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Measurement of Allocative Efficiency in Agriculture and its Determinants: Evidence from Rural West Bengal, India

[1]Arindam Laha and [2]Pravat Kumar Kuri
[1]Department of Commerce, The University of Burdwan, Burdwan, West Bengal, India
[2]Department of Economics, The University of Burdwan, Burdwan, West Bengal, India

Corresponding Author: Arindam Laha, Department of Commerce, The University of Burdwan, Burdwan, West Bengal, India

ABSTRACT

The issue of the allocative efficiency of Indian farmers deserves a special attention in the light of the controversy on the rationale of Indian farmers in the choice of input allocation decision in production. This study measures the allocative efficiency and its determinants in West Bengal agriculture by advocating cost minimization principle using Data Envelopment Analysis. Though the farmers of West Bengal are found to be moderately efficient in allocating inputs in agriculture, still there is scope of enhancing agricultural production by around sixteen percent through better allocation of resources. The choice of tenurial contracts is found to play a significant role in influencing allocative efficiency in agriculture. Among the tenurial contracts, fixed rent tenancy is observed to be the most efficient mode of cultivation. Education level of head of the household, operated land, interlinkage of factor markets and availability of credit are some of the other factors, inter alia which are found to have significant bearing on the level of allocative efficiency in West Bengal agriculture.

Key words: Allocative efficiency, agrarian institutions, tenurial contracts, rural credit, data envelopment analysis

INTRODUCTION

The importance of institutions in agrarian development has long been recognized in designing appropriate policy by the decision makers. In analyzing the relationship between institutions and agrarian development, the institutionalists argue for institutional reform which they consider an indispensable condition for the process of agricultural transformation (Bhaumik, 1993). In this process of transformation, a proper modification and replacement of existing institutions are assumed to take place especially for those inefficient institutions which put an obstacle in the allocation of resources. Efficiency in resource allocation has a far-reaching impact on the observed farm output level. The presence of shortfall in efficiency means that output can be increased without using additional conventional inputs and new technology. Efficiency measurement is useful in determining the magnitude of the gains that could be achieved by adopting improved practices in agricultural production with a given technology (Zhu, 2000; Tauer, 2001; Rahman, 2003; Armagan, 2008). There is a spurt of literature focusing on the issue of the measurement and the determinants of technical efficiency in agriculture (Lovell, 1993; Seiford, 1996, 1997; Coelli, 1996; Chattopadhyay and Sengupta, 2001; Ahmed *et al*., 2002; Reddy and Sen, 2004;

Sarkar and De, 2004; Kebede, 2001; Ajani and Ugwu, 2008; Armagan, 2008). In comparison to the literature on technical efficiency, studies[1] relating Greene (1997) to the measurement of the extent and distribution of allocative efficiency are relatively scanty. Some cross-country evidences are provided to measure allocative efficiency of farmers in Nigeria (Ogundari, 2008; Nwachukwu and Onyenweaku, 2009), Greece (Yotopoulos, 1967), China (Fan, 2000), Bangladesh (Wadud, 2003). In an earlier attempt to examine allocative efficiency of Indian farmers, Schultz (1964) argued that "there are comparatively few significant inefficiencies in the allocation of the factors of production in traditional agriculture. Some studies provided substantial empirical evidences to establish the Schultz's poor but efficient hypothesis that Indian farmers are efficient allocators of resources in the agricultural practices[2] (Hopper, 1965; Chennareddy, 1967; Sahota, 1968; Saini, 1968; Srivastava and Nagadevara, 1972). Some attempts have also been made to examine allocative efficiency in West Bengal agriculture[3]. Based on farm level data on Hooghly district of West Bengal, Rudra (1992) rejected the hypothesis of allocative efficiency in West Bengal agriculture in the framework of constrained profit maximization. In a profit maximization model, Kumbhakar (1994) also argued that the majority of 227 farmers in West Bengal are found to be under-users of the endogenous inputs, viz., fertiliser, manure, human and bullock labour. In an alternative framework, Ray and Bhadra (1993) examined the cost minimizing behaviour of farmer households in seven districts of West Bengal. It was argued that though a farmer is technically efficient but they fail to select cost minimizing input bundle. In fact, the failure of cost minimization is principally due to imperfections in the markets for capital and labour. However, if land and capital is treated as quasi-fixed inputs, then little allocative inefficiency is found in choice of variable inputs. Under the backdrop of this controversy, an attempt has been made in the study to measure the level of allocative efficiency in West Bengal agriculture and its determinants using Data envelopment analysis.

