Use of Information and Communication Technologies by the Farmers in Modernizing Agriculture at Barind Tract Area of Bangladesh

ABSTRACT

A study was carried out at Barind area of two upazilas(small administrative unit) under Chapainawabganj district in Bangladesh during January, 2024 to April, 2024 to find out the extent of use of Information and Communication Technologies (ICT), andexplore the relationship between personal attributes and their use of information and communication technologies in modernizing agriculture. Information and communication technology in the districts of Chapainawabganj, Nachole, and Gomostapur are used by the populace. There are around 3500 and 5000 users of information and communication technology in Nachole and GomostapurUpazilla, respectively. The study's population consisted of 386 ICT-using farmers from all 14 Pourasava and unions; 386 respondents were chosen using the Taro Yamane Formula. Out of 13 socio-economic characteristics of the farmers, education, agricultural knowledge, ICT ownership, ICT knowledge, farm size, cosmopoliteness, communication exposure and risk orientation had significant. In addition, age, family size, training experience, supervision of crop production and formal group affiliation are insignificant with use of information and communication technologies.Majority of the farmers had medium to high level of use of information and communication technologies

1. INTRODUCTION

In recent years, the global agricultural sector has undergone significant transformation, primarily driven by technological advancements. Information and Communication Technology (ICT) has played a pivotal role in reshaping agricultural practices, enhancing productivity, and revolutionizing decision-making. ICT applications such as precision farming, market systems, weather forecasting, and e-commerce have bridged gaps in resource allocation and information sharing, empowering farmers and other stakeholders. In Bangladesh, agriculture is critical, contributing 11.38% to GDP and employing 45.33% of the workforce [1]. However, challenges such as land loss, population growth, climate change, and lack of modernization persist. With 80,000 hectares of arable land lost annually [2] traditional knowledge is insufficient for the country's food needs. Thus, modernization is essential for Bangladesh's agricultural sector. Agricultural mechanization involves using machinery and technologies to enhance productivity in farming, vital for food production and poverty reduction. It plays a crucial role in crop establishment, protection, harvesting, processing, and value addition, areas historically neglected in Bangladesh. Mechanization boosts the efficiency of inputs like seeds, fertilizers, and labor. It requires environmental, agricultural, social, and economic cooperation and benefits from technological innovations [3]. Mechanization encompasses manufacturing, selecting, maintaining, and managing machinery, but is often associated mainly with tractors. Recognized as a major 20th-century

achievement, mechanization varies globally and is key to saving costs and increasing farmers' income [4]. Agricultural development relies on mechanization levels, often measured by factors like power per hectare [5]. Insufficient farm power hampers timely cultivation, labor productivity, and post-harvest processes. Adequate power ensures timely, efficient farming and better market control, preserving resources. Sustainable mechanization enhances post-harvest, processing, and marketing activities, and is critical for addressing agricultural challenges, especially rice production, in Bangladesh.

2. METHODOLOGY

As Barind area of Bangladesh, Chapainawabganj district was selected purposively to aim at the population of farmers of Nachole and Gomostapurupzilla under, Chapainawabganj district. Data were collected through interview schedule from a sample of 386 ICT user farmers selected by multistage sampling procedure during January 5, 2024, to April 15, 2024. Information and communication technology in the districts of Chapainawabganj, Nachole, and Gomostapur are used by the populace. There are around 3500 and 5000 users of information and communication technology in Nachole and GomostapurUpazilla, respectively. The study's population consisted of 386 ICT-using farmers from all 14 Pourasava and unions; 386 respondents were chosen using the Taro Yamane Formula [24], which is explained below:

$$n = \frac{N}{1+Ne^2}$$

n = sample size, N = population size, *e* = error (0.05) reliability level 95% or 1.95,*e* = level of precision always set the value of 0.05. Extent of use of information and communication technologies by the farmers in modernizing agriculture was the dependent variable in this study. Extent of use of information and communication technologies by the farmers in modernizing agriculture was the dependent variable in this study. While 13 characteristics of the farmers were independent variables. Use of information and communication technologies by the farmers was measured by using a frequency scale ranging from 'not use at all' to 'frequently use' (0-4) against nine different types of ICTs. All these variables were measured by computing by appropriate scores. Item analysis was needed to develop a measuring scale for some particular variables. To describe both dependent and independent variables, a variety of statistical measures were needed, including range, mean, percentage, and standard deviation coefficient of variation. Relationships were shown using regression analysis, t-test analysis, and the coefficient of correlation.

