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FACTORS AFFECTING THE APPLICATION OF INFORMATION AND COMMUNICATION TECHNOLOGIES (ICT) IN THE AGRICULTURE SECTOR OF NEPAL

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Abstract: Scaling-up of modern ICT tools produces an avenue to use ICT in the dissemination of agriculture information. To successfully apply ICT-based information for the prime development of sustainable agriculture, understanding the factors affecting the use of ICT in agriculture information is valuable. This study tried to analyze the socio-economic factors that influence the application of ICTs amongst farmers of the Rupandehi district of Nepal. Altogether, three villages, which are also declared and enlisted under smart villages by the Ministry of Agriculture, Food Technology, and Land Management of Lumbini province, were purposely selected for this study. Data were collected from randomly selected 145 respondents from Devdaha, Omsatiya and Tilotama villages, of which 95 were ICT user farmers and 50 of them were non-users of ICT. A binary probit model was used for its statistical analysis. Social, economic, and institutional factors were explored as the major factors affecting the use of ICT among farmers in the delineated study area. Farm size, sex, and income were explored as positive and significant factors that influence the use of ICT in agriculture. The governmental policies including ICT tools in extension methodologies were found at an inadequate level. Moreover, the present ICT tools assessed inappropriate in the existing market that didn't address the real needs of farmers were the major constraints of using ICT tools in agriculture in the study area. Factors and reasons explored through this study should be internalized by concerned stakeholders as input while forming their policy or implanting ICT-related activities in forthcoming technological generations.

Keywords: Agriculture, Development, Farmers, ICTs, Knowledge, Television, Tools.

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INTRODUCTION

Information and knowledge are central components of agriculture that play an important role in ensuring food security and sustainable development (FAO, 2000; Munyua, 2007). Agricultural information plays a crucial role in empowering farmers to upgrade their livelihoods by providing important agricultural information such as sowing, soil improvement, seeking the best price for their products, and different methods to combat pests and diseases (Armstrong *et al.*, 2012; Jaiswal and Singh, 2021). In the present scenario, the issues of privatized and ICT-based advisory services are gaining light

in Nepal (Paudel *et al.*, 2018). Information and communication have always mattered in agriculture (Singh, 2014). People have been exchanging knowledge and experience with one another about insurance, farming, livestock since ancient times (Jha and Singh, 2021; Singh and Mehta, 2022).

No doubt, climate change influences agriculture, development and sustainability in many ways (Mandal and Singh, 2020; Verma, 2021; Ambasht, 2022) but the adoption of ICT can minimize such adverse effects. With the increase in the coverage of modern ICT tools like mobiles, wireless, and internet services (NTA, 2021) along with the modernization of traditional ICT tools like radio, television, printed media; these tools are playing a significant role in boosting agricultural production and development with pluralistic approach engaging both public and private sectors (Singh, 2014).

Information and communications technology (ICT) includes an array of technologies, namely radio, television, telephone, mobile phone, multimedia, internet, and satellite-based communication systems (Watson, 2001). ICT use reduces the information search cost, dramatically lowers the transaction costs, and enables greater farmer participation in commercial agriculture (Harsha and Ratnadiwakara, 2008). Similarly, ICT use has helped in the use of modern farm equipment and agriculture processes like harvesting, transporting, labeling, and preserving more efficiently (Sugahara, 2008).

In developing countries, a wide variety of information sources are being used by farmers to get updated knowledge about farm practices to maximize farm profit and thereby improve livelihood (Ashraf *et al.,* 2015). These sources may be a face-to-face exchange of information between individuals or with the help of mass media (Rehman *et al.,* 2013). In most cases, the type of information used by farmers depends upon the type of information being delivered (Zhang *et al.,* 2016). Different factors influence the use of different information sources by the farming community. These factors may be social, economic, technical, or cultural (Rehman *et al.,* 2013).

While ICTs boosts information supply on smart technologies and the resultant effect on productivity and income of farmers, the great challenge is that most farmers are illiterates, living in rural areas, hence they have no knowledge of the use of ICTs facilities like computer and internet (Omotayo, 2005). Lack of education and knowledge deprives rural people of using ICT. This led to the need of recognizing the knowledge of farmers' ICT-based based information for decentralization of information, productive delivery, and accessibility to all rural farmers. Nepalese farmers least benefited from using ICT tools for getting essential information regarding quality seeds, market prices, agriculture finance, livestock, and irrigation (Thapa and Dhimal, 2017). There are many social and economic factors that limit the use of ICT tools (Williams and Agbo, 2013). Different levels should attempt to address the factors influencing the use of technology among farmers (Derso *et al.,* 2014).

