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Role of Information and Communication Technology in Sustainable Agricultural Production-A case study of Khyber Pakhtunkhwa, Pakistan

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Abstract

Focus of the current study is to assess the farmers' perception regarding the use of Information & Communication Technology (ICT) in agriculture extension system. The existing extension and communication strategies in Khyber Pakhtunkhwa Province have many limitations with rest of the Provinces in Pakistan. There is a dire need to use modern ICT tools for technology transfer in agriculture extension for agricultural development in the Province. A sample size of 400 was selected randomly in three selected districts i.e Mansehra, Swabi and Karak. Five point Likert scale was mostly used to obtain responses of respondents, data analyzed through SPSS ver.20 and presented in frequencies, percentages, and in mostly scores/ranks were obtained. It was observed that majority of the respondents were having primary, middle and Matric education i.e. 23%, 23% and 33% respectively. Findings of the study also depicts that exposure to mass media was medium (68%). Results also showed that farmers still believed on the conventional methods for communication like direct contact (19%) were mostly used by the extension department in the study area. Moreover, findings indicate that various services like weather related information, marketing of agricultural commodities can be made easy with the use of mobile phone. Similarly findings suggest that training and access to free internet facilities be ensured to all educated farmers at the field level. It is recommended that such facilities be established in the form of a small center comprising a computer laboratory, training hall with video conferencing facility at every Farm Services Center concerned.

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Introduction

Agriculture is a fundamental part of Pakistan's economy. Pakistan's agricultural contribution to Gross Domestic Product (GDP) is 18.9% and an annual growth rate of 3.81% was recorded during the year 2017-18 (Talib *et al.,* 2018).

The country has world's biggest adjoining irrigation system. Pakistan is one of the largest producers of wheat, cotton, sugarcane, mango, dates, oranges and rice in the world. Major crops (wheat, cotton, rice and sugar cane) provide 6.5% whereas minor crops provide 2.3% of the country's GDP. Fisheries and forestry add 0.4% and 0.2% to the GDP respectively. Despite its remarkable and growing agricultural production, the country is striving with huge levels of food insecurity. Pakistan's major crops production performance was weak as only rice and cotton production showed positive growth whereas other crops like sugarcane, maize and wheat production showed a negative growth against the last years. Vegetables and fruits are also revealed positive growth. The livestock sector which contributes 58.9% in agriculture showed a positive growth as compared to the last few years (www.finance.gov.pk).

Information and communication technology (ICT) in agriculture is a rising field which focuses on the improvement of agriculture and rural growth.

It includes uses of inventive approaches to utilize ICT in rural areas. The progression in ICT can be used for giving precise, opportune, pertinent information and administration to the farmers, and thus accelerating a helpful and more productive agriculture. However, all the ICT activities are not uniform with variations existing in the locals in the form and level of nature of media communications, information and the exertion of people, open and private associations, and different nature of interest of the farmers in various regions.

In order to keep the farmers informed about the latest changes in the field of agriculture, it is very essential to equip them with the latest knowledge and advanced skills in the farming. For achieving this task, only personal and direct contacts are not sufficient but the proper use of ICT can bring a changing and sustainable impact in the dissemination of agricultural innovation on the small and large scale. Similarly the use of ICT in extension services can enhance and facilitate in term of greater coverage, cost, time, awareness, and strong linkages among the stakeholders. In Pakistan, the use of ICT has been gearing up day by day. Increase in number of radio, TV channels and android mobile phone have opened new avenues for latest information access; however, its use in the field of agriculture is still limited and needs to be enhanced for over all development in the economic sector.

This study is focused on role of ICT in Sustainable Agricultural Production in the selected districts of Khyber Pakhtunkhwa for an overall agricultural improvement.

Research methodology

Universe of the study

The whole province of Khyber Pakhtunkhwa Province was considered as the universe of the study. The population of the study comprised the total number of farmers in the Province. The Khyber Pakhtunkhwa agro-climate conditions are very diverse in nature, which provides basis for the broad range of cultivation for crops and agriculture. The zones have been divided on the basis of their climate. Each zone consists of diverse climate and rainfall.

