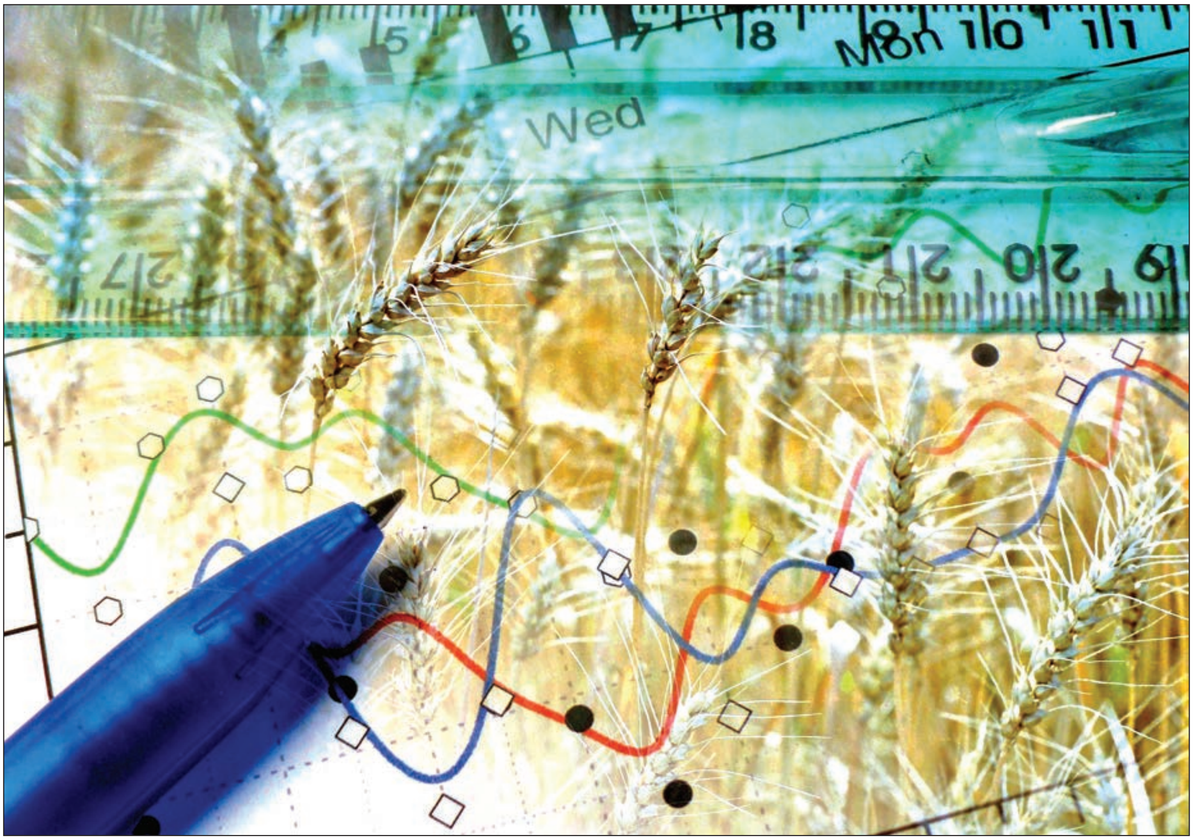

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Differences in Resource Allocation under Alternative Tenurial Contracts and its Explanations: Evidence from Rural West Bengal, India

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ABSTRACT

In the light of the debate on the differences in resource allocation under alternative tenurial contracts, an attempt has been made in the paper to measure the level of allocative efficiency across alternative tenurial contracts in West Bengal agriculture by using Data Envelopment Analysis. Empirical evidences suggest a close association between efficiency in resource allocation and land tenure contracts in the sense that owner cultivation and fixed rent tenancies are used to allocate resources more efficiently in comparison to sharecropping and cost sharecropping tenancy. The difference in allocative efficiency under alternative contractual choices is also observed to be attributable to the differences in cropping pattern and irrigation intensity under alternative contractual arrangements.

