



Farmers' use of mobile phone for accessing agricultural information in Pakistan: a case of Punjab province

Nasir Abbas Khan¹  Gao Qijie^{1*} Shoukat Ali² Babar Shahbaz² Ashfaq Ahmad Shah³

¹College of Humanities and Development Studies (COHD), China Agriculture University, No.17 Qing Hua Dong Lu, Haidian District, 100083, Beijing P.R., China. E-mail: gaobjcn@163.com. *Corresponding author.

²Institute of Agricultural Extension and Rural Development, University of Agriculture, Faisalabad, Pakistan.

³Department of Development Studies, School of Social Sciences and Humanities (S3H), National University of Sciences and Technology (NUST), Islamabad, Pakistan.

ABSTRACT: Agriculture is considered as the main driving force in Pakistan's economy employing 45% of the country's labor force and generating 20% of national GDP. Agriculture sector of Pakistan is facing numerous challenges including non-adoption of agricultural technology at the farm level, due to farmers' lack of access to the latest information. In this context, the current study focusses on the use of the mobile phone in accessing agricultural information among the farmers of the district Muzaffargarh, Punjab, Pakistan. A multistage sampling technique was used to collect data from the two tehsils (cities/sub-districts) of Muzaffargarh formulating a total sample of 180 farmers. SPSS computer-based Software was used for analyzing the data. Results revealed that 91.2% of the farmers indicated mobile phone ownership. It was further reported that 87.20% of the farmers used private sectors advisory staff to obtain agriculture information. Market information was ranked as the highest accessed information among the rest of farm-related use. Easy access to updated information and connectivity with stakeholders were reported as the highest perceived benefits of mobile phone use (4.63 & 4.72 mean). Findings reported that farmers' limited aptitude of Mobile phone usage and lack of awareness of information sources as major constraints in farm-related use of the Mobile phone. On the basis of findings, the current study provided recommendations and policy implications for utilizing the true potential of these ICT-enabled solutions in agriculture.

Key words: mobile phone, ICT, information transfer, e-extension, farmers, agriculture, Punjab, Pakistan.

Papel do celular para entrega de informações agrícolas em um distrito carente da província de Punjab, Paquistão

RESUMO: A agricultura é considerada como a principal força motriz na economia do Paquistão, empregando 45% da força de trabalho do país e gerando 20% do PIB nacional. O setor agrícola dos paquistaneses enfrenta inúmeros desafios, incluindo a não-adaptação da tecnologia agrícola entre os agricultores, devido a falta de acesso dos agricultores às informações agrícolas mais recentes. Neste contexto, o estudo atual enfoca o papel do telefone celular na disseminação de informações agrícolas entre os agricultores do distrito Muzaffargarh Punjab, Paquistão. Uma técnica de amostragem em múltiplos estágios foi usada para coletar dados dos dois tehsils (cidades / sub-distritos) de Muzaffargarh, formulando uma amostra total de 180 agricultores. O software baseado em computador SPSS foi usado para analisar os dados. Os resultados mostraram que 91,2% dos agricultores tinham propriedade de telefones celulares. Verificou-se ainda que 87,20% dos agricultores contataram o pessoal consultivo do setor privado para obter informações sobre a agricultura. As informações de mercado foram classificadas como as mais acessadas entre os demais usos relacionados à fazenda (média de 4,63). O acesso fácil a informações atualizadas e a conectividade com as partes interessadas são relatados como os maiores benefícios percebidos do uso de telefones celulares entre os agricultores com valores médios de 4,63 e 4,72, respectivamente. Os resultados relataram que a capacidade limitada dos agricultores de usar o telefone celular e a falta de conhecimento das fontes de informação como principais restrições ao uso do telefone celular relacionado à fazenda. Com base nos resultados, recomenda-se a realização de sessões de treinamento com as comunidades agrícolas para criar conscientização e educá-las sobre o uso do telefone celular.

Palavras-chave: Telemóvel, TIC, Transferência de informação, Extensão E, Agricultores, Agricultura, Punjab, Paquistão.

INTRODUCTION

Information and communication technologies (ICT) particularly the mobile phone has immensely penetrated every field of life like education, business, commerce, and agriculture. Mobile phone-based communication has rapidly grown in the recent past and became the most used communication tool among all ICTs of the current

age. Recent statistics showed that 62.9 percent of the population worldwide already own a mobile phone with 4.68 billion users on the planet (STATISTA, 2019). This trend is also similar in Pakistan as the country has seen an abrupt rise in mobile phone users from 88 million in 2008 to 152 million in 2018 (PTA, 2018). This rapid growth of Mobile telephony has emerged as a successful communication tool which has not only transformed the working style of many

sectors but also created new professional dimensions in various businesses including agriculture (SULLIVAN & OMWANSA, 2013; ASONGU & ASONGU, 2018). In the agriculture sector, smooth exchange on information is a key to the successful adoption of farm innovation needed for the agricultural development but due to lack of resources and poor infrastructure in many developing countries, a huge communication asymmetry exists between the latest agricultural knowledge and farmers (BALOCH & THAPA, 2014). In this scenario ICT, particularly the mobile phone has shown a great potential to facilitate communication by enabling the smooth exchange of knowledge between the various stakeholders in agriculture (AKER, 2011).

