

Research Article



Farmers' Perceptions and Adoption of Information and Communication Technologies (ICTs) in Peach (*Prunus persica* L.) Production and Marketing

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Abstract | There has been an increasing trend among farmers from apple growing to peach (*P. persica* L.) production in the Swat valley of Khyber Pakhtunkhwa during the last couple of years. However, these peach growers face various constraints in peach marketing. The farmers are reverting to the use of Information and Communication Technologies (ICTs) to overcome marketing hurdles. This research investigates the farmers' awareness and use of Information and Communication Technologies (ICTs) *vis-à-vis* the association between ICTs use and farmers' socioeconomic and farm level variables. A sample of 70 peach (*P. persica* L.) growers was taken. Face to face interviews were held using a well-structured questionnaire. Descriptive statistics and χ^2 tests were used for data analysis. The results showed a greater awareness level among the peach (*P. persica* L.) growers about ICTs. Moreover, the analysis indicated that more than 75 % of farmers are in use of a single or multiple type of ICTs. Among the sampled farmers, 70% of the farmers perceived ICTs as useful for farming activities. The analysis also revealed that 58.5% of the farmers are of the view that ICTs have facilitated their access to markets and information. While others 78.6 % opinioned that ICTs have reduced the influence of the middle man in peach (*P. persica* L.) marketing. The findings further show a positive association between ICTs use and farmers' socioeconomic and farm-level characteristics. More educated farmers and those who receive foreign remittances are more likely to use ICTs. Farmers' awareness level is a significant determinant of the adoption of the ICTs for farming and peach (*P. persica* L.) marketing. Farmers who perceive ICTs to be more useful, they are more likely to adopt ICTs for peach (*P. persica* L.) farming and marketing. It is concluded that ICTs have influenced the farmers' farming practices and their access to information and market accessibility. It is recommended that the government shall devise strategies for provision of ICTs. It is further recommended that peach farmers shall be trained using the governments' digital initiative program to build farmers capacity about the use of the ICTs in agriculture practices and marketing.

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Introduction

Agriculture sector in Pakistan contributes a greater chunk to the country's Gross Domestic Product

(GDP). It contributed 18.9% to the GDP in 2017. It also absorbs 42.3% of the country's labor force (ESP, 2018). It has a significant role in food security and as such it is the major source of food for the consumers

and provides fiber to the domestic industry (ESP, 2006). Its employment was recorded at 38.5% in 2018 (ESP, 2018). However, over the years this share has declined from 53.2% in 1951 (Zaidi, 2005). Despite the decrease in the employment share, the farmers' productivity has increased due to the use of modern techniques of production. This is attributed to the use of innovative techniques of production which has resulted in farmers' productivity in the developing countries (Hajirostamlo *et al.*, 2015).

The economy of the country is mainly based on agriculture, and farming is still the source of income for the majority of the people in the rural areas in Pakistan. Nonetheless, majority of farmers are small farmers. These farmers play a major role in food security and poverty alleviation (Fan and Chan-Kang, 2005). Approximately 64% of the country's population is inhabited in rural areas. The major source of livelihood of these people is agriculture (PBS, 2018). However, large quantities of edible oil, dry milk, pulses and other processed food is still imported. Consequently, the country paid US\$4 billion import bill out of which 2.7 billion US\$ is the import bill for edible oil constituting 67% of the total import bill of food items according to the MNFS (2017).

Farmers' productivity is impeded by small landholdings, credit constraints and access to market in rural and remote locations in Pakistan. Therefore, access to markets and technology is vital in current age of globalization for the survival of these farmers (Fan and Chan-Kang, 2005). Majority of these farmers due to small landholding, are dependent on subsistence farming. The subsistence farming is more prevalent in the mountains and remote geographical locations (Shahbaz *et al.*, 2010). The farmers who produce surplus agriculture produce, marketing of farm produce is a major challenge for them. Majority of the farmers are constrained by lack of finances, lack of access to information about potential markets and price of the farm produce, and lack of marketing skills among others. Consequently, they are unable to market their farm produce directly. Moreover, most of the agriculture commodities are perishable and cannot be stored for a longer period of time due to the absence of cold storage system in rural areas. In places where cold storage is available, the cost of storage is beyond the affordability of the small farmers. Therefore, most of the farmers decide to dispose of the surplus farm produce quickly. However, these

