

Does Extent of Technological Adoption Leads to Accessibility of Formal Agricultural Credit: Empirical Evidence from Odisha

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Abstract: In a developing country like India agriculture is the key indicator of engagement and livelihood of people. Many strategic policies by the government of India as well as the state governments are undertaken for development of agricultural sector through productivity improvement and price protectionism. Green revolution in India provides immense scope for increase in production through better technological adoption. The aim of the present study is to investigate impact of farm mechanization on accessibility of formal source of agricultural credit by the farmers of Odisha. The study has used a multi stage sampling technique to arrive at the 175 sample unit. The study has used the descriptive statistics such as frequency, average, percentages for the analysis purposes and in order to identify impact of farm mechanization on accessibility of agricultural credit from formal sources, Probit regression model is employed in the study. The study reveals that 66 percentages of farmers have access to formal source of credit but 75 percentages of farmers have credit constrained in different form like inadequate amount, timely unavailability of credit and not getting at all. Two composite variables; agricultural technological adoption intensity index and extension contact intensity index are the major significant variables in positively determining the access to formal source of credit by the farmers. In our study Agricultural technological adoption intensity index is taken as a proxy variable for farm mechanization. A probability of accessibility to formal agricultural credit is 30% influenced by farm mechanization extent of farmers with 5 percentage level of significance.

Keywords: farm mechanization, technological adoption, agricultural credit, accessibility to credit, credit constrained

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I. Introduction:

The agricultural sector continues to be the mainstay of India's economy. Although this sector contributes less than 20 per cent towards GDP, still it provides employment and sustenance, directly and indirectly to more than 60 per cent of the total working hand in the country. According to a well-known saying, "The Indian farmers are born in debt, lives in debt and dies in debt" (Soni 2013). The essence in this saying is no longer there. At a point of time debt was regarded as an un-mixed evil and a melancholy round the neck of the farmers, as a result had failed to provide even for the basic necessities for majority of the farmers. Now, the time has changed and debt is no longer regarded as something undesirable.

In twenty first century, economists consider credit which injects life into lifeless agriculture serves as an instrument for agricultural development. The recent green revolution in India has clearly demonstrated that in the light of available technology, there is an immense scope for developing Indian agriculture and that loan advances from various agencies are quite essential for the farmers for this purpose (Muhammad Iqbal, 2004)(Olubiyo, 2004)(Temu, 2008). As the development aspect of credit in rural areas has become important, the attitude of planners and administrators towards agricultural finance underwent a change.

Rationale of the study:

The reforms and initiatives of financial sector in India aimed at wide spread of financial service facilities for inclusive economic development. It was the common expectation of increased outreach of formal financial institution by the majority of people for equal and equitable economic development both in rural and urban area. Even though efforts are made, but formal financial facilities could not reached to its expectation level particularly in agricultural sector. The unavailability of proper financial facilities reduced the potential

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growth of agricultural sector. And also “less attention to the small and marginal farmers is a big challenge in institutional credit of agricultural sector” (Mishra S. , 2017). This is because large size of land positively impact access of credit from formal sources (Gunjal, 1998). For which the development of agricultural sector is being obstruct because the number of marginal and small farmers accounts more in our economy.

One of the most important determinants of growth in agricultural output is availability of productive credit in required quantities (Olubiyo, 2004). But it is reality that small holders get short term small amount of credit for input procurement purposes (Thapa, 2012)(Mohan, 2006)(Mishra R. , 2014). Small farmers have less availability of physical assets and collateral. But it is found that lack of collateral and guarantor are main constraints in access to formal source of credit (Olagunju, 2013). All these factors reduce the small holder farmer chances to access formal source of credit.

Social characteristics of the farmer also have impact on access to formal source of credit. It is found that farmers belonging to socially deprived classes of SC and ST are continued to experience discrimination in access to formal source of credit (Singh, 2014). The household size, education of the household head, gender, age, productive assets hold by house hold also have impact on access to formal source of credit (Temu, 2008)(Samuel Elias, 2015). It is observed that individual access to formal credit is difficult. But forming group of farmers and getting access to formal source of credit is easier (Baba Hananu, 2015). So it is better to make cooperation and get the benefit.

