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Research Paper

Factors Determining Adoption of Bhoochetana Scheme by Farmers in Rainfed Agriculture of Karnataka: A Probit Analysis

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ABSTRACT

The government of Karnataka has, over the decades, intervened in agriculture production through schemesto enhance the productivity of farm activities, sustainability and food security to increase the socio-economic standards of farmers. One of such efforts is the Bhoochetana scheme through which micronutrients are supplied to farmers to enhance the fertility of the soil to ensure productivity of farm land. This study, therefore, sought to examine the extent and factors that influenced the adoption of the Bhoochetana scheme by farmers in Kalaburagi district of Karnataka, which is one of the major rainfed district having 9,74,000 hectares of area under rainfed agriculture in the state. Data was obtained randomly from a sample of 120 farmers consisting of 60 Bhoochetana beneficiaries and equal number of non-beneficiaries using a well-structured schedule which was analyzed by using descriptive statistics and Probit model. The results of the econometric model revealed that the probability of application of Bhoochetana inputs increases significantly with an increase in education-level, access to credit and extension services but decreases with the age of farmers. Based on the findings, it is recommended that the Bhoochetana scheme should be widely publicized by the government to promote adoption. Along with, extension services must be enhanced to ensure that all farmers get appropriate and sufficient information on improved production practices and new innovations in agriculture in order to improve the productivity of rainfed agriculture in the state.

HIGHLIGHTS

- Young farmers had higher affinity towards Bhoochetana adoption.
- Education level, access to farm credit and extension contact have influenced adoption of Bhoochetana scheme.

Keywords: Bhoochetana, Probit model, rainfed agriculture, Karnataka

The development of the agriculture sector is immensely important in developing countries like India, where two thirds of its rural population depend directly or indirectly on this sector for their livelihood. Rainfed agriculture plays a vital role in the Indian economy. Nearly 50 percent of the total rural workforce and 60 percent of livestock in the country are concentrated in the rainfed areas. Rainfed agriculture covers an area of 853 million hectares, and produces 44 per cent of the food and fodder requirements of the country (Yirdaw *et al.* 2017). These areas also characterized by a high prevalence of destitution, water scarcity, droughts, land degradation and low rainwater use efficiency (Raju *et al.* 2013).

The productivity of rainfed agriculture is crucial for food security and economy of Karnataka as well, as

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it has the second largest rainfed area in India after the state of Rajasthan (Venkatramana, H. 2016). The significant of agriculture to the economy of Karnataka is paramount by providing employment for more than 60 per cent of the population in the state and directly contributes to 18 per cent of the GDP (Wani *et al.* 2015). Rainfed areas assume special significance in terms of ecology, agricultural productivity and livelihoods for millions. With proper management, rainfed agriculture has the capability of contributing a larger share to food grain production with more opportunities for faster and accelerated agricultural growth than in irrigated areas. The sustainability of rainfed agriculture can be enhanced by the adoption of improved on-farm technologies and cultivation practices.

Realizing the value of rainfed agriculture, the Government of Karnataka introduced a soil reviving scheme called "Bhoochetana" in the year 2009 to boost the productivity of crop production in rainfed areas to an extent of 20 per cent and improve the income level of farmers. The scheme is a soil test-based nutrient management technique with major emphasis on micronutrients where Bhoochetana inputs (Micro-nutrients and biofertilizers) are distributed at 50 per cent subsidy to farmers through Raitha Samparka Kendra's (RSKs). The Bhoochetana scheme has been implemented in different phases in the state over the years, in order to cover all the districts with a special focus on rainfed agriculture.

Despite, the significant impact of the scheme on improving crop productivity and enhancing farm income, there are millions of farmers in the states who still have not adopted this technology. It is, therefore, imperative to investigate the adoption of the Bhoochetana scheme by farmers. With this backdrop, the present study was conducted to determine the factors influencing the adoption of the Bhoochetana scheme by farmers in Kalaburagi district of Karnataka.

MATERIALS AND METHODS

The Kalaburagi district was chosen for the study as it is one of the major rainfed areas with 86.20 per cent of the total area under rainfed agriculture (Government of Karnataka, 2016). The survey was conducted on 120 which constituted 60 Bhoochetana beneficiaries and 60 non-beneficiaries were randomly selected farmers in Kalaburagi district of Karnataka, through interview techniques. The primary data pertaining to socio-economic characteristics were collected from sample farmers for the agriculture year 2017-18. The questionnaire covered farmers' perception of the Bhoochetana scheme, pattern of adoption and their farming practices were also recorded for this study.

