OPEN ACCESS Int. J. Agr. Ext. 10 (01) 2022. 249-259 DOI: 10.33687/ijae.010.01.4024

Check for updates

Available Online at EScience Press

International Journal of Agricultural Extension

ISSN: 2311-6110 (Online), 2311-8547 (Print)

https://esciencepress.net/journals/IJAE

FARMER KNOWLEDGE AND PRACTICES ON TECHNOLOGY TRANSFER AND FARM MECHANIZATION IN RURAL AREAS OF SOUTHERN PUNJAB

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ARTICLE INFO

Article History

Received: August 22, 2021

Revised: November 29, 2021

Accepted: January 17, 2022

Keywords

Adoption

Farm mechanization

Knowledge

Practice

South Punjab

Technology transfer

ABSTRACT

Modern agricultural technologies have much potential in increasing the crop yield. The purpose of the study was to measure knowledge of the farmers and practices towards technology transfer and farm mechanization. The study was conducted during January 2020 in two districts of South Punjab (Layyah and Dera Ghazi Khan). 120 farmers were selected randomly by using a multistage cluster sampling technique. Majority of the respondents agreed that cost of technology, educational level and lack of knowledge of farmers were the main hindrance towards technology transfer and farm mechanization. Extension workers also need to be equipped with modern and updated agricultural technologies. Scarcity of water was also a limiting factor for successful crop production. Although hybrid seed was popular, but promotion of Bt-cotton needs due attention. Modern irrigation techniques like sprinkler, drip irrigation system and solar water pump system needs to be promoted in raising crop yield and saving a lot of water. Growing of off-season vegetable in tunnels is a profitable technique but more that 50% farmers were unaware of this technology. ICT also needs due attention in the study area as maximum farmers had no idea of it.

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INTRODUCTION

Agriculture imparts 18.5% to GDP of the country and deals with 38.5% of national labour force with employment (Pakistan Economic Survey, 2018-19). High performing agriculture is a key to economic growth and poverty alleviation in a country, but agriculture performance remained passive in Pakistan during 2018-19. Instead of the 3.8% target set at start of the year, the sector develops by 0.85%. The deficit of agriculture sector was primarily due to inadequate water supply that led to a fall in the cultivated region (Pakistan Economic Survey, 2018-19). Agriculture sector output has dropped below the required stage over the previous decade, primarily due to stationary productivity of entire major crops. According to 6th Population and Housing Census 2017, population of Pakistan is increasing at the rate of 2.4% per annum. Demand for agricultural products is rising because of the rapid increase in population (Pakistan Economic Survey, 2017-18). However, Pakistan has wealthy production latent in fisheries, livestock and agriculture for viable prosperity and economic development. Long-term development of these sectors is critical to prosperity and growth of country. This requires the effective use of production means through adoption of modern technologies and creation of a representative marketing scheme (Pakistan Economic Survey, 2018-19).

REVIEW OF LITERATURE

Improved technology is one of the factors that

contributes to growth of agricultural output. Fawole, and Tijani, (2013) opined that generating new technology is not an adequate condition for increased output but it must be spread, adopted and used by farmers to increase farm output and productivity. Technology is imperative in a variety of areas such as education, health, and similar in agriculture. There are some modern technologies related to agriculture such as precision land leveling, availability of pure seed, fertilizer at low rate, timely availability of irrigation water, cultivation implements, insecticide/pesticide and ICT related technologies that directly or indirectly affect the production of the crops.

Technology can only be accessed by farmers through technology transfer. Technology transfer is the process of transferring information from knowledge or information generators such as universities and research institutions to end users such as farmers. Technology transfer, farmer's adoption and take this into practice and further dispersion to other peoples in the society/community are of prime importance (ChiNgoc and Yamada, 2002).

Singh and Yadav (2014) revealed that most of the farmers had medium knowledge of recommended technology of rice production. Similarly, they had medium level of adoption gap about production technology of the crop. They further disclosed that the knowledge and adoption gap in rice production technology was significantly correlated with socio-economic factors like annual income, education, availability of irrigation facilities, land holding, and farmhouse equipment. The respondents informed during this study that non-availability of appropriate information, non-availability of improved varieties of crops, high price of improved varieties of crops, high prices of pesticide and unfamiliarity about improved cultivation practices were the key constraints for low yield of rice.

