

Impact of Access to Credit on Rental Markets of Agricultural Capital Goods: Evidence from Assam of North-East India

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Rental market of farm capital goods plays an important role in farm operations and in enhancing production and productivity of agriculture. However, owing to financial constraints, farmers, especially the small and marginal farmers, fail to participate in such markets. Therefore, the paper examines the impact of credit on participation in rental markets of agricultural capital goods. Based on the primary data collected from 232 farm households in Assam, it is found that access to credit has a primary role in encouraging the farmers to participate in rental markets of agricultural capital goods. However, different forms of credit make the rental market participation also different. Institutional credit helps in extending such markets by encouraging the suppliers of services of farm capital goods. On the other hand, non-institutional credit promotes participation in rental markets of farm capital goods both from the supply and the demand side.

Keywords: Rental Markets, Credit, Agriculture

JEL Classification: Q12

I. INTRODUCTION

Rental market of farm capital goods like tractor, power tiller, pump set etc. plays a significant role in farm mechanisation and in augmenting production and productivity of agriculture. With the functioning of rental markets, even the poor farmers who cannot afford the expensive farm machinery can mechanise their farm operations by hiring them. Moreover, it is generally argued that the small size of landholding limits farm mechanisation as sometimes there is a mismatch between the capacity of the machinery and the cultivable land possessed by the owner of the machinery. In this context, Vaidyanathan (1986) mentioned that the size and pattern of landholding could affect the profitability of innovations and hence their adoption in other ways. If rental markets are functioning, the small

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size of landholdings will no longer be an obstacle to adoption of mechanised farming. The functioning of such rental markets, in fact, opens up additional sources of returns to the owners of agricultural capital goods. Hence, even if a farmer's rate of return from his own agricultural operation is not sufficient to meet the investment on the capital goods, the farmer can still earn by hiring out the services of such capital goods when they are not in use in his/her own farm. This will increase the ownership of farm machinery by the farmers and thereby the extent of mechanisation of this sector of the rural economy. There are also evidence of farmers hiring tractors in India (Agarwal 1984 and Rath 2015). Rath (2015) found that, In India, small farmers tend to increasingly hire tractors while large farmers use tractors rather than keeping bullocks due to the growing difficulties in maintaining even one bullock because of significant decline in the size of cultivable landholdings. As mechanisation enhances agricultural production and productivity in a variety of ways (Hamid 1972, Agarwal 1984, Singh 2006, Singh 2011, Verma 2014) by enabling the farmers to mechanise, the agricultural rental markets of farm capital goods are indeed playing a very important role. However, participation in such markets either as a lessee or as a lessor depends on the financial condition of the farmers. Studies show the presence of positive impact of institutional credit in adoption of modern technology in agricultural operations (Swamy 1980, Mohamed *et al.* 2008). The same argument can be put forth in the case of participation in rental markets of agricultural goods too as those who participate in the rental markets are none but the farmers who adopt the new technologies. Hence, the present paper looks into the impact of credit on participation of farmers in rental markets of agricultural capital goods across nine villages of Assam.¹

The specific objectives of this paper are the following:

- (i) To look into the socio-economic characteristics of lessees and lessors of farm capital goods.
- (ii) To examine the role of access to credit on participation in rental markets of farm capital goods.

Further, the paper also tries to understand how the different forms of credit influence the participation of the farmers in the rental markets of agricultural

¹Although agriculture is one of the major components of the state economy, most of the farmers are small and poor. According to the Agriculture Census, Assam, 2010-11, small and marginal holdings consist of 18.3 per cent and 67.3 per cent of operational landholding respectively. Moreover, the average size of operational landholding in the State is 1.1 hectares.

capital goods. It is expected that the ownership of capital goods and hence the supply of them will be encouraged mainly by access to institutional credit because purchase of farm capital goods, particularly the heavy machinery, requires capital on a large scale. Meeting the requirements of such a huge amount of capital from non-institutional sources can create heavy interest burden on the borrowers, whereas the same is lower in the case of institutional borrowings. Moreover, getting access to a large amount of borrowings from non-institutional sources is limited too. In contrast, as a lesser amount of capital is required for hiring agricultural capital goods as compared to the amount required for purchasing them together with instant decision making on hiring the agricultural capital goods, non-institutional sources of credit are more preferable.

In Assam, the use of combine harvesters in agriculture is quite low² (Input Survey, 2011-12, Government of Assam). On the other hand, minor farm capital goods do not require investment on a large scale and hence such equipment are often found to be owned even by the small and marginal farmers. Therefore, the present paper focuses on the ploughing and irrigation machinery which most farmers owing to financial constraint cannot procure, especially the small and marginal farmers.

