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INFLUENCE OF FARMERS' SOCIO-ECONOMIC STATUS ON THEIR INTENTIONS TO ADOPT ICT FOR AGRICULTURE IN RURAL PUNJAB, PAKISTAN

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Abstract

Usage of information and communication technology (ICT) for agricultural practices has been considered inevitable and beneficial to alleviate poverty and hunger of rural households. Despite the rapid increase of ICT usage even in the rural areas, the socio-economic divide still exists because farmers are still lagging in the use of it. This study examines the socio-economic determinants of ICT adoption decisions using survey data that comprised the sample of 416 farmers from 15 villages selected through multistage random sampling technique from the five agro-ecological zones of Punjab, Pakistan. Descriptive and inferential statistics from the logit model demonstrate that socio-economic status (income, education, landholding, and ownership of ICT) are significant determinants for ICT usage. Middle and high-income farmers were more inclined towards the use of ICT in farming as compared to low income. Similarly, farmers having ICT ownership were more intended towards the use of ICT in farming as compared to their counterparts. From the implications of the findings, the study concludes that low-cost ICTs, low-cost service delivery, and land disbursement to landless farmers are essentially important for the encouragement of ICT adoption.

Keywords

Socio-economic, Information Communication Technology, Decisions, and Adoption

1. Introduction

Farmer adoption behavior of new technologies has always been central to social science research right from industrial and agricultural revolutions usually in the west part of the world (Cole & Fernando, 2021). The hardware and software used for communication and information sharing are said as information and communication technologies (ICT). These ICTs include the internet, webpages, mobile phones, TV, radio, helplines, mobile applications, and emails, etc (Okoye AC, 2021). Information and Communication Technologies (ICT) can improve communication, reduce the cost of transactions, and exchange information instantly (Chowhan & Ghosh, 2020). In many parts of the world, the ICT is transforming many sectors like transportation, professional services, broadcasting, and agriculture. When ICT is applied in agriculture, it is termed e-agriculture (Birke & Knierim, 2020). It is well-established fact that, in this time of emerging knowledge economies, information and knowledge play a vital role in sustainable agricultural development (Rana *et al*., 2020). ICT adoption in farming can counter the failures of the traditional extension system and can equip the farmers with state-of-the-art agricultural technologies which in turn become a cause for their collective wellbeing (Ugochukwu, 2020). However, it is argued in the literature that farmers still face problems accessing accurate, relevant, and vital information that could help in making effective and efficient decisions (Chhachhar & Memon, 2019; A. Khan *et al*., 2019; Raza, 2019). Likewise, Khan *et al*. (2019), report that in Pakistan, internet connectivity is still a problem which indicates that rural economies have not been benefitted from ICT. There is still a significant digital divide exists between rural and urban areas even when this ICT widely accessible in remote areas of the country. In a study by Cole & Fernando., (2021) it was argued that the use of ICT in farming operations can enable the farmers to overcome their problems of accessing timely information, effective communication for efficient supply-chain, direct sale of produces to the customer, and pursue agricultural education.

There is an enormously challenging situation for the agricultural sector of Pakistan in recent times of economic recession and pandemic (Rana *et al*., 2020). There are various factors like population explosion, changing climatic situations, very high costs of transactions, and political instability in the country that are exerting pressure on this sector (Ahmad *et al*., 2019). The population of Pakistan is 22 billion and almost 70% of this population resides in rural areas. Out of the total GDP, 56% of it contributed by the agriculture sector and 21% of the country's labor force is engaged in it (ILO, 2019). However, there is a lack of government support for reducing transaction costs as well as providing timely information to farmers in the time of climate change. This results in the form of low production and profit for small farmers. These circumstances are making this situation worst for agriculture to feed and secure food for billions of people in the future (Elahi *et al*., 2018). ICTs and

their significance are well recognized in Pakistan for the past two decades (Aldosari *et al*., 2019). It provides benefits to every sphere and level of people just as helping the poor to access more and more information and on the other hand helping the governments to provide its services and current state of operations at a lower cost (Salam & Khan, 2020). The infrastructure of telecommunication faced rapid growth in recent years. In Pakistan, total teledensity is at the level of 64.08%, and the Pakistani market is a pre-paid market which implies that even the poorest in the country can afford these services (Chhachhar & Memon, 2019). The cost-efficient attribute of ICTs can boost their adoption in rural areas where the majority of people live in poverty. The application of ICT in agricultural affairs is not a new trend in Pakistan. Even now, almost every private sector communication service provider and mobile phone company jumped into this and they launched their Agri-related services (N. A. Khan *et al*., 2019).

