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Can Access to Institutional Credit Promote Adoption of Improved Technology? A Case of Biofertilizer Use among the Indian Paddy Farmers

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ABSTRACT

Access to institutional credit plays multiple roles in the livelihoods of agricultural households, an important among them being the promotion of adoption of improved production technologies. Using large-scale national level data from the NSS 77th round survey, the study attempts to explore the role of institutional credit in the adoption of biofertilizers among the paddy-growing farmers of India. Our analysis revealed that only 35 per cent of the agricultural households accessed institutional credit, of which a further lower share of about 18 per cent of the households had access to Kisan Credit Card (KCC). The study revealed that the adoption of biofertilizers was less among the sample farmers, with only 12.62 per cent of the agricultural households reporting using biofertilizers. Households with access to institutional credit had higher expenditure on paddy production inputs except for seeds, diesel, electricity, and irrigation. Estimates of the Double-Hurdle Model showed that while individual and demographic characters did not affect the level of expenditure on biofertilizers, affiliation to social groups other than the scheduled caste group, awareness on MSP, access to groundwater and expenditure on other production inputs had a significant positive effect on the level of expenditure on biofertilizers. The positive impact of access to KCC on biofertilizer expenditure by paddy growers was evident. However, the significant negative effect of area under paddy and crop insurance points towards less popularity of biofertilizer use among farmers with larger area under paddy and those who are risk averse.

Keywords: Agricultural Credit, Institutional Credit, Kisan Credit Card, Biofertilizer, Double-Hurdle Model

JEL codes: Q12, Q14, Q16, Q18

I

INTRODUCTION

Agricultural credit is an essential factor of production that enables the procurement of key inputs for production and investment in farm productive resources. Given the advancements in improved production technologies, the use of modern inputs is critical for achieving higher productivity and profitability in the agriculture sector. Credit in its various forms, formal, informal, or tied-input arrangements, is an essential source for financing such agricultural inputs (Esawaran and Kotwal, 1989; Adjognon et al., 2017; Sidhu and Gill, 2006). Access to credit is vital for households to maintain an optimal level of input use, which enables them to achieve a higher level of farm output and profitability (Freeman et al., 1998; Awotide et al., 2015). Thus, along with other key inputs such as improved crop varieties, fertilizers, irrigation, and farm machinery, credit is also important for augmenting farm productivity (Gulati et al. 2021).

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Keeping in view the role of institutional credit in improving the livelihoods of rural households particularly, the agricultural households, several programmes and policies have been implemented to strengthen the outreach of institutional credit to these households. An innovative financial scheme that aims to provide inclusive financial access to farm households is the Kisan Credit Card (KCC) Scheme. The KCC Scheme was initiated in 1998-99 to enable farmers to purchase inputs and meet credit demand for production needs. The KCC Scheme aims to provide adequate and timely credit support from the banking system under a single window with a flexible and simplified procedure to the individual/joint borrowers who are owner cultivators, tenant farmers, oral lessees & sharecroppers, Self Help Groups (SHGs) or Joint Liability Groups (JLGs) of farmers including tenant farmers, sharecroppers, etc. The scheme covers the diverse financial needs of farmers, such as short-term credit needs for crop production, post-harvest and marketing expenses, consumption requirements of farmer households, working capital needs for maintaining farm assets, and investment credit needs for agriculture and allied activities. It provides a flexible limit of ₹10,000 to ₹50,000 to marginal farmers (as Flexi KCC) based on the landholding and crops grown, including post-harvest warehouse storage-related credit needs and other farm expenses, consumption needs, etc., plus small term loan investments without relating it to the value of land (PIB, 2019; PIB, 2022). The KCC scheme was further extended to livestock and fisheries sectors in 2019. Special initiatives such as the KCC Saturation Drive for farmers enrolled under the Pradhan Mantri Kisan Samman Nidhi (PM-KISAN) scheme have also simplified the process and documentation involved in getting the KCC sanctioned. This study has specially examined the role of KCC in the uptake of technology by the farmers.