There are also some economic indicators which determine access to credit. Better technology adopter farmers need for the finance is more. For which they tried to uptake financial facilities from formal institutions. So the farmers who have higher cost of production, access to credit is better (Vanitha, 2010). But the repayment is a problem at the same time. Those farmers thinking repayment as a burden have less access to credit facilities (P. K. Chauke, 2013). Along with the demand side problems there are some supply side problems in credit facilities. Distance of the financial institutions demotivates the farmers for credit access (Assifaw Lemessa, 2016). Contacts with the financial agents also have impact on credit access (P. K. Chauke, 2013)(Assifaw Lemessa, 2016). Most of the studies reviewed have addressed different socio-economic variables which, affects the access to agricultural credit from formal sources as well as informal sources. But very few numbers of studies have raised the issue of farm mechanization. So the present study aims to investigate impact of farm mechanization on accessibility of formal source of agricultural credit by the farmers of Odisha.

II. Research Methodology:

In order to assess the information about agricultural credit structure, the study is conducted in Nuasantha Gram Panchayat (GP) of Nimapara block of Puri district of Odisha. A multi stage random sampling technique considered here for selection of the area. The state of Odisha constitutes 30 districts of which Puri district has been chosen for the present study. In the second stage out of Puri 11 blocks of Puri district Nimapara block has been chosen randomly. There are 28 G.Ps in Nimapara Block. Out of 28 G.Ps, Nuasantha G.P has been selected through simple random sampling technique. As the sample unit 175 households have included under the purview of the study through simple random sampling technique. A structured schedule is used as a tool to collect data from primary sources. The data has been collected through direct personal interview method with the farmer head of household in April 2017.

The dependent variable in the study (accessibility to agricultural credit) is a dichotomous one, that either yes or no. There are several methods to analyse the data involving binary outcomes. However, for this particular study, probit model is used over discriminant analysis, linear probability model (LPM) and logit model. If the independent variables are normally distributed the discriminant analysis estimator is more efficient than the logit and probit model. However, if the independent variables are not normal, the discriminant analysis estimator is not consistent, whereas probit and logit estimator is consistent and more robust (Madala 1983). The linear probability model (LPM) is a linear function of explanatory variables which is computationally simple. Despite computational simplicity, it suffers from one defect that the estimated probability values can lie outside the zero to one range.

Probit model has advantage over LPM in that the probabilities are lies between 0 and 1. Moreover, probit model best fits the nonlinear relationship between the probabilities and the explanatory variables. In the analysis of studies involving qualitative choices, usually a choice has to be made between logit and probit models. According to Amemiya (1981), the statistical similarities between logit and probit models make a choice between them difficult. But the present study has used probit model as the econometric technique. Logit model uses logistic cumulative distribution function whereas probit model uses normal cumulative distribution function. As the sample size is large, the normality of data is assumed and preferred the probit model.

The probability of an event occurring (in this case the probability that the farmers takes credit from formal sources or not) depends upon the unobservable utility index I_i , which is dependent on the number of explanatory variables (X_i). This can be expressed as

$$I_i = \beta_0 + \beta_i X_i$$

The unobserved utility index I is related to the farmers' decision as follows:

Let $Y_i = 1$ if the farmer takes credit from formal sources

$Y_i = 0$ if otherwise

It is assumed that for each farmer, there is a minimum level of I , given as I^* , below which the event will not occur, then

$Y_i = 1$ if $I^* < I$, and

$Y_i = 0$ if $I^* > I$

Since the only observable data is on Y_i and X_i , the coefficient β_i can be estimated as follows

$$I = \beta_0 + \beta_i X_i + U_i$$

Therefore, $Y_i = \beta_0 + \beta_i X_i + U_i$ if $I > I^*$

$Y_i = 0$ otherwise

Where, Y_i = the decision to take credit from formal sources or not,

$Y_i = 1$ if farmer take credit from formal sources,

$Y_i = 0$ if otherwise

β = the parameter to be estimated showing the probability that credit is taken from formal sources or not

