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Effect of Information Communication Technologies (ICTS) and its Constrains with Adaptations Through Agricultural Sector of Southern Bangladesh

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Abstract: The study was conducted to pursue the role of Information and Communication Technologies (ICTs) in agricultural development in Bangladesh. The data were collected from 50 randomly selected farmers from four unions of Noakhali at southern Bangladesh. A mixed method research design was used to determine the role of ICTs. The findings of the study revealed that the majority of the respondents (80%) had observed medium role of ICT (Information and Communication Technology) in agricultural activities followed by 18% and 02% had high and low role of ICTs respectively. Correlation analysis indicated that among the selected socio- economic condition, respondent's education, household assets, annual family income, communication exposure and agricultural training showed positive and significant relationship with the role ICTs. On the other hand, age showed negative significant relationship while credit received showed no significant relationship with the role of mobile phone for improving livelihood. It was found that the large portion (80%) of the farmers had faced medium to high constraints and they were in the categories of middle to old aged in adoption ICTs.

Key words: Icts · Respondents · Correlation · Livelihood · Constrains

INTRODUCTION

ICT in agriculture is an emerging field focusing on the enhancement of agriculture and rural development. It involves applications of innovative ways to use ICT in rural domain. The advancement in ICT can be utilized for providing accurate, timely, relevant information and services to the farmers, thereby facilitating an environment for more remunerative agriculture. However, all the ICT initiatives are not uniform with disparities between regions in the level and quality of telecommunications, information and the effort of individuals, public and private organizations and differentiated nature of demand of the farmers in different areas. As a result, there have been many successes, failures, lessons learned and experience gained, so far. While these initiatives are intended to address the needs of the farmers through ICT, their actual usage and their ability to bring significant impact on the farm productivity and socio-economic development of the intended beneficiaries actually use the facilities provided for them meaningfully to meet their needs [1].

The common problems in adoption of ICT in rural segments are ICT illiteracy, availability of relevant and localize contents in their own languages, easy and affordable accessibility and other issues as awareness and willingness for adoption of new technologies among the rural peoples etc. [2]. Most of the farmers of Bangladesh are still lack of information and modern agricultural knowledge. ICT creates opportunities for rural farmers to obtain information and knowledge about agricultural issues, problems, production and suggestions to develop the agricultural market. Mobile services in agricultural sector provide more information on weather, transport service, agricultural techniques and market that helps to contact with the agencies and department [3]. Being located in South Asia, Bangladesh is an Islamic country with a young and rapidly growing population of 164 million [4]. With more than 30 % of the citizens living below the poverty line, the country's GDP per capita ranks among the lowest in the world. The economy mainly depends on agriculture and the production of apparel and garments with little development of other industries. However favorable demographic and macro-economic

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trends, high economic growth rates (6.3 %) and a relatively liberal investment climate have convinced to identify Bangladesh as one of the most attractive emerging economies [5]. Large data and information can be effectively generated, stored, analyzed, disseminated and used to upgrade agriculture by inclusion of Information and Communication Technology. It may increase production many folds by providing prompt, reliable and locality-based information services to the farmers [6]. Information is considered a vital resource alongside land, labor, capital and skills. People need information for their day-to-day activities and for the development of their environment and describe knowledge and information as the cornerstone of successful socio-economic development because it plays a key role in decision making [7]. Access to and usage of information is necessary for improving rural people's livelihood [8].Conventional production system is becoming the greatest threat in the history of humanity. Bangladesh is one of those countries that have been fighting against food security threat for the last few decades. Every year it is losing a valuable amount of GDP due to severe natural disasters, like flood, cyclone, riverbank erosion, salinity etc. increase the loss by inadequate supply of information [9].

Moreover, Farmers Don't Use the Knowledge of ICTs Properly in Agriculture Field: Farmers can get the protection strategies of various pest and diseases from internet, agriculture related program arranged by television channels, mobile contact with upazilla (Sub city) agriculture department and AEO, questioning various experts on problems via face book, twitter, email etc. Several dailies publish news on agricultural production and comparative status of agriculture in home and abroad with policy of success. Farmers should read newspaper regularly to remain up to date with modern production strategies [10]. This research will specially help the farmers to know how to adopt the different ICT tools in agricultural practices. It will also help the planners, policy makers and concerned people to learn about the adoption practices of ICT taken by various levels' farmers against conventional cultivation method. This will help the policy-planners in preparing plan to increase the farmers' income, food security and well-being in response to modern technology at field level. It will also make the concerned people aware of thinking about various alternatives to adapt ICT tools with the problems faced by traditional tools. It is exploratory in nature and the study covered two upazilla Sadar and Begumgonj of Noakhali. In view of aforesaid research questions, the following objectives were formulated to identify the existing ICT technologies used in agricultural development and to know the role of ICT in agricultural development with the barriers faced by farmers during ICT technologies adoption.