In the agricultural context, the cellular phone has empowered the farmers to communicate from local to administrative levels regarding the agricultural trade, information exchange, and buying and selling inputs and farm commodities (OGUTU et al., 2014). This has reduced the cost of traveling and improved the production efficiency of farming communities living in remote areas. The mobile phone has tremendously been diffused even into the marginalized and underdeveloped farming communities because of its flexibility, affordability and user-friendly nature as compared to other ICT tools (OSABUTEY & JIN, 2016). Another dimension of mobile phone application in agriculture is “e-extension” that has simplified the mode of extension and advisory services by its effective role in communication between the farming communities and research organizations (AKER & KSOLL, 2016).

Generally, farm advisory services in many countries are delivered through conventional extension methods; e.g., farmers meeting, personal visits, mass discussions, etc. (FAOSTAT & PRODUCTION, 2016). But unfortunately, the current ratio of extension agents to farmers cannot satisfy the information needs of the farming communities (BALOCH & THAPA, 2014). For instance, in many developing countries the existing agriculture extension system is unable to fulfill the information needs of the farmers due to limited resources (AKER, 2011). In this regard, the emerging trend of using ICTs for extension and advisory services is commonly prevailing in many developed as well as developing countries (AKER & KSOLL, 2016). The argument that “communication technologies are the future of agricultural extension and countries cannot afford the cost of face to face extension anymore” is commonly prevailed because the cellular phone has a potential to replace the face to face extension system (ALDOSARI et al., 2017).

In this context, mobile phone’s role becomes very crucial for the agriculture sector of many developing countries like Pakistan which are facing extreme challenges due to lack of adoption of latest agricultural technologies by the farmers due to the poor access to the latest farm knowledge (REHMAN et al., 2015). This is an alarming situation for a highly agricultural based country like Pakistan.

In Pakistan agriculture sector generates nearly 20% of national GDP by employing 45% of the country’s labor force (GOP, 2016). An overwhelming majority of Pakistan’ population lives in rural areas and is engaged in farming and related businesses. Despite the abundance of the labor force in agriculture, Pakistan still lags behind in term of achieving its productivity potential as compared to other countries of the world (REHMAN et al., 2015). For the matter of fact, the agriculture sector of Pakistan faces a huge production gap between the actual and potential yield of various crops (MUDDASSIR et al., 2016; NOOR et al., 2016). Many studies in Pakistan identified several challenges to existing yield gap including non-adoption of latest farm technology (REHMAN et al., 2015). The reason behind the lack of adoption of agricultural innovation is because of farmers’ lack of information access regarding new farm technologies (AHMAD et al., 2016). Since many years in Pakistan, the farmers have been accessing agricultural information through conventional extension methods but due to the increasing population of farmers with respect to extension agents led to the failure of effective extension services in the country (BALOCH & THAPA, 2014). In Pakistan, the case of marginalized communities is even more worst where extension system does not exist at all or if it does, is biased towards the big landlords and influential farmers (ABID et al., 2015). In this situation, communication tools like mobile phone provide effective answers to farmers’ problems to ease communication between the various stakeholders of the agriculture sector.

During the past few years in Pakistan, many mobile phone-based initiatives in agricultural extension have been taken by various governmental and non-governmental agencies to assist the farming communities in the country (Figure 5). Use of mobile-based farm advisory services (FAS) was initially started in the developed countries and was later conceived by the developing countries including Pakistan (AKER, 2011). In fact, the application of such models has many success as most of the farmers in developed countries are resourceful and literate. But for a different setting like in Pakistan where a significant majority of the farmers is illiterate the use

and adoption of such models need to be explored. Considering the rationale, this study was conducted in a marginalized region of Pakistan to evaluate the role of mobile phone in agricultural knowledge dissemination purposes among those farmers who are away from the mainstream. Moreover to the authors' best knowledge, the independent evaluations of these initiatives in Pakistan, particularly in the case of marginalized regions have not yet been taken. Hence this study provided pioneer evidence from these initiatives in Pakistan.