Analytical framework and empirical model

Binary probit model

The current study given our binary choice problem, a probit model representation were utilized for the analysis. Thus, whether a farmer adopt (D = 1) or does not adopts (D = 0) given observable vector of independent variables (X) and unobserved random component (ε);

The probit model with the probability that a farmer will exhibit an action P_i (D) is given by:

$$Pr\,(Yi = 1|Xi) = F\,(\beta\,'Xi) = \phi\,(\beta\,'Xi \qquad \ldots(1)$$

Where, Pr denotes probability, Yi is the binary choice variable representing adoption and Φ is the cumulative distribution function (CDF) of the standard normal distribution. β is a vector of unknown parameters. It is assumed that the latent variable Y^* can be specified as follows:

$$Yi^* = \beta_0 + \sum\nolimits_{n=1}^{n} \beta_n Xni + u_i \qquad \ldots(2)$$

$$\text{and } Yi = \begin{Bmatrix} 1 \ if \ \ yi > 0 \\ 0 \ otherwise \end{Bmatrix}$$

Where, Xi represents a vector of explanatory variables, u_i is a random disturbance term, n is the total sample size, and β is a vector of unknown parameters to be estimated by the method of maximum likelihood estimates (MLE).

Due to the non-linearity of the probit model, the parameters are not necessarily the marginal effects of the various independent variables. The marginal effects of the coefficients are more informative and useful for policy decision-making. To estimate the marginal effect, we differentiate equation (1) with respect to xi.

$$\frac{\partial yi}{\partial xi} = \Phi\left(\beta' xi\right)\beta i$$

Where, ϕ represents the probability density function of the standard normal distribution.

The empirical specification of the probit model for the study of factors influencing adoption of Bhoochetana scheme is given as follows:

$$Y_i^* = \beta 0 + \sum_{n=1}^{10} \beta nXni + vi \qquad \ldots(3)$$

Where, Y_i = adoption of Bhoochetana (= 1 if farmer adopted Bhoochetana inputs, 0 otherwise; X_1 = Land holding (acres); X_2= Education level (0 for illiterates, 1 for primary education, 2 for SSLC level, 3 for PUC and 4 for degree and above; X_3= Age (years); X_4 = Family size (Number); X_5 = Credit use (= 1 if credit used, 0 otherwise, X_6 = Farm income; X_7 = Extension source (= 1 if farmer has extension contract, 0 otherwise).

Garrett's ranking technique

Garrett's ranking technique provides the change of orders of constraints and advantages into numerical scores. The prime advantage of this technique over simple frequency distribution is that the constraints are arranged based on their importance from the view of point of respondents. Hence, the same number of respondents on two or more constraints may have been given different rank. Garrett's formula for converting ranks into percent was given by,

$$\text{Percent Position} = \frac{100 * \left(R_{ij} - 0.5\right)}{N_j}$$

where,

R_{ij} = rank given for i^{th} factor by j^{th} individual

N_j = number of factors ranked by j^{th} individual

The per cent position of each rank was converted into scores referring to the Table given by Garret and Woods worth (1969). For each factor, the scores of individual respondents were added together and divided the total number of respondents for whom scores were added. These mean scores for all the factors were arranged in descending order, ranks were given and most important factors were identified.

Kendall's coefficient of concordance

Kendall's coefficient of concordance (*W*) is a non-parametric statistic which was applied to observations from all observers for each category of constraints independently to assess the level of agreement among the sampled farmers under current study. It was used to assess the degree to which respondents (farmers) in the study provided common ranking on the issue with same general property. Kendall's *W* was calculated by equation (4):

$$W = \frac{12S}{m^2\left(n^3 - n\right)} \qquad \ldots(4)$$

Where, *n* is the number of constraints considered under ranking and *m* is the number of sample respondents, *S* is the sum-of-squares from row sums of ranks R_i and R is the mean of the R_i values computed. The *S*can be given by equation (5):

$$S = \sum_{i=0}^{n}\left(R_i - R\right) \qquad \ldots(5)$$

The value of Kendall's coefficient of concordance ranges from 0 to 1. Zero (0) implies no agreement among all the respondents, while 1 is perfect agreement. *W* of 1 represents perfect concordance/agreement and 0 indicates perfect disagreement in the ranking.