Key words: Allocative efficiency, tenurial contracts, cropping pattern, irrigation intensity, data envelopment analysis

INTRODUCTION

The importance of institutions in agrarian development has long been recognized in designing appropriate policy by the decision makers. Agricultural tenancy, one important rural institution ever exist, has received particular academic attention over centuries and across various countries. Share tenancy, a particular form of agricultural tenancy, is debated on the ground of efficiency in improving productivity. In the first formal attempt in the debate, Marshall (1890) considered share tenancy as an inefficient mode of cultivation where resources are sub-optimally utilized. Long back of the writings of Marshall, Smith (1776) considered the institution of matayer (sharecropper) results in inefficient allocation of resource which, in turn, acts as a hindrance to agricultural development. All economists until Johnson (1950) have considered sharecropping to be a practice which is hurtful to the whole society. In an effort of rejecting Marshallian inefficiency argument, Johnson suggested that the tenant could be induced to apply the efficient level of input by landlord with constant monitoring the tenant's cultivation, leases out land in parcels and renew the contracts only after satisfactory performance. In a study, Cheung (1969) formalized the Johnson's argument and show that share tenancy is no less efficient than the owner cultivation or fixed-rent tenancy.

Bardhan and Srinivasan (1971) and Jaynes (1982) challenged the theoretical formulation of Cheung and established the conventional Marshallian inefficient argument by extending the conventional partial equilibrium analysis into a more general framework. The efficiency under alternative tenurial contracts is mostly guided by productivity differences. But, productivity differences may be influenced both by technical and allocative efficiency. Technical efficiency represents the ability to obtain maximal agricultural output from a given set of inputs and allocative efficiency which represents the ability to use the inputs in optimal proportions by adopting improved practices in agricultural production with a given technology. In comparison to the literature on technical efficiency, studies relating 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 (Welsch, 1965), Greece (Yotopoulos, 1967), China (Fan, 2000), Bangladesh (Wadud, 2003), India (Schultz, 1964; 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 (Rudra, 1992; Kumbhakar, 1994; Ray and Bhadra, 1993). However, in capital scarce economy, the productive efficiency is mostly influenced by the allocative efficiency in agriculture. Under the backdrop of this controversy, an attempt has been made in the paper to measure the level of allocative efficiency across alternative tenurial contracts in West Bengal agriculture by using Data Envelopment Analysis. An explanation of the observed difference of allocative efficiency in terms of cropping pattern and irrigation intensity is also provided in the paper.

MATERIALS AND METHODS

Data sources: The study is based on a field survey in rural West Bengal in the year 2006-07. Taking into consideration the dominant practice of tenancy, in the first stage, out of 18 districts of West Bengal, the district of Burdwan has been selected for the survey. In the second stage, among the 31 blocks 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. The selection of district, block and villages are based on a-priori information (for details see Laha, 2009). 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).

METHODOLOGY: DATA ENVELOPMENT ANALYSIS

The differences in allocative efficiency of farmers across alternative tenurial cultivations can be explained by determining the predicted farm level allocative efficiencies. Allocative efficiency can be measured using the cost minimization DEA model. This approach of non-parametric mathematical programming approach to frontier estimation was first developed by Charnes *et al.* (1978). In our analysis, a Multi input-Multi output Constant Returns to Scale Input Oriented DEA model is used. 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*, output of all paddy varieties taken together and output of all crops measured as a equivalent of *amanswarna*. 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). 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. 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. 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:

$$\mathrm{Min}_{\mu, x_i^*}\ m_i' x_i^*$$

$$\text{subject to } \sum_{i=1}^{N} \mu_i x_{ji} - x_{ji}^* \leq 0$$

$$\sum_{i=1}^{N} \mu_i y_{ki} - y_{ki} \geq 0$$

$$N1'\ \mu_i = 1$$

$$\mu_i \geq 0$$

where, m_i is vector of unit price of inputs utilized by DMU_i, x_i^* is vector of input quantities of DMU_i with respect to production cost minimization, y_{ki} is amount of output k produced by DMU_i, x_{ji} is amount of input j utilized by DMU_i, N 1 is an N×1 vector of one, μ_i is 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:

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

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: $AE < 0.7$

The above mentioned cost minimization exercise can be solved by using a number of different computer programs. In this study, we have used DEAP Version 2.1 for the measurement of allocative efficiency.