X_i = the vector of explanatory variables

U_i = the disturbance term

Table 1: Variables specified in the analytical model

Variable name	Abbreviation	Specification
Farmer head age	Age	Number
Years of schooling	Ysch	Number
Number of adult male in the family	Adlm	Number
Income from livestock	Livs	Number
Land holding	Lnho	Number
Type of cultivator	Typcul	Dummy
Annual off farm income of the household	Aoffinc	Number
Value of Physical assets	Assets	Number
Extension contact intensity index (see annexure I)	Extcind	Index
Agricultural technology adoption intensity index (see annexure II)	Agtadoii	Index
Farmers perception about risk	Risk	Dummy

The function therefore estimates the factors affecting accessibility of agricultural credit from formal sources and particularly the impact of farm mechanization on accessibility. In the analysis, the marginal concept is also used to predict the effect of a change in an explanatory variable on the probability of a favourable attitude toward access to formal credit. The marginal effect is dY/dX , which shows the change in probability of dependent variable due to change in independent variables.

III. Results and discussion:

As we know Indian farmers are poor from their birth, they suffer financial problem throughout their life. This situation makes them to borrow from anywhere to substantiate their family. The present study has made an attempt to examine the borrowing behaviour of farmers. Farmers taking Credit from any sources has been considered under the purview of the study for the period from January 2016 to December 2016. To analyse the credit access from formal sources particularly, a period of last 5 years has been taken in the study. On this ground the following discussion is continued.

Borrowing behaviour:

Agricultural activity is a sensitive one. Every requirement for agriculture should be fulfilled in time, which requires capital. If not, the production will be hampered. But Indian farmers do not have that capital in hand every time. So they are forced to borrow from others. The borrowing behaviour of sample farmer HHS is presented in following table.

Table 2: Borrowing in previous agricultural period

Borrowed	Frequency	Percentages
No	31	17.72
Yes	144	82.28
Total	175	100.0

Source: primary survey

The above table reveals that 82 percentages of farmers have borrowed from different institutions which includes both formal and informal source. This shows that most of the farmers are depending upon credit for agricultural activities whereas rest i.e. 18 percentages of farmers have not borrowed a single amount to perform their agricultural activity.

Source of credit:

Farmers borrow from different formal institutional sources as well as from different informal sources. Some farmers also borrow from both sources as per the requirements and condition. But the amount of borrowing from different sources varies. Amount of borrowing from different sources differs for the characteristics prevailing in all the sources. So the following table explains the percentage of borrower and percentage of borrowed amount from different institutions.

Table 3: Source of borrowing

Source of credit	Percentage of farmer taken loan	Percentage of credit received
Bank	12.42	17.80
Cooperative and microfinance	27.59	23.88
SHGs	4.83	2.02
Bank , cooperative and micro finance	1.38	3.33
Bank and SHGs	0.69	0.78
Cooperatives, microfinance and SHGs	4.83	6.29
Other informal source	25.51	10.64
Cooperatives, microfinance and other informal source	10.33	13.63
SHGs and other informal source	4.14	2.65
Bank, cooperative, microfinance and other informal sources	0.69	2.33
Cooperatives, microfinance, SHGs and other informal sources	6.21	13.38
Bank and other informal sources	1.38	3.27
Total	100	100

Source: primary survey

There are 12 percentages of borrowed farmers who have borrowed 18 percentage of credit from bank. Also 28 percentages of borrowed farmers have borrowed 24 percentage of credit from co-operative and MFIs. There are 5 percentage of borrowed farmer, who have borrowed 2 percentage of credit from SHGs. Borrowing from different sources in a combined manner is prevailed in the study area. There are 26 percentages of the borrowed farmers who have borrowed 11 percentage of credit from other informal sources like money lenders, relatives and traders. The percentage of farmer taking loan from informal source is high but the amount of credit received is less. One positive and interesting observation from the study is significant prevalence of agricultural credit from MFIs. But at the same time the higher interest rate (24-27%) in MFIs than other formal sources expresses passive acceptance.