farmers are dependent on local traders, middlemen, and contractors for the marketing of their farm produce. The market intermediaries purchase farmers' produce at a lower price than the market price (Zaidi, 2005). As a consequence, they lose substantial revenues due to asymmetric information. Although market intermediaries link the farmers to traders (Man and Zain, 2014) but they affect the income and commercialization (Abebe *et al.*, 2016), taking advantage of farmers' inaccessibility to market. Therefore, market accessibility is crucial for smallholder farmers in rural areas (Baloyi, 2010). In developing countries, access to the market for small farmers is a big challenge. As lack of farm to market roads, lack of cold storage system, and farmers' inaccessibility to market and price information constrain agriculture marketing, farmers' only option is the sale of their surplus to the middle man at a lower price. As a consequence, farmers lose a substantial proportion of their revenues.

Constraints in agriculture marketing have been a major cause of the loss of revenues to the farmers in many developing countries with increasing globalization and revolution in the advancement of Information and Telecommunication Technologies (ICTs) such as telephone, and the wireless mobile technology have been found to influence agriculture productivity and farmers income. Research has shown that these technologies have an impact on farmer's access to marketing information and an increase in farm productivity. The adoption of ICTs have a positive impact on agriculture productivity (Lio and Liu, 2005). These technologies have also influenced the development of small scale agriculture due to information sharing and experiences among farmers of different areas on the regional and international levels. These technologies play a vital role in agricultural marketing and the development of the agriculture sector (Poulton *et al.*, 2006). ICTs have great potential to transform an agricultural system, including smallholders' farming, into a profitable farm business. Modern ICTs such as the Internet, mobile phones, television and radio can deliver relevant and timely information that facilitates making informed decisions to use resources in the most productive and profitable way (Ekbja and Evans, 2009; Ommani and Chizari, 2008; Ali, 2012).

These technologies have rapidly spread to remote areas, and farmers like other users have been found

to use them for agriculture information and farm practices. Such technologies have been the subject of interest among researchers around the world. There is growing interest among researchers to empirically study the impact of the use of ICTs on farmer productivity, and farmers' access to information, and the role of these technologies in the marketing of farm products. Research has shown that ICTs have the potential of increasing agriculture productivity, through knowledge and information sharing and accessing markets, among others (Munyua *et al.*, 2009). Like other developing countries, Pakistan has been increasingly under the influence of ICTs revolution. A large segment of the farming community has also been found using these technologies for farming-related information and marketing of farm produce. In the province of Khyber Pakhtunkhwa, Swat valley is a remote mountainous area, where farmers face various constraints in adopting agriculture technologies (Memon *et al.*, 2015). In Pakistan, during 2005-2006, total land under fruits cultivation was 0.8 million hectares in which area occupied by Peach (*P. persica* L.) was 0.2 million hectares producing 2.5 million tones per year (MINFAL, 2006). In Khyber Pakhtunkhwa, 19% of the total fruits area is planted by peaches. Peaches (*P. persica* L.) are the major crop of Swat, producing 43935 tones per year (Khalil *et al.*, 2014). In recent years, farmers have been observed to use ICTs for different activities of farming and, more specifically, for activities related to Peach (*P. persica* L.) farming. However, empirical studies on the role of ICTs technologies in peach (*P. persica* L.) marketing and farmers' use and perceptions about these technologies have not been conducted in the context of Swat valley in Khyber Pakhtunkhwa. Therefore, this study is aimed to examine the role of Information and Telecommunication Technologies (ICTs) in framing activities and marketing of Peach (*P. persica* L.) *vis-à-vis* analyze the impact of the ICTs on the role of market intermediaries to contribute to the existing body of knowledge on ICTs and agriculture.

There has been an increasing trend in studies analyzing the role of Information and Telecommunication Technologies (ICTs) in farming activities and agriculture marketing both in developed and developing countries. As technological advancement has grown, there has been a growing trend in e-commerce and e-marketing. Like other commodities, agriculture goods are also traded on the internet and via online stores. This is attributed to the fact the research has

shown that electronic commerce mechanisms reduce transaction cost vis-à-vis increase the efficiency of intermediaries in agriculture marketing (Matsuda *et al.*, 1997).