Previously numerous studies have been globally conducted regarding the effectiveness of mobile phone and its use in the dissemination of agricultural information to the farmers (SURABHI & MAMTA, 2016; NEHA et al., 2018). But for the case of marginalized communities as in the current study, thin literature is available globally regarding the use of the mobile phone for agricultural knowledge transfer; to fill this knowledge gap and reach the literature in that context the current study was designed with the following research objectives. 1) to assess farmers' mobile phone use and related attributes in the study area 3) To identify the farmers' use of various mobile phone-based agricultural information sources and 2) To explore the farmers' experiences regarding the farm-related use of the mobile phone.

MATERIALS AND METHODS

This section outlined the methods which are used in the current study. The methodology includes study area selection, data collection methods, sample size, sampling approach, and data analysis. The description of the materials and methods used in the study area is explained below.

Study area

The study was conducted in the Muzaffargarh district of Punjab Pakistan. Muzaffargarh was chosen because the study aimed to explore the role of mobile phone for farm knowledge transfer in the marginalized area and Muzaffargarh lies in one of the most underprivileged regions in the country (NAVEED et al., 2016). The study district is located in the south of the Punjab province situated on the bank of head Panjnad (junction of all five rivers of the province). The district Muzaffargarh is comprised of four tehsils occupying a total area of 0.84 m ha. The population of the district is about 4 million, of which majority of the population is rural (87%), relying on agriculture and related businesses (GOP, 2017). Wheat, sugarcane, and cotton are the main

crops grown in the area. The major mobile phone-based agricultural information sources available in the study area include government agriculture officers/extension agents, private agricultural companies dealers/staff, private helplines for farming solutions, government agriculture department helplines and government, livestock department helplines and SMS services. The present study considered the use of the mobile phone for information transfer in the context of these available agricultural information sources in the study area. Figure 1 shows the map of the study area on the map of Punjab Pakistan.

Data collection and sampling procedure

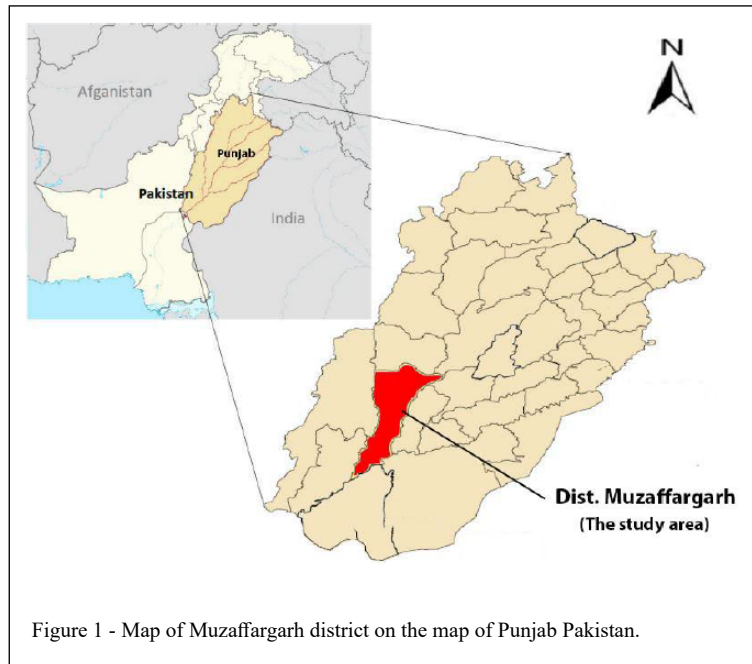
The data collection was carried out in the two tehsils (sub-district) of Muzaffargarh district between the month of February and March 2017. Initially, Muzaffargarh district was purposively selected as the study area and then a multistage sampling technique was used to collect data. In the first stage, Muzaffargarh District was selected, in the second stage, two tehsils were randomly selected among the four tehsils of the district. In the third stage, two rural union councils were randomly chosen (one from each tehsil). In the fourth stage, three villages were chosen at random (one from each union council) using Pakistan Village Statistics (GOP, 1998). In the final stage, thirty farmers were selected from each village (based on the farmer's list obtained from the District Agriculture Department). Union councils are a subsection of city government (sub-district/tehsil) in the local government system of Pakistan and rural union council may consist of various villages (GOP, 1998). Hence a total sample of 180 farmers was generated. The data were collected by a predesigned structured questionnaire. The questionnaire was pre-tested on 20 respondents (out of sample) to check the validity and reliability. The data collection was done at Farmers' convenient places in their local language and then converted into English. The collected data were then managed and analyzed using SPSS (Statistical package for social sciences) (Figure 2).

RESULTS

Results presented in the study are comprised of the descriptive statistics of the surveyed respondents. Out of the targeted 180 respondents, 164 of them possessed a mobile phone and were used for data analysis.

