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Relationship between farmers' profile characteristics and the role of ICT in adoption of agricultural innovations

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Abstract

The present study was conducted using an *ex-post-facto* research design in the South Gujarat during the year 2023–26 with 315 respondents. The study investigates relationship between profile of farmers and the role of ICT in adoption of agricultural innovations. The data were collected using interview schedule through personal contact. The relationship was studied by using Pearson's correlation coefficient, path analysis and stepwise regression analysis. The correlation analysis indicated that age was negatively and highly significantly related to the dependent variable. On the other hand, education, annual income, land holding, information-seeking behaviour, mass media exposure, innovativeness, risk orientation, scientific orientation, economic motivation, achievement motivation and decision-making ability were positively and highly significantly related to the dependent variable. The stepwise regression analysis revealed that age, innovativeness, land holding, risk orientation, decision-making ability, education and mass media exposure significantly influenced the role of ICT in adoption of agricultural innovations and jointly explained 69.20 per cent variation in the dependent variable. Path coefficient analysis revealed that innovativeness exerted the highest positive direct effect, whereas age exerted the highest negative direct effect on the dependent variable. While, economic motivation exerted the highest positive total indirect effect and age exerted the highest negative total indirect effect. Age and risk orientation emerged as the major mediating variables through which several independent variables exerted substantial indirect effects.

Keywords: ICT, adoption, agricultural innovations, correlation co-efficient, stepwise multiple regression, path analysis

Introduction

The role of Information and Communication Technology (ICT) in adoption of agricultural innovations is influenced not only by the availability of digital technologies and advisories but also by the socioeconomic, communication and psychological characteristics of farmers. Farmers differ considerably in their ability and willingness to access, understand and utilize ICT-based agricultural information. Previous studies have reported that characteristics such as age, education, farm size, information-seeking behaviour, innovativeness, risk orientation, scientific orientation and economic status influence farmers' use and selection of ICT-based information sources. Mittal and Mehar (2016) ^[1], for instance, reported that age, education and farm size significantly influenced farmers' choice of agricultural information sources in India. Similarly, Samatha *et al.* (2014) ^[2] found significant positive relationships between ICT use and education, information-seeking behaviour, economic status, achievement motivation, scientific orientation and innovativeness.

The relationship between farmers' characteristics and ICT utilization has also been observed in different regions of India. Chandra *et al.* (2023) ^[3] found that farmers' profile characteristics explained a substantial proportion of variation

in ICT utilization, with education showing the highest direct effect and extension contact having an important indirect effect.

In Gujarat, Ganvit and Chandravadia (2024) ^[4] reported that education, annual family income, extension participation, innovativeness and scientific orientation were positively associated with ICT utilization, whereas age and farming experience showed negative relationships. Further, evidence from Gujarat on agricultural technology adoption indicates that education, income, mass media exposure, innovativeness, achievement motivation, risk orientation and scientific orientation are important factors associated with farmers' awareness and adoption of new agricultural technologies (Mallappa and Pathak, 2023) ^[5].

Thus, understanding the relationship between farmers' profile characteristics and the dependent variable is important for identifying the characteristics that facilitate or constrain the role of ICT in adoption of agricultural innovations. Such analysis can help extension agencies design more targeted ICT-based interventions according to farmers' educational level, economic condition, information-seeking behaviour and psychological orientation. Therefore, the present study examined the relationship between selected farmers' profile characteristics and the role of ICT in the adoption of

agricultural innovations.

Methodology

The study was conducted in South Gujarat region of Gujarat State during the year 2023–26. The present study was conducted using an *ex-post facto* research design. The South Gujarat region has seven districts namely Surat, Bharuch, Narmada, Navsari, The Dangs, Valsad and Tapi. All districts were included in the study. Further, three *talukas* were randomly selected from each district and three villages were randomly selected from each selected *taluka*. Thus, twenty-one *talukas* and sixty-three villages were selected. Five ICT-using farmers were randomly selected from each village by following the Simple Random Sampling (SRS) technique. Therefore, a total sample of 315 respondents was obtained for the study.

For the present study, age (X_1), education (X_2), annual income (X_3), land holding (X_4), information seeking behaviour (X_5), mass media exposure (X_6), innovativeness (X_7), risk orientation (X_8), scientific orientation (X_9), economic motivation (X_{10}), achievement motivation (X_{11}) and decision-making ability (X_{12}) were selected as independent variables. The role of Information and

Communication Technology (ICT) in adoption of agricultural innovations was the dependent variable (Y). The data were collected through personal interview using a structured interview schedule. Pearson's correlation coefficient was used to ascertain the relationship between the independent variables and the dependent variable. In the actual condition, no variable occurs independently without the influence of other variables. The stepwise multiple linear regression method was used to determine the most significant independent variables to include in a multiple linear regression model. It involves a systematic process of including or excluding variables based on their statistical significance or contribution to the model's performance. The path analysis was used to assess the causal influences of a set of independent variables on the dependent variable. Direct effects and total indirect effects can be known of individual independent variables on the dependent variable. Additionally, the substantial effect among the independent variables can also be determined. The step wise multiple regression analysis was performed in SPSS while path analysis was performed in OPSTAT.

