Research Article

Socioeconomic Determinants of the Awareness and Adoption of Apple Production Practices: A Case study of Balochistan, Pakistan

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Abstract | This study was conducted in the Ziarat district of Balochistan to determine the socioeconomic determinants of the awareness and adoption of apple production practices in 2019. This study selected Ziarat district to investigate socioeconomic determinants of the awareness and adoption of apple production because it is located in the center of the high apple-growing districts in northern Balochistan. A sample of 120 respondents was selected through multi-stage-random sampling from two tehsils (Sinjawi and Ziarat) of district Ziarat. Data were collected with the help of a pre-tested interview schedule. The association of some chosen socioeconomic characteristics like age, education, and size of landholding of the farmers with their awareness and adoption level was measured through the chi-squire (χ^2) test. The research outcomes showed that 49.2% of the respondents were middle-aged (35-50 years), the majority (72.5%) were illiterate, and 45% of respondents had medium-sized landholding, and they had excellent farming knowledge and apple growing experience. Furthermore, a non-significant association exists between age and adoption, and a significant association between landholding and awareness about recommendations has been found. A non-significant association existed between apple-growing experience and awareness/ adoption of recommendations. It is recommended that apple growers need direct or indirect training about the latest technologies and innovations, which helps enhance the adoption rate, apple yield and production, andgrower's income.

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Introduction

Reducing global poverty and hunger is one of the core goals of the United Nation's Sustainable Development Goals (SDGs). It is predicted that the world population will reach 9.7 billion by the end of 2050, and Pakistan's population is expected to increase substantially in the coming decades (UN, 2021; Khan

et al., 2020). Pakistan's current population is 212 million, and it is expected to increase to 250 million by 2030 (UN, 2021). The huge population growth requires more food and more resources. For a long time, the agricultural sector has been liable for Pakistan's population growth to ensure food security. The agricultural sector plays a vital role in Pakistan's economic growth, contributing 19.2% of national income. In Pakistan, the agricultural industries provide job opportunities for 35.8% of the workforce (GoP, 2021).

Horticulture has a significant contribution to the agricultural industry. Horticultural crops, such as fruits and vegetables, play an important role in balancing human diets. On the one hand, these crops provide energy-rich foods, and essential nutrients. Pakistan is characterized by diverse topography, ecosystems, and climate zones and consider rich in natural resources, including fertile agricultural lands. Horticultural crops include fruits, vegetables, tuber crops, medicinal plants, roots, ornamental, aromatic plants, and spices (Ullah *et al.*, 2017; Khan *et al.*, 2020). In recent years, horticultural production has gained considerable momentum to increase export revenues. Specifically, Pakistan grows 12 million tons of horticultural products every year, including fruits, vegetables, and spices (Ullah *et al.*, 2018). Therefore, the horticulture sector can help eradicate poverty (PHDEC 2017; Khan *et al.*, 2020).

Apple (Malus Domestica) belongs to the Rosacea family, and the origin of the apple is unknown, but it is believed to be native to the Caucasus near the Black Sea. The wild apple is cultivated in Europe, from the Caspian Sea to the Atlantic Ocean (Smock and Neobert, 1950; Juniper *et al.*, 1996). Apple is a symbol of well-being and beauty; it contains carbohydrates, sugar, fat, protein, and vitamins A, B, and C (Weixel *et al.*, 2010; Khan and Bae, 2017). Although apple production of Pakistan reached 616,748 tons in 2018-19, only one-third (approximately 33%) of apples exported in 2018 (191,203 tons of apple worth $103 million) and 2019 (218,203 tons of apple worth $143.4 million).

Pakistan is the world's 24th largest country in apple and 34th largest by the area for apple production. Balochistan is the largest apple-producing province, followed by Khyber Pakhtunkhwa, contributing 25% of Pakistan's total apple production (GoP, 2021). Baluchistan's Apple production area was 88,807 hectares, with an annual production of 482,819 tones in 2018-2019 (GoP, 2021). About 80% of Pakistan's apple production is contributed by Baluchistan and is mainly produced in the northern part of the province (Javad *et al.*, 2020). Many varieties of apples are grown in Pakistan, including (golden apples, red apples, kala kulu, kaja, gacha, amri, mushadi and kashmiri). The major apple-growing districts in Balochistan include Mustung, Kalat, Killa Abdullah, Killa Saifullah, Loralai, Pashin, Quetta, and Ziarat. Among these districts, Ziarat is located in the center of these districts (Noonari *et al.*, 2015; GoP, 2019; Javad *et al.*, 2020).