One of the numerous promising crop production technologies that have been developed over the years is the use of biofertilizers. Biofertilizers are considered an economical and environmental friendly alternative to chemical fertilizers. They help reduce the application of inorganic fertilizers and the sustainable production of crops such as rice by reducing environmental pollution (Saxena et al., 2021; Khan, 2018; Naher et al., 2015). Thus, they can play an essential role in integrated nutrient management and sustainable agricultural productivity, as well as lower environmental impacts (Malusa et al., 2016; Praveen and Singh, 2019). Therefore, we take up biofertilizers as a specific case of technology adoption by paddy-cultivating agricultural households and explore the effect of access to institutional credit, particularly that of access to the KCC, on the expenditure incurred on biofertilizers.

II

DATA AND METHODOLOGY

The study is based on secondary data from the large-scale national level survey of the National Sample Survey (NSS) 77th round data on 'Land and Livestock Holdings of Households and Situation Assessment of Agricultural Households (LHS-SAS)' conducted during 2018-2019 by the National Statistical Office (NSO). Out of the 45,719 agricultural households covered under this study, 14,310 households that

were exclusively cultivating paddy crop were used for the study. Table 1 provides the state-wise coverage of the sample households.

TABLE 1. STATE WISE DETAILS OF PADDY GROWING HOUSEHOLDS IN THE NSS, 77TH ROUND SURVEY ON LHS-SAS (2018-19)

State (1)	No of households (2)	Share (Per cent) (3)	Estimated No. of households (in '000) (4)	Share (Per cent) (5)
Andhra Pradesh	592	4.10	1,077	3.24
Assam	922	6.39	1,751	5.26
Bihar	3,183	22.07	5,857	17.6
Chhattisgarh	844	5.85	2,450	7.36
Haryana	99	0.69	266	0.80
Jharkhand	518	3.59	1,040	3.12
Madhya Pradesh	513	3.56	1,426	4.29
Maharashtra	550	3.81	1,152	3.46
Odisha	1,515	10.5	3,797	11.41
Punjab	199	1.38	212	0.64
Tamil Nadu	382	2.65	413	1.24
Telangana	367	2.54	925	2.78
Uttar Pradesh	2,568	17.8	8,189	24.61
West Bengal	2,173	15.06	4,727	14.2
Total	14,425	100	33,281	100

Source: Authors' estimates based on NSS 77th round LHS-SAS unit level data, 2018

After addressing the issue of outliers, a total of 14,425 households were retained for further analysis. Descriptive statistics were used to examine the effect of access to credit on input expenditure by the paddy-growing farmers. The use of biofertilizers for paddy production was chosen as a case of technology for assessing the effect of access to credit on technology adoption. The double Hurdle Model (DHM) was used to evaluate technology adoption in relation to households' access to agricultural credit (Cragg, 1971), following the approach used by other researchers in similar cases (Teklewold et al., 2006; Akpan et al., 2013; Anang and Yeboah, 2019; Aditya et al., 2019). The expenditure level on biofertilizers in paddy production was the dependent variable(Y_i).

The first hurdle to technology adoption by the household could be the access to technology itself. The second hurdle would be the level of expenditure by the household on a particular technology, which would depend on a set of explanatory variables (X_i). The proposed Double Hurdle model may be summarized as follows:

First hurdle: Access: Probit model to determine farmer's access to technology

$$A_i^* = X_{1i}'\beta_1 + U_i \; U_i \sim N(0,1)$$

$$A_i = \begin{cases} 1 \; if \; A_i^* > 0 \; and \\ 0 \; if \; A_i^* \leq 0 \end{cases}$$

A_i^* Binary accessibility choice variable
X_{1i}' is the vector of explanatory variables
U_i is the error term

Second hurdle: Use intensity: estimated using a Truncated Tobit model

$$Y_i^* = X_{2i}'\beta_2 + V_i \sim N(0, \delta^2)$$

Double-Hurdle Model

$$Y_i = \{Y_i^* \; if \; A_i = 1 \; and \; Y_i^* > 0 \; and \; is \; 0 \; if \; A_i \leq 1 \; and \; Y_i^* \leq 0 \}$$

Y_i observed level of technology use (intensity). Both the linear and exponential models were estimated, and the final model was selected based on the Akaike Information Criterion (AIC) criterion.