Results and Discussion

Table 1: Correlation co-efficient and path analysis of independent variable with the role of ICT in adoption of agricultural innovations

(n=315)

Sr.	Independent variables	Correlation Co-efficient (r)	Direct effect	Total indirect effect	Substantial indirect effect through	
					1	2
1.	Age (X_1)	-0.689**	-0.496	-0.193	0.051 (X_{10})	0.029 (X_5)
2.	Education (X_2)	0.618**	0.151	0.467	0.315 (X_1)	0.044 (X_8)
3.	Annual income (X_3)	0.464**	-0.016	0.48	0.219 (X_1)	0.076 (X_3)
4.	Land holding (X_4)	0.302**	0.149	0.153	0.149 (X_4)	0.052 (X_7)
5.	Information seeking behaviour (X_5)	0.519**	-0.06	0.579	0.242 (X_1)	0.099 (X_2)
6.	Mass media exposure (X_6)	0.491**	0.123	0.368	0.164 (X_1)	0.123 (X_6)
7.	Innovativeness (X_7)	0.462**	0.216	0.246	0.076 (X_1)	0.062 (X_6)
8.	Risk orientation (X_8)	0.455**	0.172	0.283	0.132 (X_1)	0.063 (X_7)
9.	Scientific orientation (X_9)	0.435**	0.031	0.404	0.181 (X_1)	0.082 (X_8)
10.	Economic motivation (X_{10})	0.581**	-0.092	0.673	0.276 (X_1)	0.101 (X_8)
11.	Achievement motivation (X_{11})	0.510**	0.018	0.492	0.195 (X_1)	0.109 (X_8)
12.	Decision making ability (X_{12})	0.393**	0.121	0.272	0.172 (X_1)	0.034 (X_8)
**Significant at 1% level of probability				Residual: 0.3037		

The correlation analysis presented in Table 1 revealed that age was negatively and significantly associated with the role of Information and Communication Technology (ICT) in adoption of agricultural innovations, indicating that younger farmers perceived a greater role of ICT in the adoption process than older farmers. This may be attributed to greater familiarity, adaptability and confidence of younger farmers in using digital technologies, whereas older farmers may rely comparatively more on their accumulated farming experience and conventional sources of information.

Education showed a positive and highly significant association with the role of ICT in adoption of agricultural innovations. More educated farmers may possess greater digital literacy and confidence in accessing and interpreting ICT-based agricultural information, thereby enabling them to recognize and utilize ICT for adoption of agricultural innovations.

Annual income was positively and significantly associated

with the role of ICT in adoption of agricultural innovations. Farmers with higher income may have greater financial capacity to access digital devices, internet-based services and other ICT facilities, as well as to invest in agricultural innovations promoted through ICT.

Land holding also exhibited a positive and significant relationship with the role of ICT in adoption of agricultural innovations. Farmers with larger land holdings may have greater resource availability and stronger motivation to improve farm productivity and profitability, which may encourage greater utilization of ICT-based information for agricultural innovation adoption.

Information seeking behaviour showed a positive and highly significant association with the role of ICT in adoption of agricultural innovations. Farmers who actively seek information are more likely to explore multiple sources, including mobile applications, agricultural portals, social media and digital advisory services, for obtaining timely

information related to improved innovations.

Mass media exposure was positively and highly significantly associated with the role of ICT in adoption of agricultural innovations. Greater exposure to mass media may increase farmers' awareness and familiarity with different communication technologies and agricultural information sources, thereby facilitating their utilization of ICT in the adoption.

Innovativeness exhibited a positive and highly significant relationship with the role of ICT in adoption of agricultural innovations. Farmers with greater innovativeness are generally more receptive to new ideas and technologies and may therefore be more willing to explore ICT-based sources for obtaining information about agricultural innovations.

Risk orientation was positively and highly significantly related to the role of ICT in adoption of agricultural innovations. Farmers with greater willingness to take calculated risks may be more inclined to explore new technologies and practices. ICT can reduce uncertainty associated with innovation adoption and thereby support such farmers in adoption.