Despite its significance, apple production is still below its potential capacity in Pakistan. Due to the lack of new technologies, proper awareness, skilled labor, inability to provide inputs at the appropriate amounts/time, high production costs and adulterated materials, and insufficient knowledge of modern technology, there is a considerable gap between the potential and the actual fruit yields. The impacts of climate change and natural disasters on agricultural production have significantly reduced the quality and quantity of products. In most rural areas of Balochistan province, traditional farming caused low apple production in the regions. Besides, socioeconomic variables affect the implementation of skills, such as educational level, financial constraints, land lease rights, and land size (Noonari *et al.*, 2015; Siddiqui *et al.*, 2015; Khan and Bae, 2017).

Further, smaller farm size, lack of proper training for growers, and the unpredictability of national agricultural strategies have all played critical roles in undermining agricultural information delivery effectiveness. This shows farming new technology has not been implemented correctly or adequately, with skills or information failing to reach users on time (Kizilaslan, 2006; Collinson, 2019). The study reported a strong association between socioeconomic characteristics and the adoption of new skills and technologies.

Socioeconomic characteristics affect the awareness and adoption of new technology or skill. The achievement of the technology depends on its spread amongst users, which is ultimately assessed by the adoption level of that technology (Issa *et al.*, 2016; Muddassir *et al.*, 2020). Traditional farming methods dominate most places due to the long-term association between low input and low output, particularly in societies with lower education levels. According to Ogada *et al.* (2014) and Nzomoi *et al.* (2007), the technology adoption variables include education level,