Selection of sample

The current study used the multi stage sample technique to draw the required sample size for the information collection. A sample is called a multi stage sample when it is selected in various stages, the sample units at each stage being sub-sampled from the large units selected at the previous stage. Cochran (1977) adopted the said technique in is study.

Data collection and information tools

Data was collected while keeping in view objectives of the study. For the purpose of creating a more clear picture of the study both primary and secondary data

was also collected. For primary data collection, a well-structured interview schedule was prepared. Different items were included regarding the multiple variables based on objectives and the nature of respondents, reply of the items based on the scale provided to them.

Data collection tools

An interview schedule was prepared according to objectives of the study. This interview schedule was pre-tested by interviewing 30 farmers in the study area i.e. 10 farmers per District. Open ended as well close ended questions were used to gather the useful information of the respondents. Five Likert scale in majority of the questions was used to record response of the respondents. The study objectives were clarified to the respondents for obtaining the reliable and correct data.

Interview procedure

During the study each individual respondent was interviewed. The purpose of the research study was thoroughly explained to the sample respondents when starting the interview. The interview procedure was made easier and understandable keeping in mind that most of farmers are less literate.

The farmer's consent was ensured as whether the person wants to answer the asked questions or not? After that the data collection was carried accordingly.

Data analysis

The collected data was analyzed using Special Package for Social Sciences (SPSS) ver. 20. Similarly frequencies, percentages, Correlation and diagrams were also used to describe demographic characteristics of farmers. A 5-point Likert scale was mostly used to measure the perception of farmers' on use of ICT in Agricultural Extension Services and sharing of information and its ultimate role in agricultural crop production. Results of the 5-Likert scale were analyzed through Ranking/Scoring; a descriptive statistical method to know about the effectiveness of ICT gadgets mostly used in agricultural extension services.

Results and discussion

Distribution of Respondents regarding educational level

While taking the importance of education in acquisition of information in the field of agriculture, data was collected on the principle of considering education i.e. the formal years of schooling. Education has a direct relationship with the learning process and adopting the latest information through ICT, like high education, the more chances of getting information through ICT (Ekanem *et al*, 2006).

Data pertaining to the distribution of respondents as per levels of education has been shown in Fig. 1, which illustrates that majority of the respondents in the whole study area were having Matric, middle and primary levels of education i.e. 33%, 23% and 23% respectively, whereas 11% were having above intermediate. District Mansehra demonstrated highest number of respondents i.e. 67 (36%) with Secondary (Matric) as their highest education, while 7 (4%) were in the Graduate category. Similarly in district Swabi, it was 58 (38%) in Middle education category and the least number were Graduate i.e. 6 (4%). As far as district Karak was concerned, the highest figures were seen in Higher Secondary (Intermediate) category i.e. 30 (51%), followed by Graduate category, which was 18 (31%), while least number was seen in the Primary (Basic) category which was only 1 (2%).

The studies implied that education is the key which can make the farmers learn fast and get most updated knowledge in their relevant field. Education is the factor which can make them learn very fast and ICT tools can be considered as the most significant tool which can be helpful for overall agricultural development in the near future (Liu, 2017).

Mass media exposure of the Respondents for Sustainable Agricultural Production

It is observed that mass media i.e. ICT can play a very important part in uplifting the status of agriculture through enhancing the channels of communication between various stakeholders (Shamsi, 2006).

Table 1. Ranking among various ICT tools as Source of information from various Agriculture Extension agencies.

Source of information	District Mansehra			District Karak			District Swabi				
	Public	Private	Total	Public	Private	Total	Public	Private	Total	G.Total	Rank
Radio	17(9%)	1(1)	18	5(8)	1(1)	6	10(5)	1(1)	11	35	5
TV and videos	10(5%)	1(1)	11	2(1)	1(1)	3	3(2)	2(1)	5	19	6
Computer internet	5(3)	1(1)	6	1(1)	2(1)	3	6(3)	2(1)	9	18	7
Mobile and smart devices	14(7)	2(1)	16	6(10)	0(0)	6	13(7)	0	13	35	5
Computer devices like Multimedia	7(4)	1(1)	8	1(1)	0	1	2(1)	0	2	11	8
Printed material	16(9)	3(2)	19	6(10)	0	6	12(6)	3(2)	15	40	4
Direct contact	37(20)	13(7)	50	10(17)	5(3)	15	35(19)	10(5)	40	105	1
Field days/farmer days	20(11)	3(2)	23	7(12)	1(1)	8	20(11)	4(2)	24	55	2
Demonstration	15(8)	2(1)	17	5(8)	1(1)	6	12(6)	2(1)	17	40	4
Farmers gathering/workshops	18(10)	2(1)	20	7(12)	2(1)	9	15(8)	2(1)	17	46	3

Source: Field Survey 2018.

