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Effects of Farmers' Socio-economic characteristics on their Decision to Adopt ICT in Agriculture: Empirical Evidence from Rural Punjab, Pakistan

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ABSTRACT: The Challenge of food security in any society primarily depends on agricultural development. Without the effective transfer of agricultural technology, the development of this sector seems difficult. The use of modern ICT in farming is the key component of agricultural information dissemination while traditional extension system is lacking in this respect. However, farmer's decisions to use ICT in agriculture may be hindered by some socio-economic characteristics. This study designed to explore the effects of socio-economic characteristics on ICT usage decisions of farmers in rural Punjab, Pakistan. The study used a sample of 416 farmers from 15 villages selected through a multistage random sampling technique from the five agro-ecological zones of Punjab. A well-designed questionnaire prepared in light of the research objectives. Descriptive and inferential statistics demonstrate that ICT usage decisions of farmers significantly associated with their age, education, and size of landholding (socio-economic characteristics). Younger farmers were more inclined towards the use of ICT in farming as compared to elders. Similarly, more educated and large farms holders were more intended towards the use of ICT in farming as compared to their counterparts. The results of the study therefore reveal that there is a socioeconomic digital divide exits in farmers decisions of ICT use. From the implications of the findings, the study suggests that capacity building, low-cost service delivery, sustainable skill development are essentially important for the encouragement of ICT adoption.

Keywords: Socio-economic, Information Communication Technology, Decisions, and Adoption.

I. INTRODUCTION

Adoption of modern agricultural technologies has always been central not to rural sociology only but almost for all social sciences right from green revolution to precision agriculture [1–3]. ICT adoption in farming by small hold farmers disregards shortcomings of traditional extension system and rather put the small farmers on a track of collective well-being [4]. The nature of ICT adoption in farming demands no socio-economic digital divide in a society [5]. A growing adaptive behavior gets all of its nurturing from the extrinsic factors such as socio-economic status in a society [6]. Subsequently, farmer choice of agricultural technology adoption attaches with him according to his socio-economic status even in the work place. This fact compels ICT based agriculture services to be user friendly and cost efficient [5–7]. If farmer does not find balance between relative advantage of a technology and his socio-economic conditions then the technology or farmer both may in difficult situation. This conflict adversely affects the technology adoption process required for achieving agricultural development goal [8].

In recent years, the agriculture sector of Pakistan is facing difficult and challenging time. The growing population, climate change, high transaction costs and poor governance in the country are putting numerous pressure on this sector [9]. The population of the country reached at 22 billion and almost 70% of this population reside in the rural areas. The agriculture sector contributes 56% in total GDP and consume 21% of country's labor force [10]. However, government initiatives are failing to reduce transaction costs for small farmers in the time of climate change that is resulting in the form of low production and profit for them. These circumstances are making this situation worst for agriculture to feed and secure food for billions of people in the future [11].

In this scenario, role of timely, relevant and reliable agricultural information become very important [12]. If farmer becomes able to find relevant and reliable information in local contents at very low cost then it is very likely that he can overcome many of his farming problems at the time of urgency [13]. Traditionally, this is the responsibility of the agriculture extension department to perform this duty. However, in many developing countries, usually this department fails in doing this task because of high administrative and transaction cost of large population coverage[14].

The main task of extension is to acquire information from research and dissemination of this research to farmers but this linkage is weaker due to less motivation and resources [15]. ICT can broaden this linkage by removing the barriers of time and distance. ICT has the ability to strengthen the relationship between research, extension, and farmers [16]. The hardware and software used for communication and information sharing said as information and communication technologies (ICT).

These ICTs include internet, webpages, mobile phones, TV, radio, helplines, mobile applications, and emails, etc [17]. The use of information and communication technologies (ICT) is gaining popularity in every sphere of life. In the changing scenario of the globe, ICTs adoption by farmers will bring very positive changes in their livelihood [16].

