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Socio-economic Factors Influencing Adoption of Fertilizer for Maize Production in Nepal: A Cast Study of Chitwan District

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Abstract

Soil fertility is considered as the most important constraint to increase maize production in Nepal. Although farmers generally apply farmyard manure available on their farms, there is increasing trend towards the use of fertilizers that is likely to augment maize production in Nepal. This study was carried out to identify the influence of socio-economic factors of the improved maize adopters on the decision to adopt fertilizers in the Chitwan district of Nepal, using the survey data collected from 117 farm households in May-June 2005. The impact of age, education, family size, farm size, extension service, credit use, manure application, off-farm income and timely irrigation availability on the adoption of fertilizers were analyzed using the Tobit regression model. The major factors having positive influence on use of fertilizer in maize production were found to be family size, farm size, credit use, off-farm income and irrigation availability. There is need of adequate irrigation facility and assured credit availability to the farmers in the study area. Further, creation of off-farm activities is crucial to obtain additional household income to fulfill cash requirements required for investment in improved technologies. The present study emphasize the provision of technical support via training, seminars, field demonstrations to increase the adoption of fertilizers to improve maize productivity and consequent food security in Nepal.

Keywords: Maize, Soil fertility, Food security, Tobit model

1. Introduction

Agriculture is the main source of livelihood for the majority of people in Nepal and is considered as the primary engine of growth of the economy. Although declining, agriculture contributes nearly 40 percent to Nepal's total Gross Domestic Product (GDP).

Crop production is the largest component of agricultural GDP (about 61 percent). Maize (*Zea mays L.*) is one of the most important cereal crops in the world, agricultural economy both as food for human beings, feed for animals and other industrial raw materials. It is one of the world's leading crops cultivated over an area of about 142 million hectares with a production of 637 million tons of grain. In Nepal, the current area planted under maize was 849,892 ha with an average yield of 2.02 t ha^{-1} (CBS, 2006). It is a traditional crop cultivated in upland during summer as a sole crop and/ or mixed with upland rice or relayed with millet later in the season especially in the hilly areas. In these areas maize is produced in small scale, low yielding, sloppy land settings operated by subsistence farmers under rain-fed condition in various cropping systems in summer season. In the Terai (plain area), inner Terai and low-lying river basin areas the maize is also grown in winter and spring with the partial irrigation (Paudyal et al., 2001). The demand for maize is escalating as a major animal feed and industrial use and thus rising as commercial crops especially in the Terai and inner Terai of Nepal (Adhikari, 2000). It is estimated that for the next two decades the overall demand of maize will be increased by 4% ~ 8% per annum resulting from the increased demand for food in the hills and feed in the Terai and inner Terai. Such increase in demand must be met by increasing the productivity of maize per unit of land (Paudyal et al., 2001; Pingali, 2001). However, over the decades, the agricultural production including maize has either remained stagnant or increased at a very slow rate (Kaini, 2004).

Many factors are associated with low yields of maize crops in Nepal. Low level of fertilizer use and seed replacement, loss of soil fertility, lack of dry land production technology, limited irrigation facilities, unavailability of improved variety and minimum use of improved production technology are some major factors responsible for low yields. However, low soil fertility and low use of chemical fertilizers have been cited as the major factors influencing productivity growth in Nepal (Ransom and Paudyal, 2002). Furthermore, the result of the soil samples analyzed by the soil testing laboratories of the Department of Agriculture show that soils in Nepal are generally low in organic matter, nitrogen and phosphorus (Kaini, 2004). This might be due to the reasons that the fields might have been physically degraded such that top soils have been lost resulting in loss of organic matter and silty-clay fractions, as well as, resulting in shallower soils. Both