Considering this important aspect, data was collected in the study area and respondents were categorized according their exposure to mass media i.e. low, medium and greater exposure for getting more information which is essential for boosting their status of agriculture. The collected data is presented in Fig. 2 showed that the media exposure of the majority of the respondents in all the 3 districts was medium i.e. 68%.

Table 2. Distribution of Respondents regarding Present and Future of education and training by using ICT for Sustainable Agricultural Production.

Present trend of the respondents regarding ICT in Education & Trainings								
District Mansehra			District Karak			District Swabi		
Rank	Category	Score	Rank	Tool	Score	Rank	Tool	Score
1	Radio	899	1	Radio	259	1	Radio	729
2	Printed material	835	2	Mobile Phone	192	2	Printed material.	702
3	TV	651	3	Printed material	171	3	TV	526
4	Mobile Phone	590	4	TV	153	4	Mobile phone	521
5	Computer via Internet	427	5	Computer via internet	148	5	Computer via internet	325
Future trend of the respondents regarding Use of ICT in Education & Training (E&T) process								
1	Mobile Phone	949	1	Computer via Internet	264	1	Computer via Internet	736
2	Computer Via Internet	921	2	Printed Material	253	2	Mobile Phone	729
3	Printed material (PM)	711	3	Mobile Phone	247	3	Printed Material	604
4	Radio	549	4	TV	240	4	TV	600
5	TV	507	5	Radio	222	5	Radio	465

Source: Field Survey 2018.

The district wise distribution showed those 140 (74%) respondents from district Mansehra, 125 numbers (82%) from District Swabi and 40 numbers (68%) of respondents from district Karak who were having medium exposure to mass media.

Present use of Modern Disseminating agricultural technologies for Sustainable Agricultural Production

The Fig. 3 below illustrated the findings about knowledge of farmers related to modern disseminating technology.

Table 3. Ranking of various ICT tools as per their use and effectiveness in to disseminate information regarding weather forecasting.

District Mansehra			District Karak			District Swabi		
Rank	Tool	Score	Rank	Tool	Score	Rank	Tool	Score
1	Printed material	396	1	Printed Material	249	1	Computer	736
2	TV	280	2	Computer	196	2	Mobile Phone	697
3	Computer Via Internet	275	3	Mobile Phone	172	3	TV	616
4	Radio	267	4	TV	170	4	Radio	520
5	Mobile Phone	251	5	Radio	158	5	Printed Material	334
	Future							
	Use of ICT can be useful to make the E& T process more effective							
1	Mobile Phone	888	1	Printed Material	257	1	Radio	729
2	TV	811	2	Mobile Phone	242	2	Printed Material	702
3	Computer Via Internet	758	3	TV	239	3	TV	526
4	Radio	754	4	Computer	220	4	Mobile Phone	521
	Printed material	576	5	Radio	212	5	Computer	325

Source: Field data 2018.

Table 4. Distribution of Respondents regarding the Key challenges by using ICT tools in Agriculture Extension Services.