RESULTS AND DISCUSSION

A brief account of comparative analysis of the main socio-economic characteristics of the respondents is presented in Table 1. Different socio-economic characters of sample respondents were analyzed and their significance was tested. The results revealed that Bhoochetana adopters were relatively younger (35 years) compared to non-adopters (40 years) indicating that there was significant difference between the age of Bhoochetana adopters and non-adopters. This may be due to that younger farmers have the desire for the adoption of technology to attain economic optimum in the production process to increase the farm income and economic status as compared to their counterpart aged farmers whose aims are to produce to meet the food security requirements of their family and sometimes may not possessed the required energy for adoption of technology due the cumbersome and complexity associated with some farming innovations. The farm size of Bhoochetana adopters (5.74 acres) was

Table 1: Descriptive statistics of the sample respondents according to adoption status

Sl. No.	Variable	Total sample (n=120)	Adopters (n=60)	Non-adopters (n=60)	t-statistics
1	Land holding (Acres)	5.43	5.74	5.11	0.99^{NS}
2	Age (Years)	37.50	35	40	-5.41**
3	Education				
	(a) Illiterates	24	6	18	
	(b) Primary education	50	28	22	χ^2 = 19.76**
	(c) Higher education	40	22	18	
	(d) Degree and above	6	4	2	
4	Family size (Number)	5.10	4.98	5.12	1.53^{NS}
5	Access to credit (Numbers)	55	35	20	
6	Farm income (₹)	202987	212132	193841	0.85^{NS}

Note: *** indicates 5 per cent levels of significance and χ^2 : Chi-square statistics.*

Table 2: Probit regression coefficients of factors determining adoption of Bhoochetana scheme

Variables	Coefficient	P- value	Marginal Probabilities
Land holding	0.002	0.962	0.003
Age	-0.867***	0.001	-0.874
Education level	0.566***	0.002	0.193
Family size	-0.064	0.435	-0.087
Access to credit	0.743**	0.008	0.101
Farm income	-1.820	0.876	-0.010
Extension source	0.752**	0.006	0.089
Constant	2.584	0.056	
Log likelihood	-56.927		
Pseudo-R^2	0.315		

*Note: ***, ** and * indicates statistical significance at 1 per cent, 5 per cent and 10 per cent level, respectively.*

comparatively greater than non-adopters (5.11 acres) but the difference was not significant. There was no significant difference between the family size of Bhoochetana adopters and non-adopters and the average family size for the total sample was 5.10.

The classification of the farmer respondents according to their education level revealed that the majority of the farmers had primary level in both Bhoochetana beneficiary (28 farmers) and non-beneficiary farmers (22 farmers) and the difference between the education level of adopters and non-adopters was statistically significant at 5 percent level. Among Bhoochetana adopters, 35 farmers have borrowed credit from formal sources (Banks, co-operative societies et.) whereas, only 20 farmers among non-adopters have borrowed credit.

Drivers determining adoption of Bhoochetana scheme

Table 2 depicted the results of the binary probit regression coefficients of factors affecting farmers' decision to adopt Bhoochetana scheme (application of micronutrients and bio-fertilizers). The independent variable age was measured as continuous variable. The results of the econometric model revealed a statistically significant inverse relationship between age and the adoption of Bhoochetana technology. This implies that young farmers are more likely to adopt Bhoochetana inputs (micronutrients and bio-fertilizers) to improve the yield level of rainfed crops. The marginal effect value for age indicated that a unit increase in the age of the farmer decreases the probability of adoption of Bhoochetana inputs by 87.40 per cent. This implies that aged farmers may not possess the requisite energy level for carrying out the process required for the full adoption of the various components of the technology. Moreover, the aged does not regard agriculture as a business and, hence, their primary goal in the production process is not to maximise economic optimum for the utilization of inputs. This result is on par with the study conducted by Anang (2016) who reported that, age is a determinant factor for adoption of fertilizers by Cocoa Farmers in Ghana.