processes would lead to poorer water-holding capacity and thus lower soil moisture and lower fertilizer response (Adesina, 1996). Currently farm yard manure is the primary source of nutrients in the maize fields, though the use of fertilizers is of growing concern. Since farmers apply all of the manure that they have available on their farms, it is the increased use of fertilizer that is likely to enable increases in maize production in Nepal (Ransom and Paudyal, 2002). Moreover, locally available source of plant nutrients mainly compost and manure are not sufficient to meet the crop requirement for plant food elements (Subedi and Sapkota, 2001). The Agricultural Perspectives Plan (APP) of the Government of Nepal sets out the strategic priorities for the development of the agricultural sector over the period 1995-2015. The APP identifies fertilizer as a principal factor that will contribute to the achievement of accelerated agricultural growth and improved household food security in Nepal. Thus, increased, efficient, and balanced application of inorganic fertilizer together with the integrated management of plant nutrients is an important component of Nepal's agriculture led growth strategy for increasing incomes and reducing poverty while sustaining the productivity of agriculture for the long term. However, fertilizer application per unit area in Nepal is among the lowest. This was mainly due to the higher cost of chemical fertilizers, lack of operating capital required to purchase balance/ recommended dose of fertilizers as well as other socio-economic factors affecting farmers` decision to adopt fertilizer for maize production in hills area of Nepal (Ransom and Paudyal, 2002). However, no comprehensive study has been conducted so far to assess the factors behind low use of fertilizers on maize production in Terai and the inner Terai area where improved maize cultivars have been extensively grown. Thus, the present study was undertaken to determine the influence of various socio-economic features on the application of chemical fertilizer on maize production in the Chitwan, one of the inner Terai districts of Nepal.

2. Materials and Methods

2.1 The study area

The present study was conducted in the Chitwan district; *inner* Terai of Nepal which is the major maize producing area in the country. This district covers an area of 2,205.90 square kilometers and has a population of 472,048 which is 2.03% of the total population in Nepal. Administratively, this district is divided into 36 Village Development

Committees (VDCs) and 2 municipalities. The climate of Chitwan district is subtropical monsoon type with hot, humid summer, cool and dry winters. Over 75% of annual rainfall occurs during the monsoon season from June to September and very low rainfall from January to April with annual average of 2,318 mm (Anonymous**,** 2002). People are predominantly peasant farmers cultivating mainly food and cash crops such as paddy, maize, wheat, beans, lentils, mustard and vegetables. In the year 2003-04, the area under maize cultivation was 27,170 ha with the average yield of 2.23 t ha^{-1} (MOAC, 2005).

2.2 Sampling technique

Both primary and secondary sources of information were used in this study. There are basically two approaches in the social sciences research, i.e., quantitative (relational research) and qualitative approach (explanatory descriptive research) (Rajasekaran, 1993). The quantitative approach using the farm household research design was adopted to carry out this study. The data pertaining to this study were collected from 117 improved maize growers representing from 11 VDCs and one municipality of Chitwan district of Nepal between May and June 2005 covering the entire cropping year 2004-05. The selected VDCs for this study were Padampur, Chainpur, Jutepani, Bachhauli, Pithuwa, Phulbari, Parbatipur, Saradanagar, Gunjanagar, Shivanagar and Sukranagar and the Municipality was Bharatpur. The study area were playing important role for maize production in the district and were purposively selected for interview by administrating a pre-structured questionnaire adopting random sampling technique. Frequencies and mean of various physical and socio-economic variables as well as input use such as labor, fertilizer and seed used during maize production were calculated.

2.3 Analytical technique

An extension of the probit model is the Tobit model originally developed by James Tobin (1958), the Nobel laureate economist (Gujarati, 2004). This model has found several empirical applications in the adoption literature (Shakya and Flinn, 1985; Adesina and Zinnah, 1993). In order to estimate the effects of various factors on the extent of fertilizer use, a Tobit model is used to estimate the parameters of the adoption of fertilizer by maize farmers in the Chitwan district, inner Terai of Nepal. The Tobit model is a censored normal regression and truncated normal distribution which has wide applications in statistics and econometrics (Amemiya, 1973; McDonald and Moffit, 1980). The

function is estimated from censored samples where the sample population consists of both the adopters and the non adopters of fertilizer for improved maize production. It was hypothesized that a farmer's decision to adopt or reject a new technology at any time is influenced by the combined effects of a number of factors related to the farmer's objectives and constraints (CIMMYT, 1993).

The empirical model of the effects of a set of explanatory variables on the adoption of fertilizer applying the maximum likelihood estimation (MLE) technique is specified using the following linear relationship:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \varepsilon \ldots (1)$$

Where, Y is the adoption of fertilizer over the year, β_0 is the constant, $\beta_1 ... \beta_9$ are the coefficients of the independent variables, X_1 the age of the household head (years), X_2 the education of the household (schooling years), X_3 the family size (economically active members), X_4 the farm size (ha), X_5 the extension used (dummy 1= yes; 0=no), X_6 the credit facility used (dummy 1= yes; 0=no), X_7 the farm yard manure (FYM) used in ton ha^{-1}, X_8 off-farm income (Nepalese rupees), X_9 the timely irrigation availability (dummy 1= yes; 0= no) and ε the error term.

