Research Article

Assessment of Agricultural Knowledge Level Increased Among the Mobile Phone Users in Khyber Pakhtunkhwa of Pakistan

Arshad Farooq[1], Muhammad Ishaq[2], Abdul Hassan[1], Muhammad Zafarullah Khan[3] and Asif Nawaz[3]*

[1]PARC SSRI, ARI, Tarnab, Peshawar, Pakistan; [2]SSD (PARC), Islamabad, Pakistan; [3]Department of Agricultural Extension Education and Communication, The University of Agriculture, Peshawar, Pakistan.

Abstract | The Government of Khyber Pakhtunkhwa signed a memorandum of understanding (MoU) with Telenor-Pakistan (mobile operator company) to provide agricultural advisory services to the farming community in district Mardan. This study was conducted with the objective to find out the impact of mobile phones on knowledge level of farmers about improved agricultural management techniques. Out of 203 subscribers (beneficiary farmers), sixty farmers were interviewed through interview schedule. Knowledge index was used for measuring farmers' knowledge level. The study revealed that application of mobile phones decreased the communication gap (88%) between the farmers and agricultural extension department. The agricultural advisory services provided through mobile phones have improved the knowledge level of farmers in crop varieties selection (84%), sowing time (79%), land preparation (82%), fertilizer application (83%), pesticides/insecticides application (79%), irrigation (76%) and weedicide (71%). Moreover, the knowledge level of beneficiary farmers also enhanced regarding post-harvest losses (57%), weather information (78%) and market information (79%) in the research area. Overall knowledge level of beneficiary farmers increased 77 percent in the study area. The study suggested that agricultural advisory services through mobile phones should be restarted and extended to other districts of Khyber Pakhtunkhwa, Pakistan.

Received | April 12, 2021; **Accepted** | October 20, 2021; **Published** | May 20, 2022
***Correspondence** | Asif Nawaz, Department of Agricultural Extension Education and Communication, The University of Agriculture, Peshawar, Pakistan; **Email:** asif.nawaz38300@gmail.com
Citation | Farooq, A., M. Ishaq, A. Hassan, M.Z. Khan and A. Nawaz. 2022. Assessment of agricultural knowledge level increased among the mobile phone users in Khyber Pakhtunkhwa of Pakistan. *Sarhad Journal of Agriculture,* 38(2): 751-758.
DOI | https://dx.doi.org/10.17582/journal.sja/2022/38.2.751.758
Keywords | Agricultural advisory services, Beneficiary farmers, Mobile phone usage, Perceptions, Knowledge level

Introduction

Agricultural advisory services play a key role in farm productivity. Insufficient access to information may cause decline in estimated production (Ashraf *et al.*, 2015). In this regard information is an essential component of increasing production, reducing transaction and travel cost and providing rapid access to accurate and timely market information (Rashid and Elder, 2009). However, Akinsola (2014) viewed that bridging the knowledge gap of farmers using traditional agricultural knowledge support strategies are inadequate and inefficient. The use of Information Communications Technology (ICT) tools in transaction process help farmers improve their skills in marketing process (Anselme *et al.*, 2012). There-

fore, Chhachhar and Hassan (2013) rightly find that ICT has drastically reduced the communication and information costs of rural people and provided new opportunities for rural farmers to obtain knowledge and information about agricultural issues, problems and its application for the development of agriculture. Information Communications Technology (ICT) is a cheap and innovative source of exchanging market, weather, and business information (Chhachhar and Hassan, 2013; Wald and Koblo, 2008), making decision about farm practices and developing relationships with business community (Aker, 2011; Goodman, 2005; Donner, 2006; Jehan *et al*., 2014).