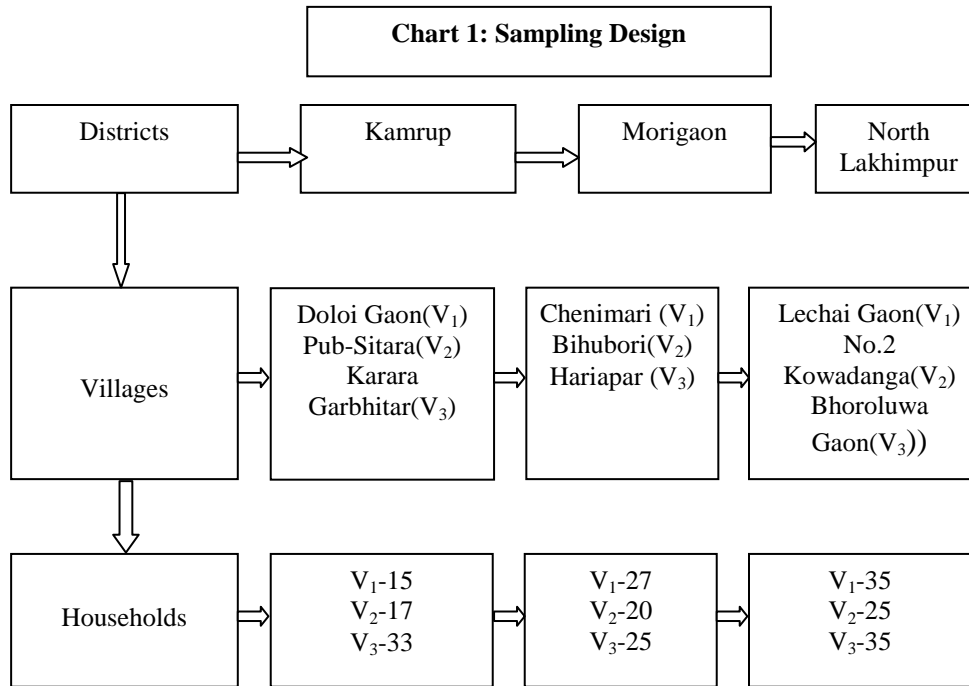
The objectives and research question of the present study have been stated in Section I. Section II discusses the sources of data, sampling procedure and analytical framework. Discussion on characteristics of rental market participants, impact of credit on participation in such markets and type of participation have been incorporated in Section III. Section IV provides concluding remarks and policy implications.

II. DATA SOURCE AND ANALYTICAL FRAMEWORK

2.1 Data Source

Although secondary data has been used, the present study is mainly based on primary data collected from 232 farm households through field survey conducted between November 2013 and January 2014. A multi-stage sampling technique has been used for collecting the primary data. In the second stage, three districts were selected randomly from three parts of the plains in Assam. In the next stage, three villages from each district, and thus a total of nine villages were selected randomly. In the third stage, about 12.3 per cent of farm households were surveyed from the selected villages.

² Only in 0.53 per cent of operational holdings combine harvesters have been used.

Chart 1: Summary of the Sample Techniques Adopted

2.2 Analytical Framework

The characteristics of the participants in the rental markets of farm capital goods have been examined by calculating the percentage distribution of the participants by their socio-economic characteristics. The impact of credit on participation in rental markets of agricultural capital goods has been examined using the LOGIT regression. Finally, the research question of the present study has been answered in two steps – (a) role of credit by sources of borrowing in procuring farm capital goods has been analysed with the help of cross tabulation, and (b) econometric tools like LOGIT regression has been used to see the role of different forms of credit on overall use and on hiring of ploughing machinery. The inferences on the impact of various forms of credit on hiring-in of ploughing machinery have been drawn by comparing the results of regressions for role of credit by forms on overall use of ploughing machinery and on its hiring-in use. The regression models used in the study have been elaborated in the relevant sections of the paper.

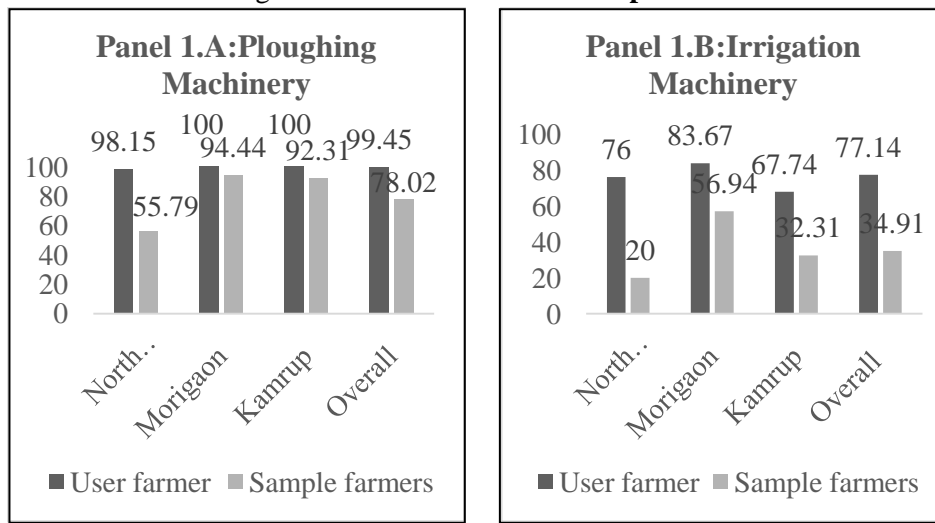
III. RESULTS AND DISCUSSION

3.1 Participation in Rental Markets and Characteristics of Participants

3.1.1 Percentage of Farmers' Participation

Before looking into the characteristics of the rental market participants, it is necessary to see the extent of farmers' participation in such markets. Accordingly, the percentage of farmers participating in such markets has been calculated. Figure 1 shows that the percentage of farmers' participation in rental markets of farm capital goods is high. In the rental markets of ploughing machinery, 99.5 per cent of user farmers and 78 per cent of sample farmers have participated. The percentage of user and sample farmers participating in the rental market of irrigation machinery is 77.1 per cent and 34.9 per cent respectively.