The major contribution of this study is for theories and practices as well as for policy. The evidence showing relationships between socio-economic characteristics and intentions to adopt ICT is provided by the growing number of literature (Jan, 2020; Modirwa, 2019; Ugochukwu, 2020; Vimalkumar *et al*., 2020). A predicted willing to adopt approach was used in this study. Furthermore, the study considers particularly those socio-economic factors that have a deep influence on ICT adoption behavior like income, education, land tenancy status, and ownership of ICT. By examining the relationships between socioeconomic factors and farmers' adoption behavior in Pakistan, the study contributes to the existing ICT sources and technology acceptance model. The government can develop pro-poor information provision programs and policies to marginal farmers for effective utilization of ICT-based services.

There is a large amount of literature concerning ICT adoption is available in other parts of the world but this phenomenon is new in Pakistan (Aldosari *et al*., 2019; N. A. Khan *et al*., 2019). Hence, there is a limited number of studies about the relationship between socio-economic characteristics and farmers' adoption intention in Pakistan. The adoption of ICT by Pakistani farmers has not been investigated in the province of Punjab through the effects of their socio-economic status (N. A. Khan *et al*., 2019). The studies on other parts of the country shows that ICT adoption by farmers is influenced by the personal characteristics like age, income, education, the status of tenancy on-farm, and ownership of any kind of ICT (Aldosari *et al*., 2019).

Qureshi *et al*. (2013) conducted fieldwork in 33 villages of seven districts in the Sindh and KPK provinces of Pakistan. Studies showed a strong positive relationship between ICT adoption and income, education, age, and availability of ICTs. Yaseen *et al.* (2016) conducted a comparative study between Pakistan and China to identified the effects of inhabited factors of farmers regarding

ICT usage. Results showed that in Pakistan socio-economic factors like age, education, farm size, and income was positively related to ICTs usage among farmers.

Jain (2017) discussed the relationship between the farmer's demographic characteristics with adoption behavior towards ICTs practices and found that income ownership of mobile phones and education of farmers a vital factor in ICT adoption. Aldosari *et al*., (2019) throw light on the importance of phone service usage among different tenancy status groups. It was discussed that mobile phones found their places in everyone's daily life and got adaptable because of their dynamic nature. Chhachhar *et al*. (2016) conducted a study in the Sindh and KPK provinces of Pakistan by interviewing 150 farmers. The results showed that (97%) farmers have their mobile phones but only (23.3%) were using the internet on their mobile phones. Haider (2014) explored the role of local radio programs in small-scale farm extension among the farmers of Layyah District, Punjab. It was observed that 94% of farmers listened to the radio and (85%) watched TV in rural areas. Moreover, (56.7%) farmers got information from peers, and (14%) got information from research publications. By identifying the farmers' intentions to use ICT through the willingness to adopt approach along with their socio-economic characteristics will help the policymakers to understand that how farmers in different income strata keep adoption behavior towards ICT (Jain, 2017). Therefore, the primary aim of the present study is to establish the relationship between socio-economic status and their intentions for the adoption of ICT in agriculture. Therefore, the following objectives were developed for this study:

i- To find out the socio-economic status of the respondents

ii. To identify the respondents' intentions to use ICT by willing to adopt approach, and

iii. To establish the associations between the socio-economic characteristics of the respondents and their intentions to use ICT.