MATERIALS AND METHODS

Data sources: The study is based on a field survey in rural West Bengal in the year 2006-07. The purpose of the survey was to explore the nature of interlinked transactions in land leasing markets and the role of credit in bringing out allocative efficiency in agriculture in West Bengal. Taking into consideration the extent and the incidence of tenancy practices, out of 18 districts of West Bengal, the district of Burdwan has been selected for the survey[4]. In the second stage, among the 31 blocks

[1]See Greene (1997) for a survey of the literature.

[2]The experience of an increase in land productivity in India is mainly caused by the input intensification in the use of fertilizer, tractor and labour (Piya *et al.*, 2011).

[3]The study on West Bengal agriculture is crucial in the context of changing dynamics of agrarian productivity over time. West Bengal emerged as one of the progressive agriculturally developed states in India during the period of 1980s. However, with the advent of globalization in the nineties and thereafter, West Bengal agriculture lost its past glory and the state evidenced significant decline in agricultural productivity growth (Ghosh, 2010a, b).

[4]The district of Burdwan comprised of 7.83% of total leased in land (wholly and partly) in the state of West Bengal. Only two hill districts, Darjeeling and Jalpaiguri, comprised of 12.11 and 21.28% of leased in area respectively are above Burdwan district. However, terms of leasing in the hill districts are distinct from other districts of West Bengal (Agricultural Census, 2000-01). Thus the choice of the district of Burdwan as our survey area is purely based on the ground of the dominant practice of land leasing for crop cultivation in the state. Historically, the district of Burdwan is known as rice bowl of West Bengal. Potato, rice, wheat, jute and mustard are the principal crops in the district (Ghosh, 2011).

under Burdwan district, one block, namely, Raina I has been selected on the consideration of the existence of diversified nature of agricultural practices and the co-existence of varied farms of interlinked transactions. Again, Raina I block has been stratified into two distinct agro climatic zones-one, developed zone with canal irrigation and the other, underdeveloped zone with rain-fed agriculture. From the developed zone, the villages, namely, Saktia and Anguna have been chosen, whereas the villages namely, Dhamash and Boro have been chosen from the underdeveloped zone under the same criteria[5]. Once villages are selected, 203 sampling units, the farm-households, have been chosen using stratified random sampling of farmers with probability being proportional to the farm size so that the sample can represent the actual proportion of all the five strata of the farmers. It is to be noted that 203 households operate over 303 agricultural holdings under alternative mode of cultivation. Our empirical analysis is restricted to 303 holdings. The farm households have been divided into five categories 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).

Data envelopment analysis: In the existing literature, several methodologies were suggested to measure allocative efficiency of farm households. Earlier studies used marginalist principal to measure allocative efficiency (Hopper, 1965; Welsch, 1965; Chennareddy, 1967; Yotopoulos, 1967; Sahota, 1968). These studies estimated a Cobb-Douglas production function to judge efficiency in cross-sectional samples and then tested the equality between the estimated single-valued marginal value products and marginal factor costs of the geometric mean firm with some statistical sampling theory test. In a reappraisal of some of the evidences mentioned by some earlier studies (Hopper, 1965; Chennareddy, 1967; Yotopoulos, 1967). Dillon and Anderson (1971) argued that there were some mixed supports to the hypothesis of profit maximizing behaviour by farmers in traditional agriculture. An alternative hypothesis of utility maximization was suggested in the study to allow subjective risk considerations and to provide a more realistic basis for policies aimed at the modernization of traditional agriculture. In a criticism of marginalist principle, Rudra (1973, 1992), Dey and Rudra (1973) and Hati and Rudra (1973) suggested an alternative test procedure without making any unnecessary assumptions like product and factor prices being the same for all cultivators. In constrained profit maximization, a test is conducted in those studies to examine whether input-output proportions are constant for all the farmers.