Nepal has seen a significant improvement in ICT throughout the past couple of decades. According to NTA (2021), Nepal has 131.3% mobile connection, 44.2% social media users, and 36.7% internet users. As a result, the nation is in a fantastic position to implement agricultural technology using a variety of ICT platforms. However, due to differences in context and community usage of various ICT characteristics, the adoption strategy for any technology varies geographically. Therefore, this study will investigate how various ICTs are used in smart agriculture in a chosen Rupandehi region.

MATERIALS AND METHODS

Data types and data sources

A semi-structured interview schedule was used to gather data for this study from families. Both primary and secondary data sources were emphasized in the study. Additionally, both qualitative and quantitative data were gathered.

Site selection and Sampling technique procedures

This research was conducted in the Rupandehi district of Nepal where the smart village program was implemented the by Ministry of Agriculture, Food Technology and Land Management of province 5. The district was selected purposively considering the popularity gained by the smart program implementation. For selecting farmers, this research considered three purposively

selected villages Devdaha, Tilotama, and Omsatiya. It is important to note that the selected villages are renowned for commercial vegetable as well as rice production, programmed under the smart village module. Consultation with advisory members and a smart village program representative was done prior to choosing the study location. A district was deliberately chosen because of the popularity it had attained as a result of clever programme implementation. The respondent from each smart village was chosen using a straightforward random selection procedure.

Sample size of the study

From the three selected smart agriculture villages, 145 farmers were selected for the study. The sample size of the survey was determined using the table constructed by Adam, 2020 which used Krejcie and Morgan's, and Cochran's formulas and coincide with Yamane's formulas when estimating sample size using a 95% confidence. Sample size from each smart village was randomly selected and the sample size of each smart village was done on the basis of disproportionate basis (table 1).

Table 1: Total sample size with the distribution of sample size in each location.

Sample size of respective smart villages			Total sample size
Devdaha	Tilotama	Omsatiya	
47(80)	51(90)	47(78)	N=145(248)

The figure in the parenthesis indicates the total population of the study area.

Data collection and analysis methods

Data were collected by using an interview schedule for each respondent various socio-economic factors influencing the use of ICTs among farmers. The available data was compiled using stata12. Data were analyzed using an econometric model specifically a probit regression model.

Model Speciation

The probit model specified in this study to analyze factors affecting the use of ICT by the respondents was expressed as follows.

$$Pr(Y = 1) = f(b0 + b1\,X1 + b2\,X2 + b3\,X3 + b4\,X4 + b5\,X5 + b6\,X6 + b7\,X7 + b8\,X8 + b9\,X9 + b10\,X10)$$

where,

Pr (Y = 1) = Probability of use of ICT

X1 = Age (continuous)

X2 = Gender (dummy)

X3 = Education (continuous)

X4 = Farm Size (continuous)

X5 = Membership in organization (dummy)

X6 = Income (continuous)

X7 = Farming experience (continuous)

X8 = Contact with extension worker (dummy)

X9 = Family Size (continuous)

X10 = Off farm activities (dummy)

RESULTS

Opportunities and constraints to use ICTs among farmers

Table (2) depicts the contact of respondents with different sources of agricultural information. Television, Mobile phone, and social media are the most used ICT tools in the study area for agriculture information. Most surprisingly Radio, which is the most used ICT tool for the farmers in the country the in the past decade, has not been preferred as an ICT tool for agricultural information. Farmers preferred Television and social media mostly for agriculture information regarding agriculture practices. Mobile phone was mostly preferred for marketing purpose by the farmers. More recently social media have been found to have great potential and can be used for the facilitation of knowledge sharing and collaboration in agriculture. This shows the opportunity to promote ICT based extension delivery system in the study area. Sampled respondents were asked about ten expected constraints that faced while using ICTs in agricultural extension. Table (3) depicts the

ranking of different constraints of using ICT tools in agriculture in the study area. They then replied lack of government policy to include ICT tools in extension methodologies, ICT tools are inappropriate in the existing market and ICT tools don't provide the real needs of farmers as a major constraint of not using ICT tools in agriculture.

Table 2: Respondents in contact with different sources of agricultural information in the study area.

Sources of information	Frequently	Sometimes	Not at all	Mean Score	Ranking
Personal locality sources					
Friends	16	79	50	1.77	2nd
Other farmer	0	32	113	1.22	8th
Cosmopolite sources					
Extension worker	10	24	111	1.30	5th
Agrovet/Input dealers	0	34	111	1.23	7th
Groups/Cooperatives	7	57	81	1.49	4th
Mass media sources					
Newspaper	0	20	125	1.13	11th
Radio	5	10	130	1.14	10th
Television	63	15	67	1.97	1st
Mobile	8	20	117	1.25	6th
Agriculture application	8	11	126	1.19	9th
Social media	18	32	95	1.47	3rd
Agriculture fair	1	16	128	1.12	12th

Table 3: Constraints for using ICT tools in agriculture in the study area.