Studies on adoption of ICT in agriculture as those of [18–22] examined the relationship between socioeconomic characteristics and perceptions of farmers about different aspects of ICT in agriculture such as awareness about prospective role of ICT, sources for different types of ICT based agricultural information, financial benefits of ICT in agriculture etc. However, there is a gap in research in terms of the relationship between socioeconomic characteristics and farmers' decisions of ICT adoption in context of Punjab, Pakistan. Various studies as those of [5, 6, 23-25] pointed out that analysis of the associations between farmers' socioeconomic status and their decisions to adopt ICT will help to understand why farmers to different socio-economic status perceive the role of ICT in different perspectives.

Therefore, the present study aims to answer the research question that, what socio-economic status farmers have and how this socio-economic status influences their decisions for the adoption of ICT in agriculture. The relationship of farmers' socioeconomic status and their decisions will help the policymakers, educationists and researcher to enhance their understanding of farmers' adoption behavior. Therefore, this study derived following objectives:

(i) To gauge the socio-economic characteristics of the respondents

(ii) To figure out the decision of respondents regarding ICT use in farming.

(iii) To examine the association between the socio-economic characteristics of the respondents and their decision to use ICT.

II. MATERIALS AND METHODS

The farmers of the five agro-ecological zones in the Punjab consisted of the population for the study. Data collection was carried out through multistage sampling technique. At the first stage, five districts (Jhelum, Narowal, Faisalabad, Vehari, and Bhakkar) were selected randomly from each agro-ecological zone of the Punjab. At the second stage, five tehsils (one tehsil from each district) such as Narowal (Narowal district), Dina (Jhelum district), Summandri (Faisalabad district), Vehari (Vehari district) and Mankera (Bhakkar district) were selected randomly. At the 3rd stage fifteen villages, 3 from each selected tehsil such as 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 were selected randomly. At the last stage, a sample size of 420 respondents (28 farmers from each village) were selected by using systematic random sampling technique. A well-structured questionnaire was used for collection of the data from the farmers. The total response rate remained 99.04% (416 respondents), which was quite acceptable. The results were obtained by using statistical Package for Social Sciences (SPSS). Frequency, percentage, mean and standard deviation were used as a descriptive statistics. Ranking of the ICT based on farmers decision to use was obtained from the weighted score that were computed by multiplying the frequency counts with score values ranging from 1-5 (Likert scale). The level of association between the independent and dependent variable was observed through the bivariate analysis.

III. RESULTS AND DISCUSSION

Socioeconomic characteristics of the respondent:

The socio-economic status based on age, education, farming experience and landholding influence the attitude and behavior of an individual. Therefore, present study consider these attributes as socio-economic characteristics. The classifications of these socio-economic characteristics are discussed below.

Table 1 shows that as compared to young farmers most of the respondents belonged to the higher age categories of middle and old. The results of the present study have similarity with those of [17, 18] in which it was found that majority of the farmers in developing countries are in their middle and old ages. The reason behind this situation is that the youngsters in rural areas are more inclined towards non-agricultural activities and more willing to work in the cities[26]. Table 1 also reveals that on educational scale, the majority of the respondents had education above middle and matriculation levels. These results are in assonance with those of [27]. Who found that due to the government efforts to promote education in rural areas since last few decades, it was observed that those farmers that had in their middle ages have at least education at matric level. These studies also found the similar results as of the above.

Table 1 also reveals that approximately sixty five percent of the respondents were small farmers who owned up to 12.5 acres of land while one fourth respondent were medium farmers who owned medium farms between 12.5 to 25 acres of land. Only fraction of almost 9% respondents were large farmers who owned large farms of above 25 acres. Various adoption studies as those of [20, 28, 29] in Punjab showed similar results that majority of the farmers in Punjab are small and medium farmers. The results further revealed that majority of the respondents had more than fifteen years of farming experience. The results shows that 42% farmers had farming experience of between 15 to 30 years and 15% farmers had experience of more than 30 years.

Table 1: Classifications of the socio-economic profile of the respondents (N=416).