III

RESULTS AND DISCUSSION

Access to Institutional Credit and KCC Among the Sample Agricultural Households

Among the paddy cultivating sample households, 35.05 per cent had access to institutional credit, of which 18.03 per cent had access to KCC (Table 2). Across the different landholding categories, the share of households with access to institutional credit was highest in the case of large landholding households. It was observed that the per cent of households reporting access to institutional credit increased with the landholding size. Marginal households, with 30 per cent of them having access to institutional loans, belonged to the landholding category with the lowest access to institutional credit among the sample

TABLE 2. ACCESS TO INSTITUTIONAL LOAN AND KCC AMONG THE SAMPLE FARM HOUSEHOLDS

Land size category	Access to institutional Loan			Access to KCC		
	No	Yes	Total	No	Yes	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Marginal	6339	2717	9056	7953	1103	9056
	(70.00)	(30.00)	(100)	(87.82)	(12.18)	(100)
Small	2115	1441	3556	2641	915	3556
	(59.48)	(40.52)	(100)	(74.27)	(25.73)	(100)
Medium	756	721	1477	1025	452	1477
	(51.18)	(48.82)	(100)	(69.40)	(30.60)	(100)
Semi-medium	81	128	209	104	105	209
	(38.76)	(61.24)	(100)	(49.76)	(50.24)	(100)
Large	4	8	12	7	5	12
	(33.33)	(66.67)	(100)	(58.33)	(41.67)	(100)
Total	9295	5015	14,310	11730	2580	14310
	(64.95)	(35.05)	(100)	(81.97)	(18.03)	(100)

Source: Authors' estimates based on NSS 77th round LHS-SAS survey. Note: Figures in parenthesis refer to per cent households.

agricultural households. Regarding access to KCC, semi-medium landholding households had the highest access to KCC, as 41.67 per cent reported having a KCC. Regarding per cent coverage, marginal households were found to be poorly covered, with only 12.18 per cent reporting having a KCC. Again, similar to access to institutional credit, a positive relationship could be seen between landholding size and

access to KCC, except for semi-medium landholding households, which showed higher access than large landholding households.

Mean Differences in Key Characteristics of the Paddy Cultivating Agricultural Households of the Sample

The key characteristics of the paddy-cultivating households with and without access to institutional credit are summarized in Table 3. Households with access to institutional loans were generally headed by older male members compared to those with no access to institutional credit. Also, these households showed positive and significant mean differences in terms of their education level, access to membership of farmers' organization, formal training in agriculture, crop insurance, and access to public and private extension services.

TABLE 3. MEAN DIFFERENCES IN KEY CHARACTERISTICS OF PADDY GROWERS WITH AND WITHOUT ACCESS TO INSTITUTIONAL LOAN, 2018-19.

Characteristic	Without institutional loan	With institutional loan	Mean difference
(1)	(2)	(3)	(4)
Age	49.046	49.686	0.6405***
Household size	4.917	4.721	-0.1960***
Education	0.12	0.135	0.0143***
Male headed household	0.894	0.935	0.0410***
Scheduled Tribe	0.146	0.082	-0.0647***
Scheduled Caste	0.177	0.186	0.0089***
Other Backward Caste	0.465	0.477	0.0113***
Access to information (Yes=1)	0.457	0.544	0.0868***
Education (above secondary)	0.12	0.135	0.0143***
Has livestock (Yes=1)	0.526	0.533	0.0068***
Membership of Farmer Organization	0.027	0.051	0.0235***
Has crop insurance (Yes=1)	0.046	0.175	0.1290***
Awareness on MSP (Yes=1)	0.331	0.473	0.1423***
Access to public information (Yes=1)	0.06	0.165	0.1046***
Access to private information (Yes=1)	0.233	0.312	0.0795***
Access to groundwater (Yes=1)	0.543	0.469	-0.0737***
Received formal training in agriculture (Yes=1)	0.01	0.018	0.0081***
Individually operated land (Yes=1)	0.949	0.955	0.0055***
No. of land parcels	2.762	3.162	0.3998***
Area under irrigation (Ha)	0.46	0.782	0.3218***
Total area under paddy (Ha)	0.528	0.787	0.2587***
Total product value (Rs/Ha)	52842.36	60329.56	7487.20***
Yield of irrigated crop (Kg/Ha)	1423.66	1554.95	131.28***
Yield of unirrigated crop (Kg/Ha)	1015.92	1118.87	102.95***
Total Yield (Kg/Ha)	3233.45	3573.2	339.74***