However, doubts have been expressed whether neoclassical model of an optimizing competitive firm is valid in traditional agriculture in a less developed country. Junankar (1980a, b, 1982 and 1989) rejected the profit maximizing hypothesis using Indian data and thus, argued against using the profit function. Contrary, the optimization rationale of Indian farmers might be based on cost-minimization principle. Cost minimization is the more appropriate assumption in rural West Bengal as rice is found produced to a large extent for subsistence consumption and so output may be treated as exogenous (Ray and Bhadra, 1993[6]; Varian, 1984).

[5]The selection of district, block and villages are based on a-priori information and hence it is purposive and non-random.

[6]In nonparametric tests of cost minimizing behaviour, Ray and Bhadra modified Weak Axiom of Cost Minimization (WACM, Varian (1984) to derive the Weak Axiom of Variable Cost Minimization (WAVCM). In fact, Varian (1984). proposes WACM as an alternative to Linear Programming procedure to solve cost minimization problem. In this nonparametric test, all inputs are considered variable. But Ray and Bhadra (1993) criticized the assumption of variable inputs in WACM in the context of less developed countries, where markets for capital and land are not well developed. An alternative WAVCM is proposed to allow for quasi-fixity of one or several inputs.

Following Data Envelopment Analysis (DEA), cost minimization is associated with three types of efficiency measures: cost efficiency, allocative efficiency and technical efficiency. For our purpose, we have used DEA approach to measure allocative efficiency of West Bengal farmers.

The differences in allocative efficiency of farmers can be explained in a two-stage approach, where in the first stage the predicted farm level allocative efficiencies are determined and in the second stage, these predicted allocative efficiencies are related to sources of the efficiency like contract choice[7] and farmer-specific factors. Allocative efficiency can be measured using the cost minimization DEA model[8] (Charnes *et al*., 1978). In present analysis, a Multi input-Multi output Constant Returns to Scale Input Oriented DEA model is used. Following Coelli *et al*. (2002), let us consider the situation with N Decision Making Units (DMU). Each of the n DMUs produce Q output using V different inputs. A cost minimization linear programming problem is solved for each DMU. The cost minimization problem for the i th DMU is given by:

$$\mathrm{Min}_{\lambda, x_i^*} w_i' x_i^*$$

$$\text{subject to} \sum_{i=1}^{N} \lambda_i x_{ji} - x_{ji}^* \le 0,$$

$$\sum_{i=1}^{N} \lambda_i y_{ki} - y_{ki} \ge 0$$

$$N1'\lambda_i = 1$$

$$\lambda_i \ge 0$$

Where:

w_i = Vector of unit price of inputs utilized by DMU_i
x^*_i = Vector of input quantities of DMU_i with respect to production cost minimization
y_{ki} = Amount of output k produced by DMU_i
x_{ji} = Amount of input j utilized by DMU_i
N1 = An N×1 vector of one
λ_i = Dual variables

In the framework of cost minimization, the total Cost Efficiency (CE) or Economic Efficiency (EE) of the i-th firm is measured by the ratio of minimum cost to observed cost as:

$$CE = \frac{w_i' x_i^*}{w_i' x_i}$$

[7]To capture four types of contract choice, viz. fixed rent, pure sharecropping, sharecropping with cost sharing and owner contract, we have used three contract dummy variables in the study.

[8]This approach of non-parametric mathematical programming approach to frontier estimation was first developed by Charnes *et al*. (1978).

