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Agricultural Efficiency among the Ultra-Poor of the Northern Region of Bangladesh: Does Credit and Training Matter?

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Abstract

Using both household and plot level data, this paper analyses the difference in agricultural productivity and technical efficiency structure of the ultra-poor households of the Northern region of Bangladesh. We find that agricultural productivity, which has been proxied by output per unit of land, is much lower for land cultivated under share-cropping contract than those of self-owned land or land cultivated under fixed rental contract. The study also reveals that this lower productivity of share-cropped land is due to sub-optimal use of agricultural inputs. Apart from the tenancy contract, technological assistance and education of the households are found to be effective for raising productivity. However, no direct impact of credit on agricultural productivity is found. Nevertheless, credit can facilitate agricultural productivity through a less direct channel by providing additional cash required to rent-in land under fixed rental contract. The result of the Logit estimates suggests that the decision to rent-in land under fixed rental contract indeed depends on the availability of credit to households. Finally, the analysis on efficiency structure of agricultural households using stochastic frontier analysis suggests that training or technological assistance, among others, increases the agricultural efficiency of households.

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1. Introduction

As part of the process of structural transformation of Bangladesh, the share of agriculture in the national income of the country has been on a declining trend. However, despite of its falling share, the importance of agriculture sector in generating employment as well as in meeting demand for food cannot be over emphasised. Productive and efficient agriculture can assure food security, generate employment and income, meet nutritional requirements, lower poverty and as a whole can act a driving factor in the development effort of a country. In addition, by supplying raw materials and intermediary products, agriculture also helps in manufacturing sector development.

Despite its falling share, agriculture in Bangladesh accounts for about a fifth of gross domestic product and employs around 54.5 percent of the rural labour force (BBS, 2010). In order to accommodate the food requirement of its growing population as well as to absorb the vast labour force in a productive manner, the key strategies for agriculture sector development of Bangladesh is argued to be that of increased productivity through diversification and modernisation. Given the livelihood of as high as 70 percent[4] of the rural people depend on agriculture, enhancement of agricultural productivity can play an important role in alleviating rural poverty, and stimulating growth in non-farm activities.

In the context of Bangladesh, availability of appropriate data set, particularly for certain vulnerable and poverty stricken areas of the country, e.g. that of the northern region of the country constrain the policy makers as well as the academicians to have a comprehensive assessment of the factors determining agricultural productivity in Bangladesh. Such information would be extremely valuable in identifying major constraints on productivity growth and in formulating strategies to overcome them.

In this paper, with the help of information of a survey on Northern region of Bangladesh, we aimed to investigate the effect of a specialised credit programme operated by Palli Karma-Sahayak Foundation (PKSF), as well as other credit disbursing organisations on agricultural productivity of the ultra-poor households of Northern Bangladesh. Along with the traditional measure of productivity like output per unit of land, we have also tried to analyse the technical efficiency structure of agriculture by means of Stochastic Frontier Approach. In addition, it is not only credit, but also the nature of the tenancy contract that can have significant contribution towards agricultural productivity, Therefore, we have also tried to explore how tenancy structure

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4 http://www.mof.gov.bd/en/budget/13_14/gender_budget/en/27%20Chapter%2029_43_Ministry%20of%20Agriculture_English.pdf

and extension services such as training programme and technological assistance can affect the productivity and efficiency of agricultural households.

The paper is organised as follows. **Section 2** provides background of the research. **Section 3** discusses the key literature in the area of tenancy contract, credit and extension service on agricultural productivity whereas **Section 4** outlines a framework to study the effect of tenancy contract, credit and extension service on agricultural productivity along with a brief overview of Stochastic Frontier Model for estimating agricultural efficiency. **Section 5** discusses econometric estimations and their implications. Finally **Section 6** offers some policy recommendations.

2. Background

In the context of a developing country like Bangladesh, there exists a variety of contractual farming, including those of share tenancy, fixed rent contract, wage contract etc. Evidences reveal that, it is the share tenancy that has been preferred over other forms of contractual arrangements. The predominance of share tenancy can be related to a host of factors. As explained by Hossain (1979), given that daily labour is often considered socially degrading, land owners often prefers to rent out his land for preventing their social position. Natural risk is argued to be another factor in preferring share tenancy over fixed rent contract and a risk-averse tenant prefers share-cropping over fixed rent tenancy. By choosing wage contract, a tenant can shift the risk to the landowner whereas by adopting share tenancy, he shares it with the land owner. From the point of view of a landowner, by adopting fixed rent contract he can entirely shift the risk whereas for share-cropping the risk can partially be transferred to the share-cropper (Hossain, 1979). On the other hand, Cheung (1969) argued that, due to its complex structure, share-cropping involves high transaction cost. In order to explain the high intensity of share-cropping in the context of Bangladesh, Hossain (1979) added that the nature of cultivation of rice along with the inequality in property distribution might also generate a bias towards share-cropping. The type of tenancy arrangement is crucial for the development and modernisation of agriculture because share-cropping is argued to be an inefficient form of contractual arrangement. As share-cropping involves output sharing, this acts as a disincentive to provide higher effort by the tenant and greater capital or management inputs by the landowner, resulting in plausible inefficiency in production, known as Marshallian inefficiency.

It is often argued that one of the most important reasons behind the differential in productivity is land tenure contracts. There exist a vast body of literature on land tenure contracts and their implications for agricultural efficiency. Adam Smith (1776), John Stuart Mill (1848), Alfred Marshall (1890), and numerous other pioneering economists have argued that share tenancy causes inefficient resource allocation. Given that share tenants receive only a fraction of the value of his marginal product of labour as marginal revenue, it reduces the tenant’s incentive to supply labour or other inputs at an optimal and efficient level.

The agriculture sector in Bangladesh is largely characterised by small and marginal farmers comprising of a large number of share-croppers. Over time, along the line with the agrarian transformation, cash based tenancy (e.g. fixed renting, leasing) gained prominence over the traditional share-cropping system. In the last 25 years the number of tenant farmers increased from 44% to 58%, and the land operated under tenancy contracts has increased from 23% to 42% (Hossain and Bayes 2014). With the adoption of modern variety of crops and increased cropping intensity At the same time the demand for agricultural input has also increased as the new crop varieties require modern agricultural inputs like modern varieties of seeds, chemical fertilizers, pesticides, modern irrigation equipments and skill labour. All such inputs require a substantial amount of investment by the farmers, which is often much higher than that most of the tenant farmers can bear with their own capital. As a result, for sustaining the technological progress and productivity growth in agricultural sector in Bangladesh, a growing need for agricultural credit especially for the small marginal and tenant farmers have emerged.