Source: Authors' estimates based on NSS 77th round LHS-SAS survey. *** p<0.01, ** p<0.05, * p<0.1. Estimates based on Visit-1 data and paid-out expenditure.

Besides, they also showed higher access to resources such as area under paddy cultivation and ownership of livestock. These households generally belonged to higher social groups in terms of their caste affiliation and reported higher yield levels and value of paddy output realised by them. Households without access to institutional

loans had larger household size, and a higher per cent of these households had access to groundwater.

Further, a cursory look at the level of input expenditure by the households with and those without access to institutional credit showed that the level of spending on key inputs such as fertilizers, biofertilizers, manures, plant protection chemicals-both chemical and biological as well as energy source such as diesel was higher in case of households having access to institutional credit (Table 4). It was observed that the mean difference was negative in the case of expenditure incurred on paddy seed, though the difference was not large. Similarly, households that did not access institutional loans had comparatively higher spending on irrigation and electricity, which could be due to their higher access to groundwater. They also incurred higher expenditure on human labour than households with access to institutional loans.

TABLE 4. MEAN DIFFERENCES IN INPUT EXPENDITURE PATTERN OF PADDY GROWERS WITH AND WITHOUT ACCESS TO INSTITUTIONAL LOAN, 2018-19 (₹/HA)

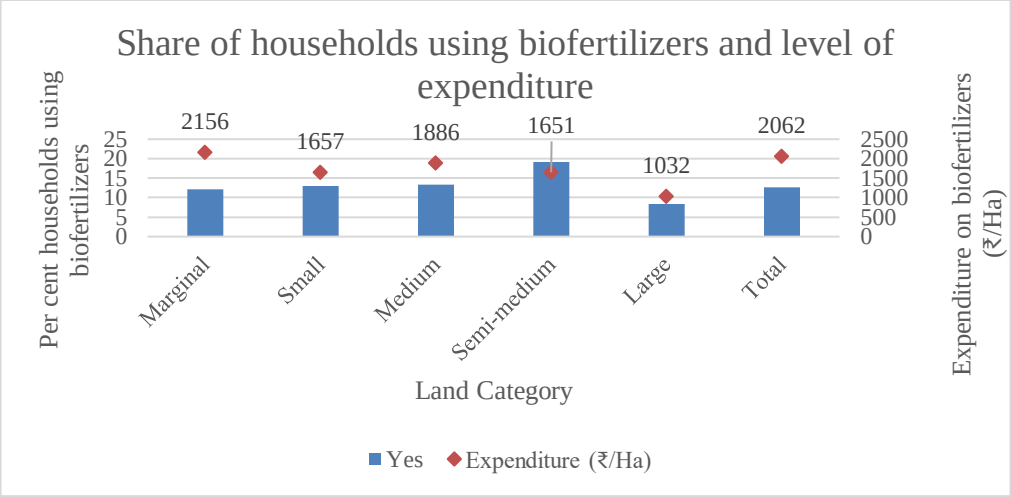
Characteristic	Without institutional loan	With institutional loan	Mean difference
(1)	(2)	(3)	(4)
Seed (₹/Ha)	2643.462	2593.65	-49.812***
Fertilizer (₹/Ha)	4693.981	5506.957	812.976***
Bio-fertilizer (₹/Ha)	2000.183	2189.187	189.004***
Manures (₹/Ha)	2610.558	2938.982	328.4241***
Plant Protection Chemicals (₹/Ha)	2120.576	3062.735	942.159***
Plant Protection Bio-chemicals (₹/Ha)	1393.757	1650.576	256.819***
Diesel (₹/Ha)	3721.552	3694.348	-27.203***
Electricity (₹/Ha)	2914.248	2053.096	-861.152***
Irrigation (₹/Ha)	5501.221	5230.107	-271.114***
Human Labour (₹/Ha)	7445.252	10160.5	2715.242***
Animal Labour (₹/Ha)	224.06	244.908	20.847***
Repair and Maintenance (₹/Ha)	898.819	1181.65	282.831***
Hiring (₹/Ha)	5565.117	6657.347	1092.231***
Crop insurance (₹/Ha)	1273.62	1521.394	247.774***
Rental (₹/Ha)	15613.14	17810.72	2197.582***
Others (₹/Ha)	1646.837	1521.878	-124.959***
Total expenditure (₹/Ha)	24511.38	33035.16	8523.779***