A firm is said to have realized allocative efficiency if it is operating with the optimal combination of inputs, given their respective prices. The allocative efficiency is calculated residually by using the following relationship between Cost Efficiency (CE) and Technical Efficiency (TE) as:

$$AE = \frac{CE}{TE}$$

We define the following ranges of allocative efficiency as:

Efficient in allocating resources	:	$AE = 1$
Little allocative inefficiency	:	$0.9 \leq AE < 1$
Moderately efficient in allocating resources	:	$0.7 \leq AE < 0.9$
Inefficient in allocating resources	:	$AE < 0.7$

In the second stage, the following model is used to determine the various socio-economic determinants of farm specific allocative efficiency. Censored maximum likelihood estimator is used to determine the value of the coefficients. The specification of the empirical model is given by:

$$AE = \gamma_0 + \gamma_1\,\text{CONT1} + \gamma_2\,\text{CONT2} + \gamma_3\,\text{CONT3} + \gamma_4\,\text{HHEXP} + \gamma_5\,\text{HHEDU} + \gamma_6\,\text{OPRT} + \gamma_7\,\text{FARG} + \gamma_8\,\text{BARGA} + \gamma_9\,\text{INTER} + \gamma_{10}\,\text{LOAN} + \varepsilon$$

Where, γ_i (i = 1, 2,....., 10) are coefficients

AE	=	Represents the level of allocative efficiency obtained in the first stage
CONT1	=	1 if the contract is fixed rent tenancy and 0 otherwise
CONT2	=	1 if the contract is pure sharecropping and 0 otherwise
CONT3	=	1 if the contract is cost sharecropping and 0 otherwise
HHEXP	=	Represents experience (i.e., square of age) of the head of the household
HHEDU	=	Represents years of schooling achieved by the head of household
OPRT	=	Represents amount of operated holdings, in bigha[9]
FRAG	=	Represents fragmentation index which is the ratio of number of fragments into which the farm holding is divided to the area of the farm land
BARGA	=	1 if the contract land is under Operation Barga[10] cultivation and 0 otherwise

[9]2.5 bigha = 1 acre.

[10]The government of West Bengal initiated Operation Barga in 1978 to reform the sharecropping system that was widespread throughout the state. The primary objective of Operation Barga is to restructure the agrarian relations and direct them to an egalitarian society by enlarging the land base of the rural poor. By the end of November, 2005, the total number of bargaders recorded in the Record of Rights was 15.31 lakh. The area under these bargaders amounted to 4.54 lakh hectares (Economic Review of West Bengal, 2005-06). The evidence reflects an unparallel history created in reforming property rights in India. However, in our surveyed villages only 17% of the surveyed tenants have participated in the drive of Operation Barga and registered their leased in land. The policy of the West Bengal government to give sharecroppers the possibility of accessing institutional credit using their land rights (in the form of pattadars and bargadars) as collateral is also not found empirical support in a significant extent in present study area

INTER = 1 if the household is involved in interlinked transactions and 0 otherwise
LOAN = 1 if the household has any access of credit facilities (whether formal or informal sources) and 0 otherwise

Statistical analysis: In this study, the statistical analysis has been made by using two sophisticated statistical packages: DEAP[11] Version 2.1 and E-Views. In the first stage to measure allocative efficiency under DEA framework, DEAP statistical package is extensively used. In the second stage, we have used E-Views statistical package to examine the determinants of allocative efficiency.

RESULTS AND DISCUSSION

Measurement of allocative efficiency

DEA approach: Allocative efficiencies are estimated by using a Multi input-Multi output Constant Returns to Scale Input Oriented DEA model. The model is comprised of data on output quantities, input quantities and prices of inputs. Output is measured by three variants: output of a particularly paddy variety like *amanswarna*[12], output of all paddy varieties taken together and output of all crops measured as a equivalent of *amanswarna*[13]. Three important input variables are chosen, viz., total operated area, total labour (both family and hired) used and total amount of fertilizer used in production. For simplicity, we assume all firms face the same input prices. Table 1 presents the summary statistics of allocative efficiency estimates at three different levels of cultivation. The average allocative efficiency for the sample of all crops is 84%, with a minimum of 11.6%. The corresponding figures for the sample of paddy cultivation is 86% with a minimum of 30.7% while in *amanswarna* cultivation the estimated average efficiency is 74% with a minimum of 41.1%. This analysis clearly indicates that in most of the holdings inputs have been allocated moderately efficient manner as specified in the ranges of allocative efficiency. In other words, there is a further scope of increasing production of all crops, paddy and *amanswarna* cultivation by 16, 14 and 26%, respectively. This can be achieved by suitably reallocating production inputs as used by the best practice farms.

