Content list available at http://epubs.icar.org.in, www.kiran.nic.in; ISSN: 0970-6429

Indian Journal of Hill Farming

2018, Special Issue, Page 126-132

Critical Analysis of Adoption Behaviour of Rice (*Oryza sativa* L.) Production Technologies by the Farmers- A Case Study through Krishi Vigyan Kendras (KVKs) in North Eastern Region

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ARTICLE INFO

Article history:
Received 13 January 2017
Revision Received 25 September 2017
Accepted 15 November 2017

Key words:
Adoption behaviour, Rice technology, Krishi vigyan kendra, Multiple regression, North eastern region

ABSTRACT

This study to analyse the adoption behaviour of farmers of rice technology was conducted in 13 purposively selected KVK districts in the region. A sample size of 130 respondents from each adopted and non-adopted villages was taken through proportionate random sampling. Data collection from the selected respondents was made with the help of pre-tested structured schedule through personal interview method. The study reveals that over half of the respondents in KVKs adopted villages had medium level of adoption of improved rice cultivation practices, while majority with over half of the total respondents in non-adopted villages were found poor adoption level of the same rice practices. Respondents of non-beneficiary farmers was found little adoption of recommendations of practices like seed rate, seed treatment using chemicals and bio-pesticides, application of manures and fertilizers and use of chemicals and bio-pesticides as plant protection measures, however, beneficiary farmers had reported medium extent of adoption of these practices. The study further shows that out of 13 independent variables under study, education and extension contact were found having positively significant relationship with the extent of adoption of improved rice cultivation practices. While three variables namely, type of primary farming activities, training received and extension contact had emerged as the most dominant factors influencing farmers to extent of adoption of improved rice cultivation practices.

1. Introduction

The North Eastern Region of India is diverse in many ways –ecologically, socially and culturally. Within this diversity, stewardship in agriculture, forestry, fisheries, livestock and other natural resource sectors continues to be a mental component of wise use of the region's natural legacy. In agriculture, rice is an important economic crop and major staple food of strategic significance across the region. Despite the importance and vast fertile land for rice production in North East, the region is faced with some challenges to reach its self-sufficiency in rice production. Some of these constraints included low level of production resources, low adoption of improved agricultural farming practices and inadequate extension delivery system. The adoption of new agricultural technology, such as the High Yielding Varieties (HYV) and good management practices could lead to significant increases in agricultural productivity in both hilly and valley areas of the region. Unfortunately, these production technologies have not been fully adopted by rice farmers into their conventional farming system. Despite various scientific efforts aiming at providing answers to the question of low adoption of technologies, the empirical evidence indicative of farmers' adoption levels of the recommended agronomic practices for rice production in the region is scanty. Therefore some of the questions are pertinent such as what are the farmers' levels of adoption of rice production technologies?

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What factors determine the level of adoption of these technologies? There is a need to identify the factors that contribute positively to the adoption of rice production technologies as well as those that represent main constraints for the diffusion /adoption process (Nell *et al.,* 1998). Their key environmental and socio-economic factors have significant influence towards adoption and diffusion of agriculture technologies (Lestrelin *et al.,* 2012). This study is an attempt to provide answers to the above questions. The findings of the study would add to the limited empirical studies on factors influencing farmers' level of adoption in agricultural development projects especially in study area, and would also inform policy in addressing these factors as entry points in promoting farmers' participation in rice development projects in the region.

2. Materials and Methods

The study was conducted during 2012-14 by the ICAR- Agricultural Technology Application Research Institute, Zone-III as part of the institute research project- "Impact Analysis of KVK Activities in North Eastern Region".