Source: Authors' estimates based on NSS 77th round LHS-SAS survey. Note: *** p<0.01, ** p<0.05, * p<0.1. Estimates based on Visit-1 data and paid-out expenditure.

Use of Biofertilizers Among the Paddy Growing Farmers

It is essential to mention two critical observations from the sample households. Firstly, the share of paddy cultivating households reported using biofertilizer was 12.62 per cent of the sample households (Figure 1). Secondly, there were variations in the use of biofertilizers among households belonging to different landholding classes. Semi-medium landholding households accounted for the highest share of households that used biofertilizers (19.14 per cent), while the share of biofertilizer-using households was lowest among the large landholders. In the case of other land size groups, the share of biofertilizer-using households ranged from 12 to 13 per cent. The average expenditure on biofertilizers was highest in the case of marginal households

(₹2156 per hectare) followed by medium landholding households (₹1886 per hectare) against the overall average of ₹2062 per hectare.



Source: Authors' estimates based on NSS 77th round LHS-SAS survey.

Figure 1. Use of Biofertilizers among Paddy Growing Households and Intensity of Expenditure

Effect of Access to Institutional Credit on Level of Expenditure on Biofertilizers

To examine the role of institutional credit in adopting technology, the effect of institutional loans on adopting biofertilizers among paddy growers was explored using Cragg's Double Hurdle Model. Both linear and exponential CDH models were estimated. Based on the model selection criteria, i.e., the Akaike Information Criterion (AIC), the exponential Cragg's Double Hurdle Model was chosen. Two models were examined viz., i) Using a dummy for access to the institutional loan as an explanatory variable (Table 5, Columns 2-4) and ii) Using access to KCC (dummy) as an explanatory variable (Table 5, Columns 5-7).

It was found that the effect of expenditure on other inputs was positive on the level of expenditure incurred on biofertilizers. Seed expenditure had a significant positive effect on the expenditure on biofertilizers at a 10 per cent significance level, though the effect size was marginal. One per cent increase in seed expenditure was found to increase the amount spent on biofertilizers by 0.23 per cent. One per cent increase in expenditure on fertilizer was found to increase the expenditure on biofertilizer by 0.47 per cent. The effect of expenditure on human labour was also marginal, as a one per cent increase in expenditure on human labour was found to increase the expenditure on biofertilizers by 0.18 per cent. The effect of

TABLE 5. RESULTS OF EXPONENTIAL CRAGG'S DOUBLE HURDLE MODEL ON EFFECT OF INSTITUTIONAL CREDIT ON ADOPTION OF BIOFERTILIZERS AMONG PADDY GROWERS