Demographic characteristics	Frequency	%
Age (Years)		
Young Age (up to35)	78	18.8
Middle Age (>35-50)	194	46.6
Old Age (Above 50)	144	34.6
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
Landholding (Acres)		
Small (up to 12.5)	271	65.1
Medium (>12.5-25)	105	25.2
Large (>25)	40	9.6
Farming Experience		
Up to 15	175	42.1
>15-30	177	42.5
Above 30	64	15.4

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

ICT	Score	Rank	Mean	S D
Internet	1603	1	3.85	1.407
Mobile	1592	2	3.83	1.501
TV	1546	3	3.72	1.361
Computer	1240	4	2.98	1.612
Radio	1207	5	2.90	1.584
Telephone	1115	6	2.68	1.603
CD players	822	7	1.98	1.451

Farmers' decision of ICT usage:

In [30] it was pointed out that usage decision may results from behavioral decision derived from user attitude and perceived usefulness of technology. Assessment of the usage decision of farmers on various ICT is the second and pivotal objective of the present study because it provide 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 adoption of ICT. Conceptually, usage decision refers to the subjective probability of farmers that they will adopt the ICT in agriculture [23].

Table 2 lists the ICT based on decision of the farmers to use in agriculture, which reveals that the internet, mobile phones and TV were ICT on which they have intentions of use. ICT like computer, radio, telephone, and CD players were least intended ICT of the responded. With respect to internet and mobile the results are in accordance with those of [19, 22, 23] who found the smart phones (internet enabled) as most inevitable and beneficial ICT. Likewise, these results are also in accordance with those of [18] who found the mobile phones and internet as the most desirable ICT to use in farming. These findings are also with accordance with those of [20] who found that computer, telephone and radio were the most significant ICT desired by the farmers for getting agricultural information.

Association between respondents' socio-economic characteristics and their decisions to use ICT in agriculture.

Farmers' decision to use ICT in agriculture is a dependent variable, which may be associated negatively or positively with the socio-economic status such as age, education, size of landholdings and farming experience of the farmers. Respondents decisions to use ICT in agriculture was computed by having sum of the scores of various ICT like mobile phones, internet, computer, television, radio, telephone, and CD players. The range of the score become between 7 to 35. Three categories i.e., low, medium and high were made and the respondents were divided into these three categories with the group intervals of 7 to 16, 17 to 26 and 27 to 35, respectively. Tables 3-6 are showing the results of these associations. The descriptive statistics as chi-square and Gamma were used to examined the association between variables.

Table 3: Association between age of the respondents and their decision to adopt ICT.

Age (years)	Decisions (decision)			Total
	Low	Medium	High	
Young Age (up to 35)	10	46	22	78
	12.8%	59.0%	28.2%	18.8%
Middle Age (>35-50)	47	117	30	194
	24.2%	60.3%	15.5%	46.6%
Old Age (Above 50)	34	92	18	144
	23.6%	63.9%	12.5%	34.6%
Total	91	255	70	416
	21.9%	61.3%	16.8%	100.0%

Chi-Square value= 11.67*, DF= 4, Gamma= -0.194

The figures in Table 3 depicts that the age of the respondent had significant association with ICT usage decision. The negative Gamma value of -0.194 indicates that if age of the farmers decreases, the decision to adopt ICT increases. Based on above statistics, it can be deduce that younger farmers are more inclined towards use of ICT in farming as compared to elders.

The data reveals in Table 4 that there is a highly significant association between ICT usage decision and education of the respondents. The value of Gamma indicates the positive relationship; which illustrates that with the increase in educational level of the respondents, the intentions to use ICT was also increase. The findings of the study are getting support from those of [17, 19] who also found significant association between education level of the farmers and their ICT usage behavior.

A highly significant relationship between size of the land holding of the respondents and their ICT usage decision can be seen from the data in Table 5. The value of Gamma pointed out a positive association between the variables; which illustrates that with the increase in the size of the land holding of the respondents the intentions to use ICT was also increase. The medium and large size farms holders were more inclined towards modern ICT as compared to small farmers. These results are in line with those of [18] who also found a positive effects of farm size on farmers adoption behavior.