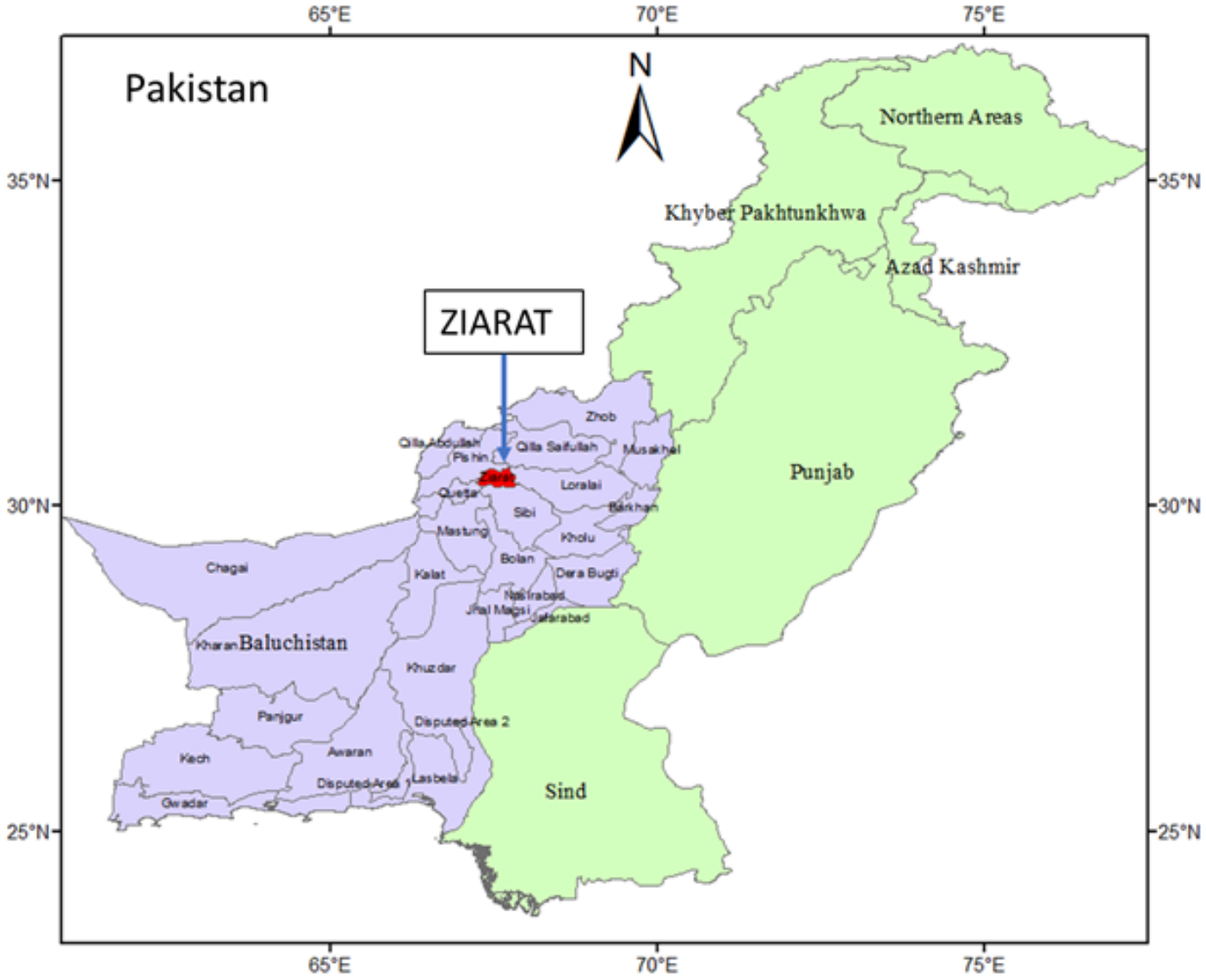

Figure 1: *Location of sampled District (Ziarat) in Baluchistan Province of Pakistan.*

local technology economic constraints, the land tenure system, and farm size. Information and communication technologies (ICTs) can link the knowledge gap by disseminating advanced technology. Still, 'all farmers' efforts are in vain due to challenges such as low education level, small land area, expensive ICTs infrastructure, and social norms (Ayinde *et al.*, 2020). In addition, if growers accept and adopt the available technology, they can make significant improvements in agriculture. The main objective of this research was to establish the association between awareness and the socioeconomic determinants of the adoption of apple production practices in the Ziarat district of Baluchistan, Pakistan.

Materials and Methods

The current study was conducted in district Ziarat Balochistan in 2019. Ziarat is the smallest district of Balochistan and has an area of 1487 square kilometers. Ziarat District lies between 67°11'18"- 68°36' East longitudes and 30°09'46"- 30°35'56" North latitudes consisting of two Tehsils namely, Sinjawi and Ziarat (Figure 1). Six union councils from both tehsils were chosen through a random sampling method. Then, two villages from each selected union council were also randomly chosen. Ten apple farmers were randomly selected from each village for the present study to make a one hundred twenty (120) sample size. The interview schedule was prepared to collect the necessary information, which included both open- and closed-ended questions. The interview schedule was pre-tested on 15 non-respondent apple growers. The professionals of the Department of Horticulture, and the Department of Agricultural Extension, PMAS-Arid Agriculture University Rawalpindi checked the content and face validity. The reliability was assessed through the test-retest method; the re-

liability score was 0.795, considered reliable for this type of study. Data was collected through interviews, organized in English but administered in Pashto (local language) to understand the respondents better and get accurate information. After the survey, data were analyzed through the Statistical Package for Social Sciences (SPSS). Chi-square (χ^2) test was used to find the association between dependent and independent variables (Khan, 2018).

Calculation of dependent and independent variables

Dependent and independent variables

Awareness: The recommendation was calculated to know the awareness level of growers regarding the horticultural recommendations involved in the research. A score of one was given for each recommendation, with the respondents having high awareness and zero for those who had no awareness. An awareness indication was developed by adding the number of recommendations with which the respondents were aware. The highest 43 and the lowest 21 scores were obtained from the analysis. Then growers were grouped into three leading categories (Table 1).

Adoption: Recommendation was calculated to ascertain the grower's adoption level regarding the horticulture recommendation comprised in the research. As a score assigned for awareness, score one was specified for the adopted respondents and zero for those who had not adopted the recommendations. An adoption index was then advanced to count the number of recommendations with which the respondents adopted. The minimum ten and the maximum 29 scores were obtained from the analysis. The respondents were grouped into three main categories (Table 1).

Table 1: *Numbers of recommendations used for grouping for awareness and adaption.*

Category	Awareness (Recommendations)	Adoption (Recommendations)	References
Low	21 - 28	10 - 16	Siddiqui *et al.*, 2006; Issa *et al.*, 2016
Medium	29 - 36	17 - 23	
High	37 - 43	24 - 29	

Results and Discussion

Demographic characteristics

Demographic characteristics, like age, education, size of land holding, and tenure-ship status, play a significant role in adopting innovations and new technology by the growers (Aziz *et al.*, 2018; Million *et al.*, 2020; Siddiqui, 2011). Considering these factors, the data were collected, analyzed, and presented in the subsequent figure.