Figure 1: Rental Market Participation



As shown in Figure 1, across locations, the percentage of participation, both in ploughing and irrigation rental markets, varies. The coefficient of variation shows that the participation rate in rental markets varies largely in the case of irrigation machinery than ploughing machinery and among sample farmers than among user farmers.³

³Across locations, the coefficient of variation of participation in rental markets of ploughing by sample farmers and user farmers is 26.9 per cent and 1.1 per cent respectively. On the other hand, the coefficient of variation of participation in rental markets of irrigation machinery by sample farmers and user farmers is 51.5 per cent and 10.5 per cent respectively.

3.1.2 Socio-economic Characteristics

In order to observe the socio-economic characteristics of the participants in the rental markets of farm capital goods, the participants have been categorised as lessee and lessor.⁴

Operational Holdings

In terms of size of the operational landholdings in hectare, it is found that lessors are relatively a larger group of farmers than the lessees. As Table I demonstrates, the size of operational holdings of the lessors of ploughing machinery is 2.1 hectares against 1.2 hectares of the lessees. In the case of irrigation machinery, the size of operational holdings of lessors is 1.7 hectares, while the same for the lessees is 1.1 hectares. Moreover, across size groups, the marginal farmers have participated more as lessees than as lessors, while it is just the reverse for other size classes of farmers. Thus, the marginal farmers dominate the demand side of the rental markets, while the large farmers dominate the supply side of the rental markets.

TABLE I
PERCENTAGE DISTRIBUTION OF MARKET PARTICIPANTS BY SIZE OF
OPERATIONAL LANDHOLDINGS

Size group (area in hectare)	Ploughing Machinery		Irrigation Machinery	
	Lessee	Lessor	Lessee	Lessor
<1	51.7	9.1	52.3	18.8
1-2	34.4	54.6	35.4	56.3
2-3	9.3	13.6	9.2	12.5
3-4	0.6	18.2	1.5	6.3
4≥	3.9	4.6	1.5	6.3
Mean size OH	1.2	2.1	1.1	1.7
S.D.	0.9	1.2	1.0	1.4

Ownership of Land Holdings of Cultivable Land

Table II shows that in terms of ownership of landholdings of cultivable land, the lessors are the group of farmers with large landholdings with respect to rental markets of both types of farm machinery. In fact, across the size groups, it is the

⁴ In classification of rental market participants, the households participating both as lessee and lessor are excluded from either groups due to technical difficulty.

small and marginal farmers who have participated in rental markets of both the machinery more as lessees than as lessors.

TABLE II
PERCENTAGE DISTRIBUTION OF MARKET PARTICIPANTS BY SIZE OF OWNERSHIP OF LANDHOLDINGS OF CULTIVABLE LAND

Size group (area in hectare)	Ploughing Machinery		Irrigation Machinery	
	Lessee	Lessor	Lessee	Lessor
< 1	68.8	40.9	84.6	56.3
1 to 2	18.5	40.9	12.3	25.0
2 to 3	10.6	9.1	3.1	12.5
3 ≥	1.9	9.1	0.0	6.3
Mean size of holdings	0.9	1.4	0.5	1.1
S.D.	0.9	0.8	0.6	0.9

Education

In terms of educational qualification of the heads of the households participating in the rental market, it is found that the participation as lessee is more than as lessor having education of below matriculation with respect to both ploughing and irrigation machinery (Table III). In contrast, participating households whose household heads have attained education of matriculation and above are found more as lessors than as lessees. Thus, on an average, the lessors are relatively those households who have attained higher level of education than the lessees.

TABLE III
PERCENTAGE DISTRIBUTION OF MARKET PARTICIPANTS BY EDUCATIONAL STATUS OF THE HEAD OF THE HOUSEHOLDS

Education	Ploughing Machinery		Irrigation Machinery	
	Lessee	Lessor	Lessee	Lessor
Not literate	19.2	13.6	29.2	18.8
Below primary	9.3	13.6	9.2	25.0
Primary to high school	47.0	36.4	50.8	37.5
Matriculate to undergraduate	19.8	27.3	9.2	18.8
Graduate and above	4.6	9.1	1.5	0.0

Caste

It is found that participation by general and OBC/MOBC farmers is more as lessors than as lessees, while it is just the opposite for the SC and ST farmers (Table IV). In the case of irrigation machinery rental markets, the SC and OBC/MOBC farmers are participating more as lessors than as lessees, while the general and ST farmers are found to be participating more as lessees.