3. RESULTS AND DISCUSSION

3.1 The extent of use of information and communication technologies by the farmers

Selected 9 items related with use of information and communication technologies were the factors to use of information and communication technologies by the farmers (dependent variables). Use of information and communication technologies by the farmers was measured by using a frequency scale ranging from 'not use at all' to 'frequently use' (0-4) against nine different types of ICTs. All these variables were measured by computing by appropriate scores. Selected 9 items related with use of information and communication technologies were the factors to use of information and communication technologies by the farmers (dependent variables). An index was used to measure the extent of use of

information and communication technologies by the farmer were use of (i) Mobile phone (voice call, SMS, etc.), (ii) Internet, (iii) Computer/Laptop/ Tab / Smartphone/ other communication device, (iv) YouTube/Facebook/ Messenger/Imo/Krishi Apps/What Sapp, (v) Union Development Centre (UDC), (vi) Agricultural Information Communication Center (AICC), (vii) Farmer's Help Line (Call center) [Krishijigyasha(7676), BanglalinkKrishibazaar (2474), GP Krishisheba(27676), Agricultural Call Center(16123),Krish ok Bondhu Phone Sheba(3331)], (viii) Farm related TV Programme and (ix) Farm related Radio Programme.

The computed scores of use of information and communication technologies by the farmers in the study area ranged from 1 to 18 being the mean, standard deviation and coefficient of variation for 7.9, 4.3 and 18.5 respectively against possible score of zero (0) to 48. Respondent farmers were classified into three categories and found such as low (17.36 %), medium (58.03 %) and high (24.61 %) use of information and communication technologies. The data also revealed that majority (82.64 percent) of the farmers had medium to high level but almost three-fourth (75.39) had medium to low level of use of information and communication technologies. The result of dependent variables shows the extent of use of information and communication technologies by the farmer.Study have consistency with the findings of Ahmed [6], Islam [8], Haque [9] and Uddin [10].Information and communication technology were used moderately to heavily by more than three-fourths of the respondents. In general, the respondents' level of information and communication technology usage in the research region was good. Training improves farmers' knowledge and skills and alters how they utilize information and communication technology in a particular region. First of all, training broadens farmers' knowledge, which raises their awareness, mental acuity, and practical familiarity.

Table 1. Distribution of the farmers according to their the extent of use of information and communication technologies by the farmers

Dependent variable	Percentage of Category			Range	Mean	SD	CV
	Low use	Medium use	High use				
Use of information and communication technologies	17.36	58.03	24.61	01-18	7.9	4.3	18.5

3.2 Characteristics of the Farmers

Human characteristics are the bundle of habits. These characteristics attributes make a man into an individual, individual to others, separated from individual to individual, from community to community even from nation to nation. Behavioral pattern of a man is the aggregation of his characteristics. In spite of the influence of geographical location, local culture and customs on human characteristics but individual to individual has a sharp difference among these characteristics which might have considerable influence of farmer's behaviourable changes that accures to farmers use of information and communication technologies. But it is necessary to limit the number of independent variables (here 13 are selected) so that all the influencing factors of use of information and communication technologies cannot be dealt within a single study which are age, education, farm size, training experience, supervision of crop production, agricultural knowledge, ICT ownership,

ICTknowledge, family size, formal group affiliation, cosmopoliteness, communication exposure and risk orientation

A more illustrative description of the findings in respect of above mentioned characteristics were as follows:

3.2.1 Age

The average age of the farmers in the research region was 42.02 years, with a standard deviation of 11.0 and a coefficient of variation of 120.95. Their ages varied from 18 to 75 years. The majority of farmers (53.11%) were middle-aged, while 25.13 percent were young and 21.76 percent were old. Ahmed [6], Razia [7], Islam [8], Haque [9], Uddin [10], Uddin [11], Islam [12], Rahman [13], Farhad [14] and Rashid [15] also found the similar findings in their study.