The use of ICTs in cities and the commercial location is no hidden fact. Nonetheless, remote agriculture niche and remote mountainous areas have also been under the influence of ICTs. Among other roles, its popularity and use have been increased among the farmers. Telecommunication is replacing the role of the intermediaries, and farmers use these technologies as are a medium of exchange and a source of information. These may also lead to better production and marketing procedures. Some ICTs such as Mobile phones have been found to help reduce marketing costs and increase the productivity of certain agriculture crops (Jehan *et al.*, 2014). It has helped in information dissemination and has led to increase in rural income due to access to knowledge and information (Asenso-Okyere and Mekonnen, 2012).

ICTs can play a significant role in agriculture productivity. There has been evidence of a positive return from the use of ICTs. Moreover, richer countries are more able to get benefit from ICTs, and their output is two times higher than the poor countries (Lio and Liu, 2006). Similarly, the use of ICTs has been shown to benefit youth and have increased their capacity to engage in profitable agriculture business and marketing (Irungu *et al.*, 2015).

Studies have also shown that ICTs are significant tools in accelerating agriculture growth. It has also been found that ICTs help to enhance women's farm income and empower them to increase their participation in decision making. Nonetheless, there are still barriers in the use of ICTs among women (Jain *et al.*, 2012) and ICTs if utilized effectively. It has the potential to help in the prosperity of rural communities in rural areas because of its role in effective communication and information and farmers have been found to have a favorable attitude toward ICTs (Dhaka and Chayal, 2010). Due to the significance of ICTs in agriculture, household commercialization, and even in food security, researchers have also worked on frameworks that establish links between ICTs use, its application in agriculture, benefits to farmers, and improved market performance (Okello *et al.*, 2010). ICTs have been found to play a significant role in the identification and knowledge about new crop species

and the adoption of these species, which in turn enhances farmer income. Moreover, the use of ICTs is a vital source of information from state institutions concerning the use of fertilizers and farm implements (Achugbue and Anie, 2011).

Evidence also shows that ICTs use meets some potential needs of the farmers. ICTs tools such as mobile and internet can be a potential source of information for the farmers. However, the bottom-up approach needs to be used to fit the information contents to the needs of the farmers (Dey et al., 2008). It has also been found that mobile technology has the potential to raise agricultural productivity but farmers' constraints in access to mobile technology need to be reduced (Aker and Mbiti, 2010).

There has been increasing evidence that due to the use of ICTs rural income are increasing, it helps in the dissemination of knowledge and information and play a significant role in agriculture production and growth (Asenso-Okyere and Mekonnen, 2012; Chavula, 2014) and improve opportunities for farmers in agriculture markets, empower the smallholders and reduce transaction costs. It also makes service provision more affordable. Nevertheless, there still many challenges for many agricultural economies to get the benefit of ICTs (Goyal and González-Velosa, 2013). Farmers may like to use ICTs for agriculture information, but the use of the ICTs is dependent on the ease and access of ICTs. Therefore, the use of ICTs by farmers is influenced by the factors of how easily accessible the particular ICTs to the farmers (Joel and Ojo, 2013). The paper is divided into five sections. In section one, an introduction to the agriculture sector has been given. Moreover, section one also outlines the significance of ICTs and agriculture productivity. Section two reviews the existing literature. In section three, the data and methodology are presented. Section four outlines the results and discussion of the analysis. The last section focuses on major conclusions and policy recommendations.

The study area

The study was conducted in the selected administrative division of the Swat District in the province of Khyber Pakhtunkhwa. Geographically district Swat is bounded on the North by the districts of Kohistan and Gilgit, on the East by district Shangla, on the South by Malakand agency, and on the West by district Dir. The area is considered as a major fruit

production zone because of its favorable ecological and soil conditions. Farmers grown cash crops and fruit such as peach (*Prunus persica* L.), apple (*Malus Domestica*), persimmon (*Diospyros kaki*), Okra (*Abelmoschus esculentus*), Peas (*Pisum sativum*), French Bean (*Phaseolus vulgaris*), Tomatoes (*Solanum lycopersicum*) and Garlic (*Allium sativum*). Swat district is famous for its peach (*Prunus persica* L.) fruit due to its aroma and attractive color of the fruit. Recent studies have shown that most farmers who grow peach (*P. persica* L.) on average have allocated 5 acres to peach (*P. persica* L.) orchards (Khan et al., 2008). Although peach (*P. persica* L.) has been an important cash crop in the area, however, farmers suffer economic losses due to lack of proper handling procedures and lack of post-harvest handling training from the public agriculture agencies. It has been found that when counted for different peach varieties in district Swat at the farm level, about 23% of post-harvest losses occur (Khan et al., 2008). Most of the Peach (*P. persica* L.) fruit is produced in these areas due to the suitability of the soil and agro-climatic conditions and water availability.