Rank	Item (District Swabi)	Score
1	Lack of training facilities to use ICT	720
2	Cost of technology	568
3	Extension deptt. Never told about the ICT for agric.	510
4	Not enough time and money with farmers to spend on technology	510
5	Lack of sufficient public funds to support ICT services for farmers?	341
6	There are some technical issues involved with the uptake of ICT in Agric. sector	334
7	Lack of technological infrastructure	326
08	There are some social issues related with the uptake of ICT in Agric. sector	320
09	Inability of farmers to use ICT	329
10	Do not understand the value of ICT	320
Rank	Item (District Karak)	Score
1	Lack of training facilities	239
2	There are technical issues with the uptake of ICT in agric.?	219
3	Cost of technology	218
4	Extension deptt. Never told about the ICT for agric.	216
5	Not enough time and money with farmers to spend on technology	160
6	Lack of sufficient public funds help to finance I T Services for Farmers?	148
7	Do not understand the value of ICT	137
8	Inability of farmers to use ICT	134
9	There are some social issues related with the uptake of ICT in Agric. sector	123
10	Lack of technological infrastructure	117
Rank	Item (District Mansehra)	Score
1	Lack of training facilities to use ICT	809
2	There are some technical issues involved with the uptake of ICT in Agric. sector	765
3	Cost of technology	685
4	Extension department never told about the ICT for agric.	589
5	There are some social issues involved with the uptake of ICT in Agric. sector	455
6	Lack of sufficient public funds to support ICT services for farmers?	439
7	Lack of technological infrastructure	427
08	Not enough time and money with farmers to spend on technology	414
09	Inability of farmers to use ICT	398
10	Do not understand the value of ICT	376

Source: Field data 2018.

It implies that majority of the farmers i.e. 148 numbers (79%) from district Mansehra, 130 (85%) from district Swabi and 40 numbers (68%) from district Karak were convinced that they are aware of innovations and use of modern technology for sustainable agricultural production.

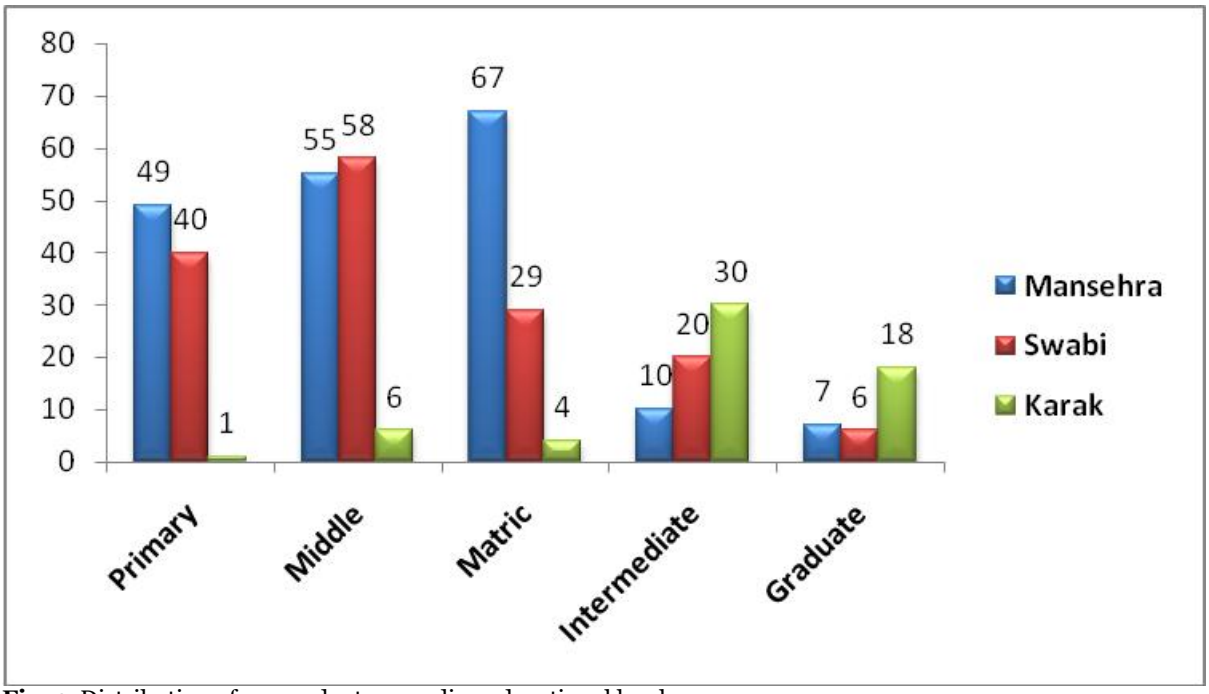

Fig. 1. Distribution of respondents regarding educational level.
Source: Field Survey 2018.