TABLE IV
PERCENTAGE DISTRIBUTION OF MARKET PARTICIPANTS BY CASTE

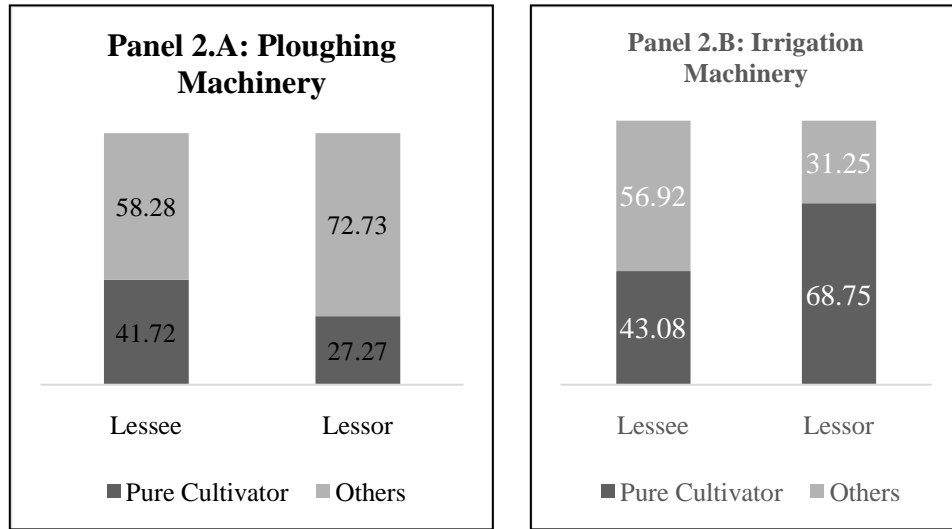
Caste	Ploughing Machinery		Irrigation Machinery	
	Lessee	Lessor	Lessee	Lessor
General	39.1	50.0	33.8	31.3
SC	9.3	4.6	13.8	25.0
ST	27.8	4.6	30.8	18.8
OBC/MOBC	23.8	40.9	21.5	25.0

Occupation

In terms of occupation of members of households participating in the rental market, the participants are classified as pure cultivators and others.⁵ It is found that in the case of ploughing machinery rental market, the pure cultivators' participation is relatively more as lessees than as lessors and reverse is the case for the others (Figure 2). While the pure cultivators are engaged more in lending out irrigation machinery, the farmers belonging to "the others" participate mostly as lessees of such machinery.

⁵Pure cultivators are those who earn their income only from own cultivation and others include the sample households except pure cultivators.

Figure 2: Percentage Distribution of Rental Market Participants by Occupation



3.2 Rental Market Participation and Access to Credit

Data show that among the participants in rental market of ploughing machinery, 55 per cent have borrowed money for farm operations. In the case of participants in irrigation machinery rental market, 64 per cent are borrowers of capital. Thus, more than half of the participants in rental markets of farm capital goods are borrowers, indicating that access to credit has some positive impact on rental market participation.

Besides access to credit, the other factors which may have impact on participation in rental markets of farm capital goods are tenancy, farm size, ownership of bullock (only in case of ploughing implements rental), education of farmers, age of farmers, family size, occupation of family members and location characteristics. Tenancy may discourage the participation in such markets, as a part of the agricultural output has to be shared with the landlord without sharing the cost of mechanisation and technology input. The probability of mechanisation and hence the participation in rental markets of machinery may also increase with the size of operational holdings for timely and easy cultivation. In general, ploughing by bullock is substituted with ploughing by machinery. Hence, the participation in rental market of ploughing machinery may be adversely affected by ownership of a bullock pair. Level of education of farmers may encourage rental market participation as it promotes farm mechanisation. In the case of non-

credit constrained households, size of the households affect negatively the technology adoption in farm operation (Mohamed *et al.* 2008). Moreover, occupation of households may also affect the participation in rental markets mainly as lessees. Because maintenance of farm capital goods is less troublesome for a pure farm household than a farm household whose member(s) has to devote time in non-farm income generating activities such as trading, service, etc. Thus it can be said that participation in rental markets will be less for pure farmers than other farmers. Explanatory variables included in regression models to see the impact of access to credit on rental market participation have been summarised in Table V.

TABLE V
VARIABLES INCLUDED IN THE REGRESSION MODELS

Variables	Notation	Definition	Expected sign
<i>Independent variables</i>			
Access to credit	ATC	1 for borrowers, 0 otherwise	+
Sources of credit	INS	1 for institutional borrowers, 0 otherwise	+
	NIS	1 for non-institutional borrower, 0 otherwise	+
<i>Control variables</i>			
Farm size	FS	Operated area in hectare	+
Tenancy	TEN	proportion of lease in area to total operational holdings	-
Possession of bullock	BULL	1 for owner, 0 otherwise	-
Education	EDU	A categorical variable with 0-illiterate, 1-below primary, 2-primary to high school, 3-matriculates and undergraduate and 4 for graduate and above	+
Age of HH	AGE	In years	+/-
Family size	SIZE	No. of family members	-
Occupation	OCC	1 for pure cultivator, 0 otherwise	-
Location dummy	L ₁ L ₂	L ₁ =1 for Morigaon, 0 otherwise and L ₂ =1 for Kamrup, 0 otherwise assuming North Lakhimpur as reference location	+/-