Keeping in view the importance of agriculture sector to the provincial economy in particular and national in general, the Government of Khyber Pakhtunkhwa recognized that transfer of improved technology to the farming community is imperative. In this connection, the Government of Khyber Pakhtunkhwa signed memorandum of understanding (MoU) with Telenor-Pakistan (mobile operator company) to provide agricultural advisory services to the farming community in district Mardan. This pilot project launched with the hope to be extended to other districts of Khyber Pakhtunkhwa province. Therefore, before its extension to other districts, it is necessary to assess the agricultural advisory services regarding beneficiary farmers' knowledge while receiving agricultural information through mobile phones from Agricultural extension department. Also, the massive use of mobile phone among the farming community provides an opportunity to ensure timely and economically dissemination of crop management practices information by the extension department for farming community. Thus, this research study assesses the potential of mobile phone usage as an information source for the farming community of Khyber Pakhtunkhwa.

Materials and Methods

Location of the study and sample selection

This study was conducted in district Mardan of Khyber Pakhtunkhwa, where the agricultural extension department launched agricultural advisory services through mobile phones using the cellular facility (Telenor-Pakistan). According to district Mardan Agricultural Extension department, about 203 farmers were subscribed for the farm advisory services. The Agricultural Extension Department of the district Mardan provided a list of the beneficiary farmers to the researchers who obtained advisory services through mobile phones (Figure 1).

The instant study was based on primary and secondary data. Primary data were collected from sixty (60) beneficiary farmers who received farm advisory services through mobile phones. For this purpose, knowledge test was developed for measuring farmers' knowledge level. For measuring farmers' knowledge level, a specific knowledge test was prepared on the basis of disseminated messages by the concerned department. For data collection, interview schedule was prepared. The formal survey was conducted after pre-testing the interview schedule on ten beneficiary farmers in the study area, in order to meet the preset objectives of the study. The interview schedule was modified accordingly. The pre-tested interview schedules were dropped from the final survey. The primary data was supplemented with the relevant secondary data, research reports and published research articles.

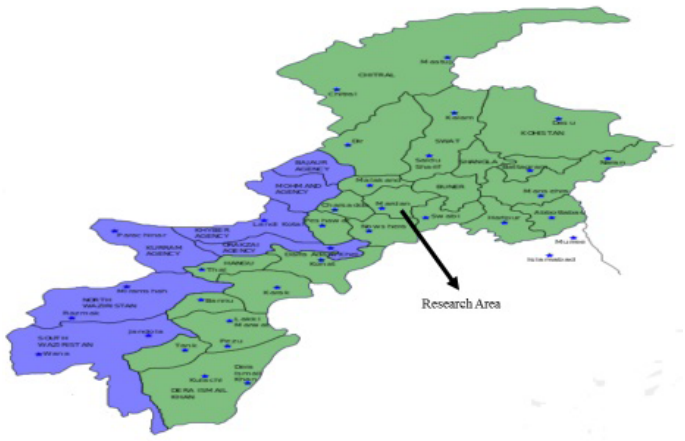

Figure 1: *Map of Khyber Pakhtunkhwa showing research area*

Data collection and analysis

Primary data for this study were collected through face-to-face interview schedule. The survey was conducted in the months of March-April, 2016. The respondents of the study were contacted well before data collection for appointment and visit of the team. At the time of interview, the beneficiary farmers were briefed about the aim and objectives of the study. The respondents were assured that the data will be used only for research purpose. This helps in developing a rapport with the respondents to get accurate information. The respondents were generally interviewed at their farms, residences and *hujras* (a drawing room where male guests were entertained in a household).

The collected data were analyzed by using Statistical Package for Social Science software and results were presented in counts and percentages. The information based on the farmers' opinion regarding agricultural advisory services through mobile phones, were ranked into (1) Most important, (2) Important and (3) Least important.