2. Materials and Methods

This paper is based on the examination of the influence of socio-economic characteristics of the farmers on their intentions to use ICT in rural Punjab, Pakistan. Therefore, to understand farmer's decision-making in terms of ICT adoption, a multistage random sampling technique was used to collect data from farmers in five agro-ecological zones of Punjab. Before executing the survey, a pre-testing of the questionnaire prepared in the light of research objectives was carried out to correct the instrument for validity. In the first stage of the sampling five districts (Jhelum, Narowal, Faisalabad, Bhakkar, and Vehari), one from each zone were randomly selected. At the second stage, from five selected districts one tehsil from each i.e. Narowal (Narowal district), Dina (Jhelum district), Summandri (Faisalabad district), Vehari (Vehari district), and Mankera (Bhakkar district) were randomly selected. At the third stage, three villages from each selected tehsil were

selected randomly i.e. Burha Jungle, Chak Akah, Chak Abdul Khaliq from Jhelum, Chak Manak, Chak Dhariwal, Chak Mangiyan from Narowal, Chak 210GB, Chak 213GB, Chak 206GB from Sumandri, Chak 109WB, Chak 111WB, Chak 107 WB from Vehari and Kohwala, Shahwala, Mohniwala from Mankera. At the last stage, 28 farmers from each village were selected by using a systematic random sampling technique. This gave a sample size of 420 respondents. The paper uses the statistical Package for Social Sciences (SPSS 20) for descriptive and inferential statistics. The dependent variable in this study is intentions to use ICT, while the independent variable includes various socio-economic characteristics of the farmers. Farmers' intentions to use ICT were measured as an ordinal variable using a 5 point liker-scale. Detailed description and measurement are provided in the next section.

As the independent variables (income, education, ownership of ICT) and dependent variable (intentions) are in categorical form, this study uses a chi-square analysis to determine the associations between the socio-economic status and intention to use ICT.

3. Results and Discussion

Socioeconomic profile of the respondents:

Socio-economic characteristics include income, education, tenancy status, and ownership of ICT and these characteristics influence the attitude and behavior of an individual. The Socioeconomic characteristics of the respondents are discussed below.

Table 1 shows that two-thirds of the respondents belonged to the high-income category and almost one-third of farmers belonged to the middle-income category. Various recent studies in rural areas of Pakistan shows the same pattern of income distribution (N. A. Khan *et al*., 2019; Raza, 2019; Ullah *et al*., 2020). The reason behind this situation is that food inflation in a country like Pakistan is very high and farmers are receiving adequate returns for their produces (Cole & Fernando, 2021).

Table 1 also shows that majority of the respondents had schooling experience because results show that farmers have an education at-least at the middle to matriculation and above matriculation level. Because most of the farmers were in their middle ages so they are from the population cohort of 1970-80 which indicate that due to the government efforts to promote education in rural areas since last few decades, it was observed that those farmers who are in their middle ages have at least education at a matric level.

Table 1. Socio-economic characteristics of the respondents (N=416)

Demographic characteristics	Frequency	%
Income (000 RS)		
Up to 150	42	10.0
>150-300	83	20.0
Above 300	291	70.0
Education		
Illiterate	43	10.3
Up to primary (1-5)	34	8.2

Primary-middle (6-8)	51	12.3
Middle-matriculation	124	29.8
Above matriculation	164	39.4
Tenancy Status		
Owner	344	82.7
Owner-cum-tenant	55	13.2
Tenant	17	4.1
Ownership of ICT		
Computer	77	18.5
Internet	142	34.1
Mobile Phone	295	70.9
TV	215	51.7
CDs player	23	5.5
Telephone	49	11.8
Radio	58	13.9

Table 1 also reveals that a significant majority two-third of the respondents were owners of their land and only 13.2% of farmers were owner-cum-tenant 12.5 to 25 acres of land. Only a fraction of almost 4.1% of respondents were tenants. Various adoption studies as those of (Chhachhar & Memon, 2019) in Punjab showed similar results that the majority of the farmers in Punjab are the owner of their farms. The results further revealed that the majority of the respondents have mobile phone ownership followed by 51.7% of respondents who own TV. 34.1% of farmers have internet connections while 18.5% have ownership of computers.