RESULTS AND DISCUSSION

Nature of tenurial contract: Tenancy is an agrarian institution in which landlord leases out his land to a tenant who cultivates the land and gives a fixed proportion of the total output (in cash or in kind) to the landlord. The most important and widely used tenurial practices are-fixed rent tenancy, sharecropping with cost sharing and without cost sharing arrangement. Coexistence of all three forms of contracts is prevalent in our surveyed villages. 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). Out of 203 households surveyed, we have come across 106 households who are involved in different types of tenancy contracts. The classification of households under alternative forms of tenancy (Table 1) reveals the fact that landless and marginal farmers are predominantly (87.73% of cases) lease in land from large landlords. About 52.22% of total surveyed households are engaged in lease in land market. Out of 106 cases, 37 cases are reported under fixed rent tenancy; and in 33 cases sharecropping is the mode of tenurial contract. Among sharecropping contract, twenty four cases are associated with pure sharecropping (i.e., no cost sharing) and 9 cases are associated with cost sharecropping. But, sharecroppers are not a homogeneous group of tenants. There is wide variation in the sharing of output between landlord and tenant even under sharecropping mode of cultivation. The dominant

Table 1: Distribution of types of tenancy under different categories of households

	Category of households					
Types of contracts	AGL	MRF	SMF	MID	LF	ALL
Fixed rent tenancy	10 (28.57)	24 (41.38)	1 (11.11)	1 (33.33)	1 (100.00)	37 (34.90)
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. AGL: Agricultural labourers, MRF: Marginal farmers, SMF: Small farmers, MDF: Medium farmers, LF: Large farmers

practice (44% of cases) is 1/2:1/2 crop sharing where landlord bears a part of total cost. If the tenant bears the full cost of cultivation, the output sharing ratio becomes 3/4:1/4 and 2/3:1/3. Thus, there is a negative association between cost sharing and output sharing.

Measurement of allocative efficiency: Allocative efficiency has been measured crop-wise under alternative tenurial contracts. Table 2 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.

The association between efficiency in resource allocation and land tenure contracts are presented in Table 3. It can be seen that in all crops cultivation, the highest level of allocative efficiency (0.877122) is found in fixed rent tenancy with 24.42% of total number of holdings. This is followed by owner cultivation (0.864822), pure sharecropping (0.834201) and cost sharecropping (0.758433) tenancy. The gap of allocative efficiency estimates in pure sharecropping and cost sharecropping tenancy and that of fixed rent and cost sharecropping tenancy are far more distinct than the existing gap of fixed rent and owner cultivation. A similar trend of association between allocative efficiency estimates and alternative tenurial contracts can be seen in case of disaggregated level analysis for paddy and *amanswarna* cultivations.

Allocative efficiency is influenced by the nature of cropping pattern and intensity of irrigation under alternative tenurial contract. It is thus desirable to look into how the choice of tenurial contracts influences these factors affecting allocative efficiency.