Table 1: Summary statistics of the estimates of allocative efficiency (in percentage) under alternative modes of cultivation

	Allocative efficiency percentage		
Statistic	All crops	Paddy	Amanswarna
Mean	84.173	86.152	74.088
Minimum	11.6	30.7	41.1
Maximum	100.0	100.0	100.0
Standard deviation	20.3496	17.5690	7.8054
Skewness	-1.722	-1.334	-.665
Kurtosis	1.971	0.407	1.064

Source: Field Survey 2006-07

[11]See Coelli A guide to DEAP version 2.1: A data envelopment analysis (Computer) program, CEPA working paper 96/08.

[12]*Amanswarna* is most preferred HYV variety of paddy cultivation in terms of coverage of area in our study villages. In fact, aman paddy accounts for about two-thirds of the net cultivated areas in West Bengal (Chandra, 1974).

[13]To measure a composite index of output of all crops, outputs of individual crops are converted as an equivalent of *amanswarna*. Prices of all crops are taken into account to make the necessary conversion.

Determinants of allocative efficiency: The second stage of the analysis in the section is devoted to identify the sources of allocative efficiency by investigating the relationship between farm specific characteristics and the computed allocative efficiency indices. Censored maximum likelihood estimator is used to estimate the γ coefficients in equation specified in the methodological section. The results under alternative crop cultivations are summarized in Table 2.

The results reveal that the choice of tenurial contract does have a role to play influencing the input allocation decision in production[14]. Coefficients of the contract dummy variables defining fixed rent, pure sharecropping and cost sharecropping[15] are all positive. But, all contracts are not equally efficient in allocating resources optimally. Only the coefficients of fixed rent tenancy (i.e, 0.049676 in paddy and 0.035394 in *amanswarna* cultivations) and cost sharecropping tenancy (i.e., 0.077376, 0.065694 and 0.029185 in three cultivations, respectively) are statistically significant and different from zero.

However, resource allocations are not uniformly efficient in nature across all contracts. To test the empirical relevance of the hypothesis, the study conducted Wald test on the equality of coefficients of alternative tenancy arrangements. Test results are presented in the Table 3. It can be seen that the hypothesis of equality of the coefficients of fixed rent and pure sharecropping (H_0: $\gamma_1 = \gamma_2$) is accepted, while the equality of the coefficients of pure sharecropping and cost

Table 2: Determinants of allocative efficiency under alternative crop cultivations

Variables	Coefficient	All crops	Paddy	*Amanswarna*
Constant	γ_0	0.808712***	0.790788***	0.705397***
CONT1	γ_1	0.040591	0.049676**	0.035394*
CONT2	γ_2	0.044204	0.056960	0.044897**
CONT3	γ_3	0.077376**	0.065694**	0.029185**
HHEXP	γ_4	2.63E-06	2.14E-05**	4.07E-06
HHEDU	γ_5	0.004327*	0.007737**	0.004438**
OPRT	γ_6	0.001509*	0.001299*	0.001204**
FRAG	γ_7	-0.008122	-0.020750**	-0.002560
BARGA	γ_8	-0.035191	-0.066068	-0.041445**
INTER	γ_9	0.042083**	0.023384*	0.006086*
LOAN	γ_{10}	0.026794	0.043876**	0.019940**
Observations	N	303	252	214
R-squared	R^2	0.204832	0.180752	0.240867

Source: Field Survey (2006-07), ***Significant at 1% level, **Significant at 10% level, *Significant at 15% level

[14]Ahmed *et al.* (2002) argued that tenure status significantly influences technical efficiency. Empirical result suggests that fixed rent, sharecropping and gift plots are less efficient compared to owner cultivated plots.