	Cragg Model_ins			Cragg Model_kcc		
VARIABLES	Lnbiofertz	selection_ll(	Lnsigma	Lnbiofertz	selection_ll	Lnsigma
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Ln age	0.0070	0.0936		0.0060	0.0934	
	(0.0086)	(0.0783)		(0.0086)	(0.0781)	
Education dummy (up to secondary=0, higher secondary &above=1)	0.0079	0.0768		0.0069	0.0756	
	(0.0073)	(0.0586)		(0.0073)	(0.0587)	
Male headed household (Yes=1)	-0.0030	-0.0099		-0.0036	0.0004	
	(0.0076)	(0.0811)		(0.0076)	(0.0809)	
Belongs to ST (Yes=1)	-0.0059	-0.3137***		-0.0037	-0.3324***	
	(0.0126)	(0.0856)		(0.0127)	(0.0858)	
Belongs to SC (Yes=1)	-0.0167**	-0.0806		-0.0156**	-0.0849	
	(0.0075)	(0.0642)		(0.0075)	(0.0642)	
Belongs to OBC (Yes=1)	0.0035	-0.1149**		0.0039	-0.1208**	
	(0.0061)	(0.0497)		(0.0061)	(0.0500)	
Ln Paddy area (Ha)	-0.0522***	0.0310		-0.0531***	0.0369	
	(0.0054)	(0.0443)		(0.0054)	(0.0443)	
Ln Seed (₹/Ha)	0.0023*	0.0174**		0.0023*	0.0175**	
	(0.0013)	(0.0084)		(0.0013)	(0.0084)	
Ln Fertilizers (₹/Ha)	0.0047**	-0.0508***		0.0045**	-0.0479***	
	(0.0020)	(0.0114)		(0.0020)	(0.0113)	
Ln Hiring (₹/Ha)	0.0025***			0.0025***		
	(0.0007)			(0.0007)		
Ln Manure (₹/Ha)	0.0023***	0.0042		0.0023***	0.0045	
	(0.0008)	(0.0067)		(0.0007)	(0.0068)	
Ln Human labour (₹/Ha)	0.0018*	0.0026		0.0018*	0.0032	
	(0.0009)	(0.0072)		(0.0009)	(0.0072)	
Ln Irrigated area (Ha)	0.0115**	0.1075**		0.0113**	0.1118**	
	(0.0054)	(0.0492)		(0.0054)	(0.0491)	
Member of registered farmer organization dummy (Yes=1)	-0.0012	0.1470		-0.0027	0.1601	
	(0.0098)	(0.1026)		(0.0099)	(0.1026)	
Crop insurance dummy (Yes=1)	-0.0278***	0.0051		-0.0307***	0.0360	
	(0.0097)	(0.0774)		(0.0098)	(0.0775)	
MSP Awareness dummy (Yes=1)	0.0204***	-0.0782*		0.0191***	-0.0676	
	(0.0056)	(0.0467)		(0.0056)	(0.0469)	
Access to government extension (Yes=1)	-0.0103	0.1128*		-0.0110	0.1268*	
	(0.0087)	(0.0665)		(0.0087)	(0.0664)	
Access to private extension (Yes=1)	0.0080	0.1144**		0.0082	0.1166**	
	(0.0061)	(0.0480)		(0.0060)	(0.0479)	

TABLE 5 (CONTD)

TABLE 5 (CONCLD.)

	Cragg Model_ins			Cragg Model_kcc		
VARIABLES	Lnbiofertz	selection_ll(	Lnsigma	Lnbiofertz	selection_ll	Lnsigma
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Livestock dummy(Yes=1)	0.0139***	-0.0858**		0.0142***	-0.0816*	
	(0.0050)	(0.0436)		(0.0050)	(0.0437)	
Ground water dummy (Yes=1)	0.0185***	0.1892***		0.0175***	0.1909***	
	(0.0061)	(0.0488)		(0.0061)	(0.0490)	
Training dummy (Yes=1)	0.0128	-0.0665		0.0124	-0.0654	
	(0.0198)	(0.1684)		(0.0197)	(0.1677)	
Ln Network effect	-0.0009	1.9367***		-0.0010	1.9346***	
	(0.0041)	(0.0312)		(0.0040)	(0.0311)	
Institutional loan dummy (Yes=1)	0.0065	0.0959**				
	(0.0053)	(0.0453)				
Access to KCC (Yes=1)				0.0196***	-0.0464	
				(0.0067)	(0.0573)	
State fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Constant	1.9355***	-2.1595***	-2.3083***	1.9425***	-2.1529***	-2.3102***
	(0.0446)	(0.3312)	(0.0205)	(0.0445)	(0.3307)	(0.0206)
Observations	14,308	14,308	14,308	14,308	14,308	14,308