The coefficients of the regression model were estimated by applying the maximum likelihood estimation for fertilizer adoption using STATA version 10.0.

3. Results and Discussion

3.1 Socio-economic characteristics

Demographic and socioeconomic characteristics of the respondent farmers for both adopters and non-adopters of fertilizer during maize cultivation along with mean and standard deviation are presented in Table 1. The characteristics included were an age of the respondent farmers, family size, schooling years, income from maize cultivation, off-farm income and livestock ownership by the farms. The result showed the mean age of adopter and non adopter farmers were 42.06 and 48.20 years with the standard deviation of 12.06 and 11.78 respectively. The mean household age was 44.63 years meaning that the farmers were comparatively younger in the study area. The smaller standard deviation of the household age denotes to the reality that most of the farmers age at the similar level in the study area. The household size of the adopter was comparatively larger (7.20) as

compared to the non adopter farmers (5.60) with the mean of 6.27. The average farm size for the adopters was 1.19 ha while the non-adopters hold 0.87 ha. This shows that the farmers in the study area were small scale for the adopter and non-adopters. However, the largest farm size per household was for the adopter farmers, while the smallest farm size was observed in the non-adopters. Similarly, education of the households head in terms of schooling years was 5.98 for the adopters, while non-adopters had 5.57 with the mean schooling years of 5.74. The result showed that the standard deviation of the both the adopter and non-adopter farmers were higher compared to mean schooling years revealed that there was a higher variation in famers regarding the number of schooling years in the study area. Off-farm income was not widely available to the respondent farmers and also found higher variation in the income among the farmers. The source of off-farm income of the farmers was service, business, overseas employment, etc. The average off-farm income in Nepalese Rupees (NRs '000) was NRs 94.59 for the adopters and NRs 56.35 for the non adopters with the mean income of 70.28. The higher standard deviation of 297.80 for the adopter farmers confirmed that there was higher variation of income among the farmers. Livestock, especially cattle play a major role for the use of fertilizer for maize production. The mean number of livestock reared by adopters was 2.63 while non-adopters hold 2.12 indicating that all farmers holds comparable livestock and were getting animal manure (FYM) for soil fertility management in their field.

3.2 Adoption level of maize production technologies

Based on the survey, adoption levels of maize production technologies used by the farmers were presented in Table 2. In the study area, out of total improved maize cultivating farmers, significant proportion (58.12%) did not apply fertilizer. This may be due to the fact that surveyed households in the study area were practicing traditional method of soil fertility management though they were cultivating improved maize varieties. It is generally accepted the fact that adoption of fertilizer and cultivation of improved maize are the most related technologies to achieve higher yield. However, very small proportion of the households applied fertilizer to their maize field. The maize area cultivated by the fertilizer adopters were higher (0.83 ha) compared to non-adopters (0.64 ha) with overall maize area of 0.72 ha. This implies that the fertilizer adoption rate was influenced by the area of maize planted by the farmers. It has been found that the yield of

maize was higher with the use of fertilizer (2,914.13 kg ha^{-1}) than those of not utilizing the fertilizer (1,979.91 kg ha^{-1}) for maize production in the study area. The user of FYM was comparable for both adopters and non-adopters of fertilizer in the study area although the dose of applied FYM was higher among the adopters as compared to non-adopters. The other technology for maize production was irrigation, which was used by 65.31% of farmers while only 4.41% farmers used irrigation those who did not apply fertilizer in their maize fields (Table 2).

