Chelonian Conservation And Biology

Vol. 18 No. 1 (2023) | https://www.acgpublishing.com/ | ISSN - 1071-8443

DOI: doi.org/10.18011/2023.06(2).72.85

THE INFLUENCE OF INFORMATION AND COMMUNICATION TECHNOLOGIES (ICTs) ON FARMING DECISIONS BY FARMERS

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Abstract: *This primary objective of the current study is to investigate that how farmers are disseminating information by using information and communication technology (ICT). This study looks at how the attitude of farmers, and sociodemographic aspects affect the acceptance of ICT technology. The primary data is collected from 480 farmers from six districts of Haryana via face-to-face interviews. For this, a pre-tested, structured questionnaire was used. Regression analysis was employed in the study to investigate the factors that affect how information from ICT-based systems is used in various agricultural activities. The findings shed light on the significance of social class, income, and education as significant sociodemographic characteristics that affect how well the farmers accepts information and communication technology (ICT)-based information systems. In addition, farmers that use a variety of cropping systems, operate on a modest scale, and consider farming as a business are more likely to benefit from the information and communications technology that is available to them.*

KEY TERMS: Farmer's Adoption Behavior, ICTs, and Decision Making.

INTRODUCTION

Information is becoming increasingly important in agriculture, enabling farmers to make wise and well-informed decisions (Ani & Correa, 2016; Arslan et al., 2015). The necessity for effective provision of cutting-edge and timely information and knowledge to farmers through a variety of media channels is highlighted by the swift advancement of technology and changes in agricultural systems (Banayo et al., 2018). Farmers' adoption of innovative agricultural technologies is usually hampered by the lack of information available. Agricultural extension services, which are funded by the government, play a major role in the spread of knowledge about advanced agro-technologies in many

developing countries. Studies by Iiyama et al. (2018) and Umali & Schwartz (1994) show that these services, however, have had trouble adapting to the changing needs of rural farmers. There have been substantial transformations in publicly financed agricultural extension services in both rich and developing nations since the 1980s (Anderson & Feder, 2004; Bentley et al., 2018). The role of the private sector has witnessed a notable rise as evolution has advanced, with a concurrent increase in the significance of ICTs in addressing the information requirements of farmers (Duruiheoma et al., 2015).

