



Research Article

Farmer's Access to ICTs Tools and Productivity Enhancement in District Charsadda, Khyber Pakhtunkhwa

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Abstract | The access to ICT and utilization of modern techniques can enhance agricultural productivity. ICT can increase and improve access to agricultural information which helps in knowledge sharing and creating awareness. The study focuses on farmer's access to ICT tools for productivity enhancement in district Charsadda, the universe of the study. For selection of sample multi stage sampling method was used and respondents were selected from three villages namely Hajizai, Katozai and Batagram of tehsil Shabqadar. A sample of 112 respondents was drawn through proportional allocation technique based on 10% of total 1120 registered farmers. A pre-tested and well-developed interview schedule was used to collect primary data. Statistical Package for Social Sciences (SPSS) was used to analyze the data. Results indicated that 42% respondents had age above 35 years, literate respondents were 80%, 45.5% had farming experience of 1-10 years, half of the respondents (50.1%) were owners, 40.2% had land size of 5.1-10 acres and the majority (78.6%) is indulged in agriculture as main occupation. All the respondents have knowledge about ICTs but 55.4% had access to internet and the tools used to access internet include mobile (54.8%), DSL (27.5%), telephone (9.7%) and USB (8.0%). In the research area 69.6% respondent know how to use ICT tools while 55.4% applied the information availed from ICT and considered that application of information will bring improvement in agricultural production. Significant association existed between age and access to internet whereas highly significant relationship existed for literacy status and tenancy status with access to internet while non-significant relationship was found with farming experience. It is recommended that farmers' skills should be upgraded through training on how to use modern ICT tools for getting information and its application in the field to increase adoption and enhance agricultural production.

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Keywords | Information and communication technology (ICT) and tools, Utilization of ICT tools, Information dissemination, Adoption, Productivity enhancement



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Introduction

Pakistan is predominantly an agrarian country where the majority of population is involved in agriculture and its related sub-sectors. Agriculture contributes 19.3% to Gross Domestic Product (GDP) and provides employment to 42.4% of the national labour (GoP, 2020). Agriculture plays a significant role in the economy of the country as 67% of the foreign exchange comes from it (GoP, 2019-2020) and helps in improving the livelihood of the rural communities. Khyber Pakhtunkhwa is the third largest economy among the provinces of Pakistan as 80% of the population in rural areas' main source of income is agriculture. It contributes 24% to the GDP and employs 44% of the province labour force (GoKP, 2020).

ICT is a collective term that is given to modern information technologies arising as a result of the combination of computers and telecommunications which includes telephone, television, video, voice information systems, and fax (Warren, 2002). A feature of ICT is the focus of the media (print, audio, video, multimedia etc.) through a common digital platform (Flor, 2001).

Information and its dissemination play an important role in empowering the farmers to improve their livelihoods. Up to date and important information like sowing techniques, soil fertility studies/techniques, proper methods to tackle pest disease attacks and price issues *etc.* all empower the farmers ability to take good decisions regarding different agricultural activities. Also, the emerging issues of climate change and its effect on agriculture, pests and disease outbreaks *etc.* influences information needs of the farmers (Lokeswari, 2016). It is the need of the day to develop an information-based decision-making agricultural system. Information should be provided at the right time and place to the end-users (Silva and Dimuthu, 2008). Nowadays it is realized that ICT is necessary for accessing information and knowledge (Anandajayasekeram *et al.*, 2008; Aker, 2010; Kabir, 2015). Raghuprasad *et al.* (2012) emphasized that ICT has emerged as an important pillar for agricultural extension for enhancing agricultural development and rural growth by improving information and knowledge communication process. Previous research studies by Armstrong *et al.* (2010) and Armstrong and Gandhi (2012) highlighted the benefits of ICT

in enhancing agricultural productivity. Information based knowledge and decision making on the basis of this knowledge is one of the effective tools for the farmers (Armstrong *et al.*, 2011) which can help develop agriculture sector and improve food production (Blurton, 2010).