2.1 Location of study

The study was conducted in purposively selected 13 districts of North Eastern Region which consists of eight states. Only those districts in the region where KVKs are in existence for last 15 years with full strength of scientific staff and infra-structural facilities were selected for the study. A pre-tested well structured schedules comprising all aspects of personal and socio-economic variables of the respondents as well as mandated activities such as demonstrations, training programmes and other extension activities conducted by KVKs were prepared for data collection from the respondents. Any farmer who has been directly associating or receiving help and technical support from Krishi Vigyan Kendras (KVKs) in carrying out of improved rice production practices in his own farming system on regular basis for last fifteen years was considered as respondent (beneficiary) for the study. Similarly, a farmer in non-adopted village who is practicing improved rice production practices in his farming system with no/ least technical support and assistance from the KVK was also considered as respondent (non-beneficiary).

2.2 Selection of farmers

From the selected 13 districts of the region (*i.e.* Assam-4, Arunachal Pradesh-1, Manipur-1, Meghalaya-1, Nagaland-1, Mizoram-2, Tripura-2 and Sikkim-1), two villages-one adopted village and one non-adopted village were selected from each district. On consultation with the available records of the KVK as well as local leaders and extension workers, a list of rice farmers representing two different categories was prepared for each village. From the individual list of rice farmers from each village, ten rice farmer respondents each from adopted and non-adopted village were randomly selected, which made 20 respondents (10 beneficiary and 10 non-beneficiary) from each district. Thus a total of 260 farmer respondents (130 beneficiary and 130 non-beneficiary) were finally selected for data collection from 13 districts of the region.

2.3 Measurement of variables

The independent variables *viz.,* age, education, caste, family type and family size were measured with the help of scales developed by Trivedi and Pareek (1964). The variables- primary occupation, annual income, size of operational land holding, type of primary farming activities, farming experience, trainings received, mass media exposure and extension contact were measured with the help of schedules structured for the study. Extent of adoption of improved rice production practices was considered as the dependent variable, which was operationally defined as the level of adoption of recommended rice production practices by the respondents in their farming system. To determine the extent of adoption, improved rice production practices were listed out and a schedule consisting of questions against each selected practice was administered to the intended respondents in a 4-point Likert type scale namely; "To a great extent", "To a significant extent", "To a little extent" and "Not adopted", with scores as 3, 2, 1 and 0 respectively. For the purpose of analysis, the mean adoption scores were calculated separately for each of the practice as well as for overall practices. Finally, on the basis of scores obtained, the respondents were classified into 3 categories by following the procedure as adopted by Gupta (1989).

2.4 Data collection

Data collection from randomly selected respondents was made by using pre-tested "-Structured Schedule-" through personal interview method followed by group discussion. For this purpose, an interview schedule was constructed for data collection from the respondents in the light of the objectives of the study. The selected respondents were personally approached and interviewed at their place of residence/ field by the investigators along with the scientific staff of the concerned KVK and their responses were carefully recorded.

2.5 Statistical analysis

The collected data were coded, tabulated and analysed in accordance with the objectives of the study using appropriate statistical tests. The rank order correlation of coefficients were calculated to see the strength of association between the rankings produced by dependent and independent variables by using the formula given.

$$r_s = 1 - \frac{6\sum d^2}{n(n^2-1)}$$

Where, r_s = Spearman's rank order correlation coefficients

d^2 = square of the difference of corresponding rank

Multiple Regression analysis was used to ascertain the contribution of independent variables on dependent variable. The regression model is given below.

$$Y = a+b_1x_1+b_2x_2+b_3x_3+b_4x_4+b_5x_5+b_6x_6+b_7x_7+ b_8x_8+b_9x_9+b_{10}x_{10}+b_{11}x_{11}+b_{12}x_{12}+b_{13}x_{13+}e$$

Where,

Y = dependent variable (extent of adoption of improved rice production practices)

a = constant, b = regression co-efficient

x_1=age , x_2= education , x_3= caste, x_4= family type, x_5= family size, x_6= primary occupation, x_7= annual income, x_8= size of operational land holding, x_9= type of primary farming activities, x_{10}=farming experience, x_{11}= training received, $x_{12=}$mass media exposure and x_{13}=extension contact. The calculated value of 't' were compared with the table value of 't' at 0.05 and 0.01 level of probability.

e=random term

Fisher 't' test, $t = r\sqrt{\frac{n-2}{1-r^2}}$ with (n-2) d. f.

Where, r = observed co-efficient of correlation, n=number of observation

d. f. =degree of freedom, and $t = \frac{B}{\hat{s}}$ with (n-k) d.f.

Where, B=regression co-efficient, $\hat{S}$= standard error, n=number of observation, K= number of independent variables were applied to respective rank order correlation coefficients and multiple regression to identify the significant cause effect relationship *i.e.* to ascertain the role of independent variables on the dependent variable.

3. Results and Discussion

3.1 Extent of adoption of improved rice production practices

The findings presented in table 1 indicate that over half of the respondents (66.15%) had medium level of adoption of improved practices of rice cultivation. While 19.23% and 14.62% respondents had low and high level of adoption of improved practices in rice cultivation in case of the farmers of adopted villages. The mean value of 20.45 indicates that by and large, farmers of adopted villages in the study area had medium level of adoption on improved practices in rice cultivation. In case of farmers of non-adopted villages, majority of the respondents (56.15%) were found in low category of adoption level followed by medium (37.69%) and high (6.16%) respectively. The corresponding mean value of 16.55 indicates that farmers in non-adopted villages were poor in adoption of improved rice cultivation practices. The mean difference of 3.90 between the adoption levels of two categories of respondents further, focuses urgent requirement of KVK interventions including for hand-on training programmes for farmers particularly those of non-adopted villages. The findings of the study were in agreement with the results obtained by Naik 2005, Thippeswamy 2007 and Kumar 2009. Sidram 2008 also reported similar findings with majority respondents belonged to medium level of knowledge in improved cultivation practices of pigeon pea in Gularga district of Karnataka, India.

3.2 Practice- wise extent of adoption of improved rice cultivation practices

Out of the nine selected practices of rice cultivation (Table 2) namely; seed selection, seed treatment, seed rate, land preparation, transplanting, manures and fertilizers application, interculture operation, water management and plant protection measures, all the respondents (100%) of adopted villages were found adoption of practices like application of manures and fertilizers, interculture operations (weeding, gap filling, thinning *etc.*), water management (with 5cm irrigation water 3 days after disappearance of ponded water) and application of chemicals and bio-pesticides as plant protection measures the specific recommendations under each practice notwithstanding. This was followed by recommended seed rate for rice (98.46%), selection of seeds from authorized

Table 1. Extent of adoption of improved rice production practices by the respondents of adopted and non- adopted villages

Category	**Score Range**	**Distribution of Respondents**								**Mean Difference**
		Adopted Village (n_1=130)				**Non-Adopted Village (n_2=130)**				
		f	*%*	*Mean*	*S.D.*	*f*	*%*	*Mean*	*S.D.*	
Low	<17.19	25	19.23	20.45	3.26	73	56.15	16.55	4.31	3.90
Medium	17.19-23.71	86	66.15			49	37.69			
High	>23.71	19	14.62			8	6.16			
Total		**130**	**100.00**			**130**	**100.00**			

dealers/agencies (96.92%), field preparation with recommended number and depth of ploughings (94.61%) and seed treatment using chemicals and bio-pesticides and transplantation (3 seedlings per hill with 20X15 cms) with 90.77% each. The table further shows that among the farmers of adopted villages, over three-fourths respondents were found medium adoption of interculture operations (82.31%) and application of chemicals and bio-pesticides as plant protection measures (78.46%). In case of farmers of no-adopted villages, all the respondents (100%) had reported adoption of practices such as application of manures and fertilizers, interculture operations (weeding, gap filling, thinning *etc.*), water management (with 5cm irrigation water 3 days after disappearance of ponded water) and application of chemicals and bio-pesticides as plant protection measures irrespective of specific recommendations under each practice. It is worthwhile to note that over half of the total respondents under this farmer category were found only little adoption of the four practices like seed treatment using chemicals and bio-pesticides (60.77%), recommended seed rate for rice (63.08%), application of manures and fertilizers (58.46%) and application of chemicals and bio-pesticides as plant protection measures (60.00%).

3.3 Relationship and influence of personal and socio-economic characteristics of respondents with and on their extent of adoption rice cultivation practices

In order to study the nature of relationship between personal and socio-economic characteristics and extent of adoption improved rice cultivation practices, the rank order correlation co-efficients were calculated with the help of computer software SAS 9.2. The results are given in Table 3. From the table, it is seen that out of 13 independent variables under study namely; age, education, caste, family type, family size, primary occupation, annual income, size of operational land holding, type of primary farming activities, farming experience, trainings received, mass media exposure and extension contact, four variables *viz.* education, trainings received, mass media exposure and training received were found having positively significant correlation with the extent of adoption of in rice cultivation practices as evident from their corresponding 'r' values having significant at 0.01 and 0.05 levels of probability in case of beneficiary respondents. While only two variables- education and extension contact were found positively significant relationship with the extent of adoption of in rice cultivation practices in case of non-beneficiary respondents. This indicates that higher the level of those positively significant variables of the respondents higher would be their extent of adoption towards improved rice cultivation practices. Raghavendra 1997, Saikrishna 1998 and Bharathamma *et al.* 2006 also noticed significant relation in case of mass media use with the adoption level of the farmers. It is interesting to note that increase in annual income of the farmers in both categories from different sources other than farming had no relationship with the extent of adoption of the rice technologies. This finding was supported by that of the study conducted by Umar *et al*. 2009, a possible inference from the finding is that respondents with high income because of their potential privileged position to acquire production inputs will be more willing to adopt new technologies and accept higher risk than a low income respondents. The findings are in conformity with the study conducted by Abubakar *et al.,* 2016 in case of household size, farming experience, extension contacts, training participation and farm size which were the determining factors influencing adoption of lowland rice production technologies. Hence, the concerned stakeholders in the region should pay higher priority to improve and develop those dominant personality traits through different innovative extension approaches including capacity building programmes supported by the development of infra-structure facilities and inputs supply. The multiple regression analysis was employed to determine the relative influence of each independent variable in explaining the variation in the dependent variable (Table 3). The thirteen independent variables namely; age, education, caste, family type, family size, primary occupation, annual income, size of operational land holding, type of primary farming activities, farming experience, trainings received, mass media exposure and extension contact were included for the purpose of this study. The predictive power of each multiple regression was estimated by working out the value of co-efficient of determination (R^2). To test the statistical significant of the regression co-efficients, the 't' values were also calculated. The results of this analysis are given in table 3. The table shows that 3 (three) out of 13 (thirteen) independent variables *viz*; type of primary farming activities, training received and extension contact of the beneficiary respondents, as shown by their significant 't' values, had significant contribution to their extent of adoption of improved rice cultivation practices and were considered as the most dominant factors affecting the extent of adoption improved rice cultivation practices. While only two variables- training received and mass media exposure had yielded significant contribution to their extent of adoption of rice cultivation practices in case of non-beneficiary respondents. This signifies that those positively significant variables had the highest contribution to the extent of adoption improved rice cultivation practices in study areas. The R^2 value of 0.237 and 0.206 clearly indicate that all the thirteen independent variables taken together helped in explaining about 23.70% and 20.60% of the total variation in beneficiary and non-beneficiary respondents' extent of adoption in improved rice cultivation respectively.

Table 2. Practice-wise extent of adoption of improved rice cultivation practices by the farmers

Sl. No.	Practice	Distribution of respondents (n_1=130, n_2=130))											
		To a great extent (3)		To a significant extent (2)		To a little extent (1)		Not adopted (0)		Total Adoption		Total Score	
		AV (f_1)	NAV (f_2)	AV (f_1)	NAV (f_2)	AV (f_1)	NAV (f_2)	AV (f_1)	NAV (f_2)	AV (f_1)	NAV (f_2)	AV	NAV
1.	Selection of seeds from authorized dealers/ agencies	24	15	75	53	27	58	4	4	126 (96.92)	126 (96.92)	249	209
2.	Seed treatment using chemicals and bio-pesticides	19	0	63	21	36	79	12	30	118 (90.77)	100 (76.92)	219	121
3.	Recommended seed rate for rice	19	2	89	35	20	82	2	11	128 (98.46)	119 (91.54)	255	158
4.	Field preparation with recommended number and depth	14	8	82	55	27	58	7	9	123 (94.61)	121 (93.07)	233	192
5.	Transplanting	21	11	78	52	19	57	12	10	118 (90.77)	120 (92.31)	238	194
6.	Application of manures and Fertilizers	19	9	88	45	23	76	0	0	130 (100.00)	130 (100.00)	256	193
7.	Interculture operations	16	14	107	78	7	38	0	0	130 (100.00)	130 (100.00)	269	236
8.	Water management (with 5cm irrigation water 3 days after disappearance of ponded water)	17	6	97	53	16	60	0	0	130 (100.00)	130 (100.00)	261	184
9.	Application of chemicals and bio-pesticides as plant protection measures	19	7	102	45	9	78	0	0	130 (100.00)	130 (100.00)	270	189

Note:- AV-Adopted village, NAV-Non-adopted village and Figures in parentheses indicate percentage

Table 3. Relationship and contribution of independent variables towards dependent variable

Independent variables	Adoption of technologies by the farmers (Dependent variable)					
	'r' value		Std. 'b' value		't' value	
	AV	NAV	AV	NAV	AV	NAV
Age	.003	.172	.136	.161	1.364	1.456
Education	.185*	.186*	.105	.094	.952	-.806
Caste	-.117	-.066	-.165	-.047	-1.602	-.492
Family Type	.010	-.065	-.056	-.121	-.475	-.980
Family Size	.025	-.018	.012	.113	.110	.846
Primary Occupation	-.144	-.144	-.133	-.150	-1.323	-1.479
Annual Income	.013	.005	.122	.056	1.144	.511
Size of Operational Land Holding	.122	.020	.110	.051	1.155	.539
Type of Primary Farming Activities	.135	-.041	-.165	.080	1.955*	.741
Farming Experience	.073	.065	-.028	-.051	-.298	-.459
Trainings Received	.232**	.077	.173	.239	1.986*	2.249*
Mass Media Exposure	.194*	.137	.160	.216	1.458	2.013*
Extension Contact	.182*	.181*	-.229	.157	2.056*	.841
R^2-value			**0.237**	**0.206**		

*Significant at 0.05 level of probability, ** Significant at 0.01 level of probability
AD-Adopted Village, NAD-Non-Adopted Village

Conclusion

It is concluded that some of the practices although very important in terms of potential quality yield of rice, were poorly adopted their specific recommendations by the majority of the respondents. Extension programmes conducted by KVKs for farmers in remote area and information transmitted orally among trained farmers in adopted villages were not enough to increase adoption of rice technologies. Technologies with complicated components, requiring more time and labours were difficult for farmers to apply the recommended specific practices in their farming systems. The study further reveals that due to various scientific and innovative approaches taken up by Krishi Vigyan Kendras KVKs in study area, farmers in adopted villages had the highest benefit of crop production per year by increasing cropping intensity in their farming system compared to that of farmers of non-adopted villages. The findings also indicate that the variables such as education, training received, mass media exposure and extension contact had significant contribution towards adoption of improved rice cultivation practices among the farmers as evident by their corresponding significant 't' values of multiple regression co-efficients. Necessary technical guidance through extension efforts including specific demonstration and training programmes followed by other extension programmes such as awareness camps may be taken up by the concerned line departments and other stakeholders including Krishi Vigyan Kendras (KVKs). Farmers should be encouraged to make use of all the improved rice cultivation and other management practices to achieve the desired result of sustainability in agriculture and boosting rice production in the region.

Acknowledgements

The research activities were carried out as an institutional project funded by ICAR-Agricultural Technology Application Research Institute, Zone-III, Barapani, Meghalaya .The authors are grateful to all scientific and technical staff of KVKs under Zone-III who directly and indirectly assisted in selection of villages and data collection from the respondents.

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