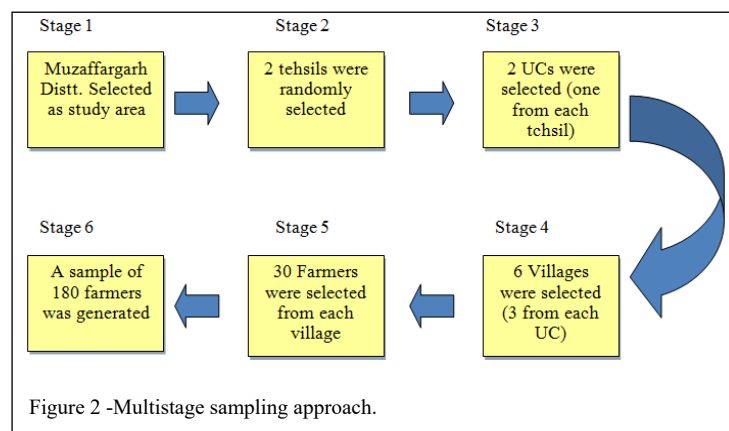
Farmers attributes regarding mobile phone use

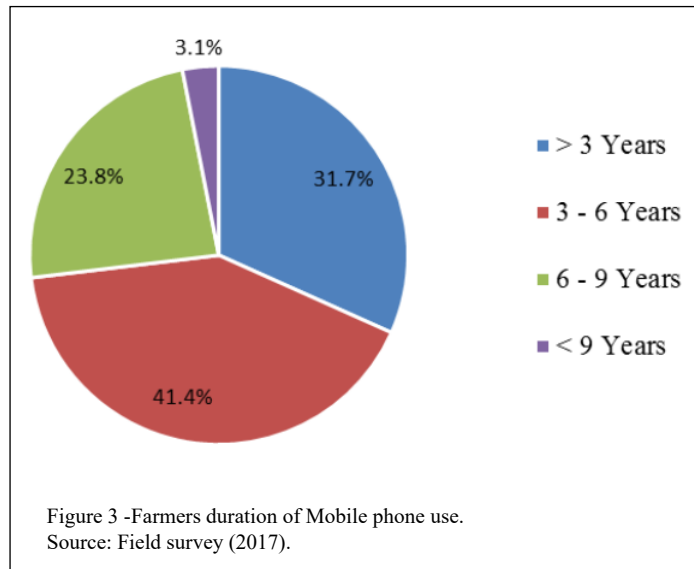
Farmer's characteristics like possession duration and their aptitude of mobile phone play a



pivotal role in understanding its farm-related use and factors associated with its adoption. It is argued that farmers possessing mobile phone for a long time have better skills of various operations i.e. making calls, SMS and internet-based mobile and hence increases the mobile phone adoption and use for agricultural purposes (AKER & KSOLL, 2016). In this regard, Farmers' mobile use related attributes like possession duration and aptitude of its use were initially assessed.

Results presented in figure 3 showed that the majority (68.3%) of the farmers reported mobile phone use for more than three years, which is a probability of farmers' better understanding regarding basic operations of the cell phone. Findings also indicated certain challenges for the feasibility of e-extension as a large proportion of farmers indicated possession duration less than three years that can negatively affect their awareness regarding various mobile-based information sources.



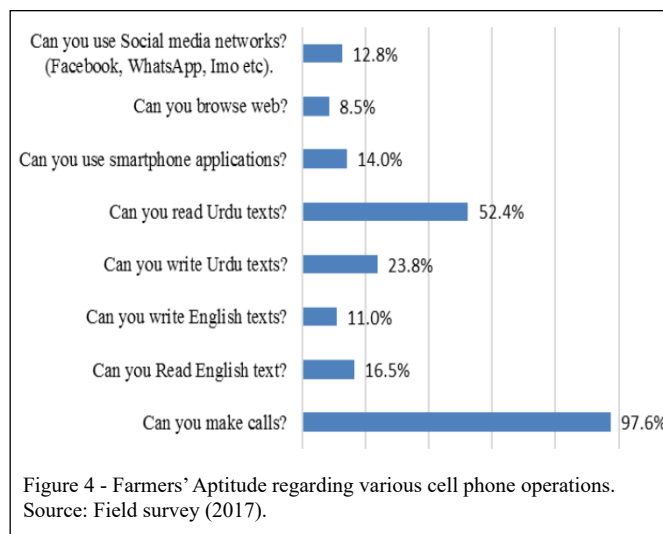


Similarly, farmers' aptitude of mobile phone use was also identified by incorporating various questions regarding their skills of various types of mobile phone uses. Results (Figure 4) showed that a significant majority of the farmers was only aware of the basic operation of mobile phones. Less than one-fourth (23.8%) of the farmers indicated SMS writing ability in Urdu language (National Language). Similarly, very few of them indicated the ability to read (16.5%) and write (11%) SMS in the English language. While in terms of advanced operating skills less than 12% of farmers

(on average) indicated the use of smartphone applications and other internet-based use of the mobile phone. Farmers' aptitude of various mobile phone operations is shown in detail in figure 4.