For assessing the improvement in knowledge level of the beneficiary farmers regarding improved agricultural management techniques, fourteen different knowledge indicators like communication gap, agriculture information according to farming situation, received new information, varieties, sowing time, land preparation, fertilizers application, pesticides/insecticides, irrigation application, weedicides, harvesting, post harvest losses, weather information and market information were pinpointed based on consultations with the experts of Agricultural Extension Department. For calculating knowledge level of beneficiary farmers, practice wise score was assigned by using scale at four levels, such as; 0: Not Extent, 1: Low Extent, 2: Some Extent and 3: Great Extent. The maximum score of the fourteen (14) questions were forty two (42) score and each question carried maximum three (3) score. The score of individual question was added for calculating the total score of an individual respondent. The obtained score was divided by maximum obtainable score to calculate the final knowledge score. Similar procedure was applied for each question of the fourteen indicators to obtain the knowledge level for each variable of the respondent. This deviation of the knowledge level was then expressed in percentage as the proportion to the respondent's maximum possible score. The knowledge level was calculated through knowledge index. The knowledge index was calculated following Hakeem and Dipak (2013) procedure as:

$$KI = \left(\frac{X}{Y}\right) \times 100 \ldots\ldots (1)$$

Where;
KI: Knowledge level index; *X*: Knowledge score obtained by the respondents; *Y*: Maximum obtainable knowledge score.

Results and Discussion

Mobile phone and its usage

Table 1 indicates that all of the sample respondents had their own mobile phone sets. Overwhelming majority (97%) of the sample respondents reported that they can use the mobile phone to great extent while remaining 3 percent viewed that they can use the mobile phone set to some extent. The result shows that three-fifth can send messages (SMSs) to other cell phones whereas the rest of the sample farmers reported that they cannot send SMSs to other cell phones. Majority (90%) of the sample respondents mentioned that they can read SMSs from cell phones while 10 percent of the respondents reported that they cannot read the SMSs from cell phones. They viewed that another person was asked to read and interpret the SMSs received from other cell phones. Our results are almost in conformity with those of Khan *et al.* (2019) who reported that 91.2% of the farmers in district Muzaffargarh of Punjab province owned mobile phone. Overwhelmingly majority (97.6%) of the farmers were able to made calls, more than half (52.4%) farmers read urdu text and 23.8% farmers showed SMS writing ability in urdu language. Similarly, Kansiime *et al.* (2019) reported that devastating majority (94%) of farmers can understand the messages they received from mobile agri-advisory services.

Table 1: *Mobile Phone Users by sample respondents.*

Categories	Frequency	Percent
Own	60	100
Mobile use		
To Great Extent	58	97
To Some Extent	2	3
Total	60	100
Sending SMSs		
Yes	36	60
No	24	40
Total	60	100
Read SMSs		
Yes	54	90
No	6	10
Total	60	100
If No request to another to interpret the SMSs		
Yes	6	10

Source: *Field Data.*

Table 2 reveals that sample respondents had mobile sets since 11.87 years. Their monthly expenditures incurred on cell phone usage were PKR 890 per month. The sample farmers sent on average 2.83 messages per day and received 8.3 messages per day. The farmers also received one message from fellow farmers per

day. Moreover, sample respondents stated that they received on average 8.63 calls per day including 2.43 calls from fellow farmers and made on average 7.87 calls per day. That shows the importance of mobile phone usage in the farming community in their daily routine activities in the study area. However, Khan *et al.* (2019) reported that majority (68.3%) of the farmers used mobile phone for more than three years.

Table 2: *SMSs and Voice Call Made Per Day from Cell Phones by sample respondents.*

Categories	Min	Max	Mean	Std. Dev.
Mobile ownership (years)	4	20	11.87	4.80
Cell phones cost (Rs./month)	200	3000	890	755.83
SMSs received (No./day)	1	15	8.3	3.99
SMSs sent (No./day)	0	15	2.83	2.40
SMSs from fellow farmers (No./day)	0	5	0.77	0.37
Voice call received (No./day)	1	30	8.63	7.47
Voice call made (No./day)	1	30	7.87	7.77
Voice calls from fellow farmers (No./day)	0	8	2.43	2.10

Source: *Field Data.*

Table 3: *Most Common Usage of mobile Phone by sample respondents.*

Categories	Most important		Important		Least important	
	Freq	Percent	Freq	Percent	Freq	Percent
Social Contact	32	53.33	18	30	8	13.33
Home Contact	10	16.67	24	40	20	33.33
Agric. Activities	16	26.67	18	30	22	36.67
Others Contact	2	3.33	-	-	-	-
No response	-	-	-	-	10	16.7
Total	60	100	60	100	60	100