The area of peach production lies in a humid temperate zone at an altitude of 1000-1500 meters above the sea level. The farmers practice double cropping, fruit, and vegetable production. The important crops are wheat (*Triticum aestivum*), Maize (*Zea mays*), and Rice (*Oryza sativa*). Onion (*Allium cepa* L.) is an important cash crop in the area. However, during the last couple of years, the area has seen tremendous growth in terms of Peach (*Prunus persica* L.) planting. Agriculture farms that previously used to grow wheat (*Triticum aestivum*), and maize (*Zeamays*) are now mostly being planted with Peach (*Prunus persica* L.) orchards.

Materials and Methods

The primary data were used for analysis. The data was gathered through a pre-structured interview scheduled. Farmers' demographics, socioeconomics, farming characteristics, cropping pattern, productivity, and use, and access to Information and Telecommunication Technologies (ICTs) were included in the interview instrument. The interview schedule was pre-tested, and the questions were adjusted accordingly. Face to face interviews was held with the farmers in different villages with the peach grower in the valley of Swat. A total of seven (07) tehsils (administrative unit)

were purposively chosen to take into account the intensity of peach orchards. A total of seventy (70) peach (*Prunus persica* L.) farmers were interviewed. The secondary data were collected from Agriculture Research Station (North) Mingora Swat, which is located at a distance of 5 kilometers from district Head Quarter-Saidu Sharif, Swat. Information on peach (*Prunus persica* L.) farming in Swat was also collected from the station. The staff of the research station was very cooperative in information provision and took a keen interest in sharing information pertaining to the current research study. The data were analyzed using descriptive statistics such as mean, percentages, standard deviation. Chi-Square test was used to identify the factors affecting the use of ICTs in farming activities or the marketing of farm produce.

Analytical framework

This research uses and modifies the framework used by Ali (2012) to identify and analyze factors that affect farmers' adoption of a particular type of Information and Telecommunication Technologies (ICTs) for farming activities and marketing of peach. Previous studies that analyzed factors influencing the adoption of information by agricultural producers include (Feder and Slade, 1984; Feder *et al.*, 1985; Wozniak, 1987, Ramirez and Shultz, 2000; Doss and Morris, 2001; Park and Lohr, 2005; Alvarez and Nuthall, 2006; Agwu *et al.*, 2008). As indicated in these previous studies farmers' choice or adoption of a particular information source is influenced by various factors; these factors can be classified into (1) socioeconomic and demographic characteristics of a farmer (2) wealth and farms associated factors (3) awareness and locational or other factors.

Ali (2012) hypothesized in a framework for the analysis of factor for the adoption of information and telecommunication technologies that farmers' adoption of ICTs for various farming activities is influenced by three groups of variables viz: Socioeconomic and demographic variables; farms characteristic related variables; and business orientation variables. This research uses and modifies the framework by additional factors such as farmers' wealth and assets, farmers' perceptions of the usefulness of a particular technology, farmers awareness, accessibility and location in addition to the socioeconomic and demographic, farms characteristics and business orientation as hypothesized by Ali (2012).

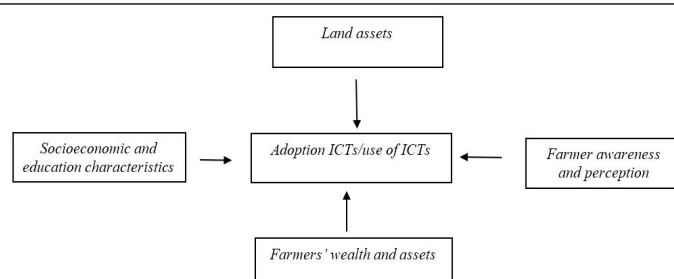


Figure 1: A modified framework adopted from Jabir Ali (2012) between the links of adaptation and farmers characteristics.