Farm related use of mobile phone
Farmers' mobile phone use pattern

Mobile phone use pattern shows the farmers' behaviors regarding the various type of communication. In this regard, farmers' mobile phone use pattern was assessed by documenting their monthly mobile phone expenditures with respect to



the various use purposes. The findings presented in figure 5 revealed that nearly three-fourths of phone bills were spent for personal and domestic use, while the rest one-fourth of the phone bills were reportedly spent on various agricultural related purposes. "market information" represents the highest share of mobile phone bills among the all farm-related uses, while the least proportion of mobile bills was reported for accessing weather forecast. Farmers mobile use pattern is shown in figure 5.

Farmers' use of various Mobile phone-based agricultural information sources

Results shown in figure 6 described the agriculture information sources being used by farmers in the study area. Farmers were asked about the use of the various mobile phone-based farm information sources available in the study area. According to the findings "private sector companies and input suppliers" reported the highest used (87.2%) of information source as compared to the other information sources agricultural department SMS service, call service, livestock department helpline, and private helplines. These responses indicated the farmers' inclination towards private enterprises and farm input suppliers. Moreover, extension agents' mobile-based communication showed a higher use as compared to the governmental officials call and SMS helplines, which indicated their inefficiency.

Farmers' perceptions regarding the benefits of farm-related use of mobile phone

The farmers' perceptions regarding the benefits of mobile phone use were also explored

by incorporating a list of various benefits of mobile phone use in accessing farm related information. In the following statistics (Table 1) a mean value above 3 represents the farmers' agreement while a mean value below 3 shows the disagreement of a farmer with the particular benefit of mobile phone use. The findings revealed that farmers agreed to all the benefits of using a mobile phone except the usefulness of weather forecast and expert opinion. Detailed responses are shown in table 1.

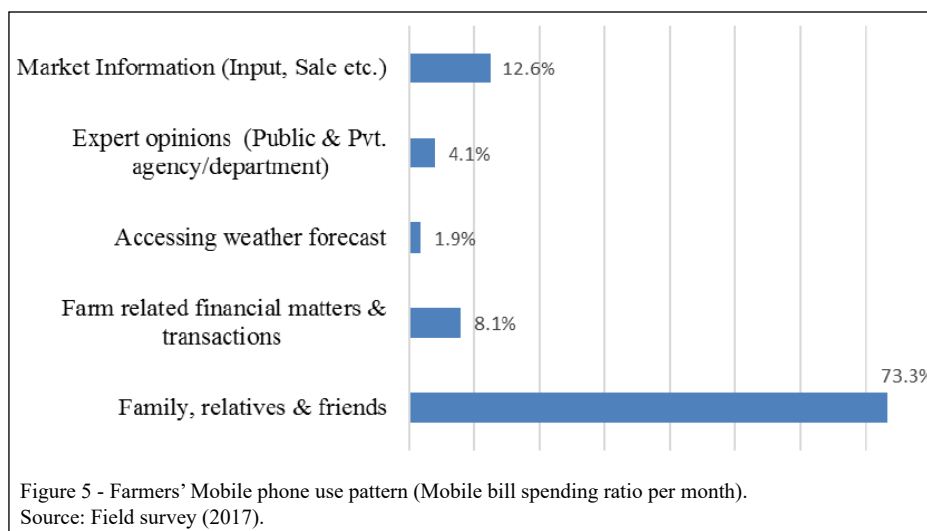
Constraints in farm-related use of mobile phone

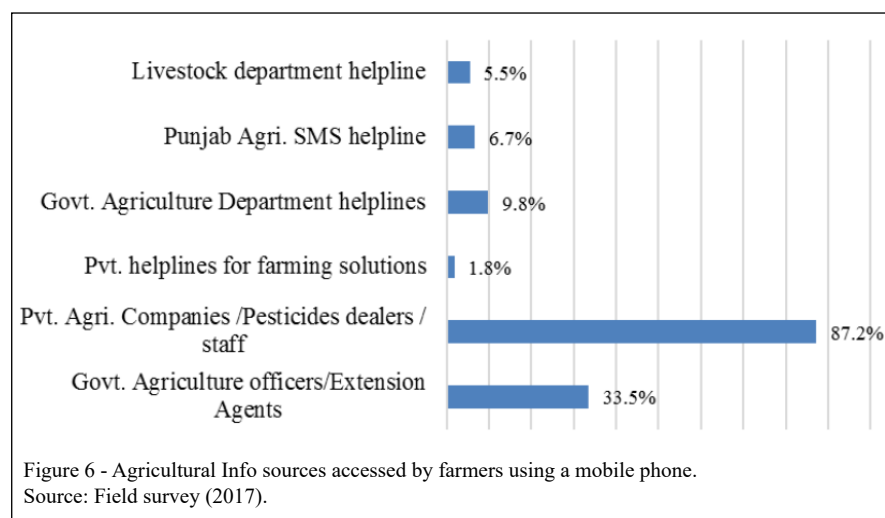
Constraints that limit the farmers' use of the mobile phone to access farm related information were also identified in the current study. Farmers were asked to recognize the limitations that hinder the effective utilization of mobile phone in accessing agricultural information from various information sources available in the study area. According to the findings (Table 2), Farmers reported two major constraints to attain the successful utilization of mobile phone for agricultural purposes. These constraints included problems in understanding the information through robocalls and limited aptitude of cell phone use (to calls only) which indicated a lack of education and mobile operating skills of the farmers in the study area.