Assuming participation in ploughing rental (PPR) and participation in irrigation rental (PIR) as dependent variables such that

PPR=1 if participated in rental market of ploughing machinery, 0 otherwise and

PIR=1 if participated in rental market of irrigation machinery, 0 otherwise and, following formulations have been modeled.

$$PPR=F(ATC, FS, TEN, BULL, EDU, AGE, SIZE, OCC, L_1, L_2)$$

$$PIR=F(ATC, FS, TEN, EDU, AGE, SIZE, OCC, L_1, L_2)$$

Specification of the Models

As the dependent variable is binary, LOGIT regression models have been formulated for ploughing and irrigation machinery as follows:

$$\begin{aligned} & E (PPR \mid \text{explanatory variables}) \\ &= \text{Prob.}(PPR=1 \mid \text{explanatory variables}) \\ &= \frac{1}{1+e^{-z}} \end{aligned}$$

where,

$$Z=\beta_0+\beta_1ATC_i+\beta_2FS_i+\beta_3TEN_i+\beta_4BULL_i+\beta_5EDU_i+\beta_6AGE_i+\beta_7SIZE_i+\beta_8OCC_i+\beta_9L_{1i}+\beta_{10}L_{2i}, \text{ and}$$

$$\begin{aligned} & E (PIR \mid \text{explanatory variables}) \\ &= \text{Prob.}(PIR=1 \mid \text{explanatory variables}) \\ &= \frac{1}{1+e^{-z}} \end{aligned}$$

where,

$$Z=\beta_0+\beta_1ATC_i+\beta_2FS_i+\beta_3TEN_i+\beta_4EDU_i+\beta_5AGE_i+\beta_6SIZE_i+\beta_7OCC_i+\beta_8L_{1i}+\beta_9L_{2i}$$

Maximum likelihood estimates of parameters obtained using STATA 13 shows that the coefficient of variable ATC is positively significant at 5 per cent and at 10 per cent for ploughing and irrigation machinery respectively. It implies that access to credit by farmers encourages their participation in rental markets. Among the control variables, coefficient of variables FS and EDU is found to be positively significant at 5 per cent and 1 per cent respectively with respect to ploughing machinery rental market. It shows the positive impact of farm size and education of farmers on participation in ploughing machinery rental market. On the other hand, coefficient of variable BULL is found to be negatively significant at 1 per cent. It shows that the ownership of a pair of bullocks adversely affects the participation in rental markets of ploughing machinery, which is quite

natural. In the case of participation in the irrigation machinery rental market, it is found that the coefficient of variable TEN is positively significant at 5 per cent. The positive impact of tenancy on irrigation machinery rental market participation is mainly due to the fact that dry season cultivation is done more by tenants than overall sample farmers.⁶ Positively significant coefficients of both location variables with respect to ploughing machinery reveal significantly higher participation in rental markets for ploughing machinery in Morigaon and in Kamrup districts than that in the North Lakhimpur district. However, no such difference is found to be present in the case of participation in irrigation machinery rental markets.

TABLE VI
RESULTS OF LOGIT MODELS FOR IMPACT OF ACCESS TO CREDIT ON
PARTICIPATION IN RENTAL MARKETS.

Independent Variables	Ploughing Machinery			Irrigation Machinery		
	Breusch-Pagan test for heteroskedasticity chi ² (1) = 63.74 Prob> chi ² = 0.0000 Result: Presence of heteroscedasticity			Breusch-Pagan test for heteroskedasticity chi ² (1) = 14.80 Prob> chi ² = 0.0001 Result: Presence of heteroscedasticity		
	Average VIF=1.37 Maximum VIF=1.71			Average VIF=1.27 Maximum VIF=1.39		
	Coefficient	Robust SE	p-value	Coefficient	Robust SE	p-value
ATC	1.158**	0.457	0.011	0.630*	0.333	0.059
FS	0.578**	0.260	0.026	-0.269	0.166	0.105
TEN	0.265	0.868	0.760	0.968**	0.467	0.038
BULL	-2.479***	0.634	0.000	--	--	--
EDU	0.783***	0.227	0.001	-0.227	0.153	0.140
AGE	0.035	0.023	0.138	-0.018	0.014	0.219
SIZE	0.100	0.087	0.252	0.101	0.065	0.124
OCC	-0.089	0.500	0.859	-0.166	0.361	0.647
L ₁	2.881***	0.754	0.000	1.566***	0.362	0.000
L ₂	2.230***	0.739	0.003	0.504	0.401	0.209
Constant	-2.911*	1.708	0.088	-0.994	1.020	0.330
Wald chi ²	49.43(10)***			47.83(9)***		
Pseudo R ²	0.3712			0.1512		

Note: Figures in parentheses represent degrees of freedom.