Education level of farmers showed positive relationship with adoption of Bhoochetana indicating, if education and awareness level are increased among farmers' they are more likely to appreciate new ideas and adopt quicker than their less educated farmers. It is evident from the econometric model that a unit increase in the education level of farmers would increase the adoption of Bhoochetana by 19.30 per cent. The study conducted by Kunwar *et al.* (2015) aptly support this result, where education had positive significant relation with adoption of off-season vegetable production technology by farmers in Nepal. However, land holding had a positive relation with Bhoochetana adoption but is not significant, whilst family size and farm income were negatively related to Bhoochetana adoption but were not statistically significant. As expected, access to credit is positively and statistically significant to influence the Bhoochetana adoption. This signifies that access to farm credit enables farmers to afford the cost associated with adoption of new technology. This marginal effect value indicated that an increase in access to credit will increase the adoption of Bhoochetana inputs by 10.10 per cent. With increased access to credit availability to farmers, the adoption of Bhoochetana could be encouraged among farmers. The study conducted by Udima *et al.* (2017) are in line with results this study, where it was observed that, the farmers who have access to credit are more likely to accept the (Nerica) rice technology) in Ghana.

The extension source was positive and significant in influencing the adoption of the technology. This implies that the increase in contact of extension sources with farmers will increase the Bhoochetana adoption by 8.90 per cent. It is acknowledged that farmers are likely to be influenced to make adoption decisions by information sources which they consider most important since such sources are associated with reliability and credibility (Rogers, 2003). Various researchers observed that the farmers with a regular extension contact are more willing to adopt new agricultural technologies (Ghimire *et al*. 2015 and Abubakar *et al*. 2016).

Constraints faced by sample farmers in adoption of Bhoochetana scheme

Different constraints faced by farmers in the adoption of Bhoochetana scheme are depicted in Table 3. It is evident from the results that lack of awareness about the recommended dose of fertilizers was the major constraint with a garret score of 64.33. Non-availability of Bhoochetana inputs at right time was ranked second with garret score of 59.81 followed by un-availability of credit with a score of 55.20. Lack of accessibility to RSK was the fourth major constraint with a score of 52.23. Shortage of micronutrients or insufficient micronutrients was the fifth major constraint with garret score of 41.61 followed by poor response/ cooperation from the

Table 3: Constraints faced by farmers in adoption of Bhoochetana scheme

Sl. No.	Constraints	Score	Rank
1	Lack of awareness about recommended dose of fertilizers	64.33	1
2	Non-availability of Bhoochetana inputs at right time	59.81	2
3	Non-availability of credit	55.20	3
4	Lack of accessibility to RSK	52.23	4
5	Shortage of micronutrients	41.61	5
6	Poor response/ cooperation from the concerned officers	41.46	6
7	Long distance to RSK and high transportation cost	32.93	7
Kendall's Coefficient of Concordance		0.69	
Chi-square		262.8*** (0.00)	
Degrees of freedom (n-1)		6	

Note: *Value in the parenthesis indicate P-value and *** indicates significance at one per cent level.*

concerned officers with a score of 40.46 and long distance to RSK and high transportation cost was the sixth constraint with a garret score of 32.93. The Kendall's W significant coefficient of 0.69 conducted on the ranked constraints implies that 69 per cent representing approximately 42 farmers' agreed on the order of constraint ranking which implies that indeed lack of awareness about the recommended dose of fertilizers was the major problem faced followed by other as given in Table 3.

CONCLUSION

In the dynamic and changing agricultural scenario, diffusion of agricultural information on new innovations plays a decisive role for the overall development of agriculture as well as improving the livelihoods of farmers but the adoption decisions are influenced by diverse drivers of socio-economic, institutional and political factors. However, political factors are beyond the scope of this paper. The results from the econometric model revealed that socio-economic factors such as age of the farmer, education level were significant and contributory factors to influence the adoption of Bhoochetana scheme, indicating the importance of socio-economic factors in improving the widespread adoption of new innovations and thereby enhance standards of living of farmers in the society. The institutional factors such as access to formal credit availability and extension services also significantly influence the adoption of Bhoochetana scheme. Lack of access to credit was one of the major constraint faced by farmers in adoption of Bhoochetana scheme. In the light of this, recommend the policy makers to focus on the proper education of farmers and readily accessibility of extension services to rural farmers as well as less cumbersome procedure for formal credit services especially in rainfed areas where average crop productivity is lower by two to five folds of achievable potential yield (Wani *et al*. 2012) to boost agricultural production.

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