DISCUSSION

Farmers attributes regarding mobile phone use

The literature is evident that farmers' characteristics of mobile phone use such as their





possession duration and skills and aptitude are closely linked with its adoption and use in agriculture (QIANG et al., 2012). Farmer's understandings and their basic skills regarding mobile phone use are also considered as mandatory factors for its successful utilizing, as the higher aptitude of mobile phone use increase tendency of accessing agricultural information and hence the farmer's efficiency (VERMA et al., 2014). Our study in this regard has identified the mobile phone usage related characteristics, which included farmers ownership duration and aptitude of the mobile phone. Results (Figure 3) of our study revealed that that majority of the farmers possessed mobile phone for more than three years these findings are parallel with the study of TADESSE and BAHIGWA (2015) who indicated

a greater probability of farm-related use among these farmers. Similarly, our findings further reported that the majority of the mobile phone users had very limited mobile phone aptitude (calls only) and a significant proportion was unable to read and write text messages (Figure 4). The literature proved that SMS (short message service) possess a huge potential for the delivery of farm advisory services, but lack of education, awareness, and training poses hampers in the way of successful utilization (ALDOSARI et al., 2017; NEHA et al., 2018). Similar is the case of the present study, where the majority of farmers lacked in reading and writing the text messages (Figure 4). Aside from the basic mobile phone operations, the advanced use of the mobile phone in the form of the Android-based smartphone holds a huge potential as many

Table 1 - Perceived Benefits of cell phone usage in Farm related matters.

Perceived Benefits of Cell phone usage	Mean	S. D	Min	Max
Access to updated information (price, availability)	4.632	0.878	1	5
Increased connectivity with stakeholders (consumers, traders etc.)	4.721	0.578	1	5
Reduced the travel hours and cost	3.323	1.293	1	5
Shirked the local markets to accessibility	3.459	1.117	1	5
Facilitated local market chains	3.972	1.146	1	5
Enabled to make the informed decisions	3.168	1.735	1	5
Access to weather forecast t	3.354	2.486	1	5
Usefulness of weather forecast	1.743	2.764	1	5
Usefulness of expert opinions	1.935	2.012	1	5

Source: Field survey (2017).

Table 2 - Constraints in the use of cell phone among the farmers.

Constraints	Mean	S.D	Min.	Max.
Problems in understanding information through robocalls (no clarification if any doubt arises)	4.02	2.23	1	5
Limited aptitude of cell phone use (calls only)	4.12	1.93	1	5
lack of electricity supply for charging mobile	3.27	2.14	1	5
Non-availability of area-specific information from private/public (helplines, call centers etc.)	3.04	2.01	1	5
Lack of financial resources to spend money on phone calls	2.21	1.87	1	5
High charges on internet services	1.73	1.63	1	5
Poor network access	1.30	1.03	1	5

Source: Field survey (2017).

agricultural related applications, web portals, and social media have more authentic information sources (MANJUPRAKASH et al., 2016). But unluckily farmers in the study area lacked in advanced operating skills to utilize them effectively which highlighted the need for farmers training regarding the use of the mobile phone to access these information sources.

Farm related use of mobile phone

Farmers' use pattern of the cell phone has also been identified in the current study. Findings (Figure 5) indicated most of the cellular phone use as personal (73.3%), parallel with another similar study in India (MEHTA, 2016). This pattern depicts that farmers have the least trend towards formal agriculture-related use. Moreover, the higher trend of domestic and personal use also indicated that farmers may share farm knowledge and experience with their family, fellow farmers and friend's circles. This strong communication within the close circle gives them a sense of security in terms of farm knowledge exchange and access to required information. For the case of the current study, 26.7% of mobile phone usage has been solely reported for farm-related purposes in which Market information and discussion on farm-related financial matters ranked as the highest accessed agriculture information with the proportion of 12.6% and 8.1% of total mobile phone use (47.2% and 30.3% of farm-related use). These findings are in line with another similar study which stated that farmers mostly rely on the mobile-based communications for their farm-related marketing and financial matters (MASUKA et al., 2016).