***, ** and * indicate significant at 1%, 5% and 10% level respectively.

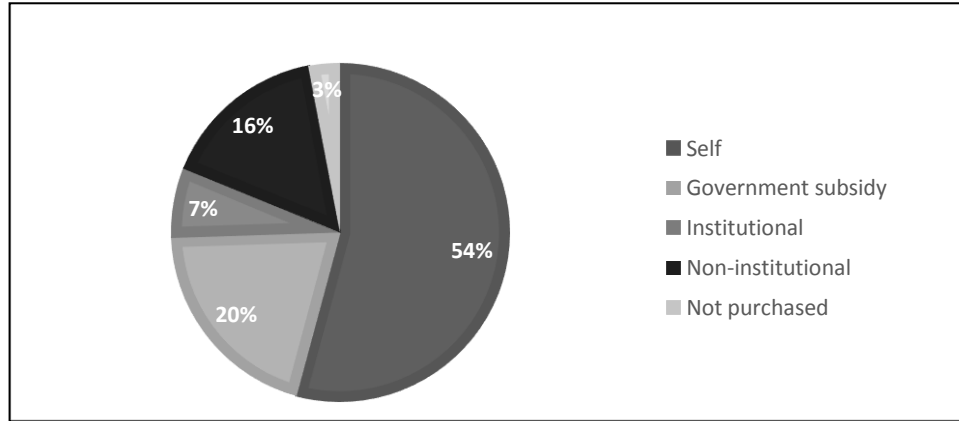
⁶It has been found that 68.4 per cent of tenants grow dry season crops against 59.9 per cent of overall sample farmers. Further, the intensity of dry season crops cultivation is 26.7 per cent for tenants against 25.3 per cent for all sample farmers.

3.3 Role of Credit Sources in Market Participation

3.3.1 Procurement of Farm Capital Goods and Credit Sources

Although more than half (54 per cent) of the farm capital goods⁷ owned by sample households are self-financed, a good percentage (23 per cent) of them has been purchased with the help of borrowed money (Figure 3). The other 20 per cent has been supplied by the government under different subsidy schemes and the remaining 3 per cent is not purchased (applicable in the case of bullocks only).

Figure 3: Sources of Finance for Procuring Agro-capital Goods



In order to examine the role of credit by sources on procuring farm capital goods, they have been categorised as more expensive and less expensive sources respectively.⁸ Table VII shows that out of the total farm capital goods purchased using borrowed money, a total of 28.3 per cent of the purchases financed by institutional credit belong to less expensive category, while the same for more expensive capital goods is 32 per cent. Thus, it is found that institutional credit encourages procurement of the expensive agricultural capital goods relatively more than the less expensive capital goods.

⁷Agricultural machinery except harvesters and bullocks is considered only. While there are hardly any sample households using a harvester, the traditional implements or capital goods used are not that expensive and hence are not included in the discussion.

⁸Out of the available farm capital goods with the sample households, tractor, power tiller, diesel engine pumpset, honda and motor are treated as more expensive and the rest as less expensive. Although a bullock pair is also relatively costly, as in almost all cases, the money invested in purchasing of a pair of bullocks is the money earned by selling the existing bullock pair, it has not been considered in the more expensive category.

TABLE VII
FINANCING OF FARM CAPITAL GOODS BY FORMS OF CREDIT

			Sources of Borrowing		Total
			Institutional Source	Non-institutional Source	
Types of implements	More expensive	Count	8	17	25
		% within types of implements	32.0	68.0	100.0
	Less expensive	Count	15	38	53
		% within types of implements	28.3	71.7	100.0
Total		Count	23	55	78
		% within types of implements	29.5	70.5	100.0

3.3.2 Hiring-in and Credit Sources

The impact of credit on own use and on hiring-in use of farm capital goods has been compared with the help of regression analysis to see the role of credit sources in hiring-in use of such capital goods. For this, two regressions have been carried out - one is on the impact of different sources of credit on overall use of farm capital goods and the other is on its impact on hiring-in of capital goods. In the analysis, only the pure hiring-in users⁹ of farm capital goods are considered "hiring-in users" as the "other hiring-in users" own at least one of the concerned capital goods. Thus, other hiring-in users belonging to "the others" are economically not so poor to be affected by the access to credit source on their hiring-in decisions. Further, the sample borrowers are classified as institutional borrowers and non-institutional borrowers. Borrowers from multiple sources (i.e. both from institutional and non-institutional sources) have been regarded as institutional borrowers as the privileges they have are not less than that of pure institutional borrowers. As cost of hiring-in is more for ploughing machinery than irrigation machinery, it can be expected that the impact of access to credit on hiring-in will be more significant for the former than the latter. Further, the

⁹Pure hiring-in users are the users of hiring-in the capital goods only.

need of ploughing operation is more than irrigation operation and also the rental market of ploughing machinery is more expensive than irrigation machinery. Hence, in the present analysis, only ploughing machinery has been considered.

It is found that 21.9 per cent of the ploughing machinery users are institutional borrowers, while among the pure hiring-in users, 18.7 per cent are borrowers from such sources. Non-institutional borrowers consist of 32.4 per cent of users of ploughing machinery and 37.3 per cent of its pure hiring-in users. The shares of non-borrowers in users and pure hiring-in users are 45.6 per cent and 44 per cent respectively. Thus, it is observed that institutional credit encourages relatively more use of own ploughing machinery as is found in the previous section, while non-institutional credit encourages relatively more hiring-in use. For conformity of this impression, appropriate econometric tools have been used in the subsequent analysis.