Despite of huge demand for agricultural credit, the marginal and small farmers, rarely have access to credit from formal financial institutions. According to Hossain and Bayes (2009), only 26% of total institutional credit of rural Bangladesh is used for agricultural purposes. They also showed that only 1.5 % of the farmers who own less than 0.20 hector land, had access to bank credit while for those owning more than 2.0 hector of land, this proportion is 20%. Therefore, in spite of the expansion of micro-finance institutions (MFIs) and formal banking sector in the last 2 decades in particular, tenant farmers, who are the dominant form of agrarian labour in Bangladesh, have been bypassed by these conventional financial institutions resulting in inadequacy of working capital and lower access to inputs. The consequential outcome is often lower productivity and low to moderate growth.

In the context of the poor households of Greater Rangpur areas, who are often threatened by food insecurity and seasonal hunger (locally known as *Monga*), such a phenomenon of lack of access to credit is even more predominant.[5] Lack of industrialisation and dearth of manufacturing jobs in this area limits income earning opportunities of the households outside agriculture and the poor households living in these areas primarily work as agriculture wage labour. From a geographical context, Northern region of Bangladesh is primarily a flat land with major river systems, resulting in occurrence of floods in a regular interval. The area is also one of the worst affected regions by draughts, which has made the lives of rural households challenging and vulnerable. In fact, this region was among the worst-hit areas during past famines, especially the one of 1974. This region has thus been characterised by extreme poverty with occasional outbreak of famine and recurrent *Monga* during pre-harvest months. All such features have undoubtedly made the region of Northern Bangladesh an important area of research and policy analysis, especially from the view point of poverty and development and therefore it has received much attention from different stakeholders in recent time.

Against this backdrop, Palli Karma-Sahayak Foundation (PKSF) has been implementing a project called Programmed Initiatives for *Monga* Eradication (PRIME) since 2006 to offer financial services to the ultra-poor households in five of the districts of greater Rangpur region. PKSF implements PRIME through 16 of its partner organisations (POs) and its objectives are: (i) to assist people to cope with the seasonal loss of livelihood causing *Monga* (short-time objective); and (ii) to create diversified income sources within the households in a way that will eradicate *Monga* (long-term objective). Financial and non-financial products like emergency loan and food-for-work were put into practice to meet the short-term objective. Long-term incentives include flexible microcredit, microsavings, and training on income generating activities for the targeted members. Moreover, PRIME also provides health services and medicines to its members. The programme initially started as a pilot project in Lalmonirhat and later received major financial support from DFID under PROSPER initiative. Currently, it is taking place in all five districts of Greater Rangpur (namely Gaibandha, Kurigram, Lalmonirhat, Nilphamari and

[5] For these poor people of Greater Rangpur, lack of work opportunities during the pre-harvest months of October and November causes this seasonal hunger.

Rangpur). Prime provides both financial services (credit, savings etc.) and non-financial support (such as training, health services). Moreover, there are multiple credit types available to the PRIME clients such as flexible, seasonal, emergency and agricultural credits in addition to more regular ones.

While using the 5th round of PRIME dataset, this paper attempts at understanding the agricultural productivity and the factors determining such productivity. The specific objectives of the paper are as follows:

- To determine the level of efficiency/inefficiency prevailing in the farm.
- To understand the factors affecting the choice of fixed rental contract in comparison to share-cropping.
- To analyse the effect of farming arrangement on the level of productivity of farms.
- To determine whether availability of credit or training facility contribute towards farm productivity.
- To ascertain the differences across different farming arrangement types in terms of input use pattern.

3. A Brief Review of Literature

There is a vast body of literature on land tenure contracts and their implications for agricultural efficiency. Adam Smith (1776), John Stuart Mill (1848), Alfred Marshall (1890), and numerous authors have argued that share tenancy causes inefficient resource allocation because the share tenant receives as marginal revenue only a fraction of the value of his marginal product of labour, thus reducing the tenant's incentive to supply labour or other inputs below the efficient level. More recently, others have argued that if the tenant's work effort can be costlessly monitored and enforced by the landlord, then resource allocation can be as efficient under share-cropping as under owner-cultivation or fixed-rent tenancy (Johnson, 1950; Cheung, 1969). Whether monitoring and enforcement of contracts are sufficiently costless to allow for efficient share-cropping is of course an empirical question.

The available empirical evidence on the efficiency of alternative land tenure contracts is mixed. The majority of studies do not find significant inefficiency of share tenancy, and the distribution of case study results shows no significant evidence of Marshallian inefficiency of share-cropping (Otsuka and Hayami, 1988). However, many of the studies that have been completed did not adequately distinguish share-croppers from fixed-rent tenants or owner-operators and did not control for other factors that may affect input use and productivity, such as land quality or differences in farmers' endowments or abilities (Shaban, 1987). Several studies that did control for such characteristics have found evidence supporting the Marshallian perspective (Bell, 1977; Shaban, 1987; Sadoulet, Fukui and de Janvry, 1994; Laffont and Matoussi, 1995; Chunrong AI, Arcand and Ethier, 1996), although inefficiency was not always found for all groups of farmers (Sadoulet, et al.), nor did it always mean lower input use or output per hectare on share-cropped land (Chunrong AI, et al.).

Similarly, a numerous number of studies have been carried out regarding agricultural credit, particularly in the countries like India, Pakistan, Nigeria, Congo, Ghana, etc. The practice of providing credits to the farmers has the evidence of boosting up agricultural production, either directly or indirectly. Most of these non-experimental and observational studies regarding agricultural credit found that availability of formal credit by the farmers has significant effect on agriculture. For instance, in India, Kumar (2012) found the evidence of a positive treatment effect in estimating the impact of bank loans for the sake of agriculture on an indicator of wealth or income. Shah et al. (2008) found positive relationship between farm productivity and agricultural credit in the context of backward District i.e. Chitral, of Northern Pakistan. Sharmeen and Chowdhury (2013) found that a positive correlation exists between available agricultural credit and greater production in the context of Bangladesh. Recent literature (Wakilur et al 2011) also provides evidence of a strong positive correlation between, agricultural credit at reasonable cost and agricultural production.