Source: *Field Data.*

In the study area, the mobile phones were mostly used for social contacts, home contacts and agricultural purposes. Table 3 shows that more than half (53.33%) of the sample respondents used mobile phones for social contacts (most important), followed by home contacts (40%) (important) and agricultural purposes (36.67%) (least important) in the study area. These results are in contrast with those of Chhachhar *et al.* (2014) who reported that 80% of the respondents used mobile to contact with friends while 13.3% of the respondents used it to contact with their family.

Table 4 reveals that half of the sample respondents used cell phone for contacting fellow farmers regarding farming activities (most important), two-fifth of the sample farmers used cell phones for contacting agricultural department for agriculture advisory services (important), while 30 percent of the sample respondents mentioned that they used cell phone for contacting input dealers (least important) in the study area. The usage of cell phone for communication in the study area is very important in general and particularly for agricultural activities. Because it spares farmers time, resources and increase farm production due to timely information received from various sources like agricultural department, input dealers and fellow farmers *etc.* Adamides and Stylianou (2013) reported that vast majority (98%) of the respondents were using the mobile phone as an information source. About 89% farmers got information from fellow farmers followed by agricultural extension services, private extension services (81%) and input dealers (74%). Similarly, Syiem and Raj (2015) reported that mobile phones were extensively used by the farmers for social contact, contacting middle men for the marketing of produce and contacting experts for obtaining agricultural advisories. Also, Chhachhar *et al.* (2014) stated that 80% of the respondents used mobile phones to contact with their friends.

Table 4: *Cell Phone Usage for Farm work of the Sample Respondents.*

Categories	Most important		Important		Least important	
	Freq	%	Freq	%	Freq	%
Contact fellow farmers for farm help	30	50	10	17	10	17
Talking to input dealers	8	13	18	30	18	30
Agriculture Department	18	30	24	40	6	10
Others	4	7	-	-	4	7
Talking to middle men	-	-	6	10	16	27
No Response	-	-	2	3	6	10
Total	60	100	60	100	60	100

Source: *Field Data.*

Perceived farmer's act to SMSs

Table 5 reveals that more than half (57%) of the sample farmers read out the SMSs received from agricultural extension department and also applied the obtained agricultural information in their farming activities. One-fifth of the sample respondents reported that they further investigated the SMSs received from the agricultural extension department. However, 17 percent of the respondents mentioned that they

just read out the SMSs and did not apply the received information in their farming. Additionally, 3% each of the sample respondents reported that they deleted the messages and ignored the messages received from agricultural extension department in the study area. Kansiime *et al.* (2019) stated that majority (76%) of the respondents taken action in association with information received on their mobile phones regarding agri-advisory services.

Table 5: *Farmers Act on SMSs Received from the Agriculture Extension Department.*

Categories	Frequency	Percent
Delete	2	3
Ignore	2	3
Read and apply on agriculture farming	34	57
Further investigation for understanding	12	20
Just read but don't apply	10	17
Total	60	100

Source: *Field Data.*

Table 6: *SMSs Relevancy to the Farming situation and Sharing with Fellow Farmers.*

Categories	Frequency	Percent
SMSs according to farming activities		
Yes	56	93
No	24	7
Total	60	100
SMSs shared with fellow farmers		
Yes	58	97
No	2	3
Total	60	100

Source: *Field Data.*

Table 6 illustrates that vast majority (93%) of the farmers reported that the SMSs received from agricultural extension department through mobile phones regarding improved agricultural management practices were compatible to farming situation of the farmers in the study area. It was astonishing to note that a limited number (7%) of the sample farmers stated that the information received through SMSs was not related to our farming activities. Additionally, the results also revealed that overwhelming majority (97%) of the sample farmers shared the messages related to agricultural information received from agriculture department through mobile phone with fellow farmers while a very limited number (3%) of the sample farmers mentioned that they did not shared these messages with fellow farmers. It is clear from the survey results that a very major portion of the farming community provided importance to this program in the study area. Kansiime *et al.* (2019) found that 86% of the farmers received agri-advisory information from fellow farmers.

Farmers' satisfaction regarding SMSs

During the present study, majority (90%) of the sample farmers reported that they were confident on the accuracy of the information received through SMSs while 10 percent mentioned that they were uncertain about the accuracy of the information received through agricultural advisory services. Table 7 further shows that 73 percent of the sample farmers were confident on the accuracy of SMSs to great extent followed by some extent (13%), low extent (4%) and 10 percent were uncertain on the accuracy of SMSs agricultural advisory services through mobile phones in the study area.

Table 7: *Farmers' perception about SMSs agricultural advisory services in the Study Area.*

Categories	Frequency	Percent
Yes	54	90
No	6	10
Total	60	100
In case of yes		
Some Extent	8	13
Great Extent	44	73
Low Extent	2	4
Don't belief on SMS advice	6	10
Total	60	100

Source: *Field Data.*

Table 8: *Farmers Satisfaction Level About SMSs.*

Categories	Frequency	Percent
Some Extent	9	30
Great Extent	17	57
Low Extent	4	13
Total	30	100

Source: *Field Data.*

Table 8 reveals that more than half (57%) of the sample farmers were satisfied from the SMSs agricultural advisory services to great extent followed by some extent (30%) and low extent (13%) in the study area. Ganesan *et al.* (2015) reported that 99% of the respondents expressed as information received through mobile messages was useful and satisfactory.

Table 9: *Knowledge Level of the Sample Respondents in the Study Area.*

Categories	Obtainable Score (Y)	Obtained Score (X)	Mean Gap (Y-X)	K I (%) (X/Y) *100	Std. Deviation
Communication gap regarding Agric. Information decreased	3	2.63	0.37	88	16.34
SMS are according to farming situation	3	2.53	0.47	84	20.96
SMS received contained New Information	3	2.17	0.83	72	15.37
Knowledge level increased regarding selection of crops varieties	3	2.53	0.47	84	16.91
Knowledge level increased regarding Sowing Time	3	2.37	0.63	79	25.50
Knowledge level increased regarding Land Preparation	3	2.47	0.53	82	24.34
Knowledge level increased regarding Fertilizers Application	3	2.50	0.50	83	22.74
Knowledge level increased regarding pesticides/insecticides	3	2.37	0.63	79	23.95
Knowledge level increased regarding Irrigation Application	3	2.27	0.73	76	26.16
Knowledge level increased regarding weedicides Application	3	2.13	0.87	71	27.31
Knowledge level increased regarding Crops Harvesting	3	2.17	0.83	72	24.89
Knowledge level increased regarding Post Harvest Losses	3	1.70	1.30	57	26.48
Knowledge level about weather information	3	2.33	0.67	78	26.96
Communication Gap about Market Information	3	2.37	0.63	79	26.74
Overall	42	32.54	6.46	77	13.52

Source: *Field Data.*

Effect of agricultural advisory services through SMSs on farmers' knowledge

The farmers used mobile phones for agricultural purpose, were more informed and in contact with extension agents and their production were more than non-mobile phone users (Bolarinwa and Oyeyinka, 2011). Jehan et al. (2014) found that mobile phone is a cheaper source of getting information and increased market participation. The study further shows that the use of mobile phone in agriculture has positive impact on crop production.

The overall knowledge level of the sample farmers was increased by 77 percent which implies that the SMSs agricultural advisory service was relatively successful in all the dimensions of its relevance in improving the knowledge level of respondents in the study area. The major increase was found in decreasing the communication gap between farmers and the agriculture extension department (88%). The relevancy of SMSs to the farming situation in the area was found 84% while new information contained by these SMSs was 72%. According to the sample respondents, their knowledge level regarding selection of crops varieties, sowing time, land preparation, fertilizers application, pesticides/insecticides application, irrigation application and weedicide application were improved by 84%, 79%, 82%, 83%, 79%, 76% and 71% respectively. Additionally, according to sample respondents, the knowledge level regarding post harvest losses, weather and market information were improved upto 57%, 78% and 79% respectively. The lowest improvement in the knowledge level of the sample respondents was found in postharvest losses (Table 9). Raghuprasad *et al.* (2013) revealed that about 70% of farmers had high to medium level of knowledge about utilization of information communication technology (ICT) tools. Mittal and Hariharan (2018) found that mobile-phone have the potential to reduce information gaps and create awareness regarding improved agricultural technologies which leads to adoption of improved technology. Kansiime *et al.* (2019) reported that the small farmers perceived that their knowledge increased by using mobile phone agri-advisory services.

Extension field staff views about mobile phone usage in agriculture

During the field survey, responses of the extension field staff about usage of mobile phone in agriculture as an information source were also recorded which can be summarized as follows:

1. Timely and economical information can be provided to the farming community by the use of mobile phone specially for farmers residing in far flung rural areas.
2. Farmers can be in constant contact with the extension agents through the use of mobile phone and seek advice in urgency situation.

3. Farmers can keep update themselves about market prices, weather forecast and subsidized inputs at the farm services centers.

Conclusions and Recommendations

The SMSs agricultural advisory services were launched by the agricultural extension department in collaboration with Telenor mobile company in district Mardan. Being a pilot project, the farm advisory services were provided through SMSs to the members of farm services centers. The study concludes that the uses of mobile phones decreased the communication gap between farmers and agricultural extension department. Knowledge level of the sample beneficiary farmers increased regarding improved agricultural production techniques disseminated through SMSs by agricultural extension department. The farmers were confident on the accuracy of SMSs advisory services. The study suggests that starting of SMSs agricultural advisory services once again and should be extended SMSs agricultural advisory services to all districts farmers of Khyber Pakhtunkhwa. Moreover, SMSs agricultural advisory services should also be extended to other cellular mobile phones to reach improved agricultural techniques to all farmers of Khyber Pakhtunkhwa for increasing crop production. Provincial extension department needs to sensitize and encourage farming community regarding usage of mobile phone as an agricultural information source. Also, district agriculture extension department needs to register entire farmers of the district with themselves and share crop specific information that will inspire them to practice scientific farming.

Novelty Statement

Novelty of this research study is to acknowledge the services provided by Agriculture Extension Department Khyber Pakhtunkhwa Pakistan regarding usage of Mobile phones in the Dissemination of Agricultural Information among farming communities to improve the agriculture production and subsequently their livelihoods.

Author's Contribution

Arshad Farooq: Conducted this study as major author by providing main idea to extract the information regarding cell phone technology and added in data collection, data analysis and supervised the whole work.
Muhammad Ishaq: Provided valuable suggestions regarding questionnaire development and research methodologies.
Abdul Hassan: Helped in data collection, editing and analysis of the data.
Muhammad Zafarullah Khan: Helped in correcting the manuscript technically.
Asif Nawaz: Contributed in data collection, data editing, and literature review.

Conflict of interest
The authors have declared no conflict of interest.

References

Adamides, G. and Stylianou, A. 2013. ICT and mobile phone use for agricultural knowledge sharing by Cyprio Farmers. Agri on-line papers in economics and informatics. 2(5):3-10. https://ideas.repec.org/a/ags/aolpei/152686.html

Aker, J.C. 2011. Dial "A" for agriculture: a review of information and communication technologies for agricultural extension in developing countries. Agric. Econom., 42(6): 631-647. https://doi.org/10.1111/j.1574-0862.2011.00545.x

Akinsola, O.S. 2014. ICT adoption for bridging South African black farmers knowledge gap. Int. J. Agric. Sci. Tech., 2(1): 39-47. https://doi.org/10.14355/ijast.2014.0301.06

Anselme, B.A., R.M.F. Vidogbena and D. Agossou. 2012. Determinants of ICT use by rice farmers in Benin: from the perception of ICT characteristics to the adoption of the technology. J. Res. Int. Bus. Manage., 2(11): 273-284.