MATERIALS AND METHODS

Study Area: Study area was selected after methodological approach and design of the study, sampling design, methods and procedures used for data collection, validity and reliability of the study and different variables and their measurement procedures used for data analysis. Sadar and Begumgonj upazilla under Noakhali district were the study areas. Four unions namely Kadir Hanif, Noannur of Sadar Upzila and Sorifpur, Kadirpur of Begumgonj upazilla were selected as research areas.

Experimental Design: This study employed both quantitative and qualitative research approaches in order to get a comprehensive view of the complex issues of factors influencing the role of ICT in agricultural development of Bangladesh. Qualitative methods such as focus group discussions and Key Informant Interviews (KII) were used. The quantitative survey approach was used. Thus, a mixed method research design was applied to determine the extent of ICT adoption in farming practices by the farmers (Fig. 2).

Sampling Design: Most of the farmers in studied areas are smallholder farmers and around 100 small farmers live in each village [11]. The total target population was 250, out of which 20 % population were selected from two upazilla as sample. Hence, the sample size was 50.

Research Instruments: The questions in this schedule were formulated in a simple and unambiguous way and were arranged in a logical order to make it easily understandable to the respondents. The survey instrument was developed in English. Two key informants were also interviewed for gathering their expert views about role of ICT in agricultural development of Bangladesh (Fig. 3)

Data Collection Methods

Survey: The researcher first established rapport with the respondents and clearly explained the objectives of the study using local language as far as possible.