Distribution of Respondents regarding ICT as a source of information for Sustainable Agricultural Production

The findings as per fig.4 shown below showed that majority of the farmers (24 %) at district Mansehra, 21% from district Swabi and 25% from district Karak were in favor of using radio as the source information for enhancing their agriculture productivity. Similarly 26% from district Mansehra, 40% from district Swabi and 29% from district Karak opted that TV is the best source of information in agriculture productivity, while 16% from district Mansehra, 30% from district Swabi and 17% from district Karak were in favor of application of mobile phone for sustainable agriculture productivity.

The least number agreed with the application of Computer devices and others. The results are very much consistent with the findings of (Omotayo *et al.* 1997), who concluded that Radio was found fruitful in dissemination of information in the field of agriculture.

Ranking among various ICT tools as Source of information from various Agriculture Extension agencies

The Table 1 below illustrates the output for various sources of information used by the Agriculture Extension agencies for providing various information related to improved agricultural practices. The results showed that farmers still agreed that the conventional methods for sharing of information like direct contact, followed by field and farmer days were mostly used by the Agriculture extension department i.e. 20% farmers from district Mansehra, 17% from district Karak and 19% from district Swabi were in favor of direct contact method. However, regarding the use of ICT, only 9% from district Mansehra, 8% from district Karak and 5% farmers from district Swabi perceived that Radio was mostly used as a source for the dissemination of various useful information regarding improved agricultural innovations. According to farmers, Radio was followed by Printed Material and Mobile Phones for dissemination of information among the end users.

The results are linked with the findings of (Murthy, 2009) who after studying various ICT tools for their important role in the dissemination of agriculture information found that mobile phone was better than other means of ICT like radio, TV and Printed Material due to its prompt and accurate sharing of agricultural information.