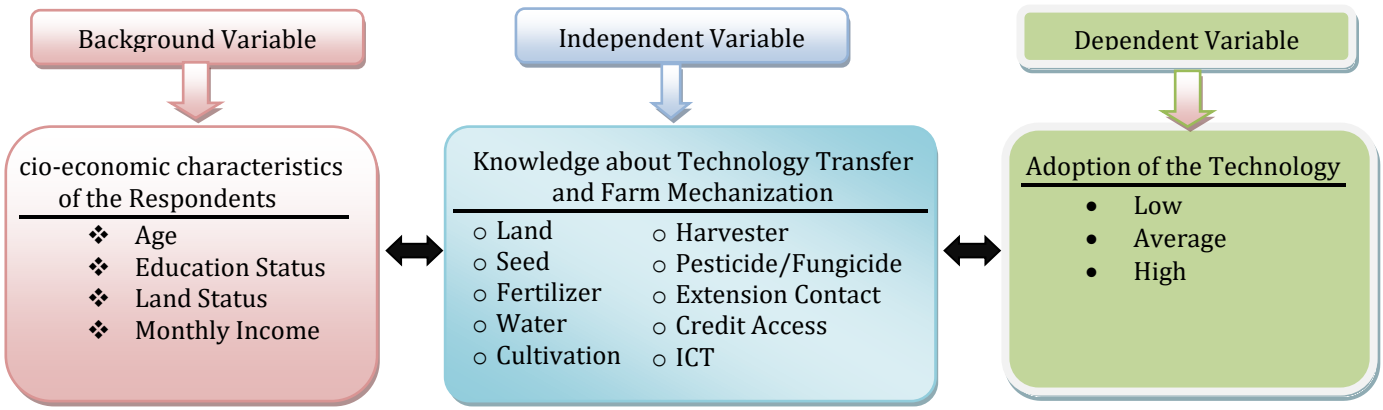
Altalb *et al. (*2015) discussed the role of extension workers in transfer and adoption of agricultural technologies. They reported that agricultural extension workers had a pivotal role in transfer of modern technologies and innovative agricultural information to farmers as well as to convince them to adopt these techniques. Further, it is their duty in helping them to solve their agriculture related problems.

Barnes *et al. (*2019) observed that farm size and income reflected the economic cost barrier to adopt the precision agricultural technologies. Moreover, attitude of famers regarding optimism towards economic return of the technology was also found an obstacle to adoption of the technology. Information and innovations seeking behaviour was found lacking in farmers.

In District Layyah and D.G Khan, more than half of the population depends on agriculture. Mostly the farm practices are found to be undertaken prevailing upon the conventional and outdated methods with a lack of requisite mechanization. As a result, fertility of the soil is decreasing day by day. One of the problems currently facing agricultural transfer is the lack of clarity and knowledge about the role of agricultural extension in the transfer of agricultural technology and lack of understanding the role of agricultural extension in helping farmers to adopt modern farming techniques. Hence, the study aims to measure the farmers knowledge towards farm technology transfer and farm mechanization and whether they practice these farm mechanizations. Further, it is to identify the factors which influence the adoption of the technology.

Conceptual Framework

A conceptual framework is the understanding of the researcher of how the specific variables interact with each other. It thus defines the variables needed in the investigation of the studies.



Profile of study area

District Dera Ghazi Khan and District Layyah from Southern Punjab were selected by using a multistage cluster sampling technique during January 2020. 120 farmers were selected randomly. From each Tehsil (Tehsil D.G Khan and Tehsil Layyah), two Union Councils (UC) were selected for the study purpose (Table 1).

Table 1. Profile of study area.

District of Study Area	Tehsil of Study Area	Rural Union Council	Sample
Layyah	Layyah	UC No. 22 (Kotla Haji Shah)	10
		UC No. 24 (Basti Shadu Khan)	10
	Karor Lal Eason	UC No. 27 (Shahpur Dorata)	10
		UC No. 28 (Sahu Wala)	10
	Choubara	UC No. 44 (Rafiqabad)	10
		UC No. 46 (Aulak Thal Kalan)	10
D.G Khan	D.G Khan	UC No. 48 (Basti Khosa)	10
		UC No. 52 (Haji Ghazi)	10
	Tounsa	UC No. 18 (Basti Buzdar)	10
		UC No. 20 (Kot Qaisarani)	10
	KotChutta	UC No. 76 (Khanpur Janubi)	10
		UC No. 79 (Choti Zareen)	10
		Total	120

Data analysis

Survey method by using a questionnaire was applied to collect data, and the research was exploratory. SPSS 20 Version was used for further analysis. The data was presented with frequency and percentage by using descriptive analysis. The collected data was further analyzed by using inferential statistical techniques which were Z test to see the relationship between distribution of farmers into yes and no for knowledge and practice of different technologies.

RESULTS AND DISCUSSION

Socio-economic characteristics of the farmers

In the study area, almost majority of the respