Statistical Evaluation to Identify the Factors Affecting of the Adoption and Non-Adaption of Technology by Farmers under Rice Production Technologies

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ABSTRACT

This study has an aim to identify the factor affecting the adoption and non-adoption of promising varieties of rice production technologies. Promising varieties are a popular genotype and being cultivated widely. In Raipur district at arang block, Out of 219 villages, 15 villages selected for the study. The independent variables i.e., Age, education, caste, size of family, social participation, occupation, size of land holding, Contact with extension agencies, Sources of information, Level of knowledge and annual income were considered as traits of the respondents. Using the Logit model, the factors that influence farm households' decisions to adopt modern agricultural production technologies were estimated. The result reveals that, out of 12 independent variables, the two variables viz. social participation and level of knowledge contributed positively and highly significantly toward extent of adoption at 0.01 per cent level of probability. Whereas, education, caste, occupation, size of land holding, annual income, credit acquisition, contact with extension agencies and sources of information contributed positively and significantly toward extent of adoption at 0.05 per cent level of probability. The variables age and size of family had no significant contribution in extent of adoption of recommended rice production technologies.

Key words: *Adoption and Non adoption, Logit Model, Production Technology*

1. INTRODUCTION

Agriculture has got a prime role in Indian economy so, it is considered as back bone of our country. Agriculture is not only responsible for food supply to 125 million population but also around 13.9 per cent of country's GDP with tremendous domestic and export marketing potential. Nearly 74 % of the country population lives in villages and depends on agriculture. It is time to fundamentally rethink the role of modern agricultural knowledge, science and technology in achieving equitable adoption and sustainability. The aim of the agriculture sector is to optimize processes and uses of resources and efficient use of existing arable land. Technology, as defined by various authors, has several meanings, such as, it is the practical application of knowledge especially in a particular area such as Agriculture, a capability given by the practical application of knowledge such as a work efficiency technology, a manner of accomplishing a task especially using technical processes, methods, or knowledge as in new technologies for information storage, and the specialized aspects of a particular field of endeavour.

The country's ability to fully utilise its agricultural production potential depends on the innovativeness of actors in the agricultural sector, particularly farmers. The capacity of farmers and actors along the agricultural value chain to innovate in their production activities is contingent on the availability of technology. The Green Revolution in Asia as demonstrated in the empirical literature (see for instance David and Otsuka, 1994; Datt and Ravallion, 1998a, 1998b; Moser and Barrett, 2003; Minten and Barrett, 2008; among others) is an indication that improved technology adoption for agricultural transformation and poverty reduction is critical in modern day agriculture. Technical change in the form of adoption of improved agricultural production technologies has been reported to have positive impacts on agricultural productivity growth in the developing world (Nin *et al*, 2003). Promotion of technical change through the generation of agricultural technologies by research and their dissemination to end users plays a critical role in boosting agricultural productivity in developing countries (Mapila, 2011). The availability of modern agricultural production technologies to end users, and the capacities of end users to adopt and utilise these technologies are also critical. Unfortunately, the Indian agricultural sector is characterized by low level of technology adoption and this according to India's Ministry of Food and Agriculture (2010) contributes to the low agricultural productivity in the country. This is worrisome given

that numerous interventions by successive governments have been implemented to promote technology adoption among farmers. Unraveling the reasons for low technology adoption among farmers requires that the factors that influence their decisions to adopt or not to adopt promising varieties and agricultural technologies be identified. Therefore examines the different factors that influence the adoption of promising varieties and modern agricultural technologies among peasant farmers in Chhattisgarh.

Promising varieties are a popular genotype and being cultivated widely. It may be a variety, an advance line, strain or land race (recommended or non-recommended). However, variety is a group of plants having distinct, uniform and stable traits which has been recommended for cultivation. Cultivar is any genotype under cultivation, it may be variety, advanced breeding line, land race (recommended or non-recommended). Variety is group of plant having specific uniform characteristics recommended for cultivation for general and specific area. This study has an aim to identify the factor affecting the non-adoption of promising varieties and technologies.

2. MATERIALS AND METHODS

Raipur district has 4 development blocks; namely Arang, Abhanpur, Tilda and Dharsiwan. Out of 219 villages, 15 villages selected for the study in Arang Block. The independent variables i.e., Age, education, caste, size of family, social participation, occupation, size of land holding, Contact with extension agencies, Sources of information, Level of knowledge and annual income were considered as traits of the respondents.

Multistage sampling was employed in the study. The first stage was purposive selection of the Raipur District because of the fact that it has a large population of small scale farmers practicing traditional farming systems relative to other districts in the State. The second stage was the selection of one (1) block out of the four (4) Block using simple random sampling. The third stage was to divide each Block into two strata – North and South. The fourth stage was to select one (1) farming community from each stratum which gave a total of two communities per selected Block and ten farming communities in all. The fifth stage was to divide each sampled community into five (5) strata – North, East, South, West and Central. The sixth and final stage was the selection of three (3) farm households from each stratum in each sampled community using simple random sampling. This gave a total of fifteen (15) farm households per selected farming community and one hundred and fifty (150) farm households in all.

2.1 Statistical Analysis

Using the Logit model, the factors that influence farm households' decisions to adopt modern agricultural production technologies were estimated. The use of the Logit model for this analysis is consistent with the literature on adoption (*see for instance* Griliches, 1957; Lionberger, 1960; Rogers, 1983; Alston *et al*, 1995) which describes the process of adoption as taking on a logistic nature. The study used the threshold decision-making theory proposed by Hill and Kau (1973) and Pindyck and Rubinfeld (1998). The theory points out the fact that when farmers are faced with a decision to adopt or not to adopt a technology, there is a reaction threshold which is dependent on a certain set of factors. As such, at a certain value of stimulus below the threshold, no adoption is observed while at the critical threshold value, a reaction is stimulated. Such phenomena are generally modeled using the relationship.

$$Y_i = \beta X_i + u_i \qquad (1)$$

Where Yi is equal to one (1) when a choice is made to adopt and zero (0) otherwise; this means: Y_i = 1 if X_i is greater than or equal to a critical value, X^* andYi = 0 if Xi is less than a critical value, X^*.
Note that X* represents the combined effects of the independent variables (X_i) at the threshold level.

Equation (1) represents a binary choice model involving the estimation of the probability of adoption of a given technology (Y) as a function of independent variables (X). Mathematically, this is represented as:

$$Prob\ (Y_i = 1) = F(\beta' X_i) \qquad (2)$$

$$Prob\ (Y_i = 0) = 1 - F(\beta' X_i) \qquad (3)$$

Where Y_i is the observed response for the i^{th} observation of the response variable, Y. This means that Y_i = 1 for an adopter (i.e. farmers who adopt modern agricultural production technologies) and Yi = 0 for a non-adopter (i.e. farmers who do not adopt modern agricultural production technologies). Xi is a set of independent variables such as farm size among others, associated with the i^{th} individual, which determine the probability of adoption, (P). The function, F may take the form of a normal, logistic or probability function. The logit model uses a logistic cumulative distributive function to estimate, P as follows (Pindyck and Rubinfeld, 1998):

$$P(Y_i = 1) = \frac{e^{\beta' x}}{1+e^{\beta' X}} \qquad (4)$$

$$P(Y_i = 0) = 1 - \frac{e^{\beta' x}}{1+e^{\beta' X}} = \frac{1}{1+e^{\beta' X}}$$

According to Greene (2008), the probability model is a regression of the conditional expectation of Y on X giving:

E(Y/X)= 1[*F(β' X')*]+0[1-*F(β' X')= F(β' X')*

Since the model is non-linear, the parameters are not necessarily the marginal effects of the various independent variables. The relative effect of each of the independent variables on the probability of adoption is obtained by differentiating equation (6) with respect to Xij resulting in equation (7) (Greene, 2008):

$$\frac{\partial p_i}{\partial x_{ij}} = \left[\frac{\lambda^{\beta' x}}{(1-\lambda^{\beta' x})^2}\right]\beta = F(\beta' X)[1 - F(\beta' X)]\beta \quad (7)$$

The maximum likelihood method was used to estimate the parameters.

The implication for applying the logit model in this paper is that, the farmer would decide to adopt modern

agricultural production technologies at a given point in time when the combined effects of certain factors exceed the inherent resistance to change in him/her. The preference for the probability model (logit) to the conventional linear regression models, in analysing the factors influencing the decisions of farm households' to adopt modern agricultural production technologies is based on the fact that, the parameter estimates from the former are asymptotically consistent and efficient. The estimation procedure employed also resolves the problem of heteroscedasticity and constrains the conditional probability of making the decision to adopt technology to lie between zero (0) and one (1). Logit model is chosen over probit model in this paper primarily because of its mathematical convenience and simplicity (Greene, 2008) and the fact that it has been applied in similar studies by Rogers (1995).

The empirical model for the logit model estimation is specified as follows:

$$Z_i = log\frac{P_i}{1-P_i} = \alpha + \beta X_i + e_i \quad (8)$$

Where Xi is the combined effects of X explanatory variables that promote or prevent farmers' decision to adopt modern agricultural production technologies.

$log\frac{P_i}{1-P_i}$ The log-odds in favour of farm households' decision to adopt modern agricultural production technologies

X1...Xi are factors that promote or prevent farm households' from adopting modern agricultural production technologies and are defined as follows: X1 = Farm size in hectares; X2 = Cost of technology, dummy (1 = Affordable; 0 = Otherwise); X3 = Level of expected benefits, dummy (1 = High expected benefits; 0 = Otherwise); X4 = Has off-farm income generating activities, dummy (1 = Yes; 0 = Otherwise); X5 = Age of respondent in years; X6 = Maximum level of education in the household measured as years of formal schooling; X7 = Gender of respondent, dummy (1 = Man; 0 = Otherwise); X8 = Access to credit, dummy (1 = Has access to credit; 0 = Otherwise); X9 = Access to extension services, dummy (1 = Has access to extension; 0 = Otherwise). (6)

3. RESULTS AND DISCUSSIONS

3.1 Analysis of independent variables with extent of adoption and non-adoption rice production technologies

The result of Logit regression analysis is presented in Table 3.1, results reveals that, out of 12 independent variables, the two variables *viz*. social participation and level of knowledge contributed positively and highly significantly toward extent of adoption at 0.01 per cent level of probability. Whereas, education, caste, occupation, size of land holding, annual income, credit acquisition, contact with extension agencies and sources of information contributed positively and significantly toward extent of adoption at 0.05 per cent level of probability. The variables age and size of family had significant contribution in extent of non-adoption of recommended rice production technologies.

For prediction of extent of adoption of recommended rice production technologies with consequences from the significant 't' value of the variables it could be inferred from the regression test that if there is one unit increase in education, caste, social participation, occupation, size of land holding, annual income, crédit acquisition, contact with extension agencies, other sources of information and level of knowledge there would be 0.222, 0.494, 0.208, 0.203, 0.350, 0.741, 0.290, 0.238, 0.375 and 0.330 unit would be increased, respectively in extent of adoption of recommended rice production technologies. The R^2 value of 0.8069 indicated that all the 12 independent variables jointly contributed towards extent of adoption of recommended rice production technologies up to extent of 80.69 per cent.

3.2 Problems faced in adoption and non-adoption of rice production technologies

Logit responses were taken to ascertain the problems faced by the rice growers in adoption of recommended rice production technologies those are given as shown in Table 3.2.

Bottleneck found by the rice growers were lack of availability of labour (78.67%), Inputs like high yielding seeds, herbicides, fungicides, pesticides *etc*. are found to be costly (78.00%), lack of training facilities on cultivation (76.67%), excess of post harvest losses (74.00%), Very little technical knowledge of herbicides, fungicides, insecticides *etc.* (63.33%), unavailability of inputs in proper time (seeds, fertilizer *etc*.) (60.67%), seldom contact with the

agricultural scientists along with SADO *etc.* (58.67%), lack of knowledge about propagation method (51.33%), non availability of loan in time (50.67%), low yield of rice (41.33%), small size of land holdings (40.00%), lack of knowledge about seed treatment (36.67%), low social participation (35.33%), lack of complete information about recommended rice production technologies (31.33%), high labour wages (26.67%), lack of irrigation facilities (25.33%), Lack of knowledge of using of herbicides, fungicides, insecticides *etc.* (23.33%), Lack of herbicides, fungicides, insecticides *etc.* (18.00%), Lack of knowledge about storage and preservation of rice (13.33%), low market price of produces (12.00%) and other crops is not taken by the farmers in rainy season because of the cultivated paddy crops. In summer season we don't have irrigation facilities, so rice is not taken by the farmers of Chhattisgarh state (10.67%), respectively.