According to Omotayo (2005), agricultural extension depends on information exchange between and among farmers and other related actors. ICT consists of three main technologies including; computer technology, communication technology and information management technology, which helps in processing, exchange and managing information and knowledge. ICT offers a great opportunity to facilitate the flow of information to the farmers (Maningas, 2006). ICT provides an electronic and interactive bridge between farmers and extension staff (Anoop *et al.*, 2015). Communication among researchers, extension workers and farmers to transfer information and technologies can be promoted through the use of modern information technologies like ICT (Mruthunjaya and Adhiguru, 2005; Chhachar *et al.*, 2014) to effectively use available resources for profit maximization (Ekbia and Evans, 2009; Ommani and Chizari, 2008).

The extension agents provides direct link between farmers and other actors of agricultural information and knowledge system. They should be able to use ICT to access updated information which will facilitate them to further communicate this information effectively to the end users and will also help them to educate the farmers about the use of ICT to access information (Usman *et al.*, 2012). Effective utilization of ICT helps to make farming communities prosperous as it disseminates the required and updated information in a friendly, easy and cost-effective way at proper time (Lokeswari, 2016). Joseph and Andrew (2008) and John and Barclay (2017) observed that one of the prime ingredients for rural development in developing countries was information access. Sinha (2013) indicated that ICT has helped agriculture sector a lot to boost livelihood of rural people by providing different information services to farmers in a timely and appropriate manner (Narula and Arora, 2010). Parmar *et al.* (2019) also emphasized on ICT based sources for accessing information on production and marketing. Access to up-to-date information through ICT can help/ allows farmers to make better decisions and enhance agricultural production. Therefore, the present research, studies the farmer's

access to ICT tools and productivity enhancement in district Charsadda- Khyber Pakhtunkhwa.

Objectives

1. To study the existing situation regarding access and use of ICT tools in the study area.
2. To solicit farmers views on effect of ICT tools on production in the study area.
3. To formulate suggestions for future improvement.

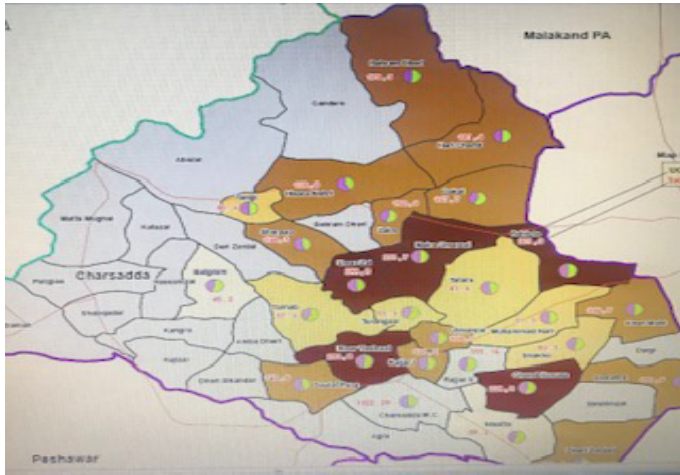


Figure 1: Map of the study area.

Materials and Methods

District Charsadda of Khyber Pakhtunkhwa was selected as the research area and all the farmers constituted the population of the research study. A multi stage sampling procedure was utilized to draw the sample. Tehsil Shabqadar was selected purposively from three tehsils of district Charsadda, which is comprised of 12 union councils (UC), out of which three UCs namely Hajizai, Katozai and Battagram were randomly selected for the study (map of the study area is given in Figure 1). District Agriculture Office record was consulted to get the list of all the registered farmers of Farm Services Center (FSC) which gives a total of 1120 farmers in selected union councils. A sample of 112 farmers was drawn based on 10% of the registered farmers while to select sample at UC level, proportional allocation technique was used. To obtain accurate and relevant primary data, a well-developed interview schedule comprising of both open and close ended questions was designed and pre-tested in the field. Face to face interviews were conducted to gather primary data while secondary data was solicited from various published and unpublished sources. To analyze the collected data Statistical Package for Social Sciences (SPSS) V-21 was used and results were presented as frequencies,

percentages and graph. A 3-point Likert scale was used to measure the sufficiency level of information and level of improvement in agricultural production (Likert, 1932). Weights were assigned as high scores specify agreement while low scores represent disagreement (Khan, 2012; Aziz and Khan, 2021). To find the association of socio-economic characteristics with access to internet, Chi-square test was utilized.