The informal source of credit exists in our country from years back. People use to take loan from informal sources for many reasons. In rural area when a poor farmer needs some amount of money for his family, usually he thinks about the rich person of the village. When a family member is in some disease and need some health expenditure, that poor fellow think about the money lenders. So in rural area informal source of credit exist in many forms. The study makes an attempt to find out the reasons why farmers take loan from informal sources. Following table shows the reasons why farmers take loan from informal sources.

Total 4: Reasons for borrowing from informal sources

Reasons	Frequency	Percent
Less time	11	15.5
No collateral requirement	29	40.84
small amount	1	1.40
Less time and less distance	1	1.40
Less time and no collateral requirement	26	36.61
Less time, no collateral requirement and small amount	1	1.40
Less time and small amount	1	1.40
No collateral requirement and small amount	1	1.40
Total	71	100.0

Source: primary survey

Informal source of credit is crucial in the study area. Out of 175 farmers, 71 farmers have taken credit from informal sources in previous agricultural period. Fifteen percentages farmers borrowed from informal source have viewed that they have taken credit from informal sources for getting the said amount within less time. Another important reason is absence of collateral. Forty one percentages of the farmers borrowed from informal sources viewed that absence collateral requirement is the reason for which they take credit from informal sources. There are 37 percentages of farmer borrowed from informal source have view that both less time requirement and absence of collateral requirement is the reason for which they take credit from informal sources. So overall we can say that absence of collateral requirement and less time requirement to get credit is the reason to take credit from informal sources.

There is some time gap in between credit demanded and received. The credit may not available at the point of time of demand. It takes some time to get credit. In formal sources there is a procedural formality which requires time to give credit to the debtor. In informal source also some time is taken by the lender to decide whether to give or not. In this manner from the time of credit demanded to credit received some time is required. But the time gap differs in different institutions. The average days to get credit from formal sources are 11.26 days. The average days to get credit from informal sources are 2.46 days. More number of days taken to get credit in formal sources due to procedural delay and more formalities. But in informal sources no collateral or any formalities is required. So it takes less time to avail credit from informal sources.

Credit from formal sources is more beneficial for a debtor. Lesser interest rate and less pressure make the debtor salutary. So credit taken from formal sources is an advantage thing for a debtor. But farmer's access to formal source of credit is regarded as a challenge. Thus the following table represents the access to formal source of credit by different group of farmers in last 5 years.

Table 5: Types of farmer and access to formal sources agricultural credit

Category of farmers and access to formal source of credit	No	Yes	Total
Marginal	39 (33.05)	79(66.95)	118 (100)
Small	0	22 (100)	22 (100)
Large	0	6 (100)	6 (100)
Landless	21 (72.42)	8 (27.58)	29 (100)
Total	60 (34.28)	115(65.72)	175 (100)

Source: primary survey

In last 5 years out of 175 farmers, 60 farmers have not accessed to formal source of credit. There are 39 marginal farmers and 21 landless farmers have not access to formal source of credit. There are 32.77 and 72.41 percentages of marginal and landless farmers respectively did not have accessed to formal source of credit in

last 5 years. All the small and large farmers have access to formal source of credit. Less access to institutional credit is observed by the landless farmer followed by marginal farmers. Lack of collateral availability is resulting less access to institutional credit by landless farmers.

Farm mechanization

The growth of agricultural sectors requires transformation from traditional agriculture to modern one. This transformation could be possible through implementation of modern technology and inputs. Thus mechanized farm activity could reduce the input cost in one hand and increase the output in the other hand. The problem of disguised unemployment and high demand for labour in the pick time could be solved. In the broad sense farm mechanization is not only limited to the machinery implementation but also considers the technological adoption. So farm mechanization is essential for the agricultural development. The following table gives us a picture of extent of farm mechanization of sampled agricultural households.