As indicated in the framework, farmers' adoption or use of the particular ICTs is determined by farmers' socioeconomic and demographic variables such as age, years of schooling, income, farm characteristics, the awareness level of farmers and wealth, and assets. Based on the assumed relationships, the following hypotheses will be tested in the analysis: The following objectives were formulated:

1. To examine the impact of literacy level and farmers' perceptions on the use of ICTs.
2. To investigate how different farmers' assets, such as land and income, impact farmers' use of ICTs.

Results and Discussion

This section outlines the results of the important variables of the study. In the forthcoming section, the selected variables and their results are presented.

Descriptive statistics of the ICTs user and non-users

The analysis of data in Table 1 shows the selected characteristics of the farmers in the area. The results show that there is no significant difference in the age of the two groups (ICTs users and Non-Users). Nonetheless, significant differences exist between the two groups with respect to several other variables.

It was observed that there is a significant difference between the number of schools attended by ICTs users and non-Users. The mean of years of schooling for the ICT user is 7.08 years, while for the Non-ICT users is 1.94 years. The difference is significant at the 5% probability level.

Moreover, our results reveal that ICTs user farmers have a larger size of land owned as compared to Non-ICT users, and the difference is significant at 5%. The data also show that there is a significant difference between the monthly income (Rs.) of ICT user and Non-ICT users. The results are significant at 1% probability level. There is also a significant difference

between the gross value of the farm produce between ICTs users and Non-Users. We also observed a significant difference between the Annual Net benefit of ICTs users and non-users. The average net benefit of ICTs users is Rs.459262.26 (US\$2870.38) as compared to Non-ICT users, which is Rs. 91017.647 (US\$568.86). The difference is significant at the 10%

probability level. The findings support the role of ICTs (Information and Telecommunication Technologies). The findings of this study are the evidence in support of the studies which have confirmed that ICTs use plays a role in enhancing agriculture productivity (Asenso-Okyere and Mekonnen, 2012; Munyua *et al.*, 2009; Goyal and González-Velosa, 2013).

Table 1: *Selected characteristics of ICTs user and ICTs non-users.*

Socioeconomic variables	ICTs Non-users (n=17)	ICTs users (n=53)	F-statistics	Prob.
Respondents' age (years)	39.24(11.29)	38.04 (12.30)	0.127	0.72
Schooling (years)	1.94(4.90)	7.08(6.09)	9.98	0.00
Farming experience (years)	19.35(10.05)	18.89(11.75)	0.022	0.88
Adult males (years)	3.24(1.64)	3.83(1.89)	1.344	0.25
Adult female (years)	2.47(1.07)	3.26(1.44)	4.356	0.04
Household size	8.706(2.73)	9.623(2.96)	1.273	0.26
land Owned area (acres)	2.1103(1.66)	4.1038(2.83)	7.531	0.00
cultivation under cultivation (acres)	1.3015(1.26)	2.1132(1.42)	4.450	0.04
Primary occupation (Rs.) earning	15294.12 (10462.81)	27452.83 (11273.80)	15.476	0.000
Monthly income (Rs.)	19670.59 (6042.63)	34724.53 (13028.44)	21.077	0.00
Market distance (Km)	84.35(185.270)	133.02(203)	0.770	0.38
Farm Produce gross value (Rs.)	157805.88 (99704.64)	622990.57 (1015605.81)	3.521	0.06
Farm Production cost (Rs.)	66788.24 (39301.98)	163728.30 (190704.88)	4.293	0.04
Farmers Annual Net Benefit (Rs.)	91017.647 (74868.20)	459262.26 (880968.97)	2.934	0.09

Note: *Figures in Parentheses are standard deviations.*

Farmers' awareness of ICTs

The farmers in the study area were asked about their awareness of Information and Telecommunication Technologies (ICTs). The analysis in Table 2 indicated that the majority of the sample farmers responded "Yes" to the question. It is evident that farmers in the study area are aware of such technologies. Awareness level of the farmers about these technologies may affect the use of it in agriculture technologies.

Table 2: *Farmers' awareness of ICTs.*

Farmers' Awareness	Frequency	%
No	16	22.9
Yes	54	77.1
Total	70	100

Source: *Field survey.*

Although the data show that majority of the farmers are aware of such technologies, there are still other farmers, who in this age of globalization and the increasing availability of these technologies do not know about these ICTs.

Farmers' use of ICTs

Table 3 showed that there is an increasing trend in the use of ICTs in the study area. The findings indicated that 75.7 % of farmers reported that they are currently using a type of ICT in farming-related information and marketing of agriculture produce. On the other hand, 24.3% reported that they do not have access or use any type of ICT.