Table 3.1: Logit regression analysis of independent variables with extent of adoption and non-adoption rice production technologies

Variable	Regression coefficient	Std. Error	P>z	't' Value
Constant	0.677	0.359	0.062	5.39
Age	-0.018	0.061	0.767	0.96
Education	-0.015	0.031	0.632	0.07
Caste	0.077	0.033	0.022	0.43
Size of Family	-0.075	0.052	0.147	1.49
Social Participation	0.005	0.027	0.861	0.49
Occupation	0.041	0.020	0.042	2.40
Land hold	-0.019	0.049	0.698	1.14
Annual Income	0.034	0.041	0.409	0.13
Contact with extension agencies	-0.090	0.052	0.084	1.21
Sources of information	0.019	0.048	0.693	1.75
Level of knowledge	-0.009	0.066	0.892	5.39

3.3 Suggestions from the rice growers to solve the problems faced during the adoption and non-adoption

The rice growers suggested measures to remove the constraints as faced by rice growers. It was observed in the Table 3.3 that market as well as storage facility should be increased as it was the main suggestion reported by 73.33 per cent of the respondents. The other suggestions were knowledge should be increased in various aspects of rice production technologies i.e. seed treatment, wise use of irrigation wise use of fertilizer, wise use of irrigation, wise use of fertilizer, use of proper dose of fungicide, insecticide, weedicide, through systematic

training/regular programme (69.33%), the trainings should be provided on different aspects of recommended rice production technologies (65.33%), the demonstrations and skill training should be organized at all level (62.00%), good transportation facilities may be made at all level (57.33%), extension agents or agencies should conveyed right information at proper time (53.33%), inputs like improved seeds, fertilizer, pesticides *etc*. should be made available subsidized rate at proper time (52.67%), improved and hybrid seed should made available in time and sufficient in quantity (51.33%), to the farmers credit should be provides without any hassles (47.33%) and through State Agricultural Marketing Board (SAMB) facilities of commodity market must be increased for selling the produces (20.00%), respectively.

Table 3.2 Problems faced by the rice growers in adoption and non-adoption of rice production technologies

S. No.	Problems	Frequency*	Percentage	Rank
1	Lack of availability of labour	118	78.67	I
2	Inputs like hybrid seeds, herbicides, fungicides, pesticides *etc*. are found to be costly	117	78.00	II
3	Lack of training facilities on cultivation	115	76.67	III
4	Excess post harvest losses	111	74.00	IV
5	Very little technical knowledge of herbicides, fungicides, insecticides *etc*.	95	63.33	V
6	Unavailability of Inputs in proper time (seeds, fertilizer *etc*.)	91	60.67	VI
7	Seldom contact with the agricultural scientists along with SADO *etc*.	88	58.67	VII
8	Lack of knowledge about Sowing method	77	51.33	VIII
9	Non availability of loan in time	76	50.67	IX
10	Low yield of Rice	62	41.33	X
11	Small size of land holdings	60	40.00	XI
12	Lack of knowledge about seed treatment	55	36.67	XII
13	Low social participation	53	35.33	XIII
14	Lack of complete information about recommended rice production technologies	47	31.33	XIV
15	High labour wages	40	26.67	XV
16	Lack of irrigation facilities	38	25.33	XVI
17	Lack of knowledge of using of herbicides, fungicides, insecticides *etc.*	35	23.33	XVII
18	Lack of herbicides, fungicides, insecticides *etc.*	27	18.00	XVIII
19	Lack of knowledge about storage of rice	20	13.33	XIX
20	Low market price of produces	18	12.00	XX
21	Other crop is not taken by the farmers in rainy season because of the cultivated only paddy crops.	16	10.67	XXI

*****Frequency based on Logit responses.

Table 3.3 Suggestions from the rice growers to solve the problems faced by them during the adoption of recommended rice production technologies

S. No.	Suggestions made the grower	Frequency*	Percentage	Rank
1	Market as well as storage facilities should be increased	110	73.33	I
2	Knowledge should be increased in various aspects of rice production technologies i.e. Seed treatment, wise use of irrigation wise use of fertilizer, use of proper dose of fungicide, insecticide, weedicide, through systematic training/regular programme	104	69.33	II
3	The trainings should be provided on different aspects of recommended rice production technologies	98	65.33	III

4	The demonstrations and skill training should be organized at all level	93	62.00	IV
5	Good transportation facilities may be made at all level	86	57.33	V
6	Extension agents or agencies should conveyed right information at proper time	80	53.33	VI
7	Inputs like improved seeds, fertilizer, pesticides *etc.* should be made available subsidized rate at proper time	79	52.67	VII
8	Improved and hybrid seed should made available in time and sufficient in quantity	77	51.33	VIII
9	To the farmers credit should be provided without any hassles	71	47.33	IX
10	Through State Agricultural Marketing Board (SAMB) facilities of commodity market must be increased for selling the produces	30	20.00	X

*Frequency based on Logit responses.

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