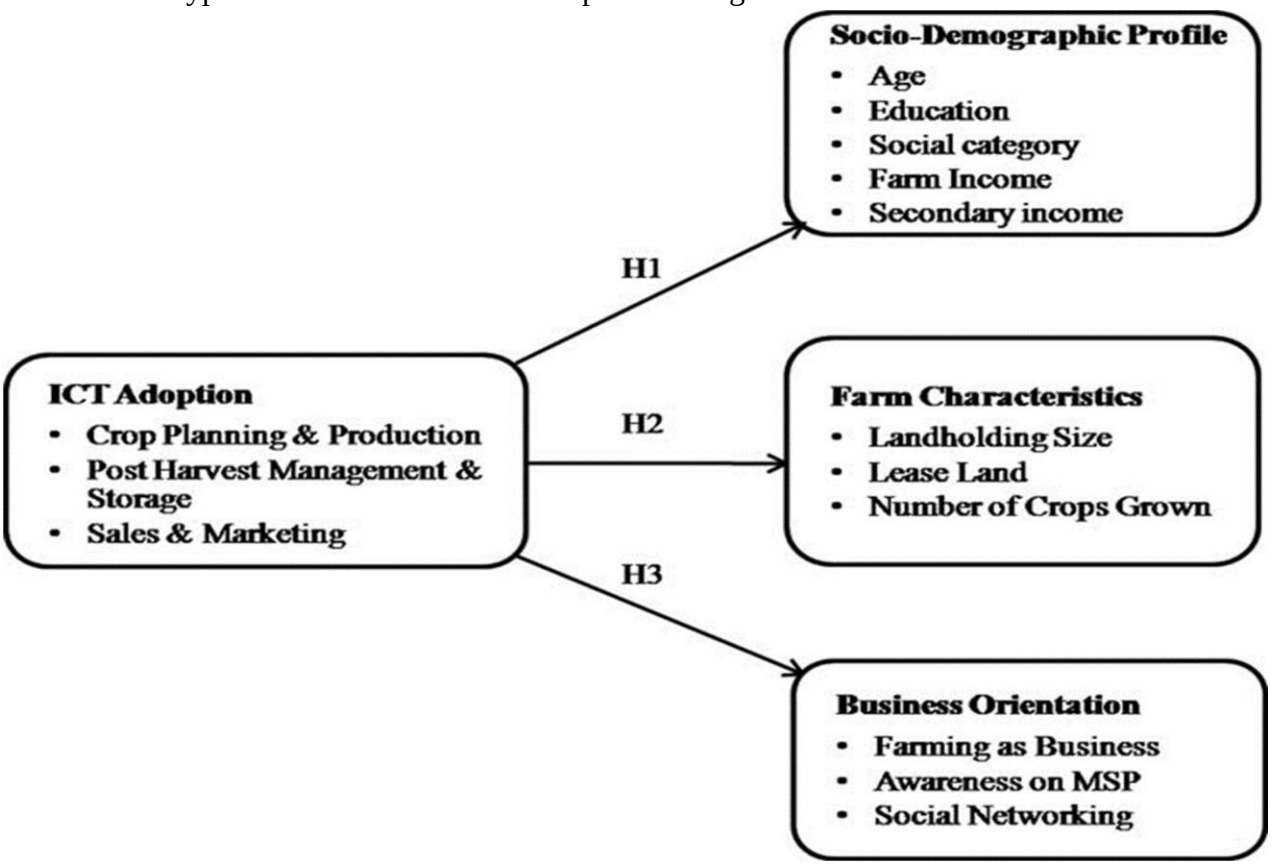
The utilisation of ICTs holds significant promise in exerting a considerable influence on agricultural systems, specifically in the context of smallholder farming, hence facilitating their transformation into economically viable enterprises. The smartphones, TVs and radio exemplify contemporary information and communication technologies (ICTs) that provide pertinent and appropriate information, enabling farmers to make well-informed choices regarding the allocation of resources and the attainment of profitability (Ommani & Chizari, 2008). India has gained recognition as a major hub for testing and implementing developments in information and communication technology over the past ten years. Numerous entities have undertaken initiatives concerning ICTs in the agricultural domain, which is popularly known as e-agriculture. ITC's e-Choupals, i-Community, Kissan.com, Drishti, Gyandoot, EID Parry's Parry Kiosks, and n-Logue are a few examples of these efforts. The projects outlined above aim to provide agricultural communities with timely, reliable, and relevant information, which will increase productivity and ensure that they receive better compensation for their produce (Fabregas et al., 2019; Rao, 2006, 2008).

The increasing significant in information and communication technology (ICT) interventions for providing agricultural advice services over the past ten years, motivates researchers in understanding the user profile to develop more effective information delivery systems. According to Rao (2008), many Indian ICT-based initiatives fail because they lack a strategy to reach the target demographic. This gap is due to poor infrastructure and technology. This study empirically examines farmers' ICT use to improve agricultural decision-making. The study has substantial implications for rural ICT adoption and diffusion policies. Several studies show that a number of factors affect the effectiveness or longevity of models based on ICT. The study covers effective leadership, tactical focus, core infrastructure, high regional demand, innovative and relevant content, cutting-edge and contextually appropriate services, and external partnerships and networking (Panda et al., 2018).

RESEARCH FRAMEWORK

A significant amount of scholarly literature has been devoted to investigating the factors that influence agricultural producers' acceptance and utilisation of information. Research by academics like Taragola & Van Lierde (2010), Manalo et al. (2019), and Mittal & Mehar (2016) makes this clear. These studies often fall under three main categories: links to agricultural products, farm features, and sociodemographic profiles of farmers. As demonstrated in Figure 1, three theories have been developed as a result of a careful analysis of the most recent academic literature.