Table 3: *Farmers use of ICTs in Farming and Farm Produce Marketing.*

Use of ICTs in marketing of farm produce	No.	%
No	17	24.3
Yes	53	75.7
Total	70	100.0

Source: *Field survey.*

This indicates that still there are farmers who do not know the use of modern Telecommunication and Information technologies or they do not access to the use of these technologies. These results refer to the fact that a large proportion of the sample farmers use the tools of modern communication for farming purposes.

This is attributed to the fact that during the last few decades, rural areas in Khyber Pakhtunkhwa have been revolutionized by advanced telecommunication technologies. These are, among others, also been used by the farmers to get farming-related information. Such type of information have played a vital role in getting access to important information on farmers' practices vis-à-vis the marketing of farm produce. These results confirm earlier findings, which suggest that ease of access and availability of ICTs are the major factors that influence the use and preference for ICTs use (Joel and Ojo, 2013).

Type of ICTs used by farmers

It is also very important to know which type of Information and Telecommunication technologies are available to the farmers in their vicinity. A particular type of information source is dependent on the cost and availability of that particular type of technology. The sample majority farmers 30.0%, as indicated in Table 4 reported the use of mobile calls and the internet for getting information about agriculture activities and peach marketing.

Table 4: Type of ICTs used by farmers in the study area.

Type of ICTs	Frequency	%
Telephone	12	17.1
Cell Phone and Internet browsing	21	30.0
Television	12	17.1
Radio	3	4.3
iPad	5	7.1
Undecided	17	24.3
Total	70	100.0

Source: Field survey.

It is attributed to the fact that recently the spread of the wireless technology in rural areas and the easy availability of the smartphone in the local market has made it possible to be in reach of the majority of the farmers. Moreover, the market has mushroomed with calling and internet packages at a low cost, attracting more and more consumers to use it. The analysis showed that 17% of the sample farmers used the telephone for various agriculture activities and peach marketing.

The decrease in the use of the telephone is attributed to the fact that the advent of mobile technology and the internet has adversely affected the use of the telephone in rural areas. The majority of the people in rural areas

who previously used telephone have now switched to wireless technology. Similarly, 17% of farmers in the sample reported watching Television for getting information about agriculture activities. The disclosed that, they use the TV for weather updates and similar other information. A small proportion of the farmers i.e. 4.3%, reported that they use radio as a source of information for agriculture activities. Similarly, 7.1 % of farmers reported that they use the iPad for various uses in farming, such as weather information. These statistics indicate that there is an increasing trend of Information Technology use among the peach farmers in the study area, particularly the use of wireless technology such as mobile and internet. This signifies the importance of these technologies and their growing role in agriculture and farming.

Farmers' perceptions on the usefulness of ICTs

The analysis in Figure 2 showed that 70% of the farmers perceived the ICTs to be useful in agriculture activities. The reason for the majority of the farmers in favor of ICTs usefulness can be explained by the fact that as the ICTs use may positive welfare impact on farmers and evidence suggest that ICTs have welfare-enhancing potential (Jensen, 2007; Goyal, 2010). While 4.3 % perceived these as very useful, and 1.4% perceived as somehow useful. On the contrary, 22.9 could not decide about the usefulness of the ICTs, and 1.4 % reported that ICTs do not have a useful role in agriculture activities (Figure 2).

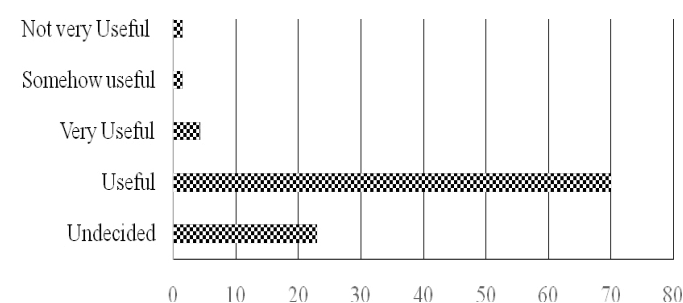


Figure 2: Farmers' perceptions of the usefulness of ICTs in Farming activities.