[15]Under fixed rent tenancy, the landlord leases out the land to the tenant and in return asks for a fixed rental payment. The sharecropping is a form of tenurial contact under which tenant leases in land from the landlord and shares the output under predetermined contractual arrangement. The sharecropping is again of two types. The cost sharing sharecropping under which the landlord shares the cost of factor of production usually in the same proportion as the share of output. On the other hand, under the arrangements of the sharecropping without cost sharing tenants bear the full cost of production and the proportion of output share to the landlord is usually smaller than under cost-sharing arrangement. Inclusion of cost sharing arrangement in our analysis is particularly relevant in view of the widespread prevalence of the arrangement as a part of the tenancy contract, which is a striking new phenomenon in Indian agriculture (Bardhan, 1984). Coexistence of all three forms of contracts is prevalent in our surveyed villages.

Table 3: Wald test on the equality of coefficients under alternative tenurial contracts

Null hypothesis	F-statistic	Probability	Chi-square	Probability	Decision
(H_0: $\gamma_1 = \gamma_2$)					
All crops	0.007027	0.933250	0.007027	0.933193	Accept Ho
Paddy	0.025248	0.873884	0.025248	0.873751	Accept Ho
Amanswarna	0.114334	0.735614	0.114334	0.735263	Accept Ho
(H_0: $\gamma_2 = \gamma_3$)					
All crops	5.714071	0.017465	5.714071	0.016829	Reject Ho
Paddy	7.021969	0.008587	7.021969	0.008052	Reject Ho
Amanswarna	11.96193	0.000662	11.96193	0.000543	Reject Ho
(H_0: $\gamma_1 = \gamma_3$)					
All crops	7.575736	0.006288	7.575736	0.005916	Reject Ho
Paddy	8.266038	0.004402	8.266038	0.004039	Reject Ho
Amanswarna	6.436919	0.011933	6.436919	0.011177	Reject Ho

Source: Field Survey 2006-07

sharecropping (H_0: $\gamma_2 = \gamma_3$) and the equality of the coefficients of fixed rent and cost sharecropping (H_0: $\gamma_1 = \gamma_3$) are rejected. This indicates that the difference in allocative efficiencies associated with fixed rent and pure sharecropping is not statistically significant, while allocative efficiency associated with pure sharecropping and cost sharecropping and that of fixed rent and cost sharecropping differ significantly.

In addition to land tenure contracts, several other socio-economic and demographic factors have an influence on the allocative efficiency. The positive and significant coefficient of the years of schooling and experience of the head of the household[16] justify the argument that schooling and experience influence positively the level of allocative efficiency in agriculture. The coefficient of the operated land variable is estimated to be positive and significant in all three regressions. The evidence indicates that larger farmers tend to be more efficient in allocating inputs than small farmers. The result is further supported by the fact that the extent of allocative efficiency is observed to be inversely related to the fragmentation of landholdings. The negative coefficient of BARGA is contrary to our expectation. But it is not significantly different from zero in all crop and paddy regressions. The positive and significant coefficient of interlinkage (INTER) in all three regressions established that interlinked transactions lead to improve the allocative efficiency. The impact of availability of credit (whether formal or informal) on the allocative efficiency of farmers is captured by a LOAN dummy variable. The positive and significant coefficients of the dummy variable justify the catalytic role of credit in improving allocative efficiency of farmers.

Let us now discuss the results in the light of existing literatures. It has been found in our study that increased farming experience coupled with higher level of formal schooling lead to enhance the skill of decision making in the use of inputs. However, the association between schooling and experience on the allocative efficiency in the existing literature is quite mixed. Some studies have found a positive connection between schooling and allocative efficiency (Wadud, 2003) while some studies have reported a negative association between education and allocative efficiency (Nwachukwu and Onyenweaku, 2009; Bravo-Ureta and Pinheiro, 1997)[17]. On the other hand, some

[16]Though the coefficients of education of head of the household are found to be significant in all three regressions, the coefficient of experience of head of the household is significant only in paddy cultivation.