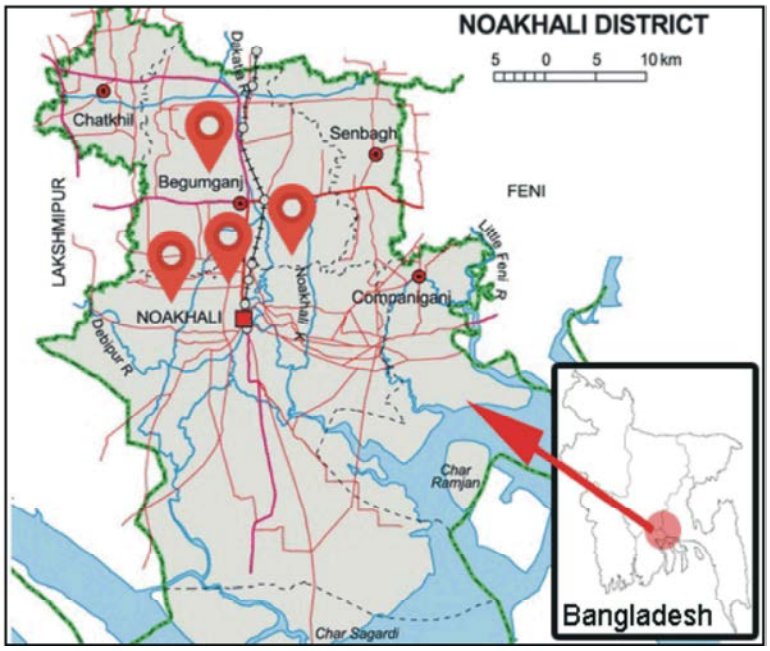

Fig. 1: Study area with GPS icon marking

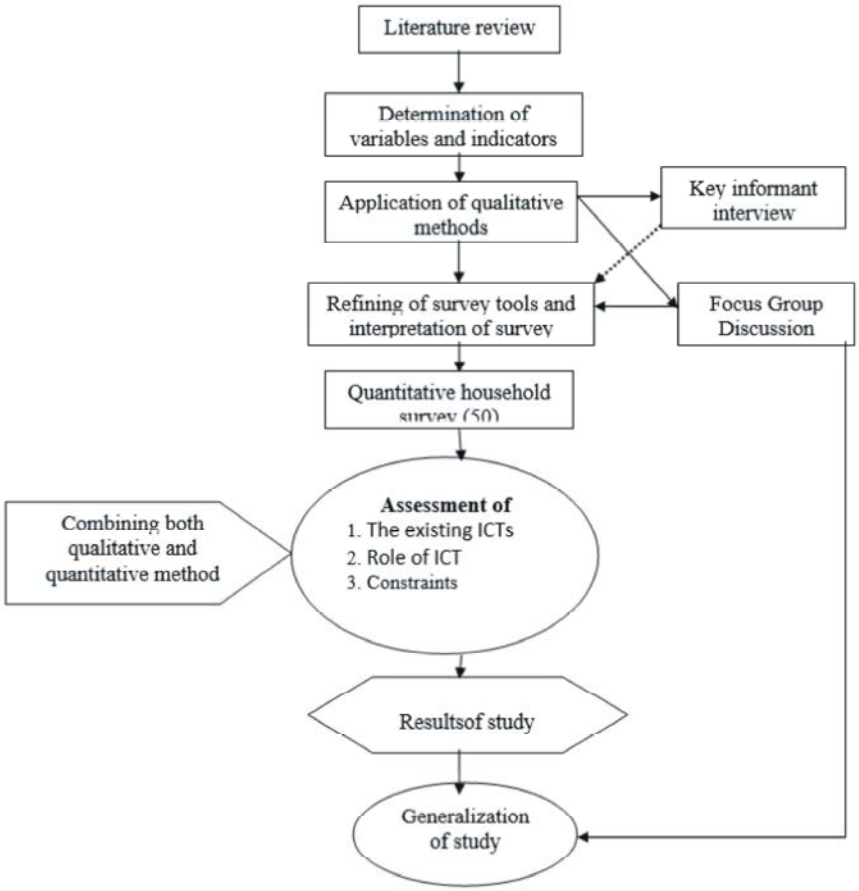

Fig. 2: Mixed-Method Research Design for the Study

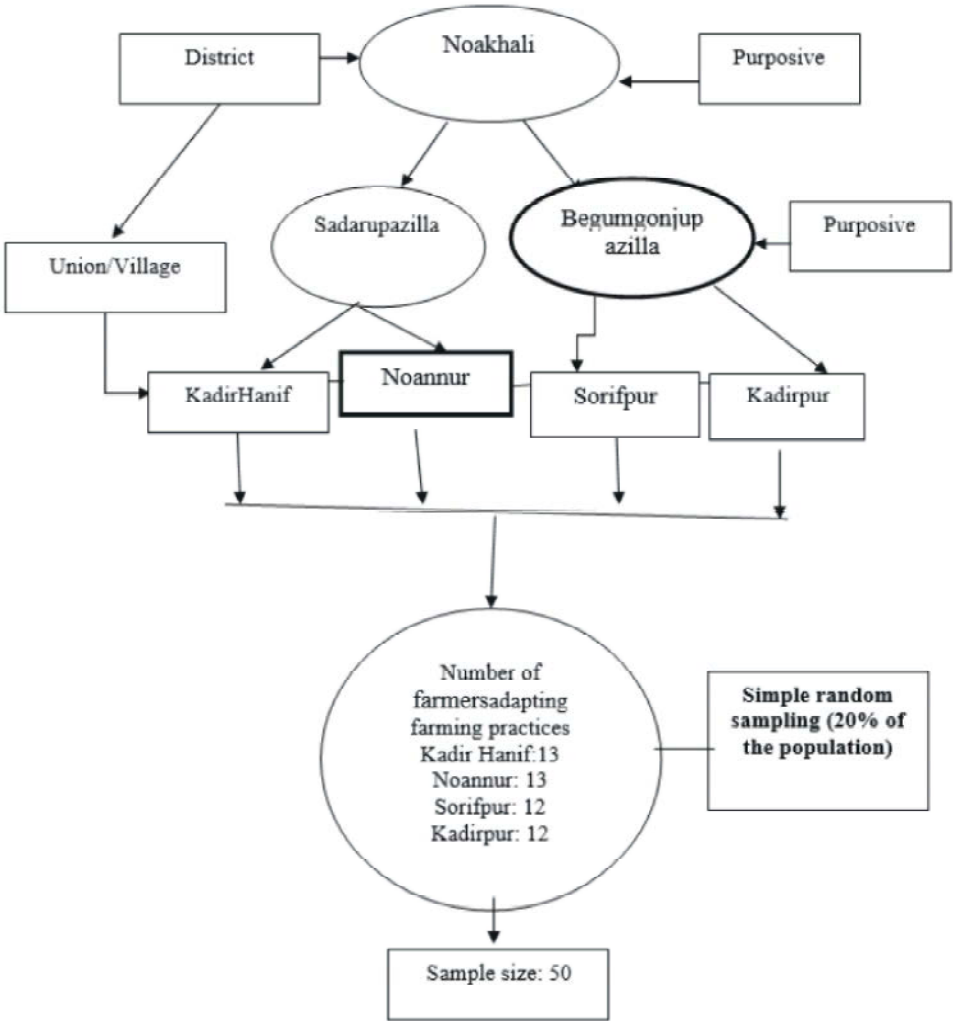

Fig. 3: Sampling Design and Data Collecting Methods

The questions were clarified whenever any respondent had difficulties in understanding. Excellent cooperation was received from the respondents and other people of the study area.

Focus Group Discussions (FGDs): One session was conducted in each upazilla, each group comprising of 10 participants. A semi-structured questionnaire was used to conduct FGDs. In FGD sessions, the researcher acted as facilitator and was supported by two assistants. The survey instrument was refined based on the results of the FGDs. The additional information gathered from the FGDs was used for interpreting the results of survey.

Interviews with Key Informants: The key informants were the Agriculture Extension Officer (AEO) and model farmer of the locality.

Processing of the Primary Data: Collected primary data were coded and taken into SPSS (Statistical Package for Social Science) software package (16.0 Version). This package helps to perform a wide range of statistical analyses.

Secondary Data: In order to develop conceptual basis of study, the researcher collected information from different relevant sources, such as books, journals, theses, abstracts, reports and websites. The researcher also collected documents from various organizations like Upazilla Agriculture Office for this purpose.

Measurement and Analysis of Variables: A dependent variable varies as the experimenter introduces, removes or varies the independent variables [12]. The role of ICT by the smallholder farmers in response to climate change is

considered as the dependent variable. The independent variables of the study were age, level of education, household assets, annual family income, credit received, communication exposure and agricultural training received by the farmers in the study area. Procedure for measuring independent variables has been presented below.