Farmers' ICT usage intentions in future:

Actual usage intentions may result from behavioral decisions derived from users willing to adopt the approach (Otieno *et al*., 2016). Assessment of the usage decision of farmers on various ICT if they are available to them in the future is the second and pivotal objective of the present study because it provides a proper description of farmers' decision-making to use ICT. The aim was to take this important concept as a dependent/response variable to understand the decision-making of farmers regarding the adoption of ICT. Conceptually, usage decision refers to the subjective probability of farmers that they will adopt the ICT in agriculture (M. Ali *et al*., 2019).

Table 2: Rank order, mean and standard deviation of ICT based on farmers' decisions.

ICT	Score	Rank	Mean	S D
Mobile	1619	1	3.89	1.433
Internet	1581	2	3.80	1.463
TV	1519	3	3.65	1.468
Computer	1183	4	2.84	1.646
Radio	1167	5	2.81	1.642
Telephone	1092	6	2.63	1.620
CD players	823	7	1.98	1.468

The ranking of the ICT according to the intentions of the farmers to use them is presented in Table 2 where mobile phones followed by the internet and television are the top three ICT that is most desirable for the farmer to use for their farming operations. Computer stands at 4th rank, it is because most of the farmers have children who are studying and mostly have computers in the house. However, radio, telephone, and CD players have been considered outdated technologies. Recent studies on the adoption behavior of ICT in Pakistan and the region pointed out similar facts

that due to the high teledensity of cellular mobile phones in the rural areas, farmers are very much aware of its usefulness in the farming operation, therefore, they are intended to use it (N. A. Khan *et al*., 2020; Vimalkumar *et al*., 2020). Similarly, the results are also in line with those of M. Ali *et al*., (2019) and Mittal & Mehar, (2016) who found similar preferences of farmers as mobile phones and the internet was the most desirable ICT to use in farming by the farmers. Aldosari., (2019) found that computers, telephone, and radio were the most accepted ICT by the farmers for getting agricultural information.

Associations between socioeconomic status and intentions of farmers to use ICT in agriculture.

To understand the decision-making process of farmers for ICT adoption, their intentions to use ICT in agriculture become dependent variables, which may be influenced positively or negatively by the socio-economic characteristics such as income, education, tenancy status, and ownership of ICT. Farmers' intentions to use ICT in agriculture was measured by the scores of various ICT. The range of the total score is from 7 to 35, and the three categories i.e., low, medium, and high were used in which respondents were divided. The group intervals between these three categories are 7 to 16, 17 to 26, and 27 to 35, respectively. The results of these associations are discussed in tables 3-6. The chi-square and Gamma statistics have been used to examine the relationships between the variables.

Table 3: Relationship between the income of respondents and their decisions to adopt ICT

Income (000)	Decisions (decision)			Total
	Low	Medium	High	
up to 150	23	12	7	42
	54.8%	28.6%	16.7%	10.0%
>150-300	41	34	8	83
	49.4%	41.0%	9.6%	20.0%
Above 300	27	209	55	291
	9.3%	71.8%	18.9%	70.0%
Total	91	255	70	416
	21.9%	61.3%	16.8%	100.0%

Chi-Square= 93.10*, DF= 4, Gamma= 0.559

The data in Table 3 shows that the intentions of farmers to use ICT are strongly associated with their income level. The Gamma value of 0.559 indicates that if the income of the farmers' increases, their intentions to adopt ICT also increases. Based on the above statistics, it can be deduced that high-income farmers are more inclined towards the use of ICT in farming as compared to low-income farmers.