Scientific orientation showed a positive and highly significant association with the role of ICT in adoption of agricultural innovations. Farmers with a stronger scientific orientation tend to seek factual and evidence-based information, which can be provide scientific recommendations, expert advice and technical information.

Economic motivation exhibited a positive and highly significant relationship with the role of ICT in adoption of agricultural innovations. Farmers with greater economic motivation may actively seek information and technologies capable of improving productivity, reducing costs and increasing farm returns. ICT can facilitate access to such information and therefore may be seen as an important means of achieving economic objectives.

Achievement motivation was positively and highly significantly associated with the role of ICT in adoption of agricultural innovations. Farmers with higher achievement motivation may continuously seek improved methods and

opportunities for enhancing farm performance. ICT provides convenient access to technical knowledge, innovations and successful farming experiences, which may support their achievement-oriented behaviour.

Decision-making ability also showed a positive and highly significant relationship with the role of ICT in adoption of agricultural innovations. Farmers with better decision-making ability may be more capable of evaluating information from different sources and selecting agricultural innovations suited to their farm conditions. Thus, ICT may serve as an important source of timely information supporting informed agricultural decisions.

Overall, all the selected profile characteristics exhibited significant relationships with the role of ICT in adoption of agricultural innovations, except that the direction of association was negative for age and positive for the remaining variables. Among the variables, age showed the strongest negative association ($r = -0.689$), whereas education showed the strongest positive association ($r = 0.618$) followed by economic motivation ($r = 0.581$) and information seeking behaviour ($r = 0.519$).

Path analysis revealed that innovativeness (0.216) exerted the highest positive direct effect followed by risk orientation (0.172), education (0.151), land holding (0.149), mass media exposure (0.123) and decision-making ability (0.121), whereas age (-0.496) exerted the highest negative direct effect. In terms of total indirect effects, economic motivation (0.673) recorded the highest positive effect followed by information seeking behaviour (0.579), achievement motivation (0.492), annual income (0.480) and education (0.467), while age (-0.193) showed a negative indirect effect. The substantial indirect effects indicated that age and risk orientation were important pathways through which several independent variables influenced the role of ICT. Education showed the highest substantial indirect effect through age (0.315) followed by economic motivation (0.276), annual income (0.219) and achievement motivation (0.195) through age.

Table 2: Stepwise multiple regression analysis of independent variables and the role of Information and Communication Technology (ICT) in adoption of agricultural innovations

Sr.	Independent variable	Partial regression coefficient (b)	Standard error	Multiple Correlation Coefficient ‘R’	Adjusted R ²
	(Constant)	166.762	13.926	0.832	0.692
1.	Age (X ₁)	-0.962	0.097		
2.	Innovativeness (X ₂)	5.887	1.093		
3.	Land holding (X ₃)	1.308	0.381		
4.	Risk orientation (X ₄)	0.990	0.259		
5.	Decision making ability (X ₅)	0.893	0.258		
6.	Education (X ₆)	2.287	0.820		
7.	Mass media exposure (X ₇)	1.192	0.446		
**Significant at 1 Percentage level of probability					

Table 2 reveals that out of seven independent variables, namely age (X₁), innovativeness (X₂), land holding (X₃), risk orientation (X₄), decision making ability (X₅), education (X₆) and mass media exposure (X₇) were found to have influence on the role of Information and Communication Technology (ICT) in adoption of agricultural innovations. These seven independent variables together accounted for 69.20 per cent variation as indicated by the adjusted R² value.

As a result of stepwise multiple regression analysis, the

following model was obtained:

$$Y = 166.762 + -0.962X_1 + 5.887X_2 + 1.308X_3 + 0.990X_4 + 0.893X_5 + 2.287X_6 + 1.192X_7$$

Where,

Y = Role of Information and Communication Technology (ICT) in adoption of agricultural innovations

a = The intercept (166.762)

b_i = Regression coefficient, $i = 1, 2, 3, \dots, n$

X_1 = Age

X_2 = Innovativeness

X_3 = Land holding

X_4 = Risk orientation

X_5 = Decision making ability

X_6 = Education

X_7 = Mass media exposure

Conclusion

The study demonstrates that individual socio-psychological and demographic characteristics—most notably age, education, innovativeness, and economic motivation—substantially dictate farmers' reliance on ICT for adoption of agricultural innovations, with younger and more digitally literate farmers exhibiting significantly higher adoption intent. Overall, key determinants like age, innovativeness, land holding, risk orientation, decision-making ability, education, and mass media exposure account for nearly 70 percent of the variation in ICT integration. These findings highlight that digital agricultural interventions are most effective when tailored to younger, resource-rich, and risk-tolerant early adopters, while older or less educated farmers require targeted digital literacy support and indirect channels.

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