Higher use of market information also represents its usefulness for farming activities as literature has also endorsed a positive impact of market information on the crop productivity and

farm income (KIKULWE et al., 2014; GICHUKI & MULU-MUTUKU, 2018). It is further argued that use of the mobile phone for accessing market information increased because generally in many rural societies the markets are distant from the farms so farmers use a mobile phone to communicate with local markets and traders (MASUKA et al., 2016). Similarly, 30% of farm-related use of the mobile phone was for "Financial matter", which showed the farmers reliance on mobile phone-based interaction for their money lending matters and credit services. Farmers in the remote areas use a cell phone for management of their financial transaction; for example, when they need a loan to buy inputs they may access the credit institutions and the fellow farmers to meet their need.

Our study has also identified farmers' use of various agricultural information sources available in the study area (Figure 5). Results of our study reported that farmers accessed private agricultural companies and their advisory staff more frequently (87.2%) as compared to public sectors advisory services. These findings are parallel with another similar study reported in India (VERMA et al., 2014) which reported that farmers prefer to consult the private sector's agents as they also provided the required inputs in addition to the advisory services. In this way, the private sector's dealers and suppliers remain connected through the cell phone because of selling their products. While the government sector's advisory services are solely for information delivery and are reported to be less responsive and the extension agents of the private sector's input suppliers like fertilizers, seeds, pesticides, and other farm-related companies are generally very responsive in terms of their advisory services (OSABUTEY & JIN, 2016; SAROJ et al., 2017). Similar is the case of our study where the government sector's SMS and call

helplines and advisory services through extension agents are least accessed by the farmers. These findings indicated the lack of interest from the public sector institutions and organization in use of ICT in agriculture and highlighted the need for consideration from the higher authorities in its application in agricultural extension.

Farmers' perceptions regarding the benefits of farm-related use of mobile phone

The findings of our study showed that farmers agreed to various benefits of the mobile phone (table 1) and indicated "Access to updated information" and "increased connectivity with stakeholders" as the highest perceived benefits. These results revealed that access to updated information has significantly helped the farming communities. It is argued that the mobile phone has enabled the farmers to negotiate the local markets in order to sell their products with higher profits (TADESSE & BAHIGWA, 2015). Similarly, while purchasing the inputs and various farm equipment, smallholders communicate with markets to check the availability, quantity, quality and the prices of the required item. This also reduced transportation cost as they fix the deal with local commission markets prior to transport their commodities. Findings of our study are parallel with the other studies which stated that access to the latest information has significantly improved farmers income (KIKULWE et al., 2014; GICHUKI & MULU-MUTUKU, 2018). Moreover, "increased connectivity with stakeholders" indicated that the mobile phone by penetrating the local demographics has significantly strengthened the connectivity of farming communities and positively impacted their agriculture and related businesses. The literature stated that mobile phone has equipped the farmers to establish a network with various stakeholders in agriculture like traders, consumers and many institutions (MASUKA et al., 2016). Results hence proved cell phone technology as an effective ICT tool which made farmer to farmer communications more flexible and easier. Farmers now are no more away from the mainstream and can actively engage themselves in any kind of local cooperation, business and can make informed decisions.

Our study has also reported farmers' disagreement with benefits of the mobile phone which included "usefulness of weather forecast" and usefulness of expert opinions". Here expert opinion referred as the emergency assistance or help being provided by farm advisory institutions and organization (through call helplines or SMS services)

to the farmers in the study area while weather forecast means delivery of weather updates and rain predictions provided to the farmers. Disagreement with the benefits of experts' opinion indicated the farmers' incompatibility with the provided information. This showed that farmers may not get information according to their actual requirement i.e. financial situation and contextual feasibility. Similarly, disagreement with the usefulness of weather forecast indicated certain hampers and constraints as a reason which needs to be explored and addressed. These constraints can be in the form of un-authentic and unreliable weather forecast resources in the study area due to which farmers find these services useless. Literature in this regard has also indicated another reason due to which farmers may find weather forecast un-useful because of their more reliance on traditional beliefs and knowledge of local climate. For example, farmers in many traditional societies and regions predict the arrival of any drought or rainy season by the changing pattern of winds, so they rely more on their local knowledge (FITCHETT & EBHUOMA, 2018).