Other group of literature suggests that lack of access to credits by the farmers has detrimental effects on agriculture. Akinterinwa and Awoyinka (2008) showed that credit unconstrained farmers have their output supply higher than that of credit constrained farmers. In Nigeria, Bolarinwa and Fakoya (2011) conducted a study on dwindling cocoa farmers' productivity as a result of lack of adequate capital to increase yield. According to the record, credit beneficiaries were able to produce 80,000 tons more cocoa compared to 21,000 tons less cocoa produced by non-credit beneficiaries. The study recommended that to have positive impacts on farmers' socio-economic status, farmers should be provided with agricultural credit and research should be intensified at the farm level for the benefit of the farmers. Foltz (2004) developed an econometric model that linked credit access with agricultural profitability and investment. His investigation from data collected from rural Tunisia revealed that the presence of credit market constraints act as significant obstacles in making profits by the farms. Muayila and Tollens (2012) conducted a study to investigate the impact of credit constraints on the economic welfare of farm households where the households' economic welfare was measured using the consumption approach. Cross sectional data on 202 randomly selected farm households was collected from the hinterland of Kinshasa, Democratic Republic of Congo. As per the findings, credit constrained households are estimated to have lower welfare outcomes than unconstrained households. Therefore, the enhancement of access to credits by farm households would improve welfare distribution. Rashid et al (2002) found in their study that credit-constrained small farms allocated less land to HYV rice, although the magnitude of the effect was very small. Carter (2009) argued that credit affects agricultural performance by relaxing the working capital constraints, inducing farmers to adapt the new technologies and intensive use of fixed resources.

However, not much study has been conducted in Bangladesh on the impact of training and technical assistance on agricultural productivity. Haq (2013) described that the impact of extension contact coefficient on crop income is positive and significant in the context of Bangladesh. He concluded that agricultural extension is necessary for the farmers. In our current paper, agricultural extension service has been discussed along with agricultural credit due to its significance in agricultural productivity.

4 Empirical Strategy

4.1 Determinants of Tenancy Choice

In order to analyse the determinants of tenancy choice, the most appropriate methodology would be that of a logistic model. Here logistic regression procedure has been used to estimate the likelihood of a share-cropping contract compared to a fixed-rental one. Logistic regression analysis is often used to investigate the relationship between the response probability and the explanatory variables (Allison, 1999) The response, Y, is a binary (0,1) variable representing the cropland lease decision. Let X denote a vector of explanatory variables and $p = pr(Y = 1/X)$ is the response probability to be modeled. The linear logistic regression model has the form Logit $(p) = log\,(p/\,(1-p)) = a + b\,'\,X$, where p is the probability of selecting a specific lease (fixed rent in this study), 'a' is the intercept parameter, and 'b' is the vector of slope parameters.

The dependent (response) variable, Y, is the cropland lease choice decision with a value of 1 for a fixed rental tenancy and 0 for a share-cropping contract. The explanatory variables include land use, management practices, and location attributes on the leased land; farm business and demographic characteristics. In a world without error or inefficiency, the farm would produce.

4.2 Effect of Tenancy Status, Credit and Training on Agricultural Productivity

Our regression model for yield realised by cultivator c on plot i can be expressed as:

$$y_{ci} = \alpha s_{ci} + \beta X_{ci} + v_c + \eta_{ci}$$

Where s_{ci} is an indicator of whether the plot is share-cropped and X_{ci} is a vector of exogenous plot characteristics. Thus, α estimates the average yield differential between share-cropped and owner-cultivated (or rented) plots. The error component v_c captures unobserved factors common to a given cultivator that determine productivity; e.g., access to credit, farming knowledge, average land quality, and ownership of non-marketed assets. The error component η_{ci} cireflects plot-specific unobservables, such as soil fertility which are not contained in X_{ci}

Since, in general, the decision to enter into a share-cropping contract depends upon cultivator's unobserved productivity, $E\,[v_c\,|s_{ci} = 1] \neq 0$ and OLS estimates of y are subject to selection bias. All of the major theories of share-tenancy proposed thus far in the literature imply that $E\,[v_c|s_{ci} = 1] < 0$ i.e., that share-croppers have lower unobserved productivity than owner cultivators or fixed renters. This means that selection bias will, if anything, lead to an overstatement of the disincentive effects of share-tenancy.

Our strategy for correcting this selectivity bias is essentially the same as that of Shaban (1987) and Bell (1977). In particular, we use household fixed effects to purge v_c. This procedure requires a sufficient number of owner-cum-share-cropper (OCS) households, owner-cultivators (or renters) that also cultivate at least one share-cropped plot.

It is important to note that, our household fixed effects estimator (as well as the one used by Shaban) is not robust to correlation between s_{ci} and η_{ci}, as would arise, most plausibly, when there is adverse selection in the leasing market. Under adverse selection, share-cropped land tends to be of lower quality than owner-cultivated land; $E\,[\eta_{ci}\,|\,s_{ci} = 1] < 0$. Thus, just as in the previous paragraph, ignoring this form of selection bias when it is present would lead us to understate the productivity of share-tenancy vis à vis owner cultivation. Importantly, this means that a failure to find a negative γ using a household fixed effects estimator cannot be due to adverse selection, since adverse selection can only make γ appear more negative. In other words, our estimate of the disincentive effects of share-tenancy is (at worst) an upper bound.

4.3 Determination of the Efficiency Structure of the Agricultural Household

We will measure the efficiency structure of the farm households by means of Stochastic production frontier model. Stochastic production frontier models were introduced by Aigner, Lovell, and Schmidt (1977) and Meeusen and van den Broeck (1977). Since then, stochastic frontier models have become a popular subfield in econometrics.[6] Suppose that the production

6 See Kumbhakar and Lovell (2000) for a detailed discussion.

function of a producer can be denoted as $f(z_i, \beta)$. In a world without error or inefficiency, the ith farm would produce

$$q_i = f(z_i, \beta)$$

Stochastic frontier analysis assumes that each farm potentially produces less than it might due to a degree of inefficiency. Specifically,

$$q_i = f(z_i, \beta)\varepsilon_i$$

Where ε_i is the level of efficiency for farm i; ε_i must be in the interval(0; 1]. If ε_i = 1, the farm is achieving the optimal output with the technology embodied in the production function $f(z_i, \beta)$. When ε_i< 1, the farm is not making the most of the inputs z_i given the technology embodied in the production function $f(z_i, \beta)$. Because the output is assumed to be strictly positive (that is, $q_i > 0$) the degree of technical efficiency is assumed to be strictly positive (that is, $\varepsilon_i > 0$).

Output is also assumed to be subject to random shocks, implying that

$$q_i = f(z_i, \beta)\varepsilon_i \exp(v_i)$$

Taking the natural log of both sides yields

$$\ln(q_i) = \ln\{f(z_i, \beta)\} + ln(\varepsilon_i) + v_i$$

Assuming that there are k inputs and that the production functions is linear in logs, defining $u_i = ln(\varepsilon_i)$ yields

$$\ln(q_i) = \beta_0 + \sum_{j=1}^{k} \beta_j \ln(z_{ji}) + v_i - u_i$$

Because u_i is subtracted fromln $\ln(q_i)$, restricting $u_i \geq 0$ implies that $0 < \varepsilon_i < 1$, as specified above.