Measurement of Dependent Variable: The variable was measured on the basis of different aspects of adoption. The adoption score was computed on the basis of the respondents' adoption on 12 aspects. The following adoption practices (e.g. Newspaper, Leaflet, Telephone/ Cell phone, Satellite, Smart phone / Mobile, Video conferences, Computer, Poster, Solar panel, Radio, Television, GIS, Internet, Sensor network, Social media [Face book, Twitter etc.] etc.) were selected on the basis of two FGDs and two KIIs conducted in the study area prior to develop interview schedule.. A-four point rating scale was developed to measure the extent of adoption of the farmers. The extent of adoption was computed by adding all scores obtained from 12 types of adoption practices followed by the farmers.

Measurement of Independent Variables: Seven characteristics of the farmers were selected as independent variables of the study. The procedures followed to measure these independent variables are briefly presented here.

Age: Age of the respondents was measured in terms of actual years from their birth to the time of interview. A score of one (1) was assigned for each year of one's age.

Level of Education: Education of respondents was measured on the basis of classes he had passed in formal educational institution.

Household Assets: The assets were first calculated in numbers and then its value was converted into USD

Annual Family Income: The income was expressed in USD.

Credit Received: Credit availability of a respondent was defined as the degree to which this credit requirement was fulfilled by the amount of credit actually received by him during last year.

Table 1: Qualitative Data is transformed to quantitative data

Role of ICTs	Score assigned
Highly agree	3
Moderately agree	2
Somewhat agree	1
Not at all	0

Table 2: Qualitative Data is transformed to quantitative data

Extent of information	Score
Regularly	3
Occasionally	2
Rarely	1
Not at all	0

Communication Exposure: The extent of information was determined against four (4) point rating scales as regularly, occasionally, rarely and not at all and score was assigned to represent the same as 3, 2, 1 and 0 respectively. For all the fourteen selected information sources, it has been described as tabulated form (Table 1 and 2).