3.3 Soil fertility management practices

Table 3 showed the fertilizer management practices and the intensity of chemical fertilizer being practiced by the adopter farmers in the study area. The average rate of fertilizer adoption was lower (47.86 kg ha^{-1}) as compared to the recommended dose of fertilizer (90 kg ha^{-1} ~ 190 kg ha^{-1}) although it depends on the cultivated seasons as well as varieties. The certified amount of chemical fertilizer was 90 kg ha (60:30 kg N, P) for the summer maize cultivation and 190 kg ha (90:60:40 kg N, P, K) for winter and spring seasons (Adhikari, 2002). The dominant fertilizers used in Nepal were DAP, Urea, and Potash. As shown in Table 3, the proportion of farmers using Di-ammonium phosphate (DAP) was at the rate of 19.19 kg ha^{-1}. As one would expect given the overall pattern of fertilizer use in the study area, a larger proportion of farm households applied urea at the rate of 21.97 kg ha^{-1}. Similarly, out of total households only very few used potash at the rate of 6.70 kg ha^{-1} and were the lowest among other fertilizers. Overall chemical fertilizers application rates were substantially below those recommended for seasonal maize production in the study area. The higher standard deviation for the use of all type of fertilizers confirms that there was a higher variation in the used of fertilizer among the farmers depending on the farmers type, land size, irrigation availability, etc.

3.4 Access to farmers support services

Accesses to credit and extension service were the primary support services for farmers in the study area and were depicted in Table 4. The descriptive statistics of the surveyed households showed that about 37% of the fertilizer adopters obtained credit while only 24% of the non-adopters obtained credit from the financial institutions. The result revealed that only limited farmers had access to buy the necessary technologies for maize cultivation. The average range of credit was NRs 5,000 to NRs 30,000 for both adopters

and non-adopter farmers depending upon credit availability and requirement for the farmers. Delivery of extension services to households by specialized extension agents or input marketers can play an important role in the dissemination of information and the adoption of new high yielding and more profitable technologies. About 57% of the adopters reported that they receive some form of extension service either through agent visits to the farmer's home or through their own visit to the extension offices directly and had better access to extension services than non-adopters (51.47%). This implies that use of extension service as technologies support service was lower in both the adopters of and non-adopters and there was no significant difference between the numbers of adopters and non-adopters regarding the advice on fertilizer use for maize production. The main extension advice was on use of fertilizers, seed and other technologies required for maize cultivation. The main source of extension services was the District Agriculture Development Office (DADO), National Maize Research Program (NMRP), NGOs and through the private companies such as agrovets as well as seed traders. However, majority of the farmers responded that they have received extension services through the officials from DADO in the study area.

3.5 Tobit model estimates

The results from the Tobit model used to determine factors affecting to fertilizer adoption using maximum likelihood estimation were presented in Table 5. Since the main purpose of the model was to identify the main factors that influenced adoption of fertilizer for maize cultivation, the model is appropriate for the purpose of considering its significant model chi-square ($p<0.001$), -2 Log Likelihood ratio as well as Goodness of fit, which is generally measured by Pseudo R^2 in such model was 0.279, which showed the soaring predictive ability (Table 5). The result from the study indicated that decision to use fertilizer cultivation was influenced by many socio-economic characteristics of the households in the study area. The variables that significantly increased the adoption of fertilizers were family size (economically active members), farm size, credit use, off-farm income and timely irrigation availability. The variables such as age of the household head, education, extension use and FYM application, which were expected to influence the adoption of fertilizer and were included in the model, were found to be insignificant regarding their influence on the adoption of fertilizer for maize cultivation. All the factors

except age of household head and FYM had positive effect on the adoption of fertilizer in the study area. The negative coefficient of household head age implies that younger farmers would likely adopt improved maize production technologies compared to the older farmers and with the increasing age a farmer will be less likely to be aware of new technology due to lower access to education. There was a negative relationship between the use of FYM by the farm household and the probability of using fertilizer, suggesting that the increased availability of manure was a substitute for fertilizer and that it is an alternate and comparatively cheaper source of plant nutrients. Furthermore, in the Nepali context, exclusive use of animal manure is most often associated with a lack of resources needed to purchase inorganic fertilizers.

The results of the model as depicted in Table 5 suggest that the household comprising larger number of able bodied family members adopt fertilizer while cultivating improved maize varieties more than those with a smaller family size as witnessed by the positive and significant coefficient (p=0.10). Most farmers in the study area were holding small-scale farm size, did not have enough capital to hire labor and relied on family labor for most of the farm operations. It should also be noted that more labor is required per unit of land area for manual application of fertilizer in each maize plant; the farmer who has a larger family size consequently uses more family labor including the labor needed for barter system in the study area. This finding is in harmony with the study report of the Ransom and Paudyal (2002) while analyzing soil fertility management practices and constraints to fertilizer utilization in the hills of Nepal.