Kumbhakar and Lovell (2000) provide a detailed version of the above derivation, and they show that performing an analogous derivation in the dual cost function problem allows us to specify the problem as

$$\ln(c_i) = \beta_0 + \beta_q \ln(q_i) + \sum_{j=1}^{k} \beta_j \ln(p_{ji}) + v_i + u_i$$

Where q_i is output, z_{ji} are input quantities, c_i is cost, and the p_{ji} are input prices.

Intuitively, the inefficiency effect is required to lower output or raise expenditure, depending on the specification.

5. Data and Empirical Estimation

5.1 Data

We used PRIME 5th round data (2013) to explore the agricultural productivity and the agricultural efficiency of the ultra-poor household of Greater Rangpur Division. In the first and second round of evaluation, some households were assigned as control group from villages outside of the programme area. Gradually, all unions were covered under the programme, so it was not possible to use the same definition for control group in the later impact studies. It was neither possible nor desirable to restrict the households from receiving other PRIME-like-interventions. Even with these interventions, there was still a set of households that had never received any kind of PRIME/PRIME-type interventions during the four-year survey period. These ever-non-participating households were used as the control households in this current study. PRIME-participants were identified as those who had reported at least once in any of the survey that they had received credit under PRIME programme or were continuing membership with the assigned PO.

Our data consists of 2070 agricultural households. Table 1 shows the descriptive statistics of the surveyed households. The summary statistics depicts the overall socio-economic status of sample households. The sample households belonged to lower segments in the farming community. Households were large (about 5 members on average) and most household heads had low levels of education with an average of only two years of schooling. The summary statistics also reveal significant differences between the borrowers and non-borrowers regarding most of the welfare indicators. The proportion of female headed households is significantly higher for the non-borrower group compared to that of borrower group.

Table 1
Borrower Versus Non-borrower Comparison

		Non Borrower		Borrower-Non Borrower	
	Observation	Mean	Standard Deviation	Co-efficient	p-value
Household Composition					
Female Head	2070	0.07	0.25	-0.04	0.00
Head's Age	2070	47.45	12.63	-2.87	0.00
Head's Education	2070	1.62	2.96	0.04	0.75
HH size	2070	4.46	1.73	0.07	0.31
Male/Female Ratio	2070	1.18	0.86	0.02	0.67
Occupation of Household Head					
Wage-Earning	2070	0.48	0.5	-0.03	0.23
Agricultural Self-Employment	2070	0.23	0.42	-0.04	0.03
Non-Agricultural Self-Employment	2070	0.21	0.41	0.10	0.00
Household Expenditure (in '000)					
Food Expenditure	2070	45.46	18.86	2.7	0.00
Non-Food Expenditure	2070	25.74	30.35	4.6	0.00
Total Expenditure	2070	71.2	41.49	7.3	0.00
Household Asset					
Owned Land(in Decimal)	2070	20	41.86	-2.95	0.07
Value of Total Asset (in '000)	2070	334	583	-10.31	0.65
Annual Income (in '000)	2070	75.7	51.57	10.82	0.00

Notes: 1) Unit of observation: household. 2) Standard errors of the differences are calculated at Household level. 3) Sample includes all households surveyed at baseline who participate in crop agriculture.

According to the farm size, treatments groups are quite similar to the control group (Difference not significant at5 percent level). Households had limited amount of owned land (19 decimal), with an average of 20 decimals of owned cultivated land for the control group. The scare amount of landholding implies most of the households resorted to tenancy market for renting in land to increase the size of operational land to an optimal level.

Wage-earning is the main occupation of most of the household head. Around 45 percent (48 percent of non-borrower group and 43 percent of borrower group) of the household's primary occupation is wage earning activities. Another 20 percent of the household heads main occupation is self-employment agriculture. The proportion of household whose main income is non-agricultural self-employment is 10 percentage points higher for the borrower group compared to that of non-borrower group. The Income, expenditure and the value of assets is also higher for the borrower group compared to those of non-borrowers.

5.2 Estimation Results

We first modeled the determinants of tenancy choice. As discussed in Section 4.1, in order to explain the determinants of tenancy choice, the most appropriate technique is that of logit/probit estimation. The logistic analysis as shown in Table 2 indicates the importance of a number of socio-demographic variables in choosing fixed rental contract. According to our estimates, access to utility services e.g. access to latrine acts positively towards selecting fixed rent contract. This is consistent with our prior expectation-given that fixed rent contract is generally preferred by relatively risk lover farmers (in comparison to share-cropping), households belonging to higher income group with better access to utility services might prefer to choose fixed rent contract than share-cropping. Similarly, households with greater amount of assets opt for fixed rent contract as opposed to share-cropping as asset holding might be associated with greater flexibility in income. Households with experiences of shocks are less likely to opt for fixed rent contract (or more likely to choose share-cropping) as their vulnerability might induce them to opt for less risky alternative. Having own land also reduces the probability of choosing fixed rent contract.

According to our estimation, the dummy variable for formal credit (whether household received formal credit in the last year or not) has turned out to be significant in the analysis-access to formal credit appears to have significant influence on household's decision of the mode of agricultural production. This is not surprising considering the fact that credit loosens the budget constraint of renting in land under fixed-tenancy. However, we see no impact of informal credit on the household's decision of the mode of agricultural production. In addition, our estimation results also didn't find any significant impact of training in his decision of tenancy arrangement.

Before going into in-depth analysis of productivity as discussed in section 4.3, in Table 3 we attempt to understand gross productivity of surveyed farms with the help of a series of OLS regressions. Here, productivity is measured as value of output per hectare of land. As shown in our estimates, in comparison to base category (own land or land leased under fixed rent contract), productivity is significantly lower in shared in land and this is consistent with theoretical models and existing empirical literature. Our estimation therefore validates the proposition of Marshallian inefficiency. One of the most important factors contributing towards productivity is found to be technical assistance and as shown in column 5 and column 5 Table 3, technical assistance increases productivity by more than 100 units. It is however interesting to note that, neither credit nor training has any significant impact on agricultural productivity.