The extent of information was computed by adding all scores obtained from 14 sources of information used by the farmers. The information score of the respondents ranged from 0 to 42 where 0 indicating no access to information and 42 indicating full access to information.

Agricultural Training Received: Agricultural training experience was measured by the total number of days of a respondent received training in his entire life under different agricultural training programs.

Statistical Analyses: The coded data were put into the computer for statistical analyses. The SPSS computer program was used for analyzing the data. Various descriptive statistical measures such as range, frequency, number, %age, mean, standard deviation (SD), coefficient of variation (CV) and rank order were used for categorization and describing the variables. Pearson's product moment correlation coefficient (r) was utilized both for data evaluation and hypotheses testing.

Pearson's Product Moment Correlation Coefficient (R): In order to test the formulated hypotheses of the study, Pearson's product Moment Correlation Co-efficient (r) was used. The formula of pearson's product moment correlation coefficient (r) is given below.

$$r_{xy} = \frac{\Sigma(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\Sigma(x_i - \bar{x})^2 \Sigma(y_i - \bar{y})^2}}$$

where,

r_{xy} = Pearson's product moment correlation coefficient
$\bar{x}$ and $\bar{y}$ = Means of the variables x and *y,* respectively

RESULTS AND DISCUSSION

This chapter deals with the results of the study. The findings and discussion have been presented in this chapter according to the objectives of the study. Necessary explanation and interpretations have also been made showing possible and logical basis of the findings whenever necessary.

Age: The age of the farmers ranged from 26 to 70 years. The mean age of the farmers was 46.54years when standard deviation was 11.27. The data presented in (Table 3) indicate that the highest portion of the respondents (62 %) were middle aged compared to 22.0 % of the respondents were young and only 16 % were old. This means that the highest portion (84%) of the farmers were young to middle aged group. Medium aged farmers are more concerned about adaptation with climate change and new technology [13].

Level of Education: The level of education of the farmers varied from 0 to 16 years of schooling, the average being 5.32 with a standard deviation 4.18. Data furnished in (Table 4) show that the highest proportion (40.0%) of the respondents had primary education followed by 34.0% having secondary education while 6.0% had Above secondary and 20.0 % of the farmers have no education. The results indicated that a large majority (40.0 %) of the farmers has primary education. The information of above table reveals that the minimum number of farmers has the ability to improve livelihood by using ICTs because of lack of proper education [14].

Household Assets: The household assets of the farmers ranged from 1 USD to 23989.44 USD with a mean of 310.66 USD and standard deviation of 28.49. Based on the household assets the respondents were classified into three categories: 'low (up to2398.94 USD.)', 'medium (2398.95 - 5997.36 USD.)' and 'high (above 5997.36 USD.)' (Table 5).

From (Table 5) it is evident that majority (60%) of the farmers had low amount of household assets while 30% of the farmers had medium household assets. It is noted that only 10% of the farmers had high household assets. This means majority (90 %) of the farmers had low to medium household assets. The farmers of these categories are not energetic and not cosmopolite enough and may not have positive awareness towards the use of ICT. The majority of agriculture in the region takes the form of subsistence grain production, providing the bulk of household income in the inter-revering communities [15].

Annual Family Income: The annual income of the farmers ranged from 0.5 USD to 3850.30 USD with an average of 1007.55 USD and standard deviation was 5.01. Based on the annual income, the respondents were classified into three categories, 'low (up to 719.68 USD)', 'medium (731.67 USD – 1199.47 USD)' and 'high (above1199.47 USD)' and presented in (Table 6).

Data presented in (Table 6) indicate that the majority (40.0 %) of the respondents had low annual income, while 38.0% having medium annual income and only 22.0% of the respondents had high annual income. Researcher researched on innovation linked to cultural and family income [16].

Credit Received: The credit received by the respondents ranged from0 USD to 1199.47 USD. The average was 196.71 USD and standard deviation was 19.4. Based on credit received all the respondents were divided into four groups, `no credit'(0 USD), `low credit ' (up to 419.81 USD), `medium credit ' (431081 USD – 839.63 USD) and` high credit ' (above 839.63 USD) and presented in (Table 7).