Age of the respondents: Along with the time, individuals begin to achieve more maturity when they understand the situation. As age increases and experiences add, it leads to rationality and maturity (Khurshid *et al.*, 2017). Age has a major influence on people's social behavior. The exact age of a person affects the activities of others. Keeping in view the importance of this factor, the data in this regard was collected and presented in Figure 2a, which illustrates that about half (49.2%) of the growers had middle age (>35-50 years) group. In contrast, slightly more than one-third (37.5%) of the respondents were young (13.3%). In this study, the average age of the respondent was 40.6 years, whereas minimum and maximum ages were 24 and 83, respectively. This result aligns with Muhammad *et al.* (2011), who found 48.33% of the respondents belonged to middle age (35 to 50 years).

Educational status: Education is a development tool, which brings required changes in the individual's behavior (Chakraborty *et al.*, 2018). An educated person tends to keep himself equipped with up-to-date information regarding the change taking place around. He/she may use all available resources to keep himself/herself aware of the latest information. Educated people are expected to have a more favorable attitude towards agricultural innovations than uneducated ones (Hassan, 1991). Considering the significance of this factor, the farmers were questioned about their education level and collected information about education level as presented in Figure 2b. It illustrates that more than half (72.5%) of the growers were illiterate, and about 27.5% were educated in the study area. Among the educated respondents, 6.7% studied up to the primary level, and the same number of the respondents were received elementary to the middle-level education. The key theme of education was bringing about desirable changes in human behavior. Education brings a difference in people's behavior and reflects the positive impact on the motivational goal of the individuals (Jaffar *et al.*, 2006), who reported similar results as they stated that only 8.33% of his respondents had elementary level education.

Size of landholding: The landholding size refers to

the piece of land cultivated by a grower (Nawaz, 1989; Lowder *et al.*, 2016). Researchers argued that the larger the size of landholding, the greater the adoption of agricultural innovations. Therefore, it was deemed necessary to collect necessary information about the size of the landholding respondents. The collected information about landholding size is presented in Figure 3. Apple growers were grouped into three different categories, such as Small farmers (12.5 acres), medium (>12.5 acres), and large (>25 acres). Results showed slightly below half (45%) of the respondents were medium landholders, followed by small (30.8) and 24.2% of them were large landholders, respectively. These results align with Aziz *et al.* (2018) findings. They found 65.0, 23.33, and 11.6% of the growers had small, medium, and large landholdings, respectively.

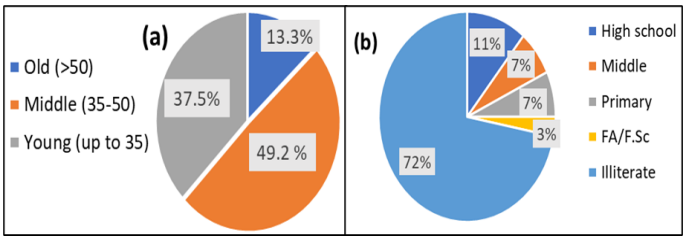

Figure 2: *Age group and education level of the respondents (%).*
Source: *Field Survey 2019.*

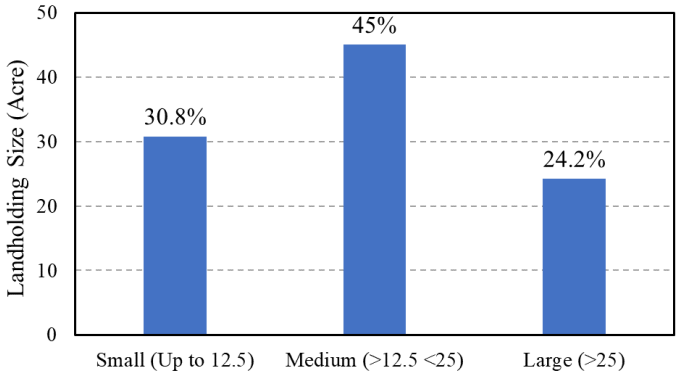

Figure 3: *Size of landholding of the respondents.*
Source: *Field Survey 2019*

Association between awareness and adoption of recommended practices of apple growers

Chi-square (χ^2) test was used to understand: (i) the association between awareness and adoption of apple growers and (ii) the association of a few chosen socio-economic characteristics, such as age, education, tenancy status, and farmer's landholding size with their awareness and adoption level. The findings of the test are presented in the preceding paragraphs.