Land characteristics also have a significant effect on the household’s decision to use fertilizer. The area of land available to the household could be it owned or rented in, has a positive relationship with the probability of using fertilizer. For each additional hectare of land available to a farm household, the probability of using fertilizer will increase as witnessed by the positive and significant effect of farm size (p=0.10) on the adoption of fertilizer for maize production in the study area. This implies that a larger farm size is expected to be positively associated with the decision to adopt maize production technologies. Furthermore, size of farm is an indicator of wealth and it is expected that farmers who own more land were more likely to invest in improved technology as opposed to those who hold smaller land area. The similar significant and positive

relationship between farm sizes on adoption of maize production technologies was also reported earlier by several researchers (Mafuru et al., 1999; Adesina, 1996; Feder et al., 1985).

The result of the Tobit model for the adoption of fertilizer suggests that use of credit will result in more adoption of fertilizer in the study area. It has a positive coefficient and was significant at p= 0.10. In the study area, most of the farmers were poor and did not have enough capital to invest in the expensive inputs such as fertilizer. However, very few farmers in the study area were facilitated by credit service (Table 4) although the physical distance between farms and credit centers such as bank, finance company and cooperatives were not more than 5-7 kilometers. This was due to the reasons that credit provided by financial institutions as well as credit cooperative groups was not so encouraging due to unfavorable policies, delay in timely transactions, higher interest rate which may cause high cost of cultivation and period of repayment. Thus, the result revealed that the increase in the access of credit for the farmers will result in greater adoption of fertilizer in the study area. Significant and positive effects of access to credit on the adoption of fertilizer was reported earlier by Ouma et al., (2002) while analyzing adoption of maize seed and fertilizer technologies in Embu district, Kenya.

The result from the Tobit model suggests that the farmers having more off-farm income would result in more adoption of fertilizer. It has a positive coefficient and was significant at p=0.05. This finding was in harmony with the observation of Ransom et al. (2003) and Adesina (1996) who also reported positive and significant influence of off-farm income on the adoption of fertilizer for maize cultivation. In the study area, it is likely that farmers with large off-farm income have one or more family members either working as government/ private jobs, business or overseas employment. This would not only increase cash required for the households to purchase inputs, but also the individuals connected to other fields would have the opportunity to acquire technology information about maize farming. The result suggests that farmers who have off-farm income may more likely adopt fertilizers.

Of the total significant factors included in the model, timely availability of irrigation had the most dramatic influence on adoption. It had the highest positive coefficient that was significant at p=0.01. This implies that availability of irrigation highly influence the

use fertilizer for maize production in the study area. Through the greater and reliable use of irrigation, the farmers can reduce the risk associated with erratic rainfall and thereby reduce the risk and increase the likelihood of enhancing productivity and profitability from crop production. The study on direct effect of irrigation and utilization of fertilizer by the plant was carried out by Abdallah and Yassen (2008) while analyzing fodder beet productivity under fertilization treatments and water augmentation in Egypt. However, in the study area, significant proportion of the land was seasonally irrigated and consequently depends upon rainfall for irrigation during maize cultivation. Moreover, most of the respondents cited the lack of irrigation as the main constraint to use fertilizer during field visit by the author. The similar and positive effect of irrigation availability on adoption of fertilizer was cited by Barakoti (2001) while analyzing factors affecting maize production technology adoption by the farmers of eastern Nepal.

To estimate the effects of each independent variable on the adoption of fertilizer, marginal effect of the explanatory variable were estimated (Table 5). The coefficients of marginal effect of the explanatory variables showed changes in the intensity of adoption with respect to a unit change of an independent variable among the improved maize farmers. Among different factors influencing the adoption of fertilizers, family size has the largest positive effect followed by timely availability of irrigation, off-farm income, farm size and credit use by the farmers. Among the factors, economically active members may play a significant role for the supply of labor at farms at the time of using fertilizers. The marginal effect of 0.440 for family size implies that increase in every one person of economically active family member would increase the adoption of fertilizer by 0.44 percent. Similarly, among the improved maize adopters one unit increase in irrigation would increase the adoption of fertilizer by about 0.38 percent. Furthermore, every 1,000 NRs increase in off-farm income would increase the adoption of fertilizer by about 0.27 percent. Among the variables, the marginal effect of 0.182 for farm size implies that overall respondents, every 1 ha increase in farm size would increase the adoption of fertilizer by about 0.18 percent in the study area.