Lastly, Table 6 indicates a non-significant relationship between farming experience of the respondents and their ICT usage decision. The non-significant relationship tells that decision to adopt ICT in farming is not influenced by farming experience of the respondents. The various studies of agricultural technology adoption as those of [19, 22, 23] reveals that more experienced farmers are always reluctant to adopt new technologies and depends on their traditional practices as compared to those farmers who spent less time in farming. The results of the present study are also in agreement with these studies.

Table 4: Association between education of the respondents and their decision to adopt ICT.

Education (No of Years)	Decisions (decision)			Total
	Low	Medium	High	
Illiterate (0)	23	15	5	43
	53.5%	34.9%	11.6%	10.3%
Up to Primary (1-5)	16	14	4	34
	47.0%	41.2%	11.8	8.2%
Primary-Middle (6-8)	10	31	10	51
	19.6%	60.8%	19.6%	12.3%
Middle-Matric (9-10)	27	78	19	124
	21.8%	62.9%	15.3%	29.8%
Above Matric (10+)	15	117	32	164
	9.1%	71.3%	19.5%	39.4%
Total	91	255	70	416
	21.9%	61.3%	16.8%	100.0%

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

Table 5: Association between landholdings of the respondents and their decision to adopt ICT.

Land holdings (Acres)	Decisions (decision)			Total
	Low	Medium	High	
Small (up to 12.5)	65	178	28	271
	24.0%	65.7%	10.3%	65.1%
Medium (>12.5-25)	15	66	24	105
	14.3%	62.9%	22.9%	25.2%
Large (>25)	11	11	18	40
	27.5%	27.5%	45.0%	9.7%
Total	91	255	70	416
	21.9%	61.3%	16.8%	100.0%

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

Table 6: Association between farming experience of respondents and their decision to adopt ICT.

Experience (Years)	Decisions (decision)			Total
	Low	Medium	High	
Up to 15	30	107	38	175
	17.1%	61.1%	21.7%	42.1%
>15-30	46	108	23	177
	26.0%	61.0%	13.0%	42.5%
Above 30	15	40	9	64
	23.4%	62.5%	14.1%	15.4%
Total	91	255	70	416
	21.9%	61.3%	16.8%	100.0%

Chi-Square value= 7.57^{NS}, DF= 4, Gamma= -0.180

IV. CONCLUSION

It can be observed that most of the respondents were not young but in middle and old age, they had education above middle to matriculation level and farming experience of up to 30 years with average land holdings up to 12.5 acres. The internet and mobile phones are farmers' most desirable ICT to use in farming followed by television, computer, radio, and telephone. The ICT usage decision of farmers were influenced by age, educational level as well as with the size of land holding, while farming experience had no effects on ICT usage decision.

Recommendations

As the small farmers have low capacity because of aging, therefore, through demonstration method in the villages and under the supervision of field assistants, the capacity building programs should be developed for using different ICT in farming. In these capacity building programs, the provision of user friendly smart phones must be ensured to the mid-aged and elder farmers.

To disseminate the agricultural information through ICT to small-scale farmers, the government should given the subsidies to private tele-communication agencies to provide low cost delivery services in rural areas. The government should also developed tele-communication infrastructure for public sector agencies for dissemination of indigenous research findings to the small-scale farmers.

There should be opportunities of sustainable skills development programs available for less educated farmers with the coordination between provincial extension departments, information and broadcasting ministries, different organizations of the farmers, and local media agencies for the effective use of ICT in agriculture.

VI. FUTURE SCOPE

Scope of the current study was limited to the province of Punjab. Future study can be done in the other provinces of Pakistan for examining the reliability of the results of present study. During the field survey it was found that some other variables such as farmers' knowledge, attitude and skills level which may influence the decisions of farmers to adopt ICT in agriculture but could not become the components of present study. Future research with these variables may conducted in Punjab, Pakistan.

Conflict of Interest: It has been declared by the authors that they have no conflict of interest with this study.

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