Table 6: type of farmer and extent of mechanization

Type of farmer Mechanization	Marginal	Small	Large	Landless	Total
Less mechanized	26	3	0	18	47 (27)
Moderate level mechanized	62	8	2	10	82 (47)
Highly mechanized	30	11	4	1	46 (26)
Total	118 (67)	22 (13)	6 (3)	29 (17)	175

Source: Primary data

The farm mechanization in the study is an index variable used as agricultural technology adoption intensity index. The index is composite of 11 indicators related to agricultural technology. The index value varies from 0 to 1.36. We consider here that 0 to 0.5 as less mechanized, 0.5 to 1 as moderate level of mechanized and more than 1 as highly mechanized. The study found that 47 percentage of farmers are moderately mechanized, which is near to half of the farmers. The extent of mechanization is low and high for 27 and 26 percentages of farmers respectively. In a comparative sense one thing could be observed that large and small farmers are more mechanized than marginal and landless farmer.

Factors affecting access to institutional agricultural credit:

The probit model is selected for analysing the factors determining accessibility of agricultural credit. The probit model involves the regression analysis of dichotomous dependent variable which takes 2 values. In the present study the dichotomous dependent variable is access to formal source of credit. If the farmer has access to formal source of credit it takes the value 1 and otherwise 0. There are 11 independent variables in the model. The following table explains the summary of the model.

Table 7: Model summary

Name of the variable	Coefficients	Marginal effect	P value
Age	.0023344	.0000685	0.952
Years of schooling	.2890131	.0084854**	0.013
Adult male	-1.579868	-.046385**	0.048
Livestock income	-2.104344	-.0617837**	0.024
Land holding	2.349435	.0689796**	0.045
Type of cultivator	2.074013	.0608932*	0.094
Annul off farm income	.0000177	5.19e-07*	0.098
Assets	-0.000377	-1.11e-06	0.125
Extcind	10.59081	.310947***	0.000
Agtadoii	10.23073	.3003749**	0.027
Risk	5.929125	.1740795***	0.000
Cons	-11.51662**		0.038

*, **, *** represents the level of significance at 10%, 5% and 1% respectively
Number of observation = 175
LR chi2(11) = 190.89
Prob> chi2 = 0.0000
Log likelihood = -9.2540045
Pseudo R2 = 0.9116
Correctly classified = 97.71%

Source: primary survey

The probit model identifies which factors affect accessibility agricultural credit from formal sources. Years of schooling, own land, types of cultivator, annual off farm income, extension contact intensity index, agricultural technology adoption intensity index and farmers perception about risk are the variables which positively and significantly determining the access of credit from formal sources. Numbers of adult male in a family, income from livestock have significant negative impact on access to formal source of credit. Age of the farmer HH head and physical asset holding are insignificant variables to determine accessibility of agricultural credit from formal sources.

Year of schooling is a positive significant variable to determine access of agricultural credit. This variable is significant one at 5 percent level of significance. This is the fact that probability of an educated person to convince the institutional authority and making a better conversation is more than that of an uneducated person. This leads years of education to affect access of credit positively. Own land holding, types of cultivator and annual off farm income have positive influence on access to formal source of credit. Type of cultivator is a dummy variable in which if farmer is the owner of land as well as cultivator it takes value 1 otherwise if he is a fully share cropper or partial share cropper the value takes 0. If the cultivator is an own cultivator then the chance to access to credit increases due to availability of collateral with him.

Number of adult male in a family is a negative significant variable to determine accessibility of agricultural credit from formal sources. As the number of adult male increases the income source increases. So credit requirement of these household from other sources diminishes. Therefore as one adult male increases the chance to access formal source of credit decreases. Income from livestock also has negative impact on accessibility of agricultural credit. Livestock's income is a regular income source. This income can fulfill the small requirement of family and agricultural activities. So increase in livestock income declines the probability of access to credit from any sources.

Extension contact intensity index is a composite variable of 5 variables. This variable is significant at 1 percent level of significance. This shows the contact with the financial institution and awareness about different scheme is one of the most important variables to determine accessibility of formal source of agricultural credit. Another important variable to determine accessibility of agricultural credit from formal sources is agricultural technology adoption intensity index. This variable positively influences the accessibility of agricultural credit. A farmer adopting modern technology requires the financial assistance and financial need of these farmers is more. This leads to positively influence accessibility of agricultural credit at 5 percent level of significance. These two composite variables are major contributor in determining access to formal source of agricultural credit. Farmer's perception about risk is another variable which positively influence accessibility of agricultural credit from formal sources. The Pseudo R^2 of the model is 0.91 and the model is also 97.7 percentage correctly classified. So the model is a significant one.