Constraints	Mean score	Rank
ICT tools not demanded in existing market	3.05	2nd
Lack of enabling government policy to execute ICT tools in extension methodologies	3.32	1st
ICT does not provide real need of farmers	2.78	3rd
Language barriers in relation to information content	2.10	6th
Limited interaction on service provision	1.85	9th
Limited feedback	1.66	10th
ICT based information are hardly useful to farmers	1.89	8th
ICT is too complex to use	2.12	5th
Lack of idea, knowledge and awareness	2.24	4th
ICT tools or application are not farmers friendly	1.92	7th

Factors affecting use of ICTs for agriculture information

Result in the Table (4) represents factors affecting use of ICTs for agriculture information. The log-likelihood value of regression is a way to measure the goodness of fit for model. The higher value of -55.71 best fit for the probit model than that of the lower value of -56.78. The value (Prob>chi2 = 0.0003) indicate model significance at 1% level. The Wald test (LR chi2) for the model indicated that, the model had good explanatory power at the 1% level. The Pseudo R^2 value (0.4035) shows 40% of the outcome is explained by the selected variable. The Wald test named after Abraham Wald, is used to compare models on best fit criteria in case of logistic regression (LR).

In this study, ten explanatory variables were used. Based on the model results; respondent age, sex, years of schooling, Income, farm size, off farm activities, membership and extension contact have positive value for ICT use in agriculture. Among them age, years of schooling, membership and extension contact have no significant effect on ICT use. Gender and Farm size affects the use of ICT in agriculture positively and significantly at 1% level of significance. Income effect ICT use positively and significantly at 5% level of significance. Family size and farming experiences have negative effect on ICT use in the study area.

Table 4: Factors affecting use of ICTs for agriculture information in the study area.

Variables	Coefficient	Standard Error (SE)	p value	dy/dx	SE(dy/dx)
Age	0.011	0.025	0.666	0.0034	0.008
Sex	1.852	0.400	0.001	0.630***	0.112
Income	1.206	1.352	0.016	0.282**	0.422
Years of schooling	0.088	0.063	0.163	0.027	0.019
Off farm activities	0.255	0.364	0.482	0.082	0.122
Family size	-0.036	0.040	0.370	-0.011	0.012
Farming experience	-0.024	0.287	0.387	-0.007	0.008
Farm size	0.234	0.048	0.003	0.073***	0.013
Membership in organization	0.119	0.301	0.693	0.037	0.094
Contact extension	0.082	0.383	0.829	0.025	0.442
Number of observations (N)	145				
Log likelihood	-55.71				
LR $chi^2(10)$	75.38				
Prob>chi^2	0.0003***				
Pseudo R^2	0.4035				

Note: *** and ** indicate significant at 1% and 5% significance level

Econometric results

The qualitative study of significant barriers that were anticipated to affect farmers' usage of ICTs was described in the part before this one in the paper. This section examines the factors influencing farmers' adoption of ICTs by estimating the binary probit regression model using the explanatory variables that were chosen. To determine the impact of potential explanatory variables on the likelihood of farmers using or not using ICTs, a binary probit regression model was constructed. As discussed earlier, the probit model was used to analyze the determinants of farmers' use of ICTs in agricultural extension. The sample households were users or non-users of ICTs in agricultural extension. Consequently, the variable which shows the use of ICTs among farmers was a binary dependent variable, taking a

value of 1 for farmers using ICTs in agricultural extension, and 0 otherwise. Ten explanatory variables (four continuous and six dummy) were included in the model. Table (3) shows the summary of the variables to affect the farmer's uses of ICTs in agricultural extension.

The likelihood ratio test statistic exceeds the Chi-square critical value. The result is significant at ($P<0.01$) probability level indicating that the hypothesis that all the coefficients except the intercept are equal to zero is rejected. The goodness of fit of the model was found to be 75.88%. Another measure of goodness of fit used in probit regression analysis is the count R^2 which indicates the number of sample observations correctly predicted by the model.

Significant explanatory variables in the probit model

In this study, ten explanatory variables were used. Based on the model results, family size and farming experience were found to have a negative sign, while the remaining variables; age, sex, farm size, income, years of schooling, off farm activities, contact with extension had a positive sign of association with use of ICTs among farmers. Out of the 10 proposed variables, three of them were statistically significant in the model while the rest were not significant at ($P<0.10$) probability level. The interpretations of the significant explanatory variables are given below.