Data presented in (Table 7) show that a large portion (42.0%) of respondents received no credit, followed by 38.0% received low amount of credit, 14.0 % of respondents received medium amount of credit, while only 6.0% received high amount of credit. This means that the young and middle aged respondents get the majority of credit with a view to adopt ICT in agricultural development. Credit receiving is positively suited to agricultural production [13].

Communication Exposure: The exposure of communication score of the farmers ranged from 0 to 42. The average score was 19.78 with the standard deviation was 8.10.

The information of (Table 8) indicate that majority (50.0%) of the farmers maintained moderate type of communication exposure for the role of ICT while 34.0% maintained low profile of communication exposure and 16.0 %of the farmers had high profile of communication exposure. This means that majority (66.0%) of the farmers have maintained medium to high contact with various information sources in getting information.

Table 3: Distribution of the farmers according to their age

Categories (years)	No.	%	Mean	Standard deviation
Young (18-35)	11	22.0	46.54	11.27
Middle aged (36-55)	31	62.0		
Old (above 55)	08	16.0		
Total	50	100.0		

Table 4: Distribution of the farmers according to their level of education

Categories	No.	%	Mean	Standard deviation
Illiterate (0)	10	20	5.32	4.18
Primary (1-5)	20	40		
Secondary (6-10)	17	34		
Higher secondary (11-12)	1	2		
Above higher secondary (Above 12)	2	4		
Total	50	100.0		

Table 5: Distribution of the farmers according to their household assets

Categories (USD)	No.	%	Mean	Standard deviation
Low (up to2398.94)	30	60	310.66	28.49
Medium (2398.95 – 5997.36-500)	15	30		
High (above5997.36)	5	10		
Total	50	100.0		

Table 6: Distribution of the farmers according to their annual family income

Categories (USD)	No.	%	Mean	Standard deviation
Low (up to719.68)	20	40	1007.55	5.01
Medium (731.67-1199.47)	19	38		
High (above1199.47)	11	22		
Total	50	100.0		

Table 7: Distribution of the farmers according to their credit received

Categories (USD)	No.	%	Mean	Standard deviation
No credit (0)	21	42	196.71	19.4
Low credit (up to 419.81)	19	38		
Medium credit (431.81-839.63)	7	14		
High credit (above839.63)	3	6		
Total	50	100.0		

Table 8: Distribution of the farmers according to exposure of information

Categories	No.	%	Mean	Standard deviation
Poor communication exposure(upto15)	17	34	19.78	8.10
Medium communication exposure(16-30)	25	50		
High communication exposure(31 and above)	8	16		
Total	50	100.0		

Table 9: Distribution of the farmers according to their training exposure

Categories	No.	%	Mean	Standard deviation
No training (0 days)	31	62		
Short duration training exposure (1 -2 days)	15	30	1.08	1.82
Medium duration training exposure (3-5 days)	3	6		
Long duration training exposure (above 5 days)	1	2		
Total	50	100.0		

Table 10: Distribution of farmers according to the role of ICT

Categories	No.	%	Mean	SD
Low role (up to 15)	1	2	25.16	5.35
Medium role (16-30)	40	80		
High role (above 31)	9	18		
Total	50	100.0		

Table 11: ICT technologies used by the farmers in agricultural development

Use of ICT technologies	% ICT technologies	Rank order
Newspaper	76	2
Smart phone	40	4
Television	94	1
Cell phone	70	3
Radio	8	5
Internet	2	6
Social media	2	6
Leaflet	2	6
Computer	2	6
Satellite	00	7
Video conferences	00	7
Poster	00	7
Solar panel	00	7
Geo-graphical information System (GIS)	00	7
Sensor network	00	7

Farmers, who are more adapted with communication, can easily overcome with climate change [13]. To cope up with these changes timely, relevant and accurate information to the farmers and other stakeholders will help them take optimum decisions [17].

Agricultural Training Received: The training exposure score of the farmers ranged from 0 to 9 days. The average score was 1.08 days and standard deviation was 1.82.

The data of (Table 9) show that a majority (62.0 %) of respondents received no training, while 30% of the respondents received short duration training, 6% of respondents received medium duration training, while only 2 % received long training. Training is important for environmental concern for green products [18].

Role of ICTs in Agricultural Production: The ICT role change as observed by the respondents ranged from 0 to 36. The mean was 25.16 when standard deviation was 5.35. The data presented in (Table 10) indicate that ICTs had medium role to the highest portion of the respondents (80.0 %) while 18% of the respondents had observed high role and only 2% had observed low role. Technologies have positive impact on agriculture production by reducing weeds [19]. Technologies in agriculture are significantly related with economic growth [20].