Conclusion

In this study we used detailed field-level data to analyze the socio-economic factors influencing the adoption of fertilizer among the improved maize adopters in the Chitwan

district, inner Terai of Nepal. On the basis of study, it has been apparent that farmers in the study area were still relying heavily on traditional techniques for cultivating the improved maize. The rate of adoption of fertilizer was lower mainly due to lack of working capital and/or credit, inadequate irrigation facility and also insufficient knowledge about soil fertility management practices. The decision to use fertilizer is influenced by a number of important factors including family size, farm size, credit use, off-farm income and timely irrigation availability. Since the irrigation and credit availability have their greater influence on the use of fertilizer there is need to provide adequate irrigation facility in the maize growing seasons as well as assure easy credit availability from credit institutions to the farmers. Further, it is important to create off-farm activities in the study area to obtain additional income at the household level to fulfill their cash requirements necessary to invest in the improved technologies. The present study further emphasize the need to strengthen the extension services related to fertilizer and/or integrated nutrient management, and other agricultural inputs to farmers in various forms like training and field demonstration that would have positive bearing on the efficient use of fertilizers in the study area. Increased, efficient, and balanced application of inorganic and chemical fertilizer together with the integrated management of plant nutrients is an important component of Nepal's agriculture led growth strategy for increasing incomes and reducing poverty while sustaining the productivity of agriculture for the long term.

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Table 1. Demographic and socioeconomic characteristics of selected farmers, Chitwan district, Nepal

Characteristics	Adopters		Non-adopters		All farmers
	Mean	Std. deviation	Mean	Std. deviation	Mean
Age of household head (yrs.)	42.06	12.06	48.20	11.78	44.63
Family size (no.)	7.20	3.56	5.60	1.97	6.27
Farm size (ha)	1.19	0.92	0.87	0.82	1.01
Schooling years	5.98	5.64	5.57	5.76	5.74
Off-farm income (NRs.'000)	94.59	297.80	52.76	56.35	70.28
Livestock (no.)	2.63	1.80	2.81	2.12	1.99

Source: Field survey, 2005

Table 2. Adoption level of maize production technologies by the adopters and non-adopters, Chitwan district, Nepal

Characteristics	Adopters	Non-adopters	All
Number of farmers (%)	41.88	58.12	100
Maize area (ha)	0.83	0.64	0.72
Maize yield (kg ha^{-1})	2,914.13	1,979.91	2,371.17
Irrigation use (% of farmers)	65.31	4.41	29.91
FYM use (% of farmers)	93.88	97.06	95.73
Rate of FYM use (t ha^{-1})	9.27	9.70	9.45

Source: Field survey, 2005

Table 3. Fertilizer management practices by the farmers, Chitwan district, Nepal

Fertilizers	Mean	Std. Deviation
Total fertilizers applied (kg ha^{-1})	47.86	77.40
DAP (kg ha^{-1})	19.19	32.07
Urea (kg ha^{-1})	21.97	42.42
Potash (kg ha^{-1})	6.70	13.48

Source: Field survey, 2005

Table 4. Farmers access to technologies support services, Chitwan district, Nepal

Technologies	Adopters	Non-adopters	All
Credit use (% of farmers)	36.73	23.53	29.06
Extension use (% of farmers)	57.47	51.47	53.85
Number of extension visits:			
<2 times	85.72	82.35	83.76
2-5 times	6.12	7.35	6.84
>5 times	8.16	10.30	9.40

Source: Field survey, 2005

Table 5. Tobit model estimates for determinants of adoption of fertilizer, Chitwan district, Nepal

Variables	Tobit function: Coefficient	Tobit function: t-statistic	Marginal effect
Constant	-1.084	-4.33	-0.493
Age	-0.008	-1.19	-0.415
Education (Schooling years)	0.006	0.40	0.040
Family size*	0.453	1.82	0.440
Farm size (ha)*	0.156	1.74	0.182
Credit use (dummy)*	0.004	1.70	0.003
Extension use (dummy)	0.272	1.03	0.089
FYM (ton)	-0.171	-1.10	-0.189
Off-farm income (NRs.'000)**	0.400	2.43	0.273
Irrigation (dummy)***	1.084	6.11	0.377
Model χ^2 ***	63.42	0.000	
-2 Log likelihood function	81.981		
Goodness of fit (pseudo R^2)	0.279		
Number of observations	117		

Note: * = significant at 10% level, ** = significant at 5% level, *** = significant at 1% level