FIGURE 1 Hypothesized model of ICT adoption among farmers.



Hypothesis 1 suggests that farmer demographic parameters like age, education, socioeconomic status, farm income, and other income sources may affect results. The adoption of ICTs is investigated using the research methodology depicted in Figure 1. The projected impact of capital on agricultural decision-making and information utilisation is essential. Farmers' ages, which are taken as a credible indicator of farming skill (Manalo et al., 2016), are likely to hinder ICT use in agriculture. Higher education increases farmers' ICT use. Additionally, farmers' income and social status may affect the adoption of ICT-based information (Taragola & Van Lierde, 2010).

According to Hypothesis 2, there should be a correlation between the number of crops grown and the degree to which information is used to inform farming decisions. Based on empirical studies, Isgin et al. (2008) and Sharma et al. (2019) have shown that there is a persistent positive link between farm size and the usage of agricultural technology. Although some studies suggest that there is no clear relationship between tenancy and the adoption of technology, other viewpoints contend that the absence of legally protected property rights could operate as a barrier to farmers investing in leased land and implementing modern farming methods. Moreover, there is evidence from studies by Silvestri et al. (2020) showing farms that grow a variety of crops have a higher tendency to use ICT-based systems to obtain pertinent agricultural data. Hypothesis 3 predicts that a farmer's economic attitude will affect how he uses information for farming decisions. According to a study by Steinke et al. (2020), farmers who approach farming as a business, demonstrate

market awareness and actively participate in social networking platforms, are more inclined to incorporate ICT resources into their operations.

RESEARCH METHODS AND DATA ANALYSIS

The current study used a primary poll method to get information from 480 farmers living in six districts of the Indian state of Haryana. In the last three months of 2022, interviews were the main way that survey managers gathered information. Thirty different areas were chosen for the poll to make sure it included a wide range of ICT users and non-users. To make sure that everyone who uses information and communication technology (ICT) feels welcome, 24 villages from 12 blocks in six regional zones in the state of Haryana were carefully chosen. They put ICT users into groups based on how they used knowledge from different ICT sources, like radio, TV, and e-Choupals, to help them make decisions about farming. The goal of this method was to give a complete picture of how farmers use information and communication technology (ICT) to make decisions about farming.

While the poll was made in Hindi, it was meant to get people to be more involved and confident so that accurate and fair data could be gathered. There were three main parts to the survey: information about the people who filled it out's social and economic background, how they farmed, and the tools they used to make decisions about farming. From the information about how people make decisions about different farming activities, three clear groups were found: (a) crop planning and production, which includes using high-yielding variety seeds, the right irrigation methods, fertiliser applications, crop protection strategies, modern farming equipment, soil analysis, and relying on weather forecasts; (b) managing and storing crops after they've been harvested; and (c) selling and marketing agricultural products. The goal of this division was to give a full and thorough look at all the different factors that affect different parts of making decisions in agriculture.

DATA ANALYSIS

This study conducted a thorough literature review to develop a methodology for examining the proposed relationship between sociodemographic traits, farming practices, and farmers' use of ICT to obtain agricultural information. This study examined the frequency of ICT use for agricultural tasks. Independent factors included age, education, income, secondary income, and social category. The study also examined land ownership or renting, farming as a company, minimum support prices, and crop diversity. The dependent variable examined how often ICT-based resources were used for crop planning, cultivation, post-harvest management, and product marketing. The study examined factors affecting ICT-driven information utilization in agricultural operations using regression analysis. Because ordinary dependent variables seldom change over time, regression model selection is a solid empirical procedure, according to Ani and Correa (2016). This modelling approach was utilized to explore the unique aspects of ICT-in-agriculture data. The researchers employed the maximum likelihood approach to evaluate the model's data understanding and ability to generate reliable conclusions regarding agricultural ICT-driven information consumption characteristics.