Table 2
Determinants of Tenancy Choice

VARIABLES	(1) Whether Participated in Fixed Rental Contract	(2) Whether Participated in Fixed Rental Contract	(3) Whether Participated in Fixed Rental Contract
Formal Credit Received in Last Year	0.259**	0.260**	0.221**
	(0.106)	(0.106)	(0.109)
Informal Credit Received in Last Year		-0.0827	-0.0518
		(0.107)	(0.109)
Household Head Female			-0.250
			(0.293)
Education of Household Head			0.0259
			(0.0182)
Self-Employment Agriculture Main Occupation			0.190
			(0.134)
Female/Male Ratio			-0.0358
			(0.0629)
Access to Sanitary Latrine			0.251**
			(0.118)
Access to Electricity			0.154
			(0.117)
HH Faced Shock in the Last Year			-0.622*
			(0.365)
HH Received Training			0.0437
			(0.169)
Amount of Total Land			-0.00955***
			(0.00337)
Total Asset			0.000433**
			(0.000204)
Constant	-1.392***	-1.355***	-1.558***
	(0.0732)	(0.0866)	(0.151)
Observations	2,089	2,089	2,057

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The simple OLS estimates show that, in addition to inputs and farming patterns, a number of socio-demographic factors are also found to have important implications towards farm's productivity. For example, holding other things constant, households headed by males or with educated household heads tend to have higher productivity. Farms operated by older household heads are found to have lesser productivity which might be the fact that older household heads are less inclined towards using modern inputs, which consequently might lead into lesser productivity. In addition, if household head's main occupation is agriculture then that positively affects productivity as he can concentrate more seriously on his production.

Table 3

Determinants of Productivity (Ordinary Least Square Estimation)

VARIABLES	(1) Gross Productivity	(2) Gross Productivity	(3) Gross Productivity	(4) Gross Productivity	(5) Gross Productivity
Share-Cropped Land	-9,554***	-9,559***	-9,660***	-9,686***	-7,147***
	(2,568)	(2,569)	(2,589)	(2,587)	(2,638)
Received Credit		760.4	577.3	463.7	745.5
		(2,583)	(2,672)	(2,671)	(2,718)
Received Training			1,301	-1,290	-1,555
			(3,253)	(3,426)	(3,442)
Received Technical				16,028**	17,060**
Assistance				(6,671)	(6,724)
HH Head Male					26,294***
					(6,520)
HH Head Age					-262.1**
					(116.3)
HH Head Education					770.6*
					(443.3)
Main Occupation					10,304***
Agriculture					(3,078)
Male/Female Ratio					-1,334
					(1,529)
Has Electricity					2,205
Connection					(2,851)
Faced Shock in					-2,242
Last Year					(7,540)
Constant	76,750***	76,414***	76,368***	76,275***	82,875***
	(1,789)	(2,122)	(2,172)	(2,171)	(6,570)
Observations	4,406	4,406	4,369	4,369	4,347
R-squared	0.003	0.003	0.003	0.005	0.012

(1 Standard errors in parentheses

(2) *** p<0.01, ** p<0.05, * p<0.1

(3) Productivity has been measured by value of output (in taka) Per Hectare of land

Table 4

Determinants of Productivity (Fixed Effect and Random Effect Estimates)

VARIABLES	(1) Gross Productivity	(2) Gross Productivity	(3) Gross Productivity	(4) Gross Productivity	(5) Gross Productivity	(6) Gross Productivity
Share-Cropped Land	-8,032***	-8,026***	-8,012***	-8,046***	-6,950***	-7,198**
	(2,099)	(2,099)	(2,115)	(2,115)	(2,145)	(3,628)
Received Credit		1,428	1,767	1,747	1,632	
		(2,393)	(2,462)	(2,462)	(2,507)	
Received Training			-914.2	-2,033	-2,188	
			(2,983)	(3,147)	(3,163)	
Received Technical				6,970	7,005	
Assistance				(6,259)	(6,309)	
HH Head Male					12,573**	
					(5,949)	
HH Head Age					-256.0**	
					(106.1)	
HH Head Education					385.0	
					(421.4)	
Main Occupation					7,991***	
Agriculture					(2,970)	
Male/Female Ratio					-1,369	
					(1,398)	
Has Electricity					1,212	
Connection					(2,673)	
Faced Shock in					1,468	
Last Year					(6,770)	
Constant	75,851***	75,216***	75,324***	75,293***	84,835***	75,580***
	(1,650)	(1,964)	(2,014)	(2,014)	(5,956)	(2,130)
Observations	2,304	2,304	2,283	2,283	2,270	2,304
R-squared						0.017
Number of Qslno	2,072	2,072	2,053	2,053	2,040	2,072

(1) Column 1-5 shows different specifications of Random Effect Model whereas column 6 shows the fixed effect estimates.
(2) Standard errors in parentheses
(3) *** p<0.01, ** p<0.05, * p<0.1
(4) Productivity has been measured by value of output (in taka) Per Hectare of land

Since, in general, the decision to enter into a share-cropping contract depends upon cultivator's unobserved productivity, OLS estimates of productivity may be subject to selection bias. Therefore we run the model specified in section 4.2. We used two alternative specifications: Fixed Effect Model and Random Effect Model. The results are reported in Table 4. Column 1-5 of the table shows different specifications of Random Effect Model. The coefficient of share-cropped land is negatively significant across all the specifications, i.e. the productivity of share-cropped land is lower compared to those of owned land or land cultivated under fixed-rental contract. This productivity differential varies around 12 percent across different specifications. This finding is not altered in case of fixed effect estimation (Column 6).

Credit and Training, however, turned out insignificant across all the specifications. Age of household head was found to negatively affect the productivity as in the case of OLS estimate. Household head with agriculture as the main occupation was also found to be more productive.

It is often argued that one of the reasons for the lower productivity on part of the share-croppers lie in the sub-optimal use of inputs. To see whether this is the case we model the use of inputs used in the production process. Table 5-7 show the results of OLS estimates and the fixed effect and random effect estimates of the model specified in section 4.2 for understanding input usage in share-cropped land vis a vis other contractual arrangements. Both of the analyses reveal that the type of contractual arrangement can have significant impact on the cost structure of farms. According to our analysis, it is not only total costs, but also the cost of individual inputs, e.g. fertilizer, insecticides, irrigation, tilling, seeds and wage which are lower in share-cropped land in comparison to other contractual land cultivation system. While interpreting the results of these tables, it has to be kept in mind that, farmers using more inputs tends to have higher cost of production for the same level of output. Higher cost is therefore associated with greater use of productive input for increased productivity. According to OLS estimates, share-cropping involves 4,727 taka lesser input cost than other forms of cultivation arrangement, indicating traditional cultivation practices and greater level of inefficiency in cultivation (Table 4). As discussed in Section 4.2, OLS estimation is unable to control the individual heterogeneity (e.g. access to credit, ownership of non-marketed assets, farming knowledge), which can lead to biased estimates of the effect of cultivation method on farming cost. A fixed effect Random effect method can control such bias and is argued to provide unbiased and inconsistent estimates. The Random Effect results as shown in Table 6 and the Fixed Effect estimate as shown in Table 7 also reflects the inefficiency in share-cropping.