expenditure on hiring and manure expenditure was found to be highly significant. One per cent increase in expenditure on these inputs was found to increase the amount spent on biofertilizers by 0.24 per cent and 0.23 per cent, respectively. Thus, farmers who spent more on inputs also showed higher expenditure on biofertilizers.

Access to institutional loans did not significantly affect the expenditure level on biofertilizer use in paddy crop. However, access to KCC showed a significant positive effect on biofertilizer use, and the estimated coefficient showed that one per cent improved access to KCC leads to an increase in biofertilizer expenditure by 1.96 per cent.

Based on the coefficient value and the level of statistical significance, it was found that area under irrigation, access to groundwater, awareness of Minimum Support Price (MSP), and having livestock along with crop production were significant factors that positively affected the expenditure on biofertilizers. One per cent increase in area under irrigation was found to increase the amount spent on biofertilizers by 1.1 per cent. Also, a one per cent increase in access to groundwater improved households' expenditure on biofertilizers by 1.8 per cent. Access to public and private extension had a significant positive effect on the selection model. However, their impact on the expenditure level of biofertilizers was not significant in the outcome model. Similar results were noted in the network effect of adopters, which was captured as the log of paddy producers who adopted biofertilizer in an FSU/village. A strong network of technology adopters does affect a household's probability of adopting a technology. However, it did not show a significant effect on expenditure incurred on the technology among the study households. Probably, expenditure on biofertilizers is more driven by

household-specific characteristics than the influence of peer adopters. Interestingly, the effect of crop insurance was found to be negative and significant. Unlike the effect of other inputs, such as improved seeds and fertilizers, the effect of biofertilizers is not very evident related to visible crop growth and yield. This could have negatively influenced risk-prone farmers' adoption of biofertilizers.

A comparison of the two models shows that the estimated coefficients of different variables did not change much, and the direction of effect remained the same in both models. However, it has to be noted that under the linear Craggs' Model, institutional credit showed a significant positive impact on expenditure incurred on biofertilizers in the selection model and a non-significant positive effect on the level of spending as evident from the Tobit coefficients, on the other hand the exponential model showed that the impact of accessing a loan either institutional or non-institutional or both was significant and positive on the level of expenditure incurred on the biofertilizer by the agricultural households. Access to KCC, if improved by one per cent, could increase spending on biofertilizers by 1.96 per cent, given the other factors.

IV

CONCLUSION

Credit plays an important role in promoting the adoption of improved crop production technology among resource-poor farmers. Using large-scale national survey data, we found that access to credit affects the input expenditure pattern among paddy farmers. Agricultural households with access to credit spent a higher amount on the use of biofertilizers. The exponential Cragg's Double Hurdle Model results showed a significant negative relationship between paddy area and biofertilizer expenditure. Meanwhile, the level of expenditure incurred on other inputs showed a positive association. The study found that individual characteristics such as age of the household head, gender, and education did not significantly affect the farmers' level of expenditure on biofertilizers. However, the area under irrigation, access to groundwater, awareness of MSP, livestock, and crop production showed a significant positive effect on farmers' expenditure on biofertilizers. Irrigation complements better use and impact of other inputs and thus could have positively influenced the adoption of biofertilizers. Agricultural households' access to KCC showed a positive effect on the level of expenditure incurred on biofertilizers. Hence, though institutional credit facilitates increased input expenditure, targeted institutional finance arrangements could promote farmers' adoption of technology such as biofertilizers.

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