The regression model is used to assess agricultural decision-making's based on ICT use if all other variables remain constant. The impact of each component is then assessed to determine ICT use for agricultural decision-making variance. A computational model was created to determine how much ICT is used in crop planning, cultivation, post-harvest management, and commodity sales.

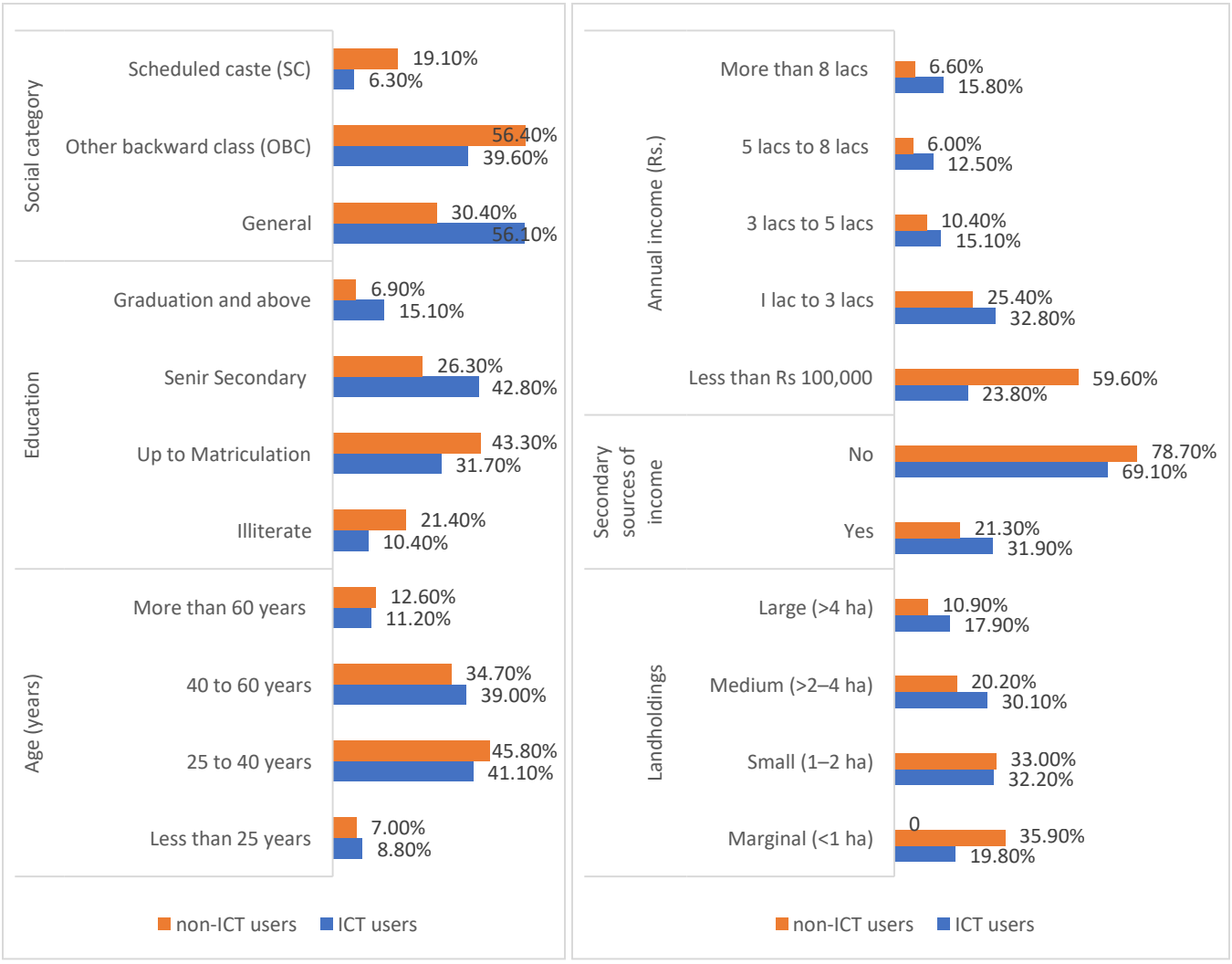
Table 1 Demographics of Farmers

	Variables used in study	**Mean**	**Std. Dev.**
AGE	Age (Years)	42.25	2.46
EDU	Education (Up to Secondary = 1, otherwise = 0)	.67	.380
SC	Social category (General/OBC =1, otherwise =0)	.79	.211
TCG	Total crops grown in a year by the farmers	3.42	.756
FB	Perception of farmers to consider farming as a business (Yes = 1, No = 0)	.69	.289
INOS	Income from other sources than agriculture (Yes = 1, No = 0)	.31	.389
MSP	MSP Awareness (Yes = 1, No = 0)	.74	.371

Source: Primary Data (SPSS 21.0 Version)

A comprehensive picture of farmers is provided in figure 2, which is categorized based on whether or not they have adopted information and communication technology (ICT). Relevant factors, including age, level of education attained, socioeconomic status, income sources, and percentage of land owned, are included in the table. A sizable fraction (68%) of the 480 participants in the sample as a whole reported using information and communication technologies (ICTs) while making decisions about their farms.

Figure 2 Sample Demographic Characteristics



Source: Primary Data (SPSS 21.0 Version)

Many people believe a farmer's age indicates their farming experience. The data suggests that a significant proportion of participants are between the ages of 25 and 60, indicating that people with strong experience and active participation are typically involved in agricultural operations. Nonetheless, it is important to note that the average age of people who use ICT and those who do not is 42.25 years, which is about equal for both groups. This finding suggests that there isn't a significant difference in these two groups' knowledge and expertise in agriculture (p =.521). In terms of education, those who use ICT tend to be more academically accomplished, especially in secondary or senior secondary school and higher. There was a statistically significant difference in educational attainment between those who did not utilize information and communication technology (ICT) and those who did (p =.000). A preference for implementing intelligent farming practices was found to be positively correlated with greater levels of education.