Constraints in farm-related use of mobile phone

Findings of the current study have also reported certain limitations in the use of mobile phone among the farmers (Table 2). According to the results, farmers indicated two major constraints "problems in understanding the information through robocalls" and "limited aptitude of cell phone use (calls only) (4.02 & 4.12 mean). The limited aptitude of the cell phone use indicated farmers' very basic knowledge of cell phone use limited to making and receiving the calls only which has already been identified in the previous section (Figure 4). These findings are in line with the other studies which have also indicated digital illiteracy among the major constraints of mobile use among the farmers (OSABUTEY & JIN, 2016; SURABHI & MAMTA, 2016; SAROJ et al., 2017). Currently, most of the agricultural knowledge lies in sources like websites, e-magazines, internet portals, and mobile phone android apps (MANJUPRAKASH et al., 2016). Similarly in Pakistan various ICT-based agricultural information sources like Cyber extension, ICT-enabled community center, Bakhabar Kissan (The well aware farmer), and UAF-clinic, etc. have also been launched in order to provide farming solutions to the Pakistani farmers (JALLO, 2016; JAZZ, 2018). These multiple sources of information need internet access and advanced operating skills which unfortunately farmers lack in the study area (Figure 4). Likewise, farmers indicated the problems

in understanding the information through the robocalls because in some cases, these pre-recorded voice calls-based information services do not satisfy the information needs of farmers in a way that there is no clarification if any unclear information or doubt arises. Similar findings have been reported in India (SHANKARAIHAH & SWAMY, 2012).

CONCLUSION

In the scenario of extreme challenges in the transfer of knowledge to the farmers in Pakistan, cellular phone-based advisory services have emerged as an effective alternative which has transformed the conventional extension methods of information exchange. The current study in this regard focused on the use of mobile phone-based agricultural information sources between the farmers and the extension agencies.

Initially, the current study identified mobile adoption rate and farmers aptitude regarding its use as it was prerequisite to further explore its farm-related use. The findings reported that majority of the farmers had mobile phone possession but indicated very basic operating skills limited to call only. Due to this limited aptitude of mobile phone farmers were unable to access information from various Internet-based information sources like web portals and android applications. This may pose a huge challenge as most of the authentic information lies over these web-based sources and social media forums which need advanced operating skill. This urges the need for training and educating the farmers regarding the use of these available information sources to utilize the true potential of mobile phone. The current study also recommends the practitioners in the field of e-extension to consider the farmers' digital literacy prior to starting ICT-based initiatives in such communities. Moreover, there is a need to implement capacity building programmes that will lead to the acquisition of the required skills for enhanced utilization of the delivered content.

Despite many mobile-based information sources most of the farmers do not utilize it, as only one-fourth of the mobile phone use was reported for agricultural related communications. This indicates farmers' lack of awareness about the available information sources and seeks the attention from the policymakers to mainstream these initiatives. This could be attained by organizing awareness campaigns by the concern departments among the farmers which are the key target of these projects. Moreover, it was reported that among all the available

agriculture information sources, the private sector's farm advisory services were highly accessed as compared to the public sector mobile-based services. These findings indicated the lack of interest from government institutions and concerned authorities in the promotion and use of ICT-based information services in agriculture. Conversely, this also indicated the huge potential of the private sector in terms of its service delivery to which public sector institutions can acquire a lesson. In this regard, serious efforts are required from the public sector's institutions and policymakers to pay attention to these ICT based initiatives as these are the contemporary mode of extension and countries like Pakistan cannot afford the cost of face to face extension.

Market information and financial matters which were reported as the most accessed agricultural information indicated the farmers' reliance on mobile-based communication in rural areas. This further indicated that easy access to market information and financial transaction through mobile phone has made the farmers more connected to the mainstream. According to the farmers' experience with the farm-related use of mobile phone, access to updated information and easy connectivity with stakeholders were identified as the highest perceived benefits in terms of service delivery and timeliness. While in term of provided content weather forecast was perceived as the least effective among the farmers. This highlighted an immediate need of attention from the weather agencies and concerned organization to ensure the provision of accurate and area-specific weather information to the farming communities in the study area as the weather is an important factor in farming and crop cultivation. Moreover, the ineffectiveness of agricultural advisor's opinion predicts certain incompatibilities between the delivered information and farmers needs and hence this study recommends the provision of farm-related content tailored according to the farmers' actual needs.

Similarly, the reported vagueness in the Robocalls (pre-recorded voice message) urges the need to consider such a mode of communication in which farmers can give their concern if they feel any doubts about the provided information. Moreover, farmers' limited aptitude of the mobile phone which was also reported as a major limitation in acquiring farm knowledge; therefore, this study recommended the information delivery using a simpler mean that requires very basic mobile operating skills.

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DECLARATION OF CONFLICT OF INTEREST

The authors declare that they have no conflict of interest. The founding sponsors had no role in the design of the study, nor in the data collection, analyses, or interpretation of data, the writing of the manuscript, nor the decision to publish the results.

AUTHORS' CONTRIBUTIONS

All authors contributed equally for the conception and writing of the manuscript. All authors critically revised the manuscript and approved of the final version.

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