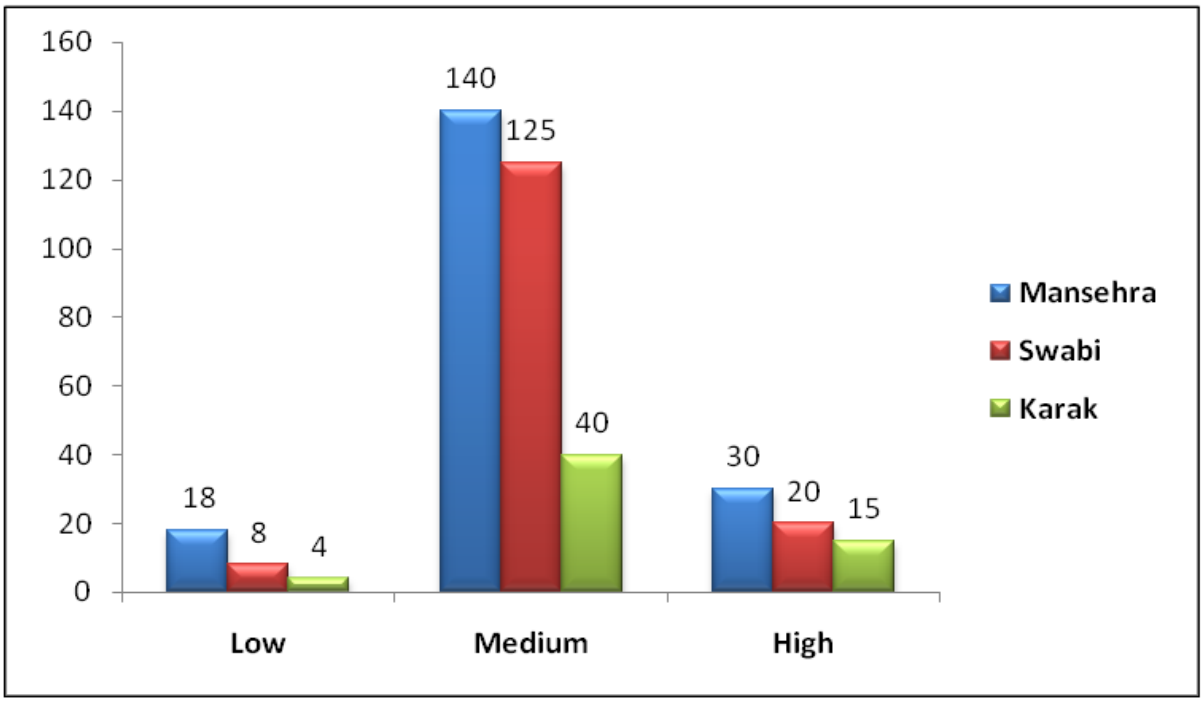

Fig. 2. Distribution of Respondents regarding mass media exposure.
Source: Field Survey 2018.

Distribution of Respondents regarding Present and Future of education and training by using ICT for Sustainable Agricultural Production

The Table 2 indicates the findings for the use and effectiveness of ICT in Advisory services for sustainable agricultural production, being the most important service provided by the Agriculture Extension department in the sample districts. In district Mansehra the Radio with 899 score was found the most useful tool used for the purposes of education and training of the farming community. The radio was followed by Printed Material with 835 score stood 2nd in rank and TV with 651 score was ranked 3rd· Similarly regarding the future scenario, mobile phone was found on top rank with 949 score followed by Computer via internet with 921 score on 2nd position and Printed Material on 3rd rank with of 711score. In district Karak, Radio was found with 259 score and ranked at top and was mostly for education and training purposes while Mobile Phone with 192 score stood at 2nd rank while Printed Material with 171 score ranked 3rd. Concerning the future context, the farmers were most positive towards the incorporation of ICT in extension services. Accordingly most of the farmers found Computer via internet (264 score) as best choice in this regard while Printed Material with 253 score at 2nd rank and mobile phone was at 3rd rank with 247 score. Similarly in district Swabi, Radio with 729 score was ranked at the top by considering its present use for the education and training purposes, Printed Material having 702 score was placed at 2nd rank and TV with 526 score at 3rd rank while in future the computer via internet was found at the top rank with 736 score, mobile phone with 729 score at 2nd rank and printed material on 3rd rank comprised 604 score.

The findings of above table have been found consistent with the study conducted by (Prasad *et al.*, 2016).