The general category, which is mostly upper-class people, comprised roughly 50% of ICT users. On the other hand, there was a statistically significant correlation (p-value =.000) between non-ICT users and lower social classes. Researchers discovered that ICT users often made more money than non-users (p =.000). It is also interesting that a portion of ICT users (p =.069) earned money from non-agricultural endeavours. ICT users had greater landholdings than non-users, with a mean of 2.88 hectares, indicating a substantial difference in landholding sizes. According to the study's findings, people who do not use ICT frequently come from underprivileged backgrounds and farm on small plots of land—typically no larger than two hectares. The amount of land owned by the two groups differs statistically significantly (p =.000). There were considerable differences between ICT users and non-users in education, income, alternative revenue sources, social standing, and landholding.

RESULTS AND DISCUSSION

The NSSO (2005) reports tells that about 40% of Indian families have access to agricultural information. A thorough examination of the many information types used by farmers is given in Figure 2. Interestingly, a large segment of the Indian farming community depends on production-related knowledge, which includes the application of enhanced seed types, suitable fertiliser dosages, and efficient crop protection methods.

But just 8% of families really make use of the knowledge they possess regarding marketing tactics and harvesting techniques, suggesting that most individuals aren't making the most of this information. A preponderance of production-related information does not always indicate a lack of interest in pricing, market connections, and agricultural processing. Nonetheless, it is conceivable to connect this situation to limitations in the provision of services related to agricultural extension.

The National Sample Survey revealed that progressive farmers were overwhelmingly recognised by respondents—24.4%—as the primary sources of agricultural knowledge in India. Furthermore, print and electronic media were said to be closely lagging behind as alternate sources of knowledge on agricultural practises. It seems that the government extension system is not very effective in disseminating information. Additionally, the results show that progressive farmers are the primary knowledge suppliers for increasing agricultural productivity, with radio and television. Data collection and commercialization are allegedly heavily reliant on important parties, including food product buyers and processors as well as media sources.