Results and Discussion

Socio economic characteristics

The socio economic characteristics (*i.e.* age, education, tenancy status, landholding size *etc.*) of the farmers are considered crucial in influencing the adoption behavior of the farmers towards innovation. Table 1 highlights the socio economic characteristics of the respondents indicating that the majority of respondents had age above 35 years (42.0%) while 34.8% were in the age group of 26-35 years. The results show that most of the respondents were mature and experienced. Aldosari *et al.* (2017) also reported same results that 34.4% and 33.3% had age of 25-35 and 36-45 years, respectively. However, Kabir (2015) got opposing results and reported that 60% of the respondents belonged to young age followed by 27.8% in 31-50 years of age. In case of education level, the maximum number of respondents was literate (80.4%) while 19.6% were illiterate. Among the literate, the maximum *i.e.* 28.9% each have education up to primary and middle, followed by 23.4% up to matric and above matric were 18.8%. This result concludes that any ICT development programme in the study area will be helpful due to large number of literate farmers. Kumar *et al.* (2021) reported that maximum respondents *i.e.* 41% were educated from 9th to 12th standard.

Table 1 also shows that half of the respondents constituting the majority (50.1%) were owners, owner-cum tenants were 28.5% while tenants were 21.4%. Similar results were obtained by Armstrong and Gandhi (2012) where the majority (87%) was owners, followed by tenants (9%) and owner-cum tenants (4%). In terms of landholding size, most of the farmers (40.2%) had land from 5.1-10 acres, followed by 33% having 1.1-5 acres and 18.7% have land above 10 acres. Opposing results were reported by Kumar *et al.* (2021) where the majority (47%) had less than 5 acres of land because of land fragmentation.

Professions like agriculture, business and government service were considered for the study and presented in Table 1. Agriculture as a major profession was reported by majority of the farmers (78.6%) while 13.4% were while 13.4% concerned with business however, minimum number (8.0%) were government servants. Farming experience is the total number of years of involvement and contribution of farmers in farming activities which is a distinctive factor in farmers learning (Agwu *et al.*, 2008). A little less than half of respondents (45.5%) are indulged in agriculture for 1-10 years, 36.6 has farming experience of 11 to 20 years while 17.9% respondents reported above 20 years of experience. This result shows less involvement of young people in farming activities in the study area.

Table 1: Socio economic characteristics of farmers.

Age (years)	Frequency	%	Literacy status	Frequency	%
18-25	26	23.2	Illiterate	22	19.6
26-35	39	34.8	Primary	26	23.2
Above 35	47	42.0	Middle	26	23.2
Total	112	100	Matric	21	18.8
			Above matric	17	15.2
			Total	112	100
Tenancy status	Frequency	%	Landholding size (in acres)	Frequency	%
Owner	56	50.1	Up to 1	9	8.1
Owner-cum-tenant	32	28.5	1.1-5	37	33.0
Tenant	24	21.4	5.1-10	45	40.2
Total	112	100	Above 10	21	18.7
			Total	112	100
Occupation	Frequency	%	Farming experience (in years)	Frequency	%
Agriculture	88	78.6	1-10	51	45.5
Business	15	13.4	11-20	41	36.6
Government job	9	8.0	Above 20	20	17.9
Total	112	100	Total	112	100

Knowledge and access to ICT

The core focus of ICT in agriculture is to fulfill the information needs of farmers (Kabir, 2015) as well as it play a major role in technology transfer, exchange and sharing of modern agricultural techniques (Armstrong and Gandhi, 2012; Lokeswari, 2016) and ultimately its adoption by the farmers. ICT consist of a wide range of technologies from radio, television and telephone to modern technologies *i.e.* mobile, multi-

media, internet etc. (Anand *et al.*, 2020). Table 2 presents respondents' knowledge about information and communication technologies (ICT), internet access and tools used to access internet in the study area. In case of knowledge about ICT, it was found that all the respondents were aware of it, while 55.4% had access to internet and 44.6% did not have any internet facility. Table 2 also highlights that the respondents having access to internet were utilizing various tools like mobile (54.8%), DSL (27.5%), telephone (9.7%) and USB (8.0%) for availing information related to agriculture on internet. It is evident from the result that farmers did not have complete access to ICT based services in the study area and still many are even not utilizing ICT for availing agricultural information. Jain *et al.* (2010) also mentioned that most of the farmers are not fully utilizing and taking full advantage of ICT. Anand *et al.* (2020) in a study reported that 80% of the farmers had access to internet and that they use Google etc. while 91% had mobile phones.