3.2.2 Education

The farmers had an average of 8.43 years of education, a standard deviation of 4.01 and a coefficient of variation of 19.09, with a range of 0.00 to 18 years. Of the farmers, over two-thirds (69.95 percent) had completed secondary school or above. Only signatory 0.00 percent and no education of 1.55 percent while more than one fourth (28.50 percent) of the ICT user farmers belonged to primary education level. The overwhelming majority (98.45 percent) of the respondents was literate (from primary level to above secondary level). Haque [9], Uddin [11] Islam [12], Rahman [13] and Rashid [18]. This result also shows that the respondents' educational attainment was comparatively higher than the average for the country, which is 77.9 [16]. In addition to the government, many NGOs have now created schools and offered financial aid to help them open. The government has taken action to give women with stipends free education up to twelve classes. It was noted that there were numerous NGOs operating in the research area, and that activities for children's education were supported by effective communications facilities. Along with the improvement in socioeconomic standing, high-value crop farming has led to agricultural diversification. Academic achievement has also been linked to the respondents' gradually growing income-generating activities. The process of influencing others to behave in a desired way is called education. Their behavior and attitude change as a result of it. Through developing their perceptions and practices in their agricultural expertise, education aids farmers in expanding their mental horizons and outlook. A person with greater education is probably more open to the latest advancements. Having more education may help them make decisions about solving problems or integrating technology into their daily lives. As a result, education increases the propensity to adopt and stimulate perceptivity. The farming community in the research region can therefore be regarded as an appropriate site for the implementation of agricultural technologies or the use of the most recent information that farmers have access to as production technologies.

3.2.3 Family size

The family size of the respondents varied from 2 to 15, with an average of 4.9, a standard deviation of 1.83, and a coefficient of variation of 3.35. The respondent farmers were categorized into three groups according to their family size. The majority of respondents, accounting for 76.94 percent, belonged to small families, while 18.91 percent had medium-sized families and 4.15 percent had large families. Data indicated that the average family size (4.9) of respondent has higher than the national average 4.26 [23]. The results indicated that 95.85 percent of the participants reported having a small to medium family size. Haque [9], Uddin [11] and Rahman [13] also found the similar findings in his study.

3.2.4 Training experience

Training experience of the respondents were found 0 to 20 days in a year with a mean of 1.1, standard deviation 2.21 and coefficient of variation 4.89. Four categories were found less than half of the farmers (45.78 %) had training experience from low to high but no training experience in 54.15 percent. Uddin [11] and Rahman [13] also reported similar types of findings in their studies.

3.2.5 Supervision of crop production

The range of available scores for crop production supervision was 5 to 45, with a mean score of 27.87, standard deviation of 6.11, and coefficient of variation of 37.31. The majority of farmers (74.73 percent) had medium level monitoring for crop production, according to the classified categories, while 13.73 percent had low supervision and 11.66 percent had high supervision. The findings of the study have consistency with the findings of Uddin [11], Rahman [13] and Hamidi [17]

3.2.6 Agricultural knowledge

The scores for knowledge on agriculture varied between 13 and 44, with a possible range of 00 to 45. The mean score was 29.40, accompanied by a standard deviation of 6.03 and a coefficient of variation of 36.31. Farmers were classified into three distinct categories: low, medium, and high knowledge in agriculture. A significant majority of the respondents, 68.13 percent, fell into the medium category, while 18.39 percent exhibited high agricultural knowledge and 13.47 percent were classified as having low agricultural knowledge. Such findings also supported by Uddin [11], Rahman [13] and Muttaleb [19] in their studies reported similar types of findings in their studies.Agricultural knowledge helps the farmers to grow crops by using information and communication technologies and modern agriculture practices.

3.2.7 ICT Ownership

The ICT Ownership scores varied from 00 to 12, with a mean of 7.04, a standard deviation of 1.60, and a coefficient of variation of 2.57. Farmers were categorized into three distinct groups: low, medium, and high ICT ownership. A significant portion (87.31%) of the farmers fell into the medium category, while 4.15 percent were classified as low and 8.55 percent as high in terms of their ICT ownership. Haque [9] and Mahmood [20] also reported comparable results.For welfare of the society ICT Ownership, should be high. ICT Ownership have a close relationship and interacts with use of information and communication technologies by the farmers in modernizing agriculture. So, it is necessary to available ICT materials at low cost.

3.2.8 ICT knowledge

The data on ICT scores varied from 0 to 20, with potential scores ranging from 00 to 22. The mean was calculated at 31.01, with a standard deviation of 5.36 and a coefficient of variation of 28.76. Farmers were categorized into three groups based on their level of knowledge regarding ICT user technologies: low, medium, and high. A significant majority of the respondents, 64.25 percent, exhibited a medium level of knowledge, while 10.36 percent demonstrated high knowledge and 25.39 percent showed low knowledge. The current findings align with those reported by Bhuyian [21].Utilizing information and communication technology in a suitable way to modernize agriculture requires farmers to possess ICT knowledge. To modernize agriculture, farmers must employ information and communication technology, but identifying their ICT knowledge is a difficult task. Farmers can more readily implement information and communication technology use in their region if they possess greater ICT knowledge. It was anticipated that farmers' positive usage of information and communication technology (ICT) knowledge would be reflected in their modernization of agriculture.