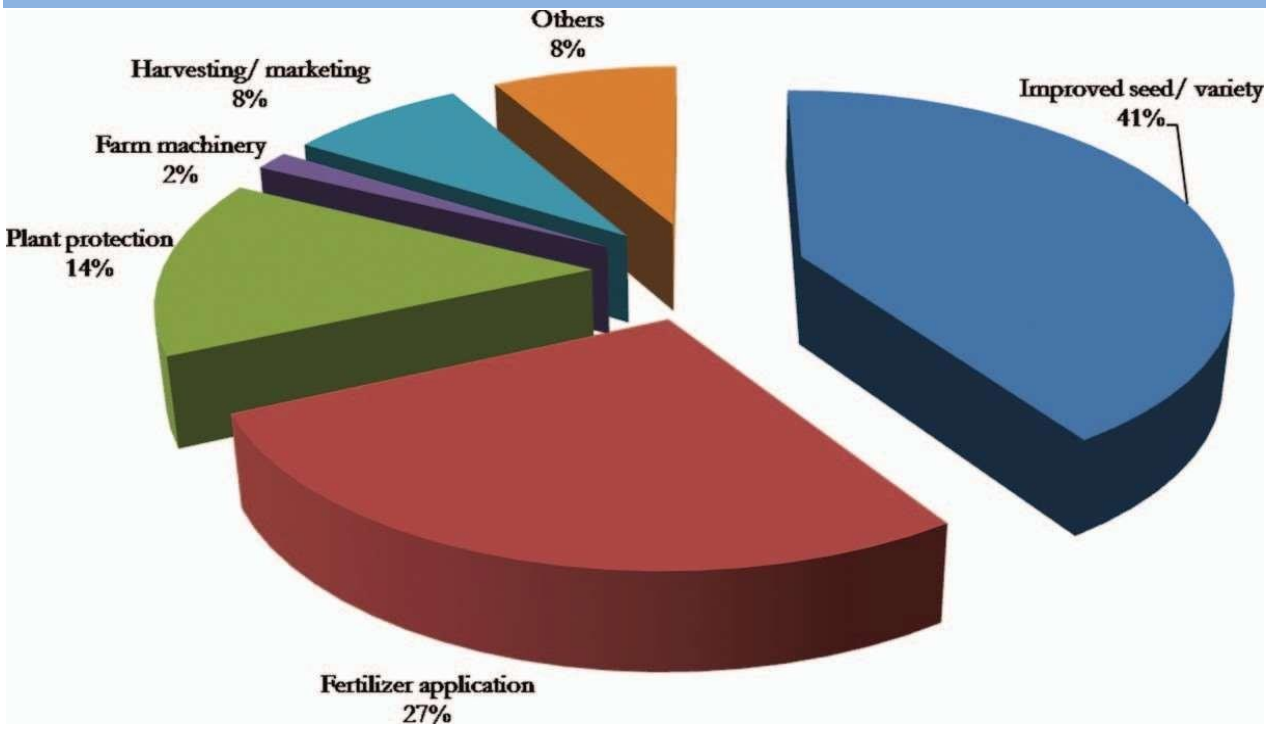


FIGURE 2 Possession of agricultural technologies or instruments by farmers.

(Source: NSSO, 2020)

FACTORS AFFECTING ICT ADOPTION

A significant amount of scholarly literature has been devoted to examining the several factors that influence agricultural producers' acceptance of new knowledge (Agwu et al., 2008; Mittal & Mehar, 2016). Table 2, which offers detailed information on the coefficient estimates, asymptotic standard errors, and significance levels related to the parameters in the Regression Model, presents the outcomes of the previously described studies.