Table 2: Respondents knowledge about ICT, internet access and tools of internet access.

Location		Knowledge about ICT		Internet access		If yes, tools of internet access			
		Yes	No	Yes	No	Mobile	DSL	Telephone	USB
Hajizai	F	45	0	26	19	16	7	1	2
	%	40.2	0	23.2	17.0	25.8	11.3	1.6	3.2
Katozai	F	35	0	17	18	9	5	2	1
	%	31.2	0	15.2	16.0	14.5	8.1	3.2	1.6
Batta-gram	F	32	0	19	13	9	5	3	2
	%	28.6	0	17.0	11.6	14.5	8.1	4.9	3.2
Total	F	112	0	62	50	34	17	6	5
	%	100	0	55.4	44.6	54.8	27.5	9.7	8.0

Know-how to use ICT tools and application of information

Timely and trust worthy agricultural information and technical guidance to use this information is needed to improve the efficiency of farmers. To create a positive attitude towards ICT, its know-how and frequent use and access is must (Lokeswari, 2016). Respondents' know-how to use ICT tools in the study area is presented in Table 3. Nearly three-fourth of respondents (69.6%) know how to use ICT tools they have while 30.4% had no knowledge and awareness about how to use ICT tools but they do know what ICT is and its tools. Village-wise distribution shows

that in Hajizai 32.1% respondents do know how to use ICT tools, 24% in Katozai and 16% in Battagram had know-how about the use of ICT tools. Whereas, 8.1% respondents in Hajizai, 9.8% in Katozai and 12.5% in Battagram had no knowledge about how to use ICT tools. Table 3 also displays respondents responses in terms of application of information availed from ICT. It indicates that 55.4% respondents do apply the information they obtain from ICT while the rest *i.e.* 44.6% do not apply the information availed from ICT in the study area. Application of information obtained from ICT is reported by 26.8% respondents in Hajizai, followed by 16.1% and 12.5% in Katozai and Battagram, respectively. Whereas, 13.4% respondents in Hajizai, 15.1% respondents in Katozai and 16.1% respondents in Battagram did not apply the information availed from ICT in the field. Usman *et al.* (2012) reported that 68.6% farmers use radio, 12.9% were mobile users while only 7.1% were using internet for availing agricultural information, which indicates that most of the farmers do not use ICT for obtaining agriculture information and then applying that information. Previous research studies by Muhammad *et al.* (2012) and Aldosari *et al.* (2017) reported that most of the respondents apply the information obtained from ICT in the field.

Table 3: Respondents know-how about use of ICT tools and application of information obtain from ICT.

Location	Know-how about how to use ICT tools			Apply information obtain from ICT		
	Yes	No	Total	Yes	No	Total
Hajizai	36 (32.1)	9 (8.1)	45	30 (26.8)	15 (13.4)	45
Katozai	24 (21.4)	11 (9.8)	35	18 (16.1)	17 (15.1)	35
Battagram	18 (16.1)	14 (12.5)	32	14 (12.5)	18 (16.1)	32
Total	78 (69.6)	34 (30.4)	112	62 (55.4)	50 (44.6)	112

Note: Figures in parenthesis are percentages

Sufficiency of agricultural information

In this era of IT, use of ICT and access to internet

for availing information and knowledge is curial for achieving high yields. But it is also important that the information obtain from different sources should be sufficient in all aspects and is easily applicable in the field (Aziz, 2020). The knowledge about how to properly use various ICT tools to elicit timely, relevant and up dated information by farmers is very important to increase production. Data regarding this aspect is presented in Table 4 which illustrates that out of total, 69.6% respondents satisfaction about the sufficiency of information availed through ICT while 30.4% respondents were not satisfied from the information obtained. In terms of level of sufficiency of agricultural information, 32.1% respondents were of the view that information obtained from ICT was sufficient, moderately sufficient was reported by 29.4% respondents while 8.1% respondents perceived the information obtained from ICT as highly sufficient. Adegbi-di *et al.* (2012) establish that 69% farmers used ICT tools while non-ICT users were 31%, which reveals that farmer are not using ICT for obtaining information on farming activities and the its subsequent use in the field.