Table 2: *Association of age with awareness and adoption.*

Awareness			Age	Adoption		
Low	Medium	High		Low	Medium	High
Percentages				Percentages		
13.3	60.0	26.7	Young (up to 35)	22.2	62.2	15.6
6.8	72.9	20.3	Middle (>35-50)	15.3	64.4	20.3
0.0	56.3	43.8	Old (>50)	0.0	62.5	37.5
8.3	65.8	25.8	Total	15.8	63.3	20.8
χ^2tab =9.488 χ^2cal=6.445 Non- significant				χ^2 tab=9.488 χ^2cal= 6.469, Non-significant		

Source: *Field Survey 2019*

Association of age with the awareness and adoption of apple growers

The age of the respondents was asked in years, and respondents (farmers) were grouped into three main classes as young (up to 25 years), middle (26 to 50 years), and old (above 50 years), which are shown in Table 2. The detail illustrates that the majority (72.9%) of middle-aged had a medium level of awareness, followed by young (60.0%) and old (56.3) ages who also had a medium level of awareness regarding production technology recommendations. Moreover, most (43.8%) and one-fourth (26.7%) of the middle and young aged, respectively, had a high level of awareness regarding apple recommendations. Data regarding age and adoption further illustrate that a majority (62.2-64.4%) of the young, old, and middle-aged had adopted apple production recommendations. Results of the chi-square test reflected a non-significant association between the age of the farmers and their consciousness and adoption regarding apple production recommendations. Because the value of Pearson is less than the critical value of chi-square, this means with the increase in age, there was a decrease in awareness and adoption of the recommendations. These results are not aligned with Siddiqui *et al.* (2006) findings. They stated a significant association of age with the adoption of recommendations regarding the pit formation of mango. Ashraf (2001) and Danquah (2019) reported a highly significant negative association of awareness of recommendation with age. However, Butt (2002) reported similar non-significant association of age with awareness and adoption.

Association of education with the awareness and adoption of apple growers

Education is one of the main components of the socio-demographic characteristics of the respondents. Developed nations are predictable to have a more

positive attitude towards farming innovations than developing and under-developed nations (Issa *et al*., 2016; Hassan, 1991). Therefore, respondent's education was asked for the number of years and grouped into four categories: illiterate, low, medium, and high, which is shown in Table 3. The result indicates that a fair majority (62.8%) of the respondents were illiterate and had medium awareness, and the majority (66.3%) of the following respondents adopted the recommendations. Data further revealed that a vast majority (84.6%) of the respondents had low education and had a medium level of awareness. However, the respondent's education had a non-significant association with the awareness and adoption of those recommendations. These results are contradicting with those of Siddiqui *et al*. (2006) and Aziz *et al*. (2018). They reported an extremely significant association of education with awareness and adoption of the recommendations.

Table 3: *Association of education with awareness and adoption.*

Awareness			Education	Adoption		
Low	Medium	High		Low	Medium	High
Percentages				Percentages		
16.3	62.8	20.9	Illiterate	8.1	66.3	25.6
7.7	84.6	7.7	Low	0.0	61.5	38.5
23.5	47.1	29.4	Medium	11.8	70.6	17.6
0.0	66.7	33.3	High	33.3	33.3	33.3
16.0	63.0	21.0	Total	8.4	65.5	26.1
χ^2tub. = 12.5916 χ^2 = cal. 5.193 Non-significant				χ^2tub. = 12.5916 χ^2 = cal. 5.425 Non-significant		

Source: *Field Survey 2019*

Association of the size of landholding with the awareness and adoption of apple growers

Respondents were asked for their land size (in an acre) and grouped into three major classes as small (up to 12.5 acres), middle (12.5-25 acres), and large (above 25 acres), which is shown in Table 4. That the majority (79.3%) of the large farmers knew a medium level of awareness, followed by small (59.5%) and medium (57.9%) sized landholders. An almost similar trend was observed for adopting known recommendations regarding apple production technologies in Table 4. However, landholding size had a positive and significant association with awareness, whereas the non-significant association with adopting those recommendations. The results are similar to Siddiqui *et al*. (2006) and Aziz *et al*. (2018). They found a significant and positive association of landholding with awareness and a non-significant association with adopting short agricultural messages telecast on television (TV).

Table 4: *Association of landholding with awareness and adoption.*

Awareness			Landholding	Adoption		
Low	Medium	High		Low	Medium	High
Percentages				Percentages		
29.7	59.5	10.8	Small (up to 12.5)	16.2	54.1	29.7
14.8	57.4	27.8	Medium (12.5-25)	5.6	68.5	25.9
0.0	79.3	20.7	Large (above 25)	3.4	75.9	20.7
15.8	63.3	20.8	Total	8.3	65.8	25.8
χ^2tab. = 9.488 χ^2cal. = 13.73 Significant				χ^2 =tab. 9.488 χ^2 = cal. 5.886 Non-significant		