Cropping pattern and allocative efficiency: The cropping pattern in agriculture is guided by the technical as well as allocative efficiency. However, in capital scarce economy, the cropping pattern is mostly influenced by the allocative efficiency in agriculture. On the other hand, tenurial contracts vary accordingly as the availability of inputs and their contract specifications and thus the tenurial contract does have its influence on allocative efficiency in agriculture. Accordingly, attempts have been made to measure the level of allocative efficiency in contract wise as well as crop wise to provide an explanation as regards the role of cropping pattern in enhancing allocative

Table 2: Summary statistics of the estimates of allocative efficiency (in percentage) under alternative modes of cultivation

	Allocative Efficiency (%)		
Statistic	All crops	Paddy	*Amanswarna*
Mean	84.173	86.152	74.088
Minimum	11.6	30.7	41.1
Maximum	100	100	100
Standard Deviation	20.3496	17.569	7.8054
Skewness	-1.722	-1.334	-0.665
Kurtosis	1.971	0.407	1.064

Source: Field survey 2006-07. The statistical analysis has been made using DEAP statistical package

Table 3: Estimated allocated efficiency levels of different types of cultivation contracts under alternative modes of cultivation

	All crops		Paddy		*Amanswarna*	
Type of cultivation	Average AE	No of cases (%)	Average AE	No of cases (%)	Average AE	No of cases (%)
Owner	0.864822	154(50.83)	0.912371	153(60.71)	0.7741	145(67.76)
Fixed rent	0.877122	74(24.42)	0.884629	35(13.89)	0.756531	10(4.67)
Pure sharecropping	0.834201	45(14.85)	0.859105	35(13.89)	0.742517	32(14.95)
Cost sharecropping	0.758433	30(9.90)	0.785	29(11.51)	0.701222	27(12.62)
All	0.841729	303(100)	0.86152	252(100)	0.740879	214(100)

Source: Field survey 2006-07. The statistical analysis has been made using DEAP statistical package

efficiency in agriculture and its variations under alternative tenurial contracts. In our study villages paddy cultivation dominates the cropping pattern followed by potato and mustard cultivation. Aman paddy is the most important single kharif crop for every firm household in our survey area. Based on field observation, we have divided the crops into two categories: commercial crops (mainly boro and potato) and non-commercial crops (aman, mustard, till, wheat, etc.). Boro and potato are high productive crops which are sensitive to irrigation facihty and have high market value. On the other hand, other crops are mainly grown in our study villages for domestic consumptions. The two-way analysis of allocative efficiency is shown in Table 4.

Table 4 brings out some interesting features relating to allocative efficiency in agriculture. The level of allocative efficiency is invariably found to be higher for the commercial crops compared to the non-commercial crops. This picture is clear from the last column of Table 3, the efficiency level for boro and potato have been estimated as 0.915 and 0.839 which are much higher than the efficiency level of all other crops. If we segregate the analysis contract wise and estimate the allocative efficiency of various crops, then it is found that allocative efficiency is influenced both by cropping pattern and contract specification. It can be found that aman paddy predominates in the cropping pattern under owned, sharecropping and cost sharecropping cultivation. The only exception in this pattern is fixed rent tenancy where potato cultivation predominates followed by boro cultivation. Aman paddy is mainly used for home consumption and the poor farmers with lack of irrigation facility can only cultivate it in monsoon season. Table 4 also provides information on the level of allocative efficiency under alternative forms of tenancy cultivation. A close look at the table shows the relation between cropping pattern and allocative efficiency under alternative tenurial contracts. Allocative efficiency is observed maximum in commercial crops like boro (0.945) and potato (0.880) under fixed rent form of cultivation while it is lowest under cost sharecropping form of cultivation. Allocative efficiency under sharecropping has been estimated between fixed

Table 4: Measurement of allocative efficiency and the nature of cropping pattern under alternative tenurial arrangements