Farms with male headed household heads tend to have higher spending whereas those with older head have lower spending. Our estimates also reveal that, recipients of technical assistance as well as training tend to spend more on inputs. In terms of other catalysts in stimulating productivity, although the role of technical support in terms of training and technical assistance is not consistent across different models that we estimated, these factors came as significant in using greater amount of input in production. This result is consistent with our expectation as technical assistance/training might induce farmers to use more inputs, resulting in higher cost. Availability of credit, according to our estimates has no significant impact on total spending on inputs.

Table 5

Determinants of Input Cost (Taka per Hectare) [OLS Estimate]

VARIABLES	(1) Fertilizers	(2) Insecticides	(3) Irrigation	(4) Tilling	(5) Seeds	(6) Wage	(7) Total cost
Share-Cropped Land	-1,522***	-565.6***	-168.5	-491.3***	-1,042***	-968.2***	-4,727***
	(302.6)	(91.37)	(235.6)	(145.6)	(189.0)	(206.6)	(780.3)
HH Head Female	1,509**	673.9***	3,027***	2,284***	2,812***	1,214**	11,482***
	(721.4)	(217.8)	(561.5)	(347.1)	(450.6)	(492.5)	(1,860)
Age of HH Head	-37.33***	-15.21***	-13.89	-17.48***	-13.81*	-21.95**	-119.6***
	(12.88)	(3.890)	(10.03)	(6.199)	(8.048)	(8.796)	(33.22)
Education of HH Head	15.87	36.37**	-13.64	13.05	53.48*	208.3***	312.9**
	(51.04)	(15.41)	(39.73)	(24.56)	(31.88)	(34.85)	(131.6)
Female/Male Ratio	-185.7	22.69	-111.2	95.59	162.9	-52.80	-70.74
	(170.8)	(51.56)	(132.9)	(82.17)	(106.7)	(116.6)	(440.3)
Access to Sanitary Latrine	-649.8**	-99.90	-118.1	-22.00	-253.0	-405.0*	-1,548*
	(314.9)	(95.07)	(245.1)	(151.5)	(196.7)	(215.0)	(811.8)
Access to Electricity	128.4	9.582	-136.3	-238.3	-365.9*	990.4***	397.9
	(319.8)	(96.57)	(248.9)	(153.9)	(199.8)	(218.4)	(824.7)
Technical Assistant	930.1	832.1***	1,801**	2,020***	3,177***	-1,396**	7,296***
	(969.3)	(292.7)	(754.5)	(466.4)	(605.5)	(661.8)	(2,499)
Faced Shock in the Last Year	-754.7	-259.4	663.6	-74.69	378.8	-310.2	-342.4
	(824.3)	(248.9)	(641.6)	(396.6)	(514.9)	(562.8)	(2,125)
Received Training	0.753	50.12	1,011**	741.4***	7.015	1,344***	3,154**
	(516.2)	(155.9)	(401.8)	(248.4)	(322.4)	(352.4)	(1,331)
Value of Total Assets	0.294	0.159*	-0.174	0.0785	0.0308	1.620***	2.026***
	(0.270)	(0.0816)	(0.210)	(0.130)	(0.169)	(0.184)	(0.696)
Constant	12,043***	2,659***	5,748***	6,701***	4,878***	4,148***	36,093***
	(727.4)	(219.6)	(566.2)	(350.0)	(454.4)	(496.6)	(1,876)
Observations	4,458	4,458	4,458	4,458	4,458	4,458	4,458
R-squared	0.011	0.023	0.013	0.026	0.027	0.061	0.032

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 6

Determinants of Input Cost (Random Effect Estimate)

VARIABLES	(1) Fertilizers	(2) Insecticides	(3) Irrigation	(4) Tilling	(5) Seeds	(6) Wage	(7) Total cost
Share-Cropped Land	-1,283***	-498.4***	-249.6	-398.1***	-940.6***	-1,130***	-4,735***
	(339.7)	(102.8)	(215.3)	(148.6)	(233.5)	(227.8)	(822.2)
Constant	6,758***	1,261*	7,370***	7,569***	4,211**	7,872***	34,981***
	(2,542)	(743.0)	(1,890)	(1,379)	(1,710)	(2,051)	(6,835)
Observations	2,303	2,303	2,303	2,303	2,303	2,303	2,303
Number of Household	2,070	2,070	2,070	2,070	2,070	2,070	2,070

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7

Determinants of Input Cost (Fixed Effect Estimate)

VARIABLES	(1) Fertilizers	(2) Insecticides	(3) Irrigation	(4) Tilling	(5) Seeds	(6) Wage	(7) Total cost
Share-Cropped Land	-1,551**	-669.8***	-410.3	-102.6	-1,200***	-154.4	-4,055***
	(643.7)	(255.4)	(335.6)	(217.7)	(459.0)	(341.5)	(1,367)
Constant	10,116***	2,157***	5,424***	5,965***	4,601***	3,563***	31,745***
	(379.3)	(150.5)	(197.8)	(128.3)	(270.5)	(201.3)	(805.7)
Observations	2,324	2,324	2,324	2,324	2,324	2,324	2,324
R-squared	0.024	0.029	0.006	0.001	0.028	0.001	0.036
Number of Qslno	2,089	2,089	2,089	2,089	2,089	2,089	2,089

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 8
Output Efficiency (Stochastic Frontier Model)

VARIABLES	(1) Total Production	(2) lnsig2v	(3) lnsig2u
Fertilizer	0.127***		
	(0.00812)		
Insecticides	0.0343***		
	(0.00378)		
Irrigation	0.0443***		
	(0.00272)		
Tilling	0.00110		
	(0.00793)		
Seeds	0.0105**		
	(0.00441)		
Labour	0.00995***		
	(0.00245)		
Constant	9.592***	-1.621***	-1.676***
	(0.0904)	(0.0448)	(0.124)
Observations	4,406	4,406	4,406
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1			

Table 9
Cost Efficiency (Stochastic Frontier Model)

VARIABLES	(1) Total cost	(2) lnsig2v	(3) lnsig2u
Fertilizer	0.453***		
	(0.00668)		
Insecticides	0.0250***		
	(0.00163)		
Irrigation	0.0450***		
	(0.00125)		
Tilling	0.407***		
	(0.00813)		
Seeds	0.0575***		
	(0.00268)		
Labour	0.0433***		
	(0.00112)		
Output	0.00729		
	(0.00640)		
Constant	1.204***	-4.297***	-2.453***
	(0.0828)	(0.0534)	(0.0406)
Observations	4,406	4,406	4,406
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1			

Finally, we try to see the efficiency structure of the agricultural plots. As discussed in Section 4.2 we measured the efficiency structure by means of Stochastic Frontier model (SFM). SFM attempts to understand the degree of efficiency/inefficiency in a production process by fitting a simple model of output on inputs. As mentioned earlier, we used two alternative specifications of SFM: (a) Production Frontier model and (b) Cost Frontier Model. Table 8 portrays the results of Production Frontier Model whereas Table 9 shows the result of Cost frontier Model. By analysing the sign and significance of relevant error terms, it is possible to infer about agricultural efficiency in that production process. Here, error term is assumed to be comprised of two terms (sigma u and sigma v) where the SFM tests the null hypothesis whether the squared error terms are significant different from zero or not. As shown in Table 8 in our production frontier model estimation, both of the error terms (or log of the squared error terms) have come out as significant with negative coefficient estimates. Therefore, according to our estimates, the households are producing less than optimal level of output so there is inefficiency in the production process adopted by them. Similarly, the error terms in Table 9 suggests, there have also been the prevalence of cost inefficiency in the production process.