Source: *Field Survey 2019.*

Table 5: *Association of an apple orchard with awareness and adoption.*

Awareness			Orchard size	Adoption		
Low	Medium	High		Low	Medium	High
Percentages				Percentages		
27.1	60.0	12.9	Small (up to 12.5)	14.3	58.6	27.1
0.0	69.4	30.6	Medium (12.5-25)	0.0	75.5	24.5
0.0	0.0	100.0	Large (above 25)	0.0	100.0	0.0
15.8	63.3	20.8	Total	8.3	65.8	25.8
χ^2 tab. = 9.488 χ^2 cal. = 22.006 Significant				χ^2tab. = 9.488 χ^2cal. = 8.917 Non-significant		

Source: *Field Survey 2019.*

Association of the size of apple garden with the awareness and adoption of apple growers

The result regarding the association of size of an apple orchard in Table 5 reveals that the majority (69.4%) and a simple majority (60.0%) of medium and small-scale orchard owners were aware of medium-level information regarding production technologies. On the other hand, all (100.0%) the large-scale apple orchard owners had high-level information on apple production technology recommendations. Similarly, all (100.0%) of the large-scale apple orchard owners adopted a medium level of production recommendations. The majority (75.5%) and a simple majority (58.6%) of medium-sized orchard holders adopted a medium level of apple production recommendations. Furthermore, the chi-square test results reveal a significant association of apple orchard size with awareness, and a non-significant association prevails with

the adoption of apple production recommendations. Similar results were reported by Siddiqui *et al*. (2006) concerning the adoption of recommendations.

Association of apple growing experience with the awareness and adoption of apple growing recommendations

The growing experience of respondents was asked in years and grouped into three major classes as low (≤12.5 years), medium (12.5-25 years), and high (> 25 years), which is shown in Table 6**.** The data indicate that half (50.0%) of the respondents having low experience had a high awareness level, and all (100.0%) respondents of the adoption group adopt apple varieties. Data further show that a fair majority (63.8%) of the respondents having a medium and high level of experiences had medium awareness. However, experience in growing apples had a non-significant association with awareness and adoption of these recommendations. Similar outcomes were reported by Siddiqui *et al*. (2006).

Table 6: *Association of apple growing experience with awareness and adoption.*

Awareness			**Apple growing experience**	**Adoption**		
Low	**Medium**	**High**		**Low**	**Medium**	**High**
Percentages				Percentages		
0.0	50.0	50.0	Low	0.0	0.0	100.0
20.3	63.8	15.9	Medium	11.6	63.8	24.6
10.2	63.3	26.5	High	4.1	71.4	24.5
15.8	63.3	20.8	Total	8.3	65.8	25.8
χ^2tub. = 9.488 χ^2cal. = 4.594 Non-significant				χ^2tub. = 9.488 χ^2cal. = 8.035 Non-significant		

Source: *Field Survey 2019.*

Conclusions and Recommendations

The passage of time has promoted productivity-enhancing technologies. However, the adoption method is very slow, and the grower's attention would vary according to technical feasibility. Awareness and adoption depend on numerous factors, such as the grower's socioeconomic attributes, including age, education, land holdings, source of income, and land on which specific crops are grown. Generally, socioeconomic characteristics can cultivate a grower's adaptability. Growers with great adaptability are expected to become innovators and early adopters.

This research examined and concluded the socioeconomic characteristics of the respondents. It is found that the majority of the farmers belong to the middle-aged; the majority of them are educated up to middle school level and had small landholding with vast apple-growing experience. It is further concluded that age, education, and experience significantly influence farmer's awareness and adoption regarding apple growing, whereas the size of landholding showed significant and positive effects on the adoption of apple growing recommendations.

It is found that socioeconomic characteristics, such as education, could play a significant role in the awareness and adoption of apple growers. Middle-aged apple growers could not go back to school for formal education. Still, they could get appropriate training on using advanced technologies, enhancing the adoption rate, apple yield and production, and grower's income.

Therefore, it is recommended that concerned authorities should provide direct or indirect training about the latest technologies and innovations to apple growers and other farmers to advance the agriculture sector, specifically, apple farming in northern Balochistan.

This study has some limitations, and future researchers could be addressed these limitations. Due to funding constraints, this study only focused on one district in Pakistan's Balochistan province. Future researchers can consider a large sample size, possibly an entire country. This research only absorbed socioeconomic determinants of the awareness and adoption of apple production practices. Future researchers could further explore other important parts of agricultural development and poverty reduction in rural areas.