Adoption of improved practices and improvement in agricultural production due to ICT usage

Berman (2008), viewed that novel ICT tools play valuable chore in the progress of developing countries through adoption of innovative techniques for getting enhanced production. The respondents' views concerning the information provided and available on ICT can enhance and speed up the adoption of innovative practices in the study area indicates that all the respondents were of the view that information obtained from ICTs can speed up and enhance the adoption of practices by the farmers. Chhachhar *et al.* (2014) highlighted that use of ICT tools for transfer of knowledge and information to farmers were proved fruitful in technology adoption in developing world. Also, utilization of modern techniques can enhance agricultural production. Figure 2 presents respondents

Table 4: Distribution of respondents regarding sufficiency of agricultural information obtained from ICT.

Location	Obtain sufficient information		Total	Level of Sufficiency			Total
	Yes	No		Sufficient	Moderately Sufficient	Highly Sufficient	
Hajizai	36 (32.1)	9 (8.9)	45 (40.2)	18 (16.1)	15 (13.3)	3 (2.7)	36 (32.1)
Katozai	24 (21.4)	11 (9.8)	35 (31.2)	12 (10.7)	10 (8.9)	2 (1.8)	24 (21.4)
Battagram	18 (16.1)	14 (12.5)	32 (28.6)	6 (5.3)	8 (7.1)	4 (3.6)	18 (16.1)
Total	78 (69.6)	34 (30.4)	112	36 (32.1)	33 (29.4)	9 (8.1)	78

Note: Figures in parenthesis are percentages

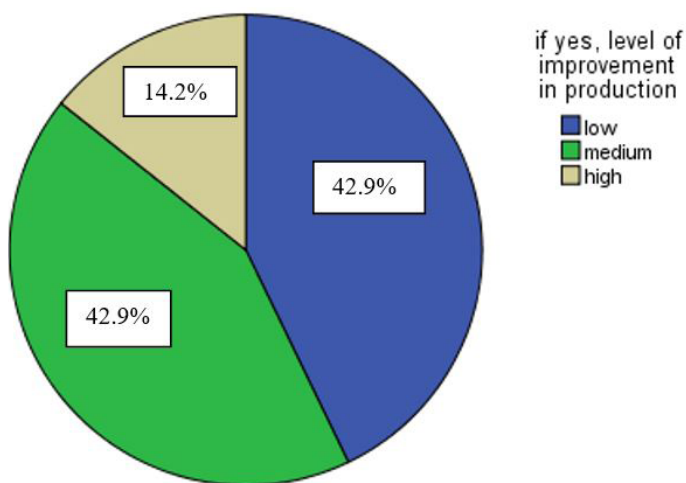


Figure 2: Level of improvement in agricultural production due to ICT.

Table 5: Association of socio-economic characteristics with access to internet.

Age	Access to internet		Total	Chi-Square	p-value
	Yes	No			
18-25	20	6	26	7.097	0.029
26-35	21	18	39		
Above 35	21	26	47		
Total	62	50	112		
Literacy Status					
Literate	56	34	90	8.738	0.003
Illiterate	6	16	22		
Total	62	50	112		
Farming Experience					
1-10	28	23	51	2.457	0.293 ^{NS}
11-20	20	21	41		
Above 20	14	6	20		
Total	62	50	112		
Tenancy Status					
Owner	39	17	56	9.634	0.008
Owner-cum tenant	12	20	32		
Tenant	11	13	24		
Total	62	50	112		

Calculated by Author

views on level of improvements in agriculture production due to use of ICTs which is grouped into three categories *i.e.* low, medium and high. High level of improvement in production due to ICT usage was reported by only 14.2% respondents, while 42.9% respondents each affirmed low and medium level of improvement in production. Sajid and Ali (2018) were also of the view that ICT is an important addition in modern innovative technologies as noteworthy

improvements in agricultural production has been observed and recorded due to dissemination of agricultural information updates through ICT. Similarly, Wereh (2012) also stated that use of modern technology increased agricultural production.

Association of socio economic characteristics with access to internet

Table 5 show the results of Chi-square test conducted to find association of socio economic characteristics with access to internet for obtaining information. The results show that there exists a significant association between age and access to internet as p-value is 0.029 indicating that as age increases the chances of access to internet services also increases. Moreover, Table 5 also shows that the relationship between literacy status and access to internet is highly significant as p-value is 0.003. It clearly indicates that literate farmers have more internet access as compared to illiterate farmers in the study area. However, non-significant association between farming experience and access to internet was found as p-value is 0.293 which explains that irrespective of the farming experience of the respondents they have access to internet service. Regarding relationship of tenancy status with access to internet, it was found that a highly significant association exists between the two variables as p-value is 0.008. It elicit that the owners have more access to internet services as compared to owner-cum tenants and tenants in the study area.