Table 4: Relationship between the education of respondents and their decisions to adopt ICT

Education (No of Years)	Decisions (decision)			Total
	Low	Medium	High	
Illiterate	23	15	5	43
(0)	53.5%	34.9%	11.6%	10.3%
Up to Primary	16	14	4	34
(1-5)	47.0%	41.2%	11.8	8.2%
Primary-Middle	10	31	10	51
(6-8)	19.6%	60.8%	19.6%	12.3%
Middle-Matric	27	78	19	124
(9-10)	21.8%	62.9%	15.3%	29.8%
Above Matric	15	117	32	164

(10+)	9.1%	71.3%	19.5%	39.4%
Total	91	255	70	416
	21.9%	61.3%	16.8%	100.0%

Chi-Square= 54.33**, DF= 8, Gamma= 0.340

The data in Table 4 indicate that farmers' adoption behavior is strongly associated with their education level that is another very important factor. The positive significant relationship can be seen from the Gamma value which illustrates that with the increase in the educational level of the respondents, there was an increase in their intentions to use ICT. The results of the present study are similar to those of (N. A. Khan *et al*., 2020; Rana *et al*., 2020) who also found a significant relationship between the education level of the farmers and their ICT usage behavior.

Table 5: Relationship between tenancy status of respondents and their decisions to adopt ICT

Land holdings	**Decisions (decision)**			**Total**
(Acres)	**Low**	**Medium**	**High**	
Owner	66	98	180	344
	15.8%	23.5%	43.2%	82.6%
Owner-cum-	9	14	32	55
tenant	2.1%	3.4%	7.7%	13.2%
Tenant	10	12	18	40
	2.4%	2.9%	4.3%	9.6%
Total	91	255	70	416
	21.9%	61.3%	16.8%	100.0%

Chi-Square = 40.17**, DF= 4, Gamma= 0.315

The data in Table 5 shows that sense of ownership of land is one of the influential factors in adoption behavior because there is a highly significant relationship between the tenancy status of the respondents and their intentions to use ICT. The positive Gamma value of 0.315 illustrates a positive association between the variables. This result depicts that if farmers have their land for cultivation then they more intended to use ICT as compared to those who have only tenancy status. These results are in line with those of (Chhachhar & Memon, 2019) who also found positive effects of farm ownership on farmers' adoption behavior.

Table 6: Relationship between ownership of ICT and intentions to adopt ICT

Experience	**Decisions (decision)**			**Total**
(Years)	**Low**	**Medium**	**High**	
Low	58	112	22	192
	30.2%	58.3%	11.5%	46.2%
Medium	28	116	20	164
	17.1%	70.7%	12.2%	39.4%
High	5	27	28	60
	8.3%	45.0%	46.7%	14.4%
Total	91	255	70	416
	21.9%	61.3%	16.8%	100.0%

Chi-Square = 55.23, DF= 4, Gamma= 0.415

The data in Table 6 reveals that if farmers have any type of ICT then they are more intended towards the use of ICT in farming. From the table above, it can be seen that there is a significant association between ownership of ICT and intentions to use them in farming activities. . the chi-square value of 55.23 is illustrated the significant relationship and reveals that ownership of ICT had positive effects on their intentions to adopt ICT in farming. The recent studies also pointed out that, farmers with mobile phones are more willing to use them for getting market and

weather-related information as compared with those who have no ICT for use.

4. Conclusions:

It can be concluded that most of the respondents were in the high-income group, and have schooling of above matriculation. Most of the farmers are owners of their farms which motivates them to use ICT in farming. Most of the farmers have mobile phones followed by television, computer, radio, and telephone. Moreover, farmers' income, educational level, tenancy status as well as ownership of ICT were found to influence their ICT usage intentions.

5. Recommendations:

As the poor farmers have no money, the provision of low-cost ICT including smart mobile phones should be provided at the village level through different national and provincial level welfare programs and workshops under the supervision of extension personnel should be provided to them for their capacity building. These workshops must have a focus on illiterate farmers for their capacity building. Provision of user-friendly smartphones also is provided to the landless tenants with operational training.

To effective dissemination of agricultural information, provincial agriculture departments of the government should collaborate with private telecommunication agencies to provide in-time, relevant, and efficient low-cost delivery services in rural areas. The more advanced telecommunication infrastructure can ensure the connectivity and coverage in remote areas for the dissemination of indigenous research findings to small-scale farmers.

Sustainable skills development programs should be introduced for extension staff for better coordination between all the stakeholders including the Agriculture Extension Department, the Ministry of Information and Broadcasting, different organizations of farmers, and media houses.

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