The analysis suggests that farmers in the study area use different types of these technologies and have found them useful in farming activities. This is evidence that ICTs among small farmers in the valley of Swat has a positive role in farming activities. Discussing the usefulness of the ICTs with farmers during interviews revealed that, farmers use technologies such as Mobile phone and internet for getting price information online, by calling to traders in the distant markets, helps farmers to get new knowledge about farming

activities such as innovative farming techniques and discovery of new farming methods. They also disclosed that they use smartphones for getting weather-related information through the internet and adjust their farming activities such as cultivation, harvesting, and irrigation accordingly. These findings show that ICTs have helped the farmers have influenced the farming activities in the study area. The farmer perceptions are conclusive of the fact that ICTs have the potential to impact farming activities positively. These facts support the earlier findings concerning ICTs that reducing information gaps, capacity building, and communicating new knowledge (Munyua *et al.*, 2009).

Farmers' perception on the impact of ICTs in the improvement of agriculture marketing

The farmers in rural areas and particularly in the valley of Swat face problems in the marketing of their agriculture produce. Farmers in the area are faced with a lack of cold storage and distant markets (Khalil *et al.*, 2014). They stated that the lack of access to the appropriate market for a particular agriculture produce and market price had been the impediments in agriculture marketing in the study area. In the past, farmers use to relay on intermediaries for such information. However, with the increase in availability and accessibility to ICTs, the influence of the middle power on information has been reduced.

Due to incorrect price information, farmers face a huge loss in their revenue. Farmers were asked to report if ICTs use has improved agricultural marketing? Although the market intermediaries, commission agents, traders, and the traders outside the valley who visit farmers from Lahore, Faisal Abad, and other big markets still operate on the majority of the farms and farmers still depend on them and sell their produce to them. But with the advent of modern technologies and rapid growth in the internet and smartphone in rural areas, agriculture marketing has got the benefit of these technologies. This is due to the fact that such technologies help to reduce the transaction costs and information gaps are closed. Moreover, and farmers are empowered to get improved opportunities in agriculture markets (Goyal and González-Velosa, 2013).

The analysis in Table 5 showed that the majority of the sample farmers perceive a positive role of the ICTs in the improvement of agriculture marketing. These facts unfold the reality that farmers have felt the role of the ICTs in their marketing. During a

discussion with farmers, they disclosed that due to the use of ICTs, particularly the internet access to information such as the purchase of packing material, and other value-added products for the marketing of the agriculture produce has greatly improved. These findings empirically support the earlier findings concerning the potential of ICTs to improve the marketing of farm products as these technologies promote agriculture through information (Irungu, *et.al*, 2015).

Table 5: *Farmers' response about the role of ICTs in the improvement of agriculture marketing.*

Farmers' response	Frequency	%
Undecided	17	24.3
Yes	41	58.6
No	12	17.1
Total	70	100

Source: Field survey.

Farmers' perceptions on the role of ICTs on market intermediaries

In the questionnaire a question was posed to understand if ICTs have reduced the role of intermediaries. Farmers were asked, do you think that ICTs have reduced the role of market intermediaries in agriculture marketing?

The analysis in Table 6 showed that 78.6 percent of the farmers in the study area reported that ICTs have reduced the role of the market intermediaries (Table 6). While 21.4 percent still believe that the role of the market intermediaries/middle man is not reduced in the marketing of farm products locally. The decrease in the role of the intermediaries suggests that farmers have begun to perform their market operation on their own due to the use of the ICTs, such as searching for price information and using mobile telephone call packages to search for potential buyers. Similarly, due to the availability of various mobile networks such as Telenor and U-phone in the area, farmers have subscribed to voice packages. They can get updated information through calls to markets in the down cities such as Lahore, Islamabad, Peshawar, and Haripure to name a few because the discussion on this question indicated that farmers now get most of their information on their own. They also can choose the appropriate market for their produce without consulting the intermediaries for information related to price and other related information about the marketing their farm produce.

Table 6: *Farmers' perception of the role of ICTs and market intermediaries.*

Farmers' response	Frequency	%
Yes	55	78.6
No	15	21.4
Total	70	100

Source: *Field survey.*

This is an indication of the fact that as farmers get access to new technologies that provide the information their dependence on the third parties is reduced, which in the past has exploited the local farmers. As a policy point, if farmers are provided access to relevant technologies concerning farming, their capacity can be built. Farmers will be able to make independent decisions about their farming activities and make farming a profitable enterprise in the valley.

Table 7: *Association of use ICTs for the marketing of agriculture produce with various socioeconomic factors.*

Socioeconomic Factor(s)/Indicator (s)		Pearson Chi-Square Value	Asymp. Sig. (2-sided)
Education	Number of schooling years of respondents	17.418**	0.043
Area	Area of the land Owned in acres	20.018	0.332
Distance	Distance to town Market (Kilometers)	31.931	0.323
Income	Total Gross value of Farm Produce (Rs) in 2018	59.123	0.232
Remittances	Are remittances being the only source of household Income?	5.710**	0.017
Awareness	Farmers' awareness of ICTS?	54.998*	0.000
Usefulness	How useful ICT in Agriculture marketing	64.673*	0.000
Perception	Do you think ICTs have enhanced Farm produce Marketing in your area?	50.057*	0.000

Note: *, ** represents significance at 1% and 5% level probability level.

Conclusions and Recommendations

This research has investigated the use of information and telecommunication technologies among farmers in the famous fruit-producing District Swat in Khyber Pakhtunkhwa, Pakistan. The results suggest that farmers are increasingly been switching for information through the use of ICTs, including smartphone, iPads, and computers, to get access to information. The introduction of the smart phone technology and its availability to the local farmers have empowered the farmers to have a grasp on the market and price information which in turn have helped to enhance revenues to the farmers. It is concluded that farmers have positive attitudes towards the use of ICTs, and farmers' opinions suggest that ICTs have a significant role in farming activities. There is evidence that ICTs have helped to improve farmers' agriculture

Determinants of ICTs use

In the next section, the association of use of ICTs for the marketing of agriculture produces with various socioeconomic factors is determined by applying Pearson Chi-Square test. Table 5 shows the results of Pearson Chi-Square Value of the use of Information and Telecommunication (ICTs) for the marketing of agriculture produce with farmers' various socioeconomic factors. The results clearly reveal that there a strong association of the use ICTs for the marketing of agriculture products with farmers' education, remittances, farmers' awareness of ICTs, and farmers' perception of the usefulness of ICTs in agriculture marketing (Table 7). Nonetheless, there is an insignificant correlation of using ICTs for the marketing of agriculture produce with farmers' area of land owned, farm household distance to town distance, and farmers' income.

marketing. The use of ICTs is influenced by the degree of usefulness perception about a particular ICTs by the farmers. The usefulness is in turn, assessed in terms of its benefits to the farmers, so if a particular ICTs is perceived to be beneficial, it is more likely that farmers will use to adopt it. The findings of this study are conclusive of the fact that ICTs tools have contributed to the farmers' accessibility of markets, farm produces price information and their conventional dependence on the middle man. As farmers have started to use the ICTs for agriculture-related information and marketing of peach in the area, there are still challenges ahead.

It is advised that the policymakers in the agriculture sector shall prioritize the needs of the fruit growers, especially in remote areas where such farmers have problems in accessing the market and price

information for their farm produce. A program should be designed to enhance farmers' capacity building and skills in using the modern ICTs. The government agencies which are working in agriculture extension and agriculture research should use modern ICTs tools to provide information related to farming particularly time of cultivation, spraying, control of insect and pests, application of mineral fertilizers, irrigation needs of the crops, information on value addition and marketing, markets location for different farm produces, information related to local weather, availability of seed and nursery stocks and storage of agriculture products. The government shall also launch programs through its digital initiative program that cater to the needs of the farming community and provision of ICTs equipment to the farmers through agriculture extension departments across the country.

Novelty Statement

The use of ICTs and their role in peach marketing and farming practices in the survey site has been for the first time been investigated by this research. This research has produced new insights on the usefulness of ICTs as well as identified the factors which constrain ICTs' use in remote areas of North East of Swat valley in Khyber Pakhtunkhwa.

Author's Contribution

Fazli Rabbi conceptualized the idea for this research and developed the overall methodology to conduct the research. Muhammad Idrees led the field survey and collected the primary data from the survey site in District Swat, Khyber Pakhtunkhwa, Pakistan. Shahid Ali assisted in the analytical part of the research. Muhammad Zamin assisted in the data pertaining to agriculture section in the manuscript. Hazrat Bilal contributed in the review of relevant literature from various sources.

Conflict of interest

The authors have declared no conflict of interest.

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