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Novelty Statement

This research provides valuable information about awareness and adoption of apple production practices because apple is one of the main fruit in the Balochistan province of Pakistan. This research is also beneficial to small farmers. The chi-squire (χ^2) test was used to assess awareness and adoption level asso-

ciated with some of the chosen socioeconomic characteristics like age, education, and size of landholding of the farmers.

Author's Contribution

Nawab Khan: Conducted this study, collected the data, and wrote the first draft
Ram L. Ray: Full reviewed the paper for the technical write-up.
Muhammad Ihtisham: Helped in data analysis, results interpretation, conclusion, and recommendation.
Badar Naseem Siddiqui: Helped in the review literature and final paper setting. Proofread the final draft.
Muhammad Khayyam: Helped in model specification and data analysis.
Raheel Anjum: Helped in paper proofreading.
Simplice A. Asongu: Helped in model specification and data analysis.

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

References

Ashraf, I. 2001. A study into the effectiveness of communication methods used by pesticide companies to popularize their products among the farmers of tehsil Arifwala. M. Sc. (Hons.) Agricultural Extension Thesis University of Agriculture Faisalabad.

Ayinde A.F., O.E. Fapojuwo, A.A. Soetan, M.O. Suleiman and A.O. Adeyinka. 2020. Effects of social media on researchers' attitude to work at the international institute of tropical agriculture, Oyo State, Nigeria. J. Agric. Ext., 24(4):12-22. http://eoi.citefactor.org/10.11226/v24i2 https://doi.org/10.4314/jae.v24i2.2

Aziz R., B.N. Siddiqui and J. Ali. 2018. Relationship between socio-economic aspects of farmers and their awareness & adoption of short agricultural messages telecast on PTV. Int. J. Adv. Res. Biol. Sci., 5(1):25-33.

Butt, S.A. 2002. Role of television in the dissemination of agriculture technologies among the farmer of tehsil Faisalabad. M. Sc. (Hons.) Agri. Ext. Thesis, University of Agriculture, Faisalabad.

Chakraborty S., B. Chakraborty, V. Singh and D.L. Timajo. 2018. Education as an instrument of social change and enhancing teaching-learning process with the help of technological development. J. Nur. Edu., 1(1): 1-16. links/5afa5406458515c00b6bd4ff/

Collinson, M. 1983. Farm Management in Peasant Agriculture (1st ed.). CRC Press.

Danquah, F.O., Twumasi, M.A. and Asare I. 2019. Factors influencing zai pit technology adaptation: the case of smallholder farmers in the upper east region of Ghana. Agric. Res. Tech., 21(1):13-24.

Govt of Pakistan. 2021. Fruit vegetables and condiments statistics of Pakistan. Federal Bureau of Statistics, Government of Pakistan, Islamabad.

Hassan, I. 1991. Determination of factors inhibiting adoption of improved technology in cotton production, M. Sc. (Hons.). Agricultural Extension Thesis, University of agricultural, Faisalabad.

Issa, F.O., T.K. Atala, J.G. Akpoko and S.A. Sanni. 2016. Socio-economic determinants of adoption of recommended agrochemical practices among crop farmers in Kaduna and Ondo States, Nigeria. Asi. J. Agric. Ext. Econ. Soc., 10(1): 1-12. https://doi.org/10.9734/AJAEES/2016/22423

Jaffar, S.S., K. Javed and T.E. Lodhi. 2006. An evaluation of microcredit schemes of small and medium enterprise development authority (SMEDA). J. Anim. P. Sci. 16(34):111-113. http://thejaps.org.pk/docs/16_3-4_2006/04-415.pdf

Javed M.T., A. Mubarik, F. Umar, Y. Aqsa and Y.S. Khan. 2020. Apple Cluster Feasibility and Transformation Study, In Ali Mubarik 2020 Cluster Development Based Agriculture Transformation Plan Vision-2025, Planning Commission of Pakistan and Centre for Agricultural Bioscience International (CABI), 131(434)PC/AGR/CDBAT-120/2018.

Juniper, B.E., R. Watkins and S.A. Harris. 1996. The origin of the apple. In Eucarpia Symp. Fruit Breeding Genet. 484(2): 27-34. https://doi.org/10.17660/ActaHortic.1998.484.1

Khan M. and J.H. Bae. 2017. The environmental perspectives of apple fruit supply chain management in Chitral, Northern Pakistan. Int. J. Suppl. Chai. Manage., 6(4): 1-16. http://excelingtech.co.uk/

Khan, D., A. Ullah, Z. Bibi, I. Ullah, M. Zulfiqar and Z.U. Khan. 2020. Forecasting area and production of guava in Pakistan: An econo-

metric analysis. Sarhad. J. Agric. 36 (1): 272-281. https://doi.org/10.17582/journal.sja/2020/36.1.272.281

Khan, N. 2018. Role of agricultural extension services in enhancing apple production in district ziarat, Balochistan, arid agriculture university Rawalpindi, Pakistan. pp- 89.