IV. Findings

After a rigorous analysis of credit scenario and factors determining to it in the study area, the study made some general findings as followed.

- Absence of collateral and less time to avail credit are the major reasons to take credit from informal sources.
- Average days take to get credit from formal sources are 11.26 and from informal sources are 2.46 days.
- Years of schooling, own land, types of cultivator, annual off farm income, extension contact intensity index, agricultural technology adoption intensity index and farmers perception about risk are the variables which positively significantly determine the access of credit from formal sources.
- Adult male in a family, income from livestock have significant negative impact on access to formal source of credit.
- Extension contact intensity index and agricultural technology adoption intensity index are two important variables to determine accessibility of agricultural credit from institutional sources.

V. Conclusion:

The study reveals that marginal and landless farmers have less access to institutional financial services. The line “poor is getting poor” is justified here in the manner that lack of assets in the form of collateral restricts farmer to get credit from formal sources and enforce him to take credit from informal sources. By which he is being exploited by the higher rate of interest. Contact to the financial agent, aware about financial scheme and modern technology adopted by the farmers are important variables to determine access of agricultural credit from formal sources. Greater the need of credit for production leads the chances to access formal credit to greater extent. The other socio economic factors also have role in determining accessibility of agricultural credit from formal sources. After careful analysis of factors determining accessibility of agricultural credit from institutional sources through probit model we can see various problems in access to agricultural credit from formal sources. Therefore the study suggests some policy implications to improve the standard of credit delivery.

1. Documentary preparation for share croppers and forming rules and regulation in the banking sector to grant loan to them against this document can help them to get credit from institutional sources.
2. Agricultural activities are sensitive work. Delay in any form will hamper the production. So in case of credit sanction, Procedural complexity & delays should be minimized.

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Annexure I- Procedure followed to obtain the extension contact intensity index of the sample households

The extension contacts intensity index is obtained by asking the respondents whether they had any contacts with agricultural extension agents. For those who indicated to have contacts are asked further to indicate the frequency of the contacts, source extension messages. They are further requested to indicate whether they read agriculture bulletin, newsletter or magazine and whether they listen to agricultural programmes aired through radio or Television. The responses from these questions are given scores which are summed and averaged to give final scores for each respondent. These scores are then used as intensity score for extension contacts of sampled households. The following Table shows indicators used to develop the scores.

Indicators	Score
Ever received advice on agriculture from extension services (yes-1, No-0)	1
Source of the extension advice (government-4, NGO-3, Trader-2, fellow farmer-1, no-0)	4
Frequency of extension contacts (very frequent-4, frequent-3, not frequent-2, irregular-1, not at all-0)	4
Reading agricultural bulletin or newspaper or magazine (yes-1, no-0)	1
Listening to radio/TV agricultural programme (yes-1, no-0)	1
Total score	11

Annexure II. Procedure to obtain the agricultural technology adoption intensity index of the sample HHs
In order to be able to establish the household intensity of agricultural technologies adoption some questions are asked to the sample HHs. The questions relating to types input use and irrigation method and method of mechanisation are the major indicators of this index. Different scores are obtained from different variables of the sample HHs. The scores are summed up and averaged to determine the intensity of technology adoption.

Indicators	Score
Use of improved varieties (yes-1, No-0)	1
Use of correct plant spacing (yes-1, no-0)	1
Planting in time (yes-1, no-0)	1
Use of inorganic fertilizer (yes-1, no-0)	1
Use of organic manure (yes-1, no-0)	1
Pest and disease control (None -0, traditional-1, chemical-2)	2
Irrigating crops (yes-1, no-0)	1
Irrigation method (Flooded water-1, sprinkler-2, furrow-3)	3
Practicing mechanized farming (yes-1, no-0)	1
mechanization (most of the time-2, irregular-1)	2
Processing (modern-1, traditional-0)	1
Total score	15

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