	Owner cultivation		Fixed rent tenancy		Sharecropping tenancy		Cost sharecropping tenancy		All modes of cultivation	
Cropping pattern	Average AE	No of cases (%)	Average AE	No of cases (%)	Average AE	No of cases (%)	Average AE	No of cases (%)	Average AE	No of cases (%)
Aman	0.687	154 (49.20)	0.678	11 (11.23)	0.615	34 (57.64)	0.578	29 (78.38)	0.641	228 (44.97)
Boro	0.912	30 (9.58)	0.945	27 (27.55)	0.901	2 (3.39)	-----	0 (0.00)	0.915	59 (11.64)
Potato	0.856	55 (17.58)	0.88	47 (47.96)	0.79	1 (1.69)	0.829	1 (2.70)	0.839	104 (20.51)
Mustard	0.73	31 (9.90)	0.73	4 (4.08)	0.769	5 (8.47)	0.694	4 (10.81)	0.731	44 (8.68)
Til	0.592	30 (9.58)	0.63	5 (5.10)	0.588	13 (22.03)	0.683	3 (8.11)	0.623	51 (10.06)
Wheat	0.687	4 (1.28)	0.749	1 (1.02)	0.75	2 (3.39)	-----	0 (0.00)	0.729	7 (1.38)
Others	0.717	9 (2.88)	0.723	3 (3.06)	0.739	2 (3.39)	-----	0 (0.00)	0.726	14 (2.76)
All crops	0.865	313 (100.00)	0.877	98 (100.00)	0.834	59 (100.00)	0.758	37 (100.00)	0.834	507 (100.00)

Source: Field survey 2006-07. The statistical analysis has been made using DEAP statistical package

rent tenancy and cost sharecropping form of tenancy. In general, the level of allocative efficiency in owner cultivation is found to be almost at per with fixed rent tenancy. Other forms of tenurial contracts are less efficient in terms of the level of allocative efficiency.

It is to be noted that fixed rent tenants prefer capital intensive crop. In fact, the wealthy tenants can take the whole risk associated with cultivation. In other words, wealth is inversely related to risk aversion. This finding supports the argument of Laffont and Matoussi (1995). In particular, the fixed rented land is occupied mostly by potato cultivation which is a disease-prone crop and thus risky in this sense. This is followed by boro cultivation which is highly sensitive to the irrigation potentiality of the region. On the other hand, sharecropped tenants are mostly interested in cultivating those crops which can meet their subsistence requirements and are less labour intensive in nature. Thus a sharecropper is reluctant to venture into the more profitable but risky crops which also require a considerable amounts of inputs per acre (labour and other materialized inputs) since he has to share the profits with the landlord. A weak bargaining position of the tenant in the output market reduces profitability of the crop in a great extent. The sharecropper would rather prefer to produce more food crops, requiring less input per acre and also protecting their subsistence requirement. The preference is further strengthened in case of cost sharecroppers' where a landlord partly shares the cost burden of the tenant. On the basis of Farm Management Survey data for Punjab, Bharadwaj (1974) also observed similar effect of tenurial system on cropping pattern: the share-rented lands have a higher percentage area under food and less under cash crops as compared with owner-cultivated and fixed-rented holdings. Thus allocative efficiency is sensitive to the cropping pattern and the nature and forms of tenurial contracts.

Irrigation intensity: Allocative efficiency in agriculture is found to be intertwined with irrigation intensity and the nature of tenurial contracts. Table 5 presents a two way analysis of allocative efficiency in the percentage of cropped areas irrigated and alternative forms of cultivation.

Empirical evidences suggest that the level of allocative efficiency is much higher for the irrigated holdings compared to the non-irrigated holdings. The general pattern of movement of allocative efficiency in irrigated land is also justified across alternative tenurial contracts. However, there exist variations in the percentage of irrigated area under alternative tenurial contracts. The percentage of area irrigated (above 80%) is found to be higher on owned holding than other

Table 5: Measurement of allocative efficiency and the percentage area irrigated under alternative tenurial arrangements