TABLE 2 Regression Estimates of adoption of ICT by farmers

	FMKT		FPHS		FADM		FCPP	
Parameters	β	Sig.	β	Sig.	β	Sig.	β	Sig.
AGE	−.048***	0.015	−.060***	0.000	−.025***	0.000	−.029***	0.000
EDU	0.104	0.614	0.301	0.218	.227***	0.000	.179**	0.022
SC	−.100	0.95	−.451**	0.021	.332***	0.000	0.111	0.424
TCG	0.112	0.882	0.113	0.575	.213***	0.000	.194***	0.001
FB	0.161	0.514	.625***	0.000	.519***	0.000	.445***	0.000

INOS	0.105	0.521	−.042	0.885	.215**	0.048	0.121	0.329
MSP	.436***	0.001	.582***	0.001	.659***	0.000	.720***	0.000

Source: Primary data (SPSS 21.0)
***, ** Significant at the .01 & .05 level respectively.

The present study's conclusions are in line with those of Panda et al. (2018), which found that older farmers are less likely than younger ones to adopt modern agricultural practices. The results of this study show a statistically significant negative connection between age and the variable under inquiry, which supports the pattern that has been observed. This result is consistent with earlier academic studies on the topic.

It has been discovered that schooling has a major impact on information absorption, which is consistent with other research findings. A higher degree of education has a good impact on the acceptance of information, which in turn makes it easier to integrate new production and management techniques into farm practices and improve them (Arslan et al., 2015). The tendency of farmers to use information and communication technology (ICT) to make agricultural decisions is positively correlated with their level of education. Those who have completed secondary school or above exhibit a 23 percent greater propensity to use this type of technology than farmers who have not completed secondary school. This suggests that farm laborers with 10 years of formal education are more likely to profit from ICT services. The study's findings emphasize the need for information service providers to adapt their modules for farmers with less expertise and access.

Sharma et al. (2019) provide evidence for this claim by stating that decision-making in agriculture varies among various socioeconomic groups and has a significant impact on the social and cultural milieu of a particular society. As to the research conducted by Saidu et al. (2017), those that adopt new technologies quickly are often linked to the influential and dominant demographic. Within their particular social systems, these early adopters are seen as opinion leaders and have a great deal of influence over other participants. According to the research, farmers from the General and Other Backward Class (OBC) groups, who are typically associated with higher socioeconomic levels, are more likely to use ICTs to make agricultural decisions (56.10% and 39.60%, respectively). According to this research, farmers from higher socioeconomic classes are more likely to engage in entrepreneurial endeavors that enhance farming methods in order to increase revenue and provide job chances.

The presence of off-farm earnings makes knowledge integration easier since farmers with additional sources of income are better able to devote resources to the adoption of contemporary agricultural technologies. ICT-based information is 21.50% more likely to be used by farmers who receive outside funding to make farm-wide decisions. This means that farmers with alternate agricultural revenue streams are affected by ICT decision-making. As a result, the findings lend credence to Hypothesis 1, which postulates that farmers' sociodemographic characteristics probably influence how much information they take in. Four of the five factors under investigation show statistically significant effects from this impact.

According to Hypothesis 2, a number of farm-related factors, including landholding size, leasing arrangement, and crop count, are expected to have an impact on how information is incorporated into cultivation decisions. The findings demonstrate that the presence of landholdings that are both leased and in use significantly hinders the adoption of ICTs. Smallholder and large-scale farmers use ICTs differently. This study uses landholding sizes to examine how ICT-based systems effect agricultural decision-making. Small landholders realize they need advanced agricultural methods to increase productivity and profit. Farmers who rent land utilize ICTs 22% less for farming decision-making. This discrepancy is primarily due to their limited adoption of modern farming techniques, which is usually the result of their unstable land tenure systems. On the other hand, farmers who grow multiple crops in a year have a significantly higher inclination to use ICT-based systems. Information utilization is expected to increase by 21.3% as a result of this adoption. Given that two of the three indicators showed statistical significance, it is possible to draw the conclusion that Hypothesis 2 has some support.

Farmers that view farming as a business use ICT 52% more than subsistence farmers for agricultural decision-making. Minimum support prices increase ICT-based information use by 66% and allow farmers to sell produce for more. However, social networking, notably through self-help groups (SHGs), doesn't seem to affect ICT-enabled information utilization. Researchers found that business-oriented farmers use information more in their farming decisions, supporting Hypothesis 3's partial acceptance. It is worth mentioning that statistical significance was established for two out of the three components under investigation.