[17]Some studies also pointed out the favourable impact of agrarian reform on the allocation of resources (Bravo-Ureta and Pinheiro, 1997; Dewalt, 1979; Meyer, 1989; Seligson, 1982).

studies also reported a positive relationship between experience and allocative efficiency (Bravo-Ureta and Pinheiro, 1993; Nwachukwu and Onyenweaku, 2009), The link between allocative efficiency and farm size has been the subject of much discussion in the literature (Berry and Cline, 1979). Present result that larger farmers tend to be more efficient in allocating inputs than small farmers is consistent with the findings of Bravo-Ureta and Pinheiro (1997) of Dominican Republic; Wadud (2003) of Bangladesh while they are contradicted with the findings of Nwachukwu and Onyenweaku (2009) of Nigeria. Fragmentation of landholding has an important bearing on allocative efficiency in agricultural production. Present result that highly fragmented land hinders the use of improved technologies conforms to the results obtained by Wadud (2003). In the study, it is expected that successful implementation of the policy of Operation Barga would enhance farmer's incentive to invest in yield-increasing inputs and to put land to its most productive use[17]. However, in the light of our empirical findings, it is to be noted that the successful implementation of Operation Barga in West Bengal has led to marginalization of operational holding NSSO (1997)[18] which is essentially a stylized feature of West Bengal agriculture. So marginalization of landholdings might act an adverse impact on allocative efficiency. On the issue of interlinkage in factor markets and allocative efficiency, our empirical evidence supports the neoclassical presumption that interlinked transactions resulted in improving the allocative efficiency in agricultural production[19]. Regarding the impact of availability of credit (whether formal or informal) on the allocative efficiency of farmers our proposition is that the availability of credit either from formal or informal sectors can act as a catalytic role in channeling desired inputs in the process of production and thus it enhances the allocative efficiency level of the farmers. Contrary to present result, Nwachukwu and Onyenweaku (2009) have observed a significant negative relationship between the access of credit and allocative efficiency. Their argument was that inaccessibility of credit acts as a constraint in timely purchases of inputs and engagement of farm resources and thus puts an obstacle in improving the allocative efficiency in agriculture.

CONCLUSION

It is possible to increase agricultural output by reallocating input mix efficiently without any resort to new technology. Allocative efficiency can be measured in three alternative ways: neo-classical profit maximization method where equality between the marginal value products and marginal factor costs is tested; constrained profit maximization method where a test is conducted to examine whether input-output proportions are constant for all the farmers; and constrained cost minimization method of Data Envelopment Analysis. In our study, we have used cost minimizing behaviour to examine allocative efficiency in the light of several criticisms of profit maximization hypothesis in Indian agriculture. Empirical results based on DEA reveals that farmers are moderately efficient in the choice of inputs of rural West Bengal. It is interesting to note that various attributes of farmer and farm specific characteristics determine the input allocation decision in production. Choice of tenurial contracts has a significant role to play in influencing resource

[18]Nearly 81% of the operational holdings in West Bengal now belong to the marginal category (NSSO, 1997).

[19]On the impact of interlinked transactions on allocative efficiency, there are two schools of thought: Neoclassical and the Marxist. Present result is in line with the Neoclassical presumption that the institution of interlinkage is conducive to improve allocative efficiency and thus, in turn, induces for more rapid adoption of innovation (Cheung, 1969; Bardhan, 1984, Braverman and Srinivasan, 1981; Braverman and Srinivasan, 1982; Basu *et al.*, 2000).

allocation of inputs. All contracts are not found to be equally efficient. Fixed rent tenants are able to allocate resources more efficiently than the sharecroppers. Besides tenurial contracts, other determinants which have significant bearings in allocative efficiency are education level of head of the household, operated land, interlinkage of factor markets and availability of credit to the rural household.

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