Percentage area irrigated	Owner cultivation		Fixed rent tenancy		Sharecropping tenancy		Cost sharecropping tenancy		All modes of cultivation	
	Average AE	No of cases (%)	Average AE	No of cases (%)	Average AE	No of cases (%)	Average AE	No of cases (%)	Average AE	No of cases (%)
0-20	0.659	60 (38.7)	0.846	39 (52.7)	0.591	29 (61.7)	0.632	17 (56.7)	0.65	145 (47.39)
20-40	0.857	12 (7.70)	0.867	2 (2.70)	0.733	2 (4.30)	-----	0 (0.00)	0.827	16 (5.23)
40-60	0.865	11 (7.10)	0.895	4 (5.40)	0.954	2 (4.30)	0.705	2 (6.70)	0.869	19 (6.21)
60-80	0.933	14 (9.00)	0.906	6 (8.10)	0.909	4 (8.50)	0.813	3 (10.0)	0.847	27 (8.82)
80-100	0.926	58 (37.4)	0.943	23 (31.1)	0.923	10 (21.3)	0.887	8 (26.7)	0.935	99 (32.35)
Total	0.865	155 (100.0)	0.877	74 (100.0)	0.834	47 (100.0)	0.758	30 (100.0)	0.842	306 (100.00)

Source: Field survey 2006-07. The statistical analysis has been made using DEAP statistical package

alternative tenurial arrangements. It is followed by fixed rented land where a little more than 31% of its land is found included in the group of above 80% of irrigated area. All other tenurial arrangements have less than 30% of land belonging to the highly irrigated area. The analysis leads to the following broad conclusion: the percentage area irrigated is found to be higher on owned and fixed rented holdings than on share-rented. The empirical findings of the study thus supports two possible hypothesis drawn out by Farm Management Survey data for Punjab: firstly, tenants who can secure land on the basis of a fixed rent system have a greater incentive to undertake the provision and maintenance of irrigational facilities; and secondly, a rent contract on already irrigated land may appear more attractive as he can exploit the full economics of irrigation which requires an intensive application of his own inputs, particularly labour (Bharadwaj, 1974).

Irrigation potentiality of the land has a distinct advantage in the choice of cropping pattern of the holding under alternative mode of cultivation. The share-rented lands have a higher percentage area under food grain crops and less under cash crops as compared with owner-cultivated and fixed rented holdings. It indicates that higher irrigation potentiality acts as an incentive to cultivate commercial crops. The higher percentage of irrigated area makes it possible to cultivate boro paddy and potato cultivation in owned and fixed rented holdings. On non-irrigated holdings, on the other hand, aman paddy is the main food crop in share-rented holdings. If the rains are expected to be poor, the cultivators prefer to sow aman paddy which requires much less irrigation. Accordingly, allocative efficiency of commercial crops under owner and fixed rent tenancy are higher compared to the other forms of tenancy. This again reestablishes the fact that allocative efficiency is sensitive to irrigation intensity and thus to the cropping pattern under alternative form of tenurial contracts.

CONCLUSION

It is possible to increase agricultural output by reallocating input mix efficiently without any resort to new technology. Based on a firm field data on West Bengal agriculture, this paper attempts to estimate the level of allocative efficiency under alternative forms of tenurial contracts. Using Data Envelopment Analysis, empirical evidences suggest that allocative efficiency in agriculture is sensitive to the mode of tenurial contracts. Allocative efficiency is observed to be highest in fixed rent tenancy and lowest in cost-sharecropping. Pure sharecropping takes the intermediate position between fixed rent tenancy and cost sharecropping. The gap of allocative efficiency estimates in pure sharecropping and cost sharecropping tenancy and that of fixed rent and cost sharecropping tenancy are far more distinct than the existing gap of fixed rent and owner cultivation. The measurement of allocative efficiency under commercial and non-commercial crops shows that the level of allocative efficiency of the commercial crops is much higher than the non-commercial crops. On the other hand, commercial crops are found to be highly sensitive to irrigation intensity and the forms of tenurial contracts. Thus, the resource allocation under alternative tenurial contracts is crucially dependent on the cropping pattern and irrigation intensity in agriculture.

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