Conclusions and Recommendations

It is concluded that mostly farmers fall in the middle aged group, were literate and majority had farming experience of 1-10 years. Agriculture was the major profession of the majority, owners were in majority and mostly farmers have land holding size from 5.1 to 10 acres. In the study, all the respondents knew about ICT and more than half of respondents had access to internet service by using mobile phones. The study concludes that most of the farmers knew how to use ICT and practically apply the information obtained from it. Farmers perceived the information availed from ICT as moderately sufficient, can enhance adoption and can bring improvement in production. Highly significant association existed for literacy status and tenancy status with access to internet while significant relationship is found with age. However, non-significant association existed between farming experience and access to internet.

1. Provision of improved internet facilities in the rural areas be made by the government and to resolve the issues related to poor network, boosters should be installed to improve internet accessibility. Also low price internet connection should be ensured in rural areas to enhance its access and availability to farmers for availing relevant information.
2. To increase the access and use of ICT tools by farmers, extension agents should upgrade the skills of farmers to properly use ICT tools for obtaining information and its subsequent application in the field to get high production. Therefore, measures like ICT infrastructure development and training of farmers to use ICT tools, should be taken to improve the access to information in rural areas.
3. Extension workers should work and create awareness among the youth and middle-aged farmers regarding ICT services and boost up their level of utilization of ICT tools for obtaining up to date agriculture information. The authorities should make efforts to improve the situation and create a better environment to use various ICTs to ensure the availability of relevant information useful to farmers.
4. Government needs to take initiative to establish new technology centers using ICT to disseminate updated agricultural information among farming communities for the development of agriculture in the country.
5. Government need to develop ICT policy and regulatory framework to expand ICT infrastructure to help increase the access and flow of information and knowledge to the end users.

Novelty Statement

The article shows that mostly farmers use mobiles and internet to avail agriculture information and the application of this information in the field can increase adoption and ultimately the production of crops.

Author's Contribution

Ayesha Khan: Principal author who wrote the manuscript.

Mohammad Tariq Aziz: Collected the field data and performed the analysis.

Urooba Pervaiz: Helped in data analysis.

Muhammad Zafarullah Khan: Helped editing of manuscript and perform language correction.

Conflict of interest

The authors have declared no conflict of interest.

References

- Adegbidi, A.B., R. Mensah, F. Vidogbena and D. Agossou. 2012. Determinants of ICTS use by rice farmers in Benin: from the perception of ICTs characteristics to the adoption of the technology. *J. Res. Int. Bus. Manage.*, 2 (11): 273-284.
- Agwu, A.E., J.N. Ekwueme and A.C. Anyanwu. 2008. Adoption of improved agricultural technologies disseminated via radio farmer programme by farmers in Enugu State, Nigeria. *Afr. J. Biotechnol.* 7(9): 1277-1286. [Online] <http://www.bioline.org.br/request?jb08215>. Accessed on: June 10, 2021.
- Aker, J.C. 2010. Dial 'A' for Agriculture: Using Information and Communication Technologies for Agricultural Extension in Developing Countries. *Agric. Econ.*, 42 (6): 631-647. <https://doi.org/10.1111/j.1574-0862.2011.00545.x>
- Aldosari, F., M.S. Al-Shunaifa, M.A. Ullah, M. Muddassir and M.A. Noor. 2017. Farmers' perceptions regarding the use of information and communication technology (ICT) in Khyber Pakhtunkhwa, Northern Pakistan. *J. Saudi Soc. Agric. Sci.*,
- Anand, S., S. Prakash, A.K. Singh and S. Yedida. 2020. Access and availability of ICT tools used by farmers for crop practice in Bihar, India. *Int. J. Curr. Microbiol. Appl. Sci.*, 9 (5):1-5. <https://doi.org/10.20546/ijcmas.2020.905.125>
- Anandajayasekeram, P., Puskur, R., Workneh, S. and Hoekstra, D. 2008. Concepts and practices in Agricultural extension in Developing countries: A source book. IFPRI (International Food Policy Research Institute), Washington, DC, USA, and ILRI (International Livestock Research Institute), Nairobi, Kenya. p. 275.
- Anoop, M., N. Ajjan, K. Amp and R. Ashok. 2015. ICT based market information services in Kerala-Determinants and barriers of adoption. *Econ. Aff.*, 27 (2): 55-65.
- Armstrong, L. and N. Gandhi. 2012. Factors influencing the use of information and communication technology (ICTS) tools by the rural famers in Ratnagiri districts of Maharashtra, India. *Proceedings of the Third National Conference on Agro Informatics and Precision Ag-*