The factors considered above as determinants of participation in rental markets of ploughing machinery are also expected to affect the use-either own or hiring-in. The explanatory variables included in regressions for role of credit in overall use and hiring-in use have already been defined in Table V.

Assuming ploughing machinery user (PMU) and pure hiring-in user of ploughing machinery (PHUPM) as dependent variables such that,

PMU=1 if ploughing machinery adopted, 0 otherwise

PHUPM=1 for pure hiring-in user of ploughing machinery, 0 otherwise

PMU=F (INS, NIS, FS, TEN, BULL, EDU, AGE, SIZE, OCC, L₁, L₂)

PHUPM=F (INS, NIS, FS, TEN, BULL, EDU, AGE, SIZE, OCC, L₁, L₂)

Specification of the Models

As the dependent variable is binary, a LOGIT regression model is found to be appropriate. Accordingly, we have constructed a LOGIT regression model to serve the purpose. The LOGIT regression models for overall users and pure hiring-in users have been formulated as follows:

$$\begin{aligned} & E(\text{PMU} \mid \text{explanatory variables}) \\ &= \text{Prob.}(\text{PMU}=1 \mid \text{explanatory variables}) \\ &= \frac{1}{1+e^{-z}} \end{aligned}$$

where,

$$Z = \beta_0 + \beta_1 \text{INS}_i + \beta_2 \text{NIS}_i + \beta_3 \text{FS}_i + \beta_4 \text{TEN}_i + \beta_5 \text{BULL}_i + \beta_6 \text{EDU}_i + \beta_7 \text{AGE}_i + \beta_8 \text{SIZE}_i + \beta_9 \text{OCC}_i + \beta_{10} \text{L}_{1i} + \beta_{11} \text{L}_{2i}, \text{ and}$$

$E(\text{PHUPM} \mid \text{explanatory variables})$

$= \text{Prob.}(\text{PHUPM}=1 \mid \text{explanatory variables})$

$$= \frac{1}{1 + e^{-z}}$$

where,

$$Z = \beta_0 + \beta_1 \text{INS}_i + \beta_2 \text{NIS}_i + \beta_3 \text{FS}_i + \beta_4 \text{TEN}_i + \beta_5 \text{BULL}_i + \beta_6 \text{EDU}_i + \beta_7 \text{AGE}_i + \beta_8 \text{SIZE}_i + \beta_9 \text{OCC}_i + \beta_{10} \text{L}_{1i} + \beta_{11} \text{L}_{2i}$$

The results of LOGIT regressions reveal that the coefficient of variable INS is positively significant at 10 per cent for the overall use of ploughing machinery, while it is not significant in the case of hiring-in. This means institutional credit encourages use of ploughing machinery only through increasing its ownership. However, coefficient of variable NIS has been found to be positively significant at 5 per cent for overall use and at 10 per cent for hiring-in use. This implies that non-institutional credit encourages use of ploughing machinery as a whole and also its hiring-in. While considering the control variables, farm size has been found to be positively significant at 1 per cent in overall use but negatively significant at the same level. This implies that the large farmers use ploughing machinery more through purchase than by hiring-in. The ownership of bullock is found to be negatively significant in overall use but positively significant in hiring-in use at the same level. Thus, the use of purchased machinery for ploughing has been discouraged by bullock ownership, whereas the use of such machinery by hiring-in is found to be encouraging. The positively significant coefficient of variable EDU for overall users depicts the role of education of farmers in extending mechanisation. However, insignificance of this variable in the case of hiring-in use reveals the absence of any role of farmers' education in hiring-in of ploughing machinery. Further, the size of the household has been found to be insignificant in overall use of ploughing machinery but negatively significant in its hiring-in use. It implies that the probability of hiring-in is more for the small size farm households. Positively significant coefficients of location dummies in both models show the use of more ploughing machinery either own or hiring-in in Morigaon and Kamrup districts than that in the North Lakhimpur district.

TABLE VIII
RESULTS OF LOGIT REGRESSION MODELS FOR THE ROLE OF SOURCES
OF CREDIT IN USE AND HIRING-IN OF PLOUGHING MACHINERY

Variables	User of ploughing machinery, n=232			Pure Hiring-in user of ploughing machinery, n=182		
	Coefficient	Robust SE	p-value	Coefficient	Robust SE	p-value
	Breusch-Pagan test for heteroskedasticity chi ² (1) = 64.37 Prob> chi ² = 0.0000 Result: Presence of heteroscedasticity			Breusch-Pagan test for heteroskedasticity chi ² (1) = 38.63 Prob> chi ² = 0.0000 Result: Presence of heteroscedasticity		
	Average VIF=1.39 Maximum VIF=1.71			Average VIF=1.46 Maximum VIF=2.03		
INS	1.049*	0.633	0.098	-0.059	0.671	0.930
NIS	1.192**	0.509	0.019	1.441*	0.756	0.057
FS	0.774***	0.246	0.002	-0.864***	0.242	0.000
TEN	0.129	0.880	0.884	-0.896	0.806	0.266
BULL	-2.526***	0.632	0.000	3.094***	0.899	0.001
EDU	0.815***	0.238	0.001	-0.380	0.318	0.231
AGE	0.037	0.025	0.134	-0.007	0.025	0.773
SIZE	0.101	0.092	0.271	-0.230**	0.102	0.024
OCC	-0.099	0.513	0.847	-0.225	0.697	0.747
L ₁	2.911***	0.776	0.000	1.508*	0.914	0.099
L ₂	2.318***	0.779	0.003	1.676**	0.735	0.023
Constant	-3.212*	1.811	0.076	3.683**	1.569	0.019
Wald chi ²	52.19(11)***			41.09(11)***		
Pseudo R ²	0.3809			0.3367		

Note: Figures within () represent degrees of freedom.