Education: The model result reveals that education affect use of ICTs positively but not significantly at ($P<0.1$).

Age: The variable is not significant at ($P<0.1$) and related negatively with the farmers use of ICTs in agricultural extension.

Family size: The variable is not significant at ($P<0.1$) and negatively related with the use of ICTs among farmers.

Farm size: Farm size was positively related to the use of ICT among farmers and significant at ($P<0.01$). The dy/dx value of 0.073 implies that, when farm size increase by one unit, the probability of using ICT for agriculture increase by 7.3%.

Income: Income was positively related to the use of ICT among farmers and significant at ($p<0.5$). The dy/dx value of 0.283 implies that, when income increase by one unit, the probability of using ICT for agriculture increase by 28.3% as far as the other things remain constant.

Sex: Sex of the respondent was positively related to the use of ICT among farmers and significant at ($p<0.0.01$). The dy/dx value of 0.630 implies that, when respondents sex have probability to be male then the probability of using ICT for agriculture increase by 28.3%, as far as the other things remain constant. This shows ICT a more male friendly nature with gender discrimination over its use.

Farming experience: The variable is not significant at ($P<0.1$) and related negatively with the farmers use of ICTs in agricultural extension.

Membership in organization: The variable is not significant at ($P<0.1$) and related positively with the farmers use of ICT in agricultural extension.

Contact with extension: The variable is not significant at ($P<0.1$) and related positively with the farmers use of ICT in agricultural extension.

Off farm activities: The variable is not significant at ($P<0.1$) and related positively with the farmer's use of ICT in agricultural extension.

DISCUSSION

The majority of the research cites language barriers, technological complexity, and unfriendliness to farmers as barriers to farmers using ICT, although this is not true in the study area. The main barriers to employing ICT tools in agriculture in the study area include a lack of supporting government policy, the lack of demand for ICT tools in the market, and the fact that ICT solutions do not meet the needs of farmers. Though the respective provincial government of the study area has formulated the ICT related policy in the study area, lack of ICT tools in the extension program within the study area is the major constraints. Similarly the farmers revealed that there is no relevancy of the ICT tools in the existing market and they felt that the government should organize the agriculture market so that the farmers can use the ICT for market information. This result is in concurrent with the Aphunu and Atoma (2011) which

suggest lack of government enabling policy is one of the main pressing constraints against effective utilization of ICTs in the study area. Similarly, Nkwocha *et al.* (2009) concluded the same findings from his study and stated that government's low level of assistance to ICTs infrastructural provision and absence of any policy to encourage farmer's gain.

Farm size has positive and significant effect on ICT use in the study area. This is due to the fact that farmers with higher farm size tend to seek higher information for the betterment of the agriculture rather than their counterpart with less landholding. This is in line with (Derso *et al.,* 2014; Mittal and Mehar, 2016; Luqman *et al.,* 2019). They were of the view that with the increase in the size of land holding information needs of the farmers will increase followed by the increase in the level of use of ICTs to bridge the information gap. The result contradicts with Bakari *et al.* (2018) where positive but non-significant result was found. Income has positive and significant effect on use of ICT in agriculture in the study area. This is due to the fact that ICT users have involvement on off farm activities along with the agriculture. Besides this, farmers with higher farm size have positive income effect and higher income favors farmers to higher access to ICT tools. Number of research studies affirms a strong association between the size of land holding size and income level of farmers in rural settings. Similar results obtained by (Ojo and Babayo, 2013; Pervaiz *et al.,* 2013; Derso *et al.,* 2014; Luqman *et al.,* 2019). They were of view that the size of land holding in rural areas predicts the level of income of farmer and higher income enforces farmers to use ICT.

Sex of the respondents has positive and significant effect on use of ICT in agriculture in the study area. This is due to the fact that majority of the women do household activities and immobile in nature. This results into passive involvement of women in agriculture information. Hafkin and Taggart (2001) identified social and cultural norms as constraints against women's use and access to information technology. The study of Nsibirano (2009) has shown that males and females differ in both access to and use of ICTs. This result is contradicted with the study of Nwafor *et al.* (2020).

CONCLUSION

The study concluded that there are a number of social, economic and institutional factors that influence the use of ICT among farmers. Among the socioeconomic variables farm size, Income and sex of the respondents have positive and significant effect on ICT use in agriculture. Therefore, the study recommends that concerned stakeholders and partners found at different levels should attempt to address gender gap on technology usage. This study also recommends that policymakers at different levels should recognize that farmers are using ICT in addition to traditional ICT like Radio and TV. Hence, this fact should be taken as an input for policy formation of ICT in smart village development program in future.

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