- riculture 2012 (APIA 2012). pp. 58-63. <https://doi.org/10.1109/CSNT.2012.202>
- Armstrong, L., D. Diepeveen and N. Gandhi. 2011. Effective ICTs in agricultural value chains to improve food security: An international perspective. World Congress on Information and Communication Technologies Conference (WICT). Issue Date: 11-14 Dec. on page(s):1217-1222 Print ISBN: 978-1-4673-0127-5 Digital Object Identifier: 10.1109/WICT.2011
- Armstrong, L.J., D.A. Diepeveen and K. Tantisan-tisom. 2010. An eAgriculture-based decision support framework for information dissemination, IGI Global Publications, Madrid Spain. Int. J. Human Capital Inf. Technol. Professionals, 1: 1-13. <https://doi.org/10.4018/jh-citp.2010100101>
- Aziz, M.T. 2020. Role of information and communication technologies (ICTs) in disseminating agricultural information in District Charsadda. M. Sc (H) thesis, Department of Agricultural Extension Education and Communication, The University of Agriculture Peshawar, Khyber Pakhtunkhwa-Pakistan. Pp. 23-26.
- Aziz, M.T. and A. Khan. 2021. Utilization of ICTs for availing agricultural information in District Charsadda, KP. Sarhad J. Agric., 37 (3): 797-806. <https://doi.org/10.17582/journal.sja/2021/37.3.797.806>
- Berman, S.D. 2008. ICT-based distance education in South Asia. International Review. Open Distribut. Learn. 9 (3). <https://doi.org/10.19173/irrodl.v9i3.581>
- Blurton. C. 2010. New directions of ICT-Use in education. Available online. 2002, Accessed 7th April <http://www.unesco.org/education/educprog/lwf/dl/edict.pdf>
- Chhachhar, A.R., B. Querestic, G.M. Khush and S. Ahmad. 2014. Impact of ICTs in agriculture development. J. Basic Appl. Sci. Res., 4 (2014): 281-288.
- Ekbja, H.R. and T.P. Evans. 2009. Regimes of information: Land use, management, and policy. Inf. Soc., 25(5): 328-343. <https://doi.org/10.1080/01972240903212789>
- Flor, A.G. 2001. ICT and poverty: Indisputable link. Paper for Third Asian Development Forum on 'Regional Economic Cooperation in Asia and Pacific' organized by Asian Development Bank, Bangkok, June 11-14. Ranjon Roy-
<http://www.bdresearchpublications.com.journal> 318. Accessed on Nov, 2019.
- GoP. 2019-2020. Pakistan economic survey. Ministry of Finance, Economic Advisory Wing, Finance Division, Islamabad. Pakistan. pp. 18.
- GoP. 2020. Economic survey report. Finance Division, Economic Advisory Wing, Islamabad. Pakistan.
- GoPK (Government of Khyber Pakhtunkhwa). 2020. Agriculture Policy, Khyber Pakhtunkhwa. Planning and Development Department. Pp. 1-10.
- Jain, R., A. Alka and A. Usha. 2010. Clustering approach to diagnose determinants of ICT empowerment to women farmers. Editors: Armstrong, L. J. and J. Clayden. Proceedings of the knowledge discovery for rural system workshop 2010, the 14th Pacific-Asia Conference on Knowledge Discovery and Data Mining. IIIT Hyderabad, 21-24 June. Hyderabad India.
- John, A. and F.P. Barclay. 2017. ICT Usage and Effects among Rural Farming Communities. J. Media Commun., 1(1): 100-136.
- Joseph, K.M. and T.N. Andrew. 2008. Participatory approaches for the development and use of Information and Communication Technologies (ICTS) for rural farmers. Retrieved on June 6, 2021, from. <http://ieeexplore.ieee.org/document/4559774/>
- Kabir, K.H. 2015. Attitude and level of knowledge of farmers on ICT based farming. Eur. Acad. Res., 2 (10): 13177-13196.
- Khan, A. 2012. Analysis of barriers to communication regarding production technology among researchers, extension personnel and farmers in Khyber Pakhtunkhwa: Pakistan. Unpublished PhD dissertation, Department of Agricultural Extension Education and Communication, The University of Agriculture, Peshawar-Pakistan. pp. 62-63.
- Kumar, R., P. Kumar and S. Pal. 2021. Farmers' awareness regarding information and communication technology (ICT) based equipments in agriculture sector of Haryana. UGC Care Group 1 Journal. 51 (XXIV): 172-183.
- Likert, R. 1932. A technique for the measurement of attitudes. Arch. Psychol., 22(140):1-55.
- Lokeshwari, K. 2016. A study of the use of ICT among rural farmers. A case study. Int. J. Commun. Res., 6 (3):232-238.
- Maningas, R.V. 2006. Mainstreaming farmers and