Table 10
Determinants of Inefficiency

VARIABLES	(1) Output Inefficiency	(2) Cost Inefficiency
Share-Cropped Land	0.00762*	0.0323**
	(0.00439)	(0.0150)
Formal Credit Received	0.00129	0.0273*
	(0.00442)	(0.0151)
Technical Assistance Received	-0.00212	-0.0873**
	(0.0106)	(0.0361)
Maximum Education of Household	-0.00107*	0.00153
	(0.000648)	(0.00221)
Female Household Head	0.00139	0.0152
	(0.0108)	(0.0369)
Age of Household Head	0.000736***	0.00132**
	(0.000190)	(0.000649)
Female/Male Ratio	0.00335	-0.00369
	(0.00254)	(0.00867)
Self-Employment Agriculture Main Occupation	-0.0102**	-0.0669***
	(0.00513)	(0.0175)
Access to Electricity	-0.0138***	-0.0143
	(0.00477)	(0.0163)
Constant	0.314***	0.342***
	(0.0112)	(0.0382)
Observations	4,347	4,347
R-squared	0.009	0.008

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Once we find that there is inefficiency involved in the production process, we try to see the determinants of inefficiency of the farm plots. To this end, we run a simple Ordinary Least Square regression of inefficiency on different predictor variables. Column 1 of Table 10 shows the determinants of output inefficiency as measured by Production frontier model whereas column 2 of table 10 shows the determinants of cost inefficiency as measured by cost frontier model. The results in column 1 shows that output Inefficiency is higher for the share-cropped land. This finding is in line with the earlier results. We also find that education helps to reduce the output efficiency. The output inefficiency was found to be higher for the aged households and lower for the household with agriculture as the main occupation. Finally, Households with access to electricity were found to be less inefficient. This findings is almost analogous to the determinants of cost inefficiency except for the fact that technical assistance, was found to reduce the cost inefficiency.

6. Concluding Observations

With the farm level information of input use and the type of contractual arrangement, this paper attempts to disentangle the productivity differential across different contractual arrangements and tries to understand the role of credit and training programme on enhancing farm productivity. Our analysis reveals that, in comparison to other forms of contractual arrangement, share-cropping involves lesser spending on inputs, indicating relatively less-modern and traditional cultivating technique. This result has been supported by both OLS as well Fixed Effect estimation method where the latter is argued to control for farmer specific heterogeneity in input use. This paper also examined the productivity differential between share-cropping vis a vis other contractual arrangements and came to the conclusion that, yield per hectare is lower in share-cropped land. This result is robust in terms of individual farmer specific heterogeneity and validates the proposition of Marshallian inefficiency. As discussed in Section 4.2, yield of land can be influenced by both observed as well as unobrserved plot characteristics along with unobserved factor of a cultivator where a Fixed effect estimation is expected to provide unbiased estimator. While examining the effect of credit on farm productivity, although credit has not come as significant in a separate set of regression, we have found that, if farmers have received formal credit in the year before the survey was conducted, they would prefer to choose fixed rental contract to share-cropping. Formal credit therefore discourages a farmer to choose share-cropping. While summing up our estimation results, it can be concluded that, availability of formal sources of credit shifts a farmer’s interest away from an inefficient mode of contract that is share-cropping.

Based on the analysis, we can infer that, policies to increase supply of formal credit to the farmers at affordable interest rate and flexible terms of condition can act as a significant policy stimulus to encourage them to choose more productive mode of contractual arrangement. Given the insignificant effect of informal credit, it can also be emphasised that, expanding the network of formal credit to remote areas like that of PRIME and providing credit particularly for the farmers can turn out to be beneficial in raising farm productivity.

In addition to the availability of credit, it is also crucial to maintain accountability in disbursement and recovery. Following the steps proposed by National Agriculture Policy (NAP), greater monitoring by strengthening the district level agricultural credit committee and also strengthening the role of government representatives at thana and union level for the efficient flow and recovery of credit (Sattar and Bidisha, 2014).

Empirical evidences show that, lengthy and cumbersome bureaucratic process often acts as an obstacle for accessing credit, which is especially more crucial in the context of less developed parts of the country like that covered by PRIME. Ensuring timely sanction of credit and quick and efficient transaction by streamlining the bureaucratic processes in formal financial institutions can proved to be helpful for the poor and marginalised farmers (Khondker et al. 2013).

Although the estimates have not come significant in our analysis, landless and marginalised farmers often fall victim of bad weather or natural calamities. In order to protect the interest of the vulnerable farmers, the government should enforce the financial institutions to show greater flexibility in terms of repayment of credit and requirement of collateral.

Given the importance of input use in agricultural productivity, it is of significant importance to ensure good quality inputs, e.g. seeds and in this context, the government should emphasize on strengthening the management of production, storage and distribution of seeds at upazila and thana levels.

Skilled manpower is an important pre-requisite for the modernization of agriculture sector. Although the role of technical support in terms of training and technical assistance is not consistent across different models that we estimated, these factors came as significant in using greater amount of input in production. In this context, supporting marginal and landless farmers with technical assistance can proved to be important for the modernization and efficiency of the sector. In order to expand agriculture support services, strategies to offer short term training programme and diplomas at the district and upazila level can be undertaken.

Finally, improving agricultural productivity requires, in addition to credit, inputs, training, effective marketing network for ensuring fair price for the farmers. In this context, setting up Agriculture Price Commission, supportive trade policies and strictly monitoring the supply chain for managing and controlling the role of middlemen can prove to be highly instrumental for longer term benefit of the sector and for safe guarding the interests of the marginal farmers.

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Appendix

Table A1 shows productivity as defined by value of output per unit of land (input) and simple descriptive shows that share-cropping is less productive farming arrangement than farming in own land or than leased in land or mortgage in land. The differences are statistically significant too.