ICT Technologies Used by the Farmers in Agricultural Activities: The findings of the study revealed that 20% farmers of studied areas frequently use newspaper, 34% farmers read newspaper occasional occasionally while 22% farmers rarely read newspaper and rest 24% farmers don't read newspaper at all. About 12% farmers frequently and 28% farmers rarely use smart phone for farming purposes while remaining 60% farmers never use smart phone.

Television is widely adopted ICT technology in studied areas because about 50% farmers frequently, 26% farmers occasionally and 18% farmers use television rarely in practical life. About 30% farmers are moderately, 40% farmers of selected areas are rarely use cell phone and rest is not at all. About 8% farmers rarely use radio, 2% farmers occasionally use internet and 2% farmer's use social media occasionally, only 2% farmers rarely use leaflet and computer for their farming activities while remaining farmers do not use these technologies at all. Farmers implicated technologies and developed agricultural productions [21]. There have no single farmer who uses Satellite, Video conferences, Poster, Solar panel, Geo-graphical information System (GIS) and Sensor network etc. for farming purposes (Fig. 5).

Pearson's Product Moment Correlation Coefficient (R) Analysis: From the Table 12, it shows that age and credit of the farmers were negatively insignificant relationship with the role of ICTs in agricultural activities. On the other hand, level of education, household assets, income, training received and communication exposure were positively correlated with the role of ICTs in agricultural activities.

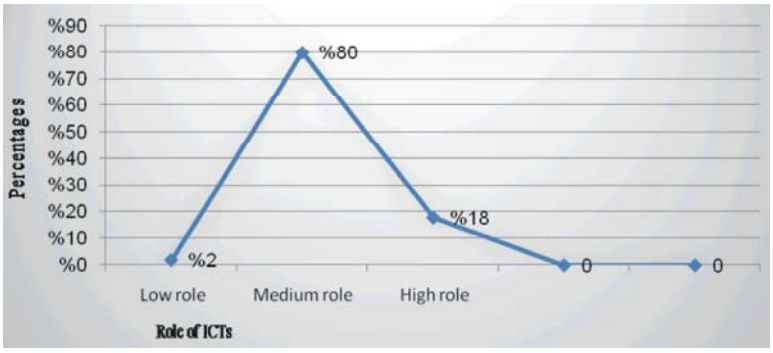

Fig. 4: Role of Information and Communication Technologies (ICTs) in agricultural production

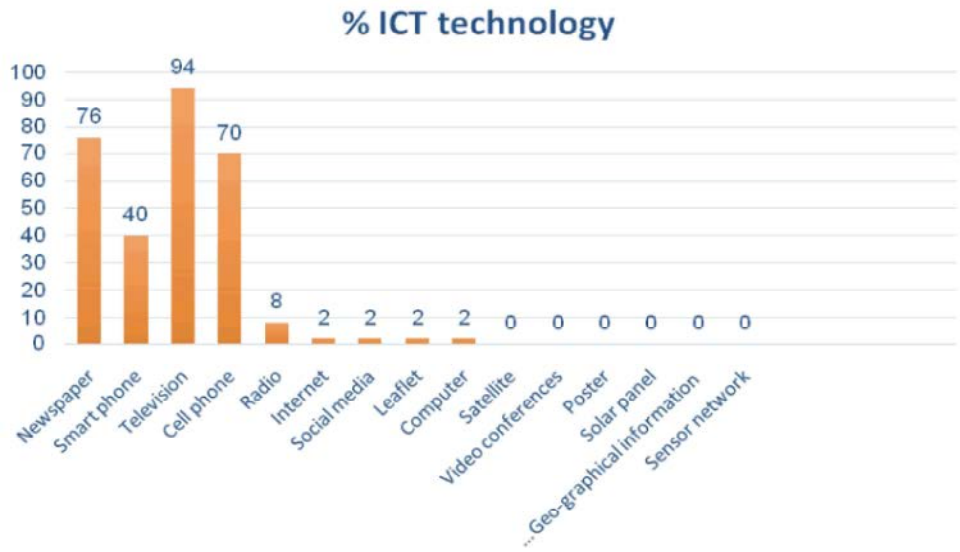

Fig. 5: Graph showing the ICT technologies (%) used by the farmers in agricultural development