- intermediaries into information and communications technology (ICT): A strategy towards adopting ICT for rural development and agricultural extension. *Computers in Agriculture and Natural Resources*, 4th World Congress Conference, USA. Pp. 28-31.
- Mruthunjaya and A. Adhiguru. 2005. ICT for livelihood security: A reality check. *Mainstreaming ICTs*. II (2): 14-18.
- Muhammad, S., T.E. Lodhi and G.A. Khan. 2012. Indepth analysis of electronic media to enhance their role in agricultural technology transfer in the Punjab-Pakistan. *Pak. J. Agric. Sci.*, 49: 221-227.
- Narula, S.A. and S. Arora. 2010. Identifying stakeholders' needs and constraints in adoption of ICT services in rural areas: the case of India. *Soc. Responsibility J.*, 6(2): 222-236. <https://doi.org/10.1108/17471111011051739>
- Ommani, A.R. and M. Chizari. 2008. Information dissemination system (IDS) based e- learning in agricultural of Iran (Perception of Iranian extension agents). *World Acad. Sci. Eng. Technol.*, 38: 468-472.
- Omotayo, O.M. 2005. ICT and agricultural extension. Emerging issues in transferring agricultural technology in developing countries. In: Adedoyin, S. F. (ed), *Agricultural extension in Nigeria*. Ilorin: Agric. Ext. Soc. Nigeria,
- Parmar, I.S., P. Soni, J.K.M. Kuwornu and K.R. Salin. 2019. Evaluating Farmers' Access to Agricultural Information: Evidence from Semi-Arid Region of Rajasthan State, India. *Agriculture*, 9(60): 1-17. <https://doi.org/10.3390/agriculture9030060>
- Raghuprasad, K.P., S.C. Devaraja and Y.M. Gopala. 2012. Attitude of farmers towards utilization of information and communication technology (ICT) tools in farm communication. *Res. J. Agric. Sci.*, 3 (5): 1035-1037.
- Sajid, A. and S. Ali. 2018. Role of ICTs in disseminating agricultural knowledge and updates among farmers of Punjab. *J. Appl. Environ. Biol. Sci.*, 8(5): 9-15.
- Silva, D.H. and R. Dimuth. 2008. Using ICT to reduce transaction costs in agriculture through better communication: A case-study from Sri Lanka. *LIRNEasia*, Sri Lanka. Available at: <http://www.lirneasia.net/wp-content/uploads/2008/11/transactioncosts.pdf>
- Sinha, G.R. 2013. ICT enabled agriculture transforming India. *CSI Commun.*, 27-28.
- Usman, J.M., J.A. Adeboye, K.A. Oluyole and S. Ajijola. 2012. Use of information and communication technologies by rural farmers in Oluyole local government area of Oyo State, Nigeria. *J. Stored Prod. Postharvest Res.*, 3(11):156-159.
- Wereh, H. 2012. The role of ICTs in dissemination of information on ecological organic agriculture. *Biovision farmer communication programme*, Kakamega, Kenya. Pp. 67-72.
- Warren, M.F. 2002. Adoption of ICT in agricultural management in the United Kingdom: The Intra-Rural Digital Divide. *Agric. Econ.*, 48(1): 1-8. <https://doi.org/10.17221/5280-AGRI-CECON>