Table A1
Productivity Difference (Value of Output per Decimal Land)

	Share-cropping	Owned land	Difference	p-value
Productivity	272	306.24	-34.24	0.00
	Share-cropping	**Leased-in**	**Difference**	**p-value**
Productivity	272.04	331.22	-59.18	0.00
	Share-cropping	**Mortgage-in**	**Difference**	**p-value**
Productivity	272.04	313.59	-41.55	0.00

Table A2
Input Use (Self-Owned Land vs Share-Cropped Land)

	Self-own	Share-in	difference	p-value
Fertilizer	39.53	33.73	5.8	0
Insecticides	8.47	5.98	2.49	0
Irrigation	18.79	19.94	-1.15	0.21
Tilling	25.15	22.96	2.19	0
Seeds	17.52	13.8	3.72	0
Wage	17.44	11.73	5.72	0
Total cost	126.9	108.15	18.75	0

Table A3
Input Use (Leased-in Land vs Share-Cropped Land)

	Share-in	Leased-in	difference	p-value
Fertilizer	33.73	47.4	-13.67	0
Insecticides	5.98	11.08	-5.1	0
Irrigation	19.94	21.43	-1.49	0.42
Tilling	22.96	22.61	0.35	0.71
Seeds	13.8	21.37	-7.57	0
Wage	11.73	22.23	-10.5	0
Total cost	108.15	146.13	-37.98	0

Table A4
Input use (Mortgaged-In Land vs Share-Cropped Land)

	Share-in	Leased-in	difference	p-value
Fertilizer	33.73	38.5	- 4.77	0
Insecticides	5.98	8.57	- 2.59	0
Irrigation	19.94	23.14	- 3.20	0.02
Tilling	22.96	26.99	- 4.03	0
Seeds	13.8	19.01	- 5.21	0
Wage	11.73	20.2	- 8.47	0
Total cost	108.15	136.51	- 28.36	0

Comparison of input use pattern across different farming arrangement (Table A2, Table A3 and Table A4) indicate that, in comparison to self owned land, leased in land as well as mortgaged-in land, share-cropping contract involves significantly lesser use of inputs e.g. fertilizer, insecticides, seeds as well as labour. The total spending on inputs is also significantly lower in share-cropping as opposed these forms of farming arrangements, indicating the possibility of resulting productivity loss of share-cropping.

Table A5
Yield of Aman

Type of Land	N	Yield Rate (Maund/Decimal)
Self-Owned and Cultivating	523	0.3751937
Not Owned but Occupied	14	0.3186483
Share-in	795	0.3898636
Lease-in	54	0.3629357
Mortgage-in	259	0.4004827

Table A6
Yield of Boro

Type of Land	N	Yield Rate (Maund/Decimal)
Self-Owned and Cultivating	405	0.6304235
Not Owned but Occupied	17	0.5115505
Share-in	801	0.6046739
Lease-in	50	0.6732112
Mortgage-in	200	0.7375817

Table A7
Yield of Wheat

Type of Land	N	Yield Rate (Maund/Decimal)
Self-Owned and Cultivating	22	0.2230596
Share-in	56	0.2548817
Lease-in	4	0.4588319
Mortgage-in	12	0.641546

Table A8
Yield of Maize

Type of Land	N	Yield Rate (Maund/Decimal)
Self-Owned and Cultivating	95	0.5782536
Not Owned but Occupied	37	0.7501909
Share-in	124	0.6141665
Lease-in	27	0.6852118
Mortgage-in	41	0.778269

Table A9
Yield of Jute

Type of Land	N	Yield Rate (Maund/Decimal)
Self-Owned and Cultivating	63	0.2133243
Not Owned but Occupied	6	0.2764475
Share-in	86	0.2218213
Lease-in	6	0.2051698
Mortgage-in	23	0.223395

Table A10
Yield of Tobacco

Type of Land	N	Yield Rate (Maund/Decimal)
Self-Owned and Cultivating	78	0.26008
Not Owned but Occupied	6	0.2119071
Share-in	102	0.2187224
Lease-in	16	0.1685441
Mortgage-in	12	0.2150366

Table A11
Yield of Potato

Type of Land	N	Yield Rate (Maund/Decimal)
Self-Owned and Cultivating	79	1.251773
Not Owned but Occupied	1	1.8
Share-in	64	1.38687
Lease-in	23	1.654579
Mortgage-in	32	1.589414

Table A12
Yield of Aman

Status	N	Yield Rate (Maund/Decimal)
Prime Credit Plus	282	0.40
Prime Credit Only	343	0.38
Non-Prime Credit Only	682	0.38
Non-Prime Credit Plus	109	0.44
Never Participated in Any MFI	248	0.37

Table A13
Yield of Boro

Status	N	Yield Rate (Maund/Decimal)
Prime Credit Plus	263	0.60
Prime Credit Only	315	0.60
Non-Prime Credit Only	573	0.63
Non-Prime Credit Plus	116	0.84
Never Participated in Any MFI	223	0.61

Table A14
Yield of Wheat

Status	N	Yield Rate (Maund/Decimal)
Prime Credit Plus	18	0.30
Prime Credit Only	25	0.24
Non-Prime Credit Only	23	0.30
Non-Prime Credit Plus	3	1.47
Never Participated in Any MFI	29	0.24

Table A15
Yield of Maize

Status	N	Yield Rate (Maund/Decimal)
Prime Credit Plus	31	0.54
Prime Credit Only	66	0.56
Non-Prime Credit Only	174	0.68
Non-Prime Credit Plus	26	0.66
Never Participated in Any MFI	32	0.68

Table A16
Yield of Jute

Status	N	Yield Rate (Maund/Decimal)
Prime Credit Plus	32	0.19
Prime Credit Only	43	0.22
Non-Prime Credit Only	64	0.24
Non-Prime Credit Plus	6	0.24
Never Participated in Any MFI	40	0.22

Table A17
Yield of Tobacco

Status	N	Yield Rate (Maund/Decimal)
Prime Credit Plus	35	0.22
Prime Credit Only	59	0.22
Non-Prime Credit Only	93	0.25
Non-Prime Credit Plus	9	0.21
Never Participated in Any MFI	18	0.22

Table A18
Yield of Potato

Status	N	Yield Rate (Maund/Decimal)
Prime Credit Plus	38	1.45
Prime Credit Only	42	1.55
Non-Prime Credit Only	88	1.27
Non-Prime Credit Plus	9	1.65
Never Participated in Any MFI	28	1.48

Table A5 and Table A18 illustrate the simple yield of a number of crops across several groups, e.g. across different tenancy contracts, with/without credit etc. Table 15 shows that, for Aman crop, among the types of tenancy contracts that we have chosen, yield is highest in mortgage-in land, followed by shared-in land. The lowest yield across these categories is found to be in 'not owned but occupied' land.

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