Regression analysis highlights a number of important variables that have an impact on farmers' inclination to use ICTs to make decisions regarding crop planning and production. These variables include age, education level, the availability of alternatives to farming for income, the size and ownership status of the landholding, and a business-oriented mindset. However, a farmer's expertise and commercial perspective may affect postharvest management and marketing decisions using ICT-based data. The study's expected percentage changes in ICT use for agricultural decision-making highlight three positive factors: agricultural pricing information, socially beneficial family, and business-centric perspective. Although significant, education level has a relatively smaller effect.

The log likelihood estimates and the information criteria confirm the significant goodness of fit for the explanatory factors. With the exception of the size of the farm, the expected impacts of most explanatory factors consistently show a logical directional relationship. The study highlights a significant trend that small landholders in India have been using: the use of ICTs for agricultural decision-making. This is especially relevant considering the high number of marginal or small-scale farms in the nation.

CONCLUSIONS AND IMPLICATIONS

The agricultural industry has become more reliant on information over the past ten years, which emphasizes how crucial it is to acquire a variety of scientific and technological expertise in order to make well-informed decisions. In many developing nations, publicly funded agricultural extension

projects are essential to the dissemination of knowledge about improved agricultural practices and technologies. The dissemination of contemporary and innovative knowledge has been made possible by the use of ICTs, although there are still ongoing discussions regarding the effectiveness of these kinds of projects. The importance of knowledge and information in accelerating agricultural development, enabling effective production planning, modern input adoption, higher agricultural yield, and improved marketing and distribution strategies is continuously highlighted by empirical studies (Ani & Correa, 2016; Saidu et al., 2017).

Regression analysis was used in this study to investigate the variables impacting the adoption of ICT-based information systems empirically. The results unequivocally demonstrate that a variety of sociodemographic and farm-specific factors significantly influence farmers' use of ICTs for agricultural decision-making. Marketing, postharvest management, crop planning, and production are just a few of the issues that have an impact on the use of ICTs in agricultural decision-making processes. These factors include age, educational attainment, social status, availability of non-agricultural income options, land ownership, and propensity for commercial endeavors among farmers. The empirical data emphasizes how crucial it is to take these factors into account when creating an ICT-based framework for long-term information delivery.

This study emphasizes how crucial it is to recognize the diversity among farmers and shows that a one-size-fits-all strategy for information sharing might not produce the best outcomes. In order to improve the effectiveness of ICT initiatives in the public and private sectors—especially where end-users are the focus, it is helpful to have a thorough grasp of the variety of people who utilize ICT-based systems. One significant barrier to successful agricultural ICT dissemination techniques is the challenge of reaching farmers who do not fit the mold of traditional ICT users. The study's conclusions strongly support the following recommendations, which pertinent agencies ought to endorse:

- Farmers' information needs and resource constraints should be included in ICT-based information delivery methods. The ongoing analysis of changes in farming systems is essential to the efficient distribution of content and the development of information delivery technology.
- Prioritize developing alternative methods for informing those who cannot use ICT-based solutions. Campaigns aimed at distributing agricultural knowledge throughout India ought to involve all farmers. It is possible to improve the ability of people who are not proficient in ICT to use agricultural information effectively by combining informal and formal teaching. This method considers the availability of existing models in the public domain as well as their possible incorporation as extra components in private-sector products.

It is imperative to recognize that the outcomes of the study are not universally applicable to various settings. The study's narrow emphasis on a single Indian state, the type of data utilized to identify factors impacting ICT adoption, and the analysis's restricted use of an empirical model are the main causes of these shortcomings. Subsequent investigations may seek to improve the prediction ability

and understanding of farmers' ICT-based information system adoption trends by determining and fine-tuning extra explanatory variables, such as psychological characteristics.

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