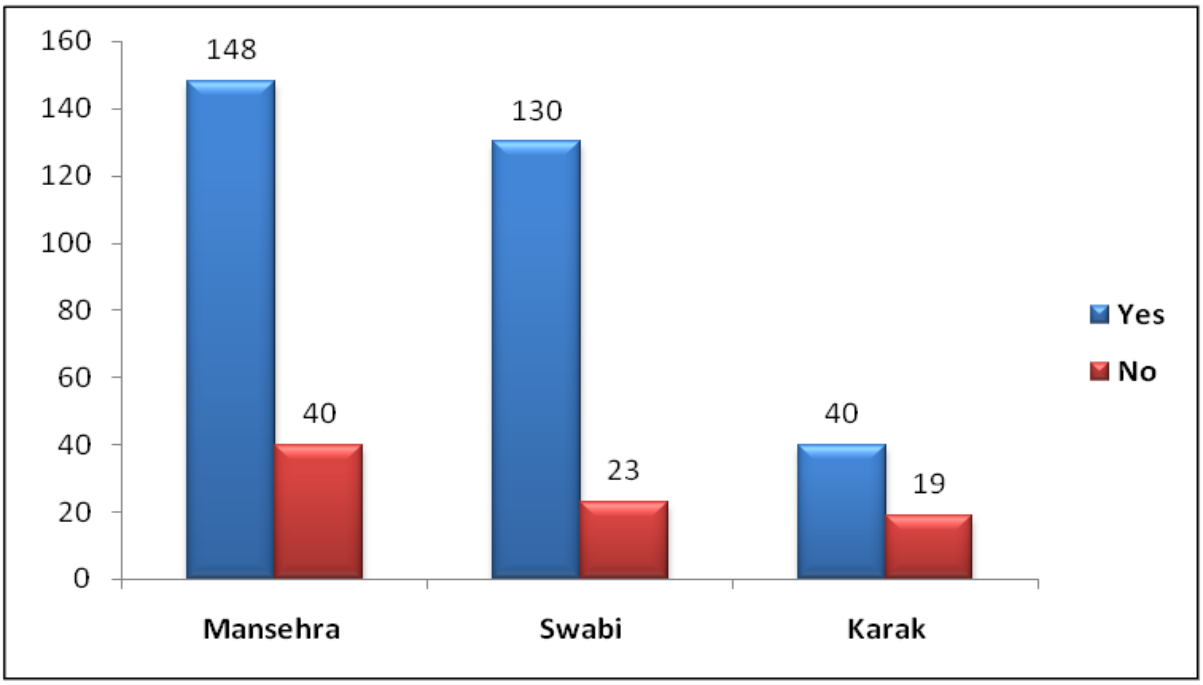

Fig. 3. Distribution of Respondents regarding Modern Disseminating Agricultural Technologies Sustainable Agricultural Production.

Source: Field Survey 2018

The results also concluded that the old sources of ICT like Radio is still used by the department for the purpose of dissemination of information in Agriculture to the large masses, while it was confirmed by the farmers that in future this technology may be advanced for better communication and dissemination of latest agricultural information to them through mobile phone and Computer Internet.

Ranking of various ICT tools as per their use and effectiveness in to disseminate information regarding weather forecasting

The Table 3 illustrates the findings for the services of dissemination of information regarding weather related updates and marketing of agricultural production by the Agriculture Extension department in the study districts.

At present, sharing of information pertaining to these services to the farming community by the Agriculture Extension department through use of ICT tools is very low; but farmers were hopeful of its use and effectiveness in future. As per use and effectiveness of ICT tools in forecasting of weather related information's at district Mansehra, the Printed Material with 396 score was ranked at the top and TV with 280 score was at 2nd rank and Computer via internet with 275 score was ranked at 3rd while in future the Mobile Phone was found on top rank with 888 score while TV with 811 score on 2nd rank and computer via internet was at 3rd rank with 758 score. In district Karak, Printed Material with 249 score was ranked at the top while Computer with 196 score was at 2nd rank and Mobile Phone having 172 score was ranked at 3rd position. Similarly regarding its perspective use, the printed material was found the best option with 257 score while mobile phone with 242 score on 2nd rank and TV was on 3rd rank with 239 score.

In district Swabi, computer via internet with 736 score was ranked at the top. Mobile Phone with 697 score stood at 2nd rank and TV with 616 score was found 3rd in this context, while in future the Radio was found at top rank with 729 score while Printed Material with 702 score at 2nd rank and TV was on 3rd rank with 526 score. The findings of above table have been found consistent with the study conducted by (Balaji and Craufurd, 2011).

Distribution of Respondents regarding Key challenges by using ICT tools in Agriculture Extension Services

During the study perceptions of the farmers were also recorded on the key issues/challenges that hinder the process of adopting ICT in the field of agriculture extension in the three selected districts is presented in Table 4. Regarding district Swabi, the results showed that majority of the farmers were agreed that due to lack of training facilities (720 score), high cost of technology (568 score), unawareness about the technology (510 score) were found as the top three that created hurdles in the adoption of ICT in agriculture sector. Similarly the results pertaining to district Karak showed that majority of the scores included are lack of training facilities (239 score), some technical issue for its use (219 score), high cost of technology (218 score) and the ignorance of the agriculture extension department to inform them about the technology (216 score) were the four key challenges.