Khurshid, L.A., A. IL, M.Z. Khan and U. Pervaiz. 2017. Role of agricultural extension agents in transfer of onion production technology in district Swat. Int. J. Agric. Environ. Res. 3(1): 158-164. http://www.ijaaer.com/

Kizilaslan, N. 2006. Agricultural information systems: A national case study. Lib. Rev., 55(8): 497-507. https://doi.org/10.1108/00242530610689347

Lowder, S.K., J. Skoet and T. Raney. 2016. The number, size, and distribution of farms, smallholder farms, and family farms worldwide. World Dev. 8(7): 16-29. https://doi.org/10.1016/j.worlddev.2015.10.041

Million, M., M. Like and T. Chalchisa. 2020. Adoption status and factors determining coffee technology adoption in jimma zone, south west Ethiopia. PeliPerke Coffee and Coco. Res. J., 36(1): 68-83. https://ccrjournal.com/index.php/ccrj/article/download/413/399 https://doi.org/10.22302/iccri.jur.pelitaperkebunan.v36i1.413

Muddassir, M., M.S. A-Shenaifi, H.S. Kassem and B.A. Alotaibi. 2020. Adoption of improved maize production technologies in Punjab province, Pak.. J. Agric. Ext., 24(4): 1-11. http://eoi.citefactor.org/10.11226/v24i2

Muhammad, N.D., M. Jan, A.U. Sajjad, Jan and G. Ali. 2011. Role of microcredit advance by Dir area Support Project in the development of agriculture. Int. J. Agric., 1(8): 708-709.

Nawaz, M. 1989. Farmer's perception of the working of extension field staff in tehsil Jhang, district Jhang M. Sc. (Hons.). Agricultural Extension Thesis, University of Agriculture, Faisalabad.

Noonari, S., M.I.N. Memon, R. Wahid, M.B. Peerzdo, M. Bhatti and G.Y. Kalwar. 2015. Economic analysis of apple orchards production in district mastung Balochistan Pakistan. Econ. Anal. 7(10): 40-54. https://core.ac.uk/download/pdf/234626420.pdf

PHDEC. 2017. Pakistan horticulture development and export company, Ministry of Commerce. php Accessed on, August 19. http:// www.phdec.org.pk/phs

Siddiqui, B.N. 2011. Communication in Agriculture Extension: Analysis of communication interventions of extension field staff in apple growing areas of Balochistan, Pakistan lap lambert academic publishing, gmbh & co. Kg. Germany.

Siddiqui B.N., S. Muhammad and N.H. Malik. 2006. Effect of socio-economic aspects on awareness and adoption of recommended horticultural practices by apple growers in Balochistan. Pak. J. Agric. Sci., 43(1-2): 73-76.

Smock, R.M. and Neubert, A.M. 1950. Apples and apple products, Indian agricultural research institute, new Delhi, Intercedence Publishers Ltd., New York and London 1-485.

Ullah, A., D. Khan and S. Zheng. 2017. The determinants of technical efficiency of peach growers: evidence from Khyber Pakhtunkhwa, Pakistan.

Ullah, A., D. Khan and S. Zheng. 2018. Testing long-run relationship between agricultural gross domestic product and fruits production: evidence from Pakistan. Ciência Rural, Santa Maria, v.48:05, e20170854, https://doi.org/10.1590/0103-8478cr20170854

UN. 2021. World population prospects the revision: Volume I: Comprehensive tables. New York. Department of Economics Social Affair Population Development, UN.

Weixel, S., F. Wempen, J. Ward, J. McPhee, D. Hacker, R. Sutcliff and J. Upton. 2010. Food & nutrition for you, Pearson/prentice hall.

Ogada, M.J., Mwabu, G. and Muchai, D. 2014. Farm technology adoption in Kenya: a simultaneous estimation of inorganic fertilizer and improved maize variety adoption decisions. Agric. Food Econ., 2(1): 1-18. https://doi.org/10.1186/s40100-014-0012-3

Nzomoi, J.N., Byaruhanga, J.K., Maritim, H.K. and Omboto, P.I. 2007. Determinants of technology adoption in the production of horticultural export produce in Kenya. Afr. J. Bus. Manage., 1 (5): 129-135 http://www.academicjournals.org/ajbm