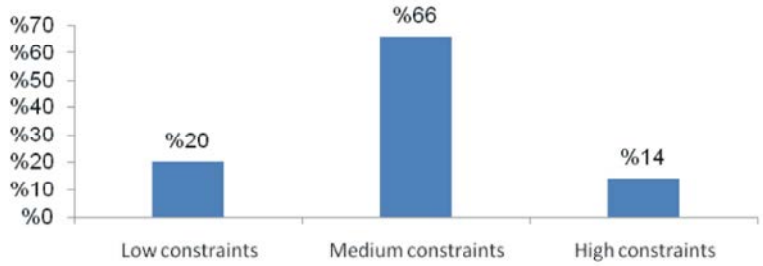

Fig. 6: Graph showing the Constraints Faced by the Farmers in Adopting ICT Practices

As indicated by the negative coefficient of the age of the farmers with role of ICTs (r = -0.207, p > 0.05) means the middle aged farmers were less adoptive than the younger farmers.

The positive significant correlation of formal education of the respondents with the role of ICT technologies (r= 0.694**, *p*> 0.05) clearly points out that with the increase of the formal education of the farmers the role of ICT technologies increases.

Household assets has a positive significant correlation with the role of ICTs (r = 0.491**, *p* > 0.05), indicating that the farmers having more ability to adopt ICTs for their agricultural activities.

Income has a positive significant correlation with the role of ICTs (r = 0.804**, *p* > 0.05), indicating that the farmers having more ability to adopt ICTs for the usefulness of their agricultural activities.

Table 12: Correlation analysis the role of ICTs in agricultural activities

Variables	Correlation co-efficient (r)
Age	-0.207
Education	0.694**
Household assets	0.491**
Income	0.804**
Credit	-0.276
Trainingreceived	0.575**
Communication exposure	0.869**

** = Significant at 1 % (0.01) level (2-tailed)

Table 13: Distribution of the farmers according to the constraints faced by them

Categories	No.	%	Mean	Standard deviation
Low constraints (up to 15)	10	20	21.24	6.30
Medium constraints (16-30)	33	66		
High constraints (above 31)	7	14		
Total	50	100.0		

Training has a positive significant correlation with the role of ICTs(r = 0.575**, $p > 0.05$), indicating that the farmers having more training play more role than the low trained farmers. Being trained the farmers become more innovative about the role of ICTs on agricultural activities. Training makes a farmer careful about doing something better than others [22].

Communication exposure has a positive significant correlation with the role of ICTs (r = 0.869**, $p > 0.05$), indicating that the farmers having more communication are more role than the low informed farmers.

Constraints Faced by the Farmers in Adopting ICT Practices: The constraints faced by the respondents in adopting farming practices ranged from 0 to 30. The mean was 21.24 when standard deviation was 6.30. The data presented in (Table 13) shows that the highest portion of the respondents (66%) had faced medium constraints in adopting ICTs in their farming practices, while 14% of the respondents had faced high constraints and 20 % had faced low constraints (Fig. 6). This means that the large portion (80%) of the farmers had faced medium to high constraints and they were in the categories of middle to old aged.

It is a general assumption that the middle to old aged people are not educated enough, receive less training and information from different sources and are not curious enough to the adoption of ICTs in farming practices [3], [23]. Findings revealed important specific constraints to include: poor ICT infrastructure development, high cost of broadcast equipment, high charges for radio/television presentations, high cost of access/interconnectivity and electricity power problems [24], [25], [26], [27].

CONCLUSION

The major findings of the study are summarized below. The average role score of the respondents was 25.16against the possible range of 0 to 42. Majority of the respondents had observed medium role of ICT in agricultural activities. Average role of ICTs score was found 25.16 which are not so satisfactory, because all aspects of role of ICTs were not properly fulfilled by the farmers in larger extents. The study revealed that education of the farmers had positive and significant relationship with the role of ICTs. It may be concluded that high role of ICTs were found in case of farmers having enough household assets and annual family income. The study illustrated that training and communication exposure of the farmers had highly positive and significant relationship with the role of ICTs in agricultural activities. Findings showed that majority of the farmers had faced medium to high extent of barriers in adopting ICTs in agricultural activities.

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