Source: Field Survey 2018

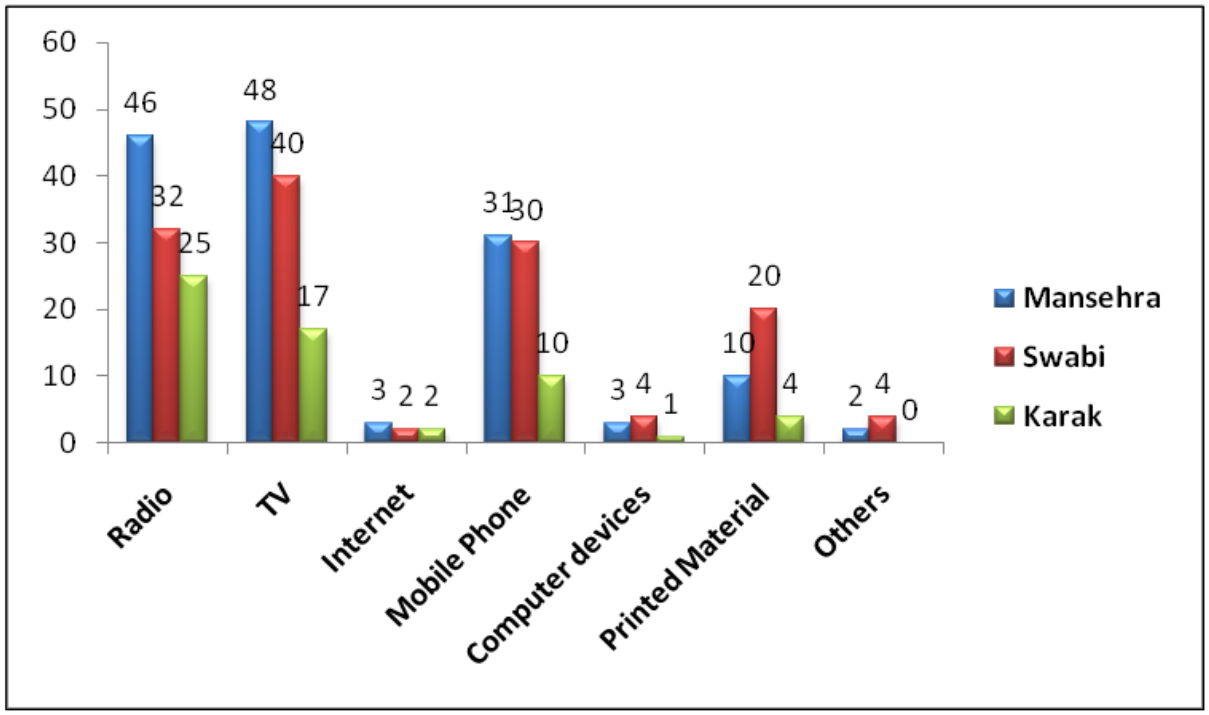

Fig. 1. Distribution of Respondents regarding ICT as a source of information for Sustainable Agricultural Production.

The results of district Mansehra depicts that due to lack of training facilities to use ICT with 809 score was ranked 1st, some technical issues for its use with 765 score with rank 2nd, cost of technology with 685 score was ranked at 3rd.

The above results pertaining to various hurdles perceived by farmers at the three selected districts for adoption of ICT in the field of agriculture are very similar to the work of (Bolorunduro *et al.* 2004), who conducted a study in Nigeria mainly concerning to the dissemination of latest information to the farming communities in agriculture sector. They identified various hurdles like lack of awareness, lack of sufficient funds, lack of access i.e. mobility and lack of strong contacts with the farmers as key challenges to adoption process.

Conclusion

Despite of various advancements and the facilities along with infrastructure available in term of ICT and its use as a source of information in agriculture sector of Khyber Pakhtunkhwa province scenario, the results are very discouraging as compared to its use on

national and international levels. The farmers are still using the old source of ICT like Radio and Printed Material as a major source of information for their sustainable agricultural production. The farmers were hoping the incorporation and provision of a formal structure in term of mobile phone technology, internet, advanced radio and TV facilities, the innovations in the field of agriculture can be improved towards overall improved agricultural productivity. The farmers believed that use of ICT in the field of agriculture as an information source is very much necessary for getting maximum production. Moreover, some technical problems/obstacles were identified by the farmers like lack of interest by Provincial Agriculture Extension department, availability of sufficient public funds and training facilities to the stakeholders for use of ICT.

The farmers can be motivated and trained for using the various ICT gadgets through various technical and skilled training programmes by the concerned Farm Services Centers (FSC) or District Extension offices if provided the access to free helpline available on mobile phone, it will increase number of users and the feedback mechanism can be improved through using helpline. Training and access to free Internet facilities be insured to all educated farmers at the field level. Similarly SMS service (In local languages) through the provided android phones to farmers (the service will include market rates, weather updates, crop & Livestock production tips.

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