3.2.9 Farm size

The farm size scores of the farmers in the study area varied between 0.04 and 16.47 hectares, with an average of 0.95 hectares, a standard deviation of 1.11, and a coefficient of variation of 1.23. Framers were categorized into five distinct groups according to their farm size: landless, marginal, small, medium, and large. A significant majority, specifically 62.44

percent, of the farmers operated small farms, while there were no landless farmers, 5.70 percent classified as marginal, 28.50 percent as medium, and 3.37 percent as large farmers. This finding aligns with the work of Uddin [11], Rahman [13], and Hamidi (2004).The average farm size is larger in the Barind area because of the low population density. However, as small and medium-sized farmers made up the majority of the farmers in the research region, the government, extension development agencies, and non-governmental organizations should focus on implementing programs for them on a priority basis.

3.2.10 Formal group affiliation

The respondents' formal group affiliation ratings ranged from 0 to 14, with a mean of 1.57, a standard deviation of 2.25, and a coefficient of variation of 5.08.Farmers were classified into four categories and found as the highest proportion (48.19 percent) had no formal group affiliation compared to 45.85, 5.44 and 0.52 percent low, medium and high formal group affiliation respectively. The present findings had similarity with that of Uddin (2012), Islam (2010) and Rahman (2008).

3.2.11 Cosmopoliteness

The cosmopoliteness scores of the respondent ICT user farmers varied from zero (0) to 16, within a possible range of zero (0) to 36. The mean, standard deviation, and coefficient of variation were recorded as 5.98, 3.25, and 10.57, respectively. The classification of farmers revealed three distinct categories: low cosmopoliteness at 15.80%, medium cosmopoliteness at 68.13%, and high cosmopoliteness at 16.06%. The findings agreed well with the study of Ahmed (2017), Uddin (2015), Uddin (2012), Rahman (2008), and Hamidi [17].This might be due to the fact that road transport and communication network in Bangladesh has considerably been developed in recent years. Rural communication system has been also improved much, which enables the rural people to keep them in close contact with Upzilla, district head-quarters and other places.

3.2.12 Communication exposure

The extension media contact scores of the respondents varied from 1 to 54, with a possible score range from zero (0) to 100. The calculated mean was 20.98 with standard deviation 10.62 and co- efficient of variation112.82. Farmers were classified into three categories based on their extension media contact scores: low extension media contact (10.62%), medium extension media contact (75.39%), and high extension media contact (13.99%). The findings agreed well with the study of Ahmed [22], Uddin [10], Uddin [11], Rahman [11], and Hamidi [17].Several improved technologies and new innovations have been developed by different research organizations. But these technologies will be unused until the ideas are communicated rightly to the farmers who are the actual users.

3.2.13 Risk orientation

The respondents' risk orientation scores varied between 13 and 42, with potential scores ranging from 0 to 56. The computed mean was 30.93, accompanied by a standard deviation of 5.49 and a coefficient of variation of 30.11. The observed scores led to the classification of respondent farmers into three categories: low risk orientation at 13.21%, medium at 69.43%, and high at 17.36%. The finding has the similarity with the study of Uddin (2012), Rahman (2008), and Hamidi (2004).High risk oriented farmers have the ability to encounter risk and uncertainty by new idea. Risk bearing farmers generally have large farm size and higher annual income. Thus, majority of the farmers were at satisfactory level of risk orientation and it was expected that favorable the use of information and communication technologies would be reflected from risk oriented farmers.

Table 2. Results of characteristics of respondent farmers in a sample

Characteristics with Categories	Percentage of Category	Range	Mean	SD	CV

1	Age-young, middle and old	25.13	53.11	21.76			18-75	42.02	11.00	120.95
2	Education-no, signature only, primary, secondary and above secondary	1.55	0.00	28.50	41.71	28.24	0-18	8.43	4.01	16.09
3	Family size-small, medium and large	76.94	18.91	4.15			2-15	4.90	1.83	3.35
4	Training experience -no, low, medium, high and very high	54.15	43.78	0.52	0.52	1.04	0-20	1.10	2.21	4.89
5	Supervision of the crop production-low, medium and high	13.73	74.61	11.66			5-45	27.87	6.11	37.31
6	Agricultural knowledge -low, medium and high	13.47	68.13	18.39			13-44	29.40	6.03	36.31
7	ICT ownership-low, medium and high	4.15	87.31	8.55			0-12	7.04	1.60	2.57
8	ICT knowledge-low, medium and high	25.39	64.25	10.36			0-20	5.56	4.03	16.27
9	Farm size-landless, marginal, medium and large	0.00	5.70	62.44	28.50	3.37	0.04 - 16.47	0.95	1.11	1.23
10	Formal group affiliation-no, low, medium and high	48.19	45.85	5.44	0.52		0-14	1.57	2.25	5.08
11	Cosmopoliteness-low, medium and high	15.80	68.13	16.06			0-16	5.98	3.25	10.57
12	Communication exposure-low, medium and high	10.62	75.39	13.99			1-54	20.98	10.62	112.82
13	Risk orientation-low, medium and high	13.21	69.43	17.36			13-42	30.93	5.49	30.11