***, ** and * indicate significance at 1%, 5% and 10% level respectively.

IV. CONCLUSION AND POLICY IMPLICATION

In the agrarian set-up of Assam, access to credit has been found to be playing a significant role in promoting the participation of the farm households in rental markets of farm capital goods. However, different sources of credit encourage the participation of farmers in such markets differently. Across sources of credit, non-institutional credit plays a predominant role in both procurement and hiring-in of farm capital goods. Institutional credit encourages only the ownership of such goods by the farmers. More importantly, institutional credit increases ownership of more expensive equipment like tractors, power tillers, pump sets, etc. more than the less expensive farm implements. It is understandable that the rental markets are likely to be more extensive for more expensive capital goods, assuming that other things remain constant. In the case of less expensive farm

capital goods, such markets may not even exist as they do not require huge investments. The fact that among the users of concerned capital goods, participation in rental markets for ploughing machinery is more than that in irrigation machinery supports this argument as the former is more expensive than the latter. Hence, as lessors in such markets are the owners of the farm capital goods, whose ownership is also encouraged by institutional credit, it can be concluded that institutional credit encourages participation in rental markets of farm capital goods as suppliers, while participation on the demand side in such markets is encouraged by non-institutional credit. Of course, non-institutional credit also increases the suppliers in such markets. Thus, while access to credit is a vital precondition to participate in rental markets of farm capital goods, institutional credit plays the single most important role in encouraging participation while non-institutional credit plays a dual role.

Thus, greater penetration and deployment of institutional credit in the agriculture sector can be suggested in order to encourage farmers' participation as suppliers in such markets. This can, in fact, help in more efficient functioning of rental markets of farm capital goods by increasing competitiveness.

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APPENDIX

APPENDIX 1

DESCRIPTIVE STATISTICS OF EXPLANATORY VARIABLES OF REGRESSION MODELS

Variables	Ploughing machinery						Participants in rental markets of irrigation machinery		Sample households [232]
	Participants in rental market		Users				Participants [81]	Non-participants [151]	
	Participants [181]	Non-participants [51]	Users [182]	Non-users [50]	Owner users [32]	Pure hiring-in users [150]			
	Mean (S.D)	Mean (S.D)	Mean (S.D)	Mean (S.D)	Mean (S.D)	Mean (S.D)	Mean (S.D)	Mean (S.D)	
ATC	0.55 (0.50)	0.45 (0.50)	NA	NA	NA	NA	0.64 (0.48)	0.46 (0.50)	0.53 (0.50)
INS	NA	NA	0.22 (0.42)	0.18 (0.39)	0.38 (0.49)	0.19 (0.39)	NA	NA	0.22 (0.41)
NIS	NA	NA	0.32 (0.47)	0.28 (0.45)	0.09 (0.30)	0.37 (0.49)	NA	NA	0.32 (0.47)
FS	1.37 (1.11)	1.23 (0.74)	1.38 (1.13)	1.17 (0.63)	2.29 (1.42)	1.18 (0.95)	1.25 (1.12)	1.38 (1.00)	1.34 (1.04)
TEN	0.32 (0.37)	0.30 (0.35)	0.32 (0.37)	0.31 (0.36)	0.38 (0.37)	0.31 (0.37)	0.42 (0.38)	0.26 (0.34)	0.32 (0.36)
BULL	0.41 (0.49)	0.99 (0.27)	0.41 (0.49)	0.92 (0.27)	0.22 (0.42)	0.45 (0.50)	NA	NA	0.52 (0.50)
EDU	1.86 (1.12)	1.59 (1.17)	1.86 (1.12)	1.56 (1.16)	2.09 (1.15)	1.81 (1.11)	1.47 (1.05)	1.97 (1.14)	1.80 (1.13)
AGE	47.25 (11.29)	47.00 (11.60)	47.26 (11.25)	46.98 (11.71)	47.72 (9.38)	47.16 (11.64)	46.44 (11.33)	47.60 (11.35)	47.20 (11.33)
SIZE	6.45 (2.57)	5.92 (2.25)	6.45 (2.56)	5.90 (2.27)	7.59 (3.19)	6.20 (2.35)	6.73 (2.99)	6.12 (2.19)	6.33 (2.51)
OCC	0.41 (0.49)	0.47 (0.50)	0.41 (0.49)	0.48 (0.51)	0.34 (0.48)	0.42 (0.50)	0.48 (0.50)	0.39 (0.59)	0.42 (0.50)

Note: Figures in [] are number of observations.

N.A.-Not Applicable, S.D.-Standard Deviation.