharecropping and cost sharecropping arrangements are less efficient as compared to rental and owner cultivated holdings (Table 6). Thus it implies that different forms of tenurial contracts are subjected to different levels of technical efficiencies.

In addition to tenurial contracts, the size of operated land can significantly influences technical efficiency. The coefficient of the operated land is found to be positive in all three sets of regression, but it is significant only in case of bank customers. The evidence suggests that large farms having access to formal credit are technically more efficient compared to small farms. In an asset based lending policy, land size often determines the probability of access to credit, and thereby, large farmers having access to credit are able to channelize credit in the utilization of inputs and in achieving technical efficiency in agriculture. The negative, though insignificant, coefficient of fragmentation index indicates that highly fragmented land exhibits an obstacle in the use of improved technologies, and thus, making small farms more inefficient. In addition, tying up of credit with fertilizer is the predominant form of interlinked transaction in our study area where fertilizer is given on credit on the condition that it is to be repaid after harvest. The positive, though insignificant coefficient of fertilizer interlinkage indicates that such interlinkage is aimed at improving technical efficiency in production.

5. Conclusion

Access to credit plays a significant role in input utilization and in achieving technical efficiency in agriculture. A comparative analysis of technical efficiency of bank customer's vis-à-vis a group of non-bank customers is made in the paper so as to examine the effect of access to credit on the technical efficiency of farmers in West Bengal. A two-stage Stochastic Frontier Approach is used in the paper, whereby technical efficiencies of bank and non-bank customers are estimated in the first stage and plausible determinant of technical efficiency are identified in the second stage. Empirical analysis confirms that bank customers, in general, achieve a higher technical efficiency than a comparable group of non-bank customers. In order to deeper delve into the matter, the determinants of technical efficiency has been carried out separately for bank and non-bank customers. Empirical evidences identified contractual arrangements and operated farm size as significant determinants of observed variation of technical efficiency estimates. In the context of higher probability of access to credit in case of fixed rent tenants and large farmers, it can be argued that farmers having access to credit achieved a higher efficiency level by adopting the improved technology in agricultural production. Thus an expansion of institutional credit can bring about efficiency in enhancing agricultural production and productivity.

References

Bandyopadhyaya, N. & Krishnaji, N. (1982). *A Study on Evaluation of Land Reform Measures in West Bengal*. A Report prepared for the International Land Organisation by the Center for Studies in Social Sciences, Calcutta.

Banerjee, A.V, Gertler, P.J. & Ghatak, M. (2002). Empowerment and Efficiency: Tenancy Reform in West Bengal. *The Journal of Political Economy*, 110, 239-280.

Chaudhuri, M. & Pal, S. S. (1993). Peasant Status of Land Reform: A Case Study in a Village. In K. P. Sandilya (Eds.), *Proceedings of National Workshop on the Socio-Economic Impact of Land Reforms*, Calcutta: Visva-Bharati, Santiniketan, and Board of Revenue, Government of West Bengal.

Bhattacharyya, S. (1996). Evolution of Agricultural Credit Market in West Bengal since 1977: A Journey from Peasant Class Differentiation to Agriculture-led Development. In A. Roychaudhuri & D. Sarkar (Eds.) *Economy of West Bengal-Problems and Prospects* (pp.172-198). Allied Publishers Limited.

Bhaumik, S.K. (1993). *Tenancy Relations and Agrarian Development: A Study of West Bengal.* Sage Publications, New Delhi.

Chattopadhyay, M. & Sengupta, A. (2001). Tenancy Inefficiency: A Study Based on West Bengal Agriculture. *Economic and Political Weekly*, February, 3-10.

Coelli, T.J. & Battese, G. (1996). Identification of factors which influence the technical inefficiency of Indian farmers. *Australian Journal of Agricultural Economics*, 40(2), 103-128.

Coelli, T.J., Rao, D.S.P., & Battese, G.E. (2002). *An Introduction to Efficiency and Productivity Analysis.* Kluwer Academic Publishers, Boston / Dordrecht / London.

Eswaran, M. & Kotwal, A. (1986). Access to Capital and Agrarian Production Organisation. *The Economic Journal*, 96 (382), June, 482-498.

Greene, W. (2004). *Econometric Analysis.* Fifth Edition, Prentice Hall.

Jaynes, G. D. (1982). Production and Distribution in Agrarian Economics. *Oxford Economic Papers*, 34, 346-367.

Kohli, A. (1987). *The State and Poverty in India: The Politics of Reform*. Cambridge University Press, Cambridge.

Kundu, S. (2011). Tenancy Efficiency in Paddy Cultivation: A Study of West Bengal. *Journal of Economic and Social Development*, 7(1), 48-56.

Laha, A. & Kuri, P, K. (2010). Rural Credit Market and the Choice of Tenurial Contracts: A Micro Evidence from Rural West Bengal, India. *The Bangladesh Development Studies*, 33 (4), 63-83.

Narayan, T. A. (2001). *Does credit constrain land-leasing decisions? Fresh evidence from India*. Preliminary draft, Department of Agricultural and Resource Economics, University of Maryland, July 15th, 2001.

Rao, B. P. (1970). *The Economies of Agricultural Credit Use in Brazil* (Unpublished Ph.D. thesis), Ohio State University.

Saha, A. & Swaminathan, M. (1994). Agricultural Growth in West Bengal in the 1980s: A Disaggregation by Districts and Crops. *Economic and Political Weekly*, 29 (13), March 26.

Saha, U.S. & Saha, M. (2001). Case Study, Regulating the Sharecropping System: Operation Barga. In A. Janvry, G. Gordillo, J.P.Platteau & W. Sadoulet (Eds.) *Access to Land, Rural Poverty and Public Action* (pp.230-245), Oxford University Press.

Sarkar, D. & De, S. (2004). High Technical Efficiency of Farms in Two Different Agricultural Lands: A Study under Deterministic Production Frontier Approach. *Indian Journal of Agricultural Economics*, 59(2), 197-208.

Shaban, R. A (2000). Testing between Competing Models of Sharecropping. In P. Bardhan & C. Udry (Eds.) *Readings in Development Economics* (pp. 139-169), vol. II, MIT press.

Tayor, T. G., Drummond, H. E. & Gomes, A. T. (1986a). Agricultural Credit Programs and Production Efficiency: An Analysis of Traditional Farming in Southeastern Minas Gerais, Brazil. *American Journal of Agricultural Economics*, February, 110-119.

Tayor, T. G. & Shonkwiler, J. S. (1986b). Alternative stochastic specifications of the frontier production function in the analysis of agricultural credit programs and technical efficiency. *Journal of Development Economics*, 21, 149-160.