Table 3. Correlation between independent and dependent variables (N=386)

Dependent variables	Independent variables	Correlation coefficient (r)
Use of information and communication technologies	1. Age	-0.022 ^{NS}
	2. Education	0.168**
	3. Family size	0.081 ^{NS}

4. Training experience	-0.009 ^{NS}
5. Supervision of crop production	0.059 ^{NS}
6. Agricultural knowledge	0.453**
7. ICT ownership	0.227**
8. ICTknowledge	0.367**
9. Farm size	0.198**
10. Formal group affiliation	0.061 ^{NS}
11. Cosmopoliteness	0.390**
12. Communication exposure	0.326**
13. Risk orientation	0.378**

*** Significant at 0.01 level, * significant at 0.05 level,^{NS} Not Significant*
Source: collected and calculated from data of sample

3.3 Relationship between the selected characteristics and use of information and communication technologies

As it was shown in Table 2, the use of information and communication technologies (dependent variable) had a significant positive relation with 8 factors such as: education 0.168**, agricultural knowledge 0.453**, ictownershi 0.227**, ICT knowledge 0.367**, farm size 0.198**, cosmopoliteness 0.390**, communication exposure 0.326** and risk orientation 0.378**. On the other hand, five characteristics (independent variables) like age -0.022^{NS}, family size 0.081^{NS}, training experience -0.009^{NS}, supervision of crop production 0.059^{NS} and formal group affiliation 0.061^{NS} had insignificantly relationship with use of information and communication technologies (Table 3).

The correlation coefficient demonstrated significance for the aforementioned eight independent variables in relation to the use of information and communication technologies, whereas the remaining five characteristicss showed no significant correlation. Based on the computed 'r' value, the concerned null hypothesis was rejected for the above mentioned significant (positive) characteristics and accepted in case of insignificant.

The research depended on collected several related literatures and selected only 8 relevant characteristics that would be played a vital role to use of information and communication technologies. But five variables (age, family size, training experience, supervision of crop production and formal group affiliation) showed insignificant relation might be due to locality, respondents of the study area, their socio-economic condition, and previous experience to use of information and communication technologies.

4. CONCLUSION

This should briefly state the major findings of the study.If you are using copy-paste option theAmong 13 selected characteristics use of information and communication technologies had significant positive relationship with 8 characteristics such as: education, agricultural knowledge, ICT ownership, ICT knowledge, farm size, cosmopoliteness, communication exposure and risk orientation. Rest five characteristics (age, family size, training experience, supervision of crop production and formal group affiliation) showed non-significant relation.Consequently, it may be concluded that improvements in the diversity of ICTs in several aspects will not be possible unless effective steps are taken to raise their expectations. As a result, both governmental and non-governmental groups should make an effort to plan initiatives that will raise knowledge and improve attitudes around the usage of ICTs.

5. RECOMMENDATIONS

It is essential to focus on the eight characteristics mentioned above that hold positive significance in order to enhance the effectiveness of information and communication technologies, ultimately paving the way for modern agriculture. Gradually use of information and communication technologies is increasing with the positive growth of yield and production. The application of information and communication technologies has the potential to enhance yield, which is associated with the average national yield. The utilization of information and communication technologies tends to positively influence the growth of production. The anticipated increase in the utilization of information and communication technologies is aimed at enhancing production and achieving optimal yield. Therefore, to attain the experimented yield achieved by specialists, it is essential that farmers utilize information and communication technologies at a high level. Therefore, there is significant potential to enhance yield, contingent upon farmers' willingness to adopt precision practices and effectively utilize information and communication technologies. The findings indicate that the overall utilization of information and communication technologies among the farmers in the study area will not see improvement unless significant and effective measures are implemented to enhance their access to diverse agricultural information sources. Consequently, there is a need for substantial support and a unified approach from the government, non-governmental organizations, and other stakeholders who can effectively leverage information and communication technologies to advance agricultural modernization.

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