Ashraf, S., G.A. Khan, M.S. Ali, S. Ahmed and M. Iftikhar. 2015. Perceived effectiveness of information sources regarding improved practices among citrus growers in Punjab Pakistan. Pak. J. Agri. Sci., 52(3): 861-866.

Bolarinwa, K.K. and R.A. Oyeyinka. 2011. Use of cell phone by farmers and its implication on farmers' production capacity in Oyo State Nigeria. World Acad. Sci. Eng. Technol., 51: 653-658.

Chhachhar, A.R. and M.S.H. Hassan. 2013. The use of mobile phone among farmers for agriculture development. Int. J. Sci. Res., 2(6): 95-98.

Chhachhar, A.R., B. Qureshi, G.M. Khushk and

Z.A. Maher. 2014. Use of mobile phone among farmers for agriculture information. Eur. J. Sci. Res., 119(2): 265-271.

Donner, J. 2006. The social and economic implications of mobile telephony in Rwanda: An ownership/access typology. Knowl. Technol. Policy. 19 (2): 17-28. https://doi.org/10.1007/s12130-006-1021-7

Ganesan, M., J. Umadikar and S. Prashant. 2015. Assessment of Mobile Voice Agricultural Messages Given to Farmers of Cauvery Delta Zone of Tamil Nadu, India. J. Commun. Inf., 11(1): 1-15. https://doi.org/10.15353/joci.v11i1.2850

Goodman, J. 2005. Linking mobile phone ownership and use to social capital in rural south Africa and Tanzania, Vodafone Policy Paper Series, Number 2. https://sarpn.org/documents/d0001181/P1309-Vodafone_March2005.pdf

Hakeem, S.A. and D. Dipak, 2013. Knowledge of tomato growers using polly plastic in Thi-Qar province of Iraq. Indian Res. J. Ext. Educ., 13 (3): 55-58.

Jehan, N., K.M. Aujla, M. Shahzad, A. Hussain, M. Zahoor, M. Khan and A. Bilal. 2014. Use of mobile phones by farming community and its impact on vegetable productivity. Pak J. Agric. Res., 27 (1): 58-63.

Kansiime, M.A., A. Alawy, C. Allen, M. Subharwal, A. Jadhav and M. Parr. 2019. Effectiveness of mobile agric-advisory services extension model: Evidence from direct 2 farm program in India. World Dev. Perspect., 13:25-33. https://doi.org/10.1016/j.wdp.2019.02.007

Khan, N.A., G. Qijie, S. Ali, B. Shahbaz and A.A. Shah. 2019. Farmers' use of mobile phone for accessing agricultural information in Pakistan: a case of Punjab Province. Ciência Rural. 49(10): 1-12. http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0103-84782019001000901 https://doi.org/10.1590/0103-8478cr20181016

Mittal, S. and V.K. Hariharan. 2018. Mobile-based climate services impact on farmers risk management ability in India. 22: 42-51. https://repository.cimmyt.org/bitstream/handle/10883/19782/59900.pdf?sequence=1&isAllowed=y

Raghuprasad, K.P., S.C. Devarage and Y.M. Gopala. 2013. An analysis of knowledge level of farmers on utilization of ICT tools for farm communication. J. Rural Dev., 32(3): 301-310.

Rashid, A.T. and L. Elder. 2009. Mobile phones and development: An analysis of IDARC-supported projects. J. Inf. Syst. Dev. Countries. 36(2): 1-16. https://onlinelibrary.wiley.com/doi/abs/10.1002/j.1681-4835.2009.tb00249.x

Syiem, R. and S. Raj. 2015. Access and usage of ICTs for agriculture and rural development by the tribal farmers in Meghalaya state of North-East India. J. Agric. Inf., 6(3): 24-41. https://doi.org/10.17700/jai.2015.6.3.190

Wald, A. and R. Koblo, 2008. ICT and poverty reduction: mobile telecommunications advancing fast. Rural 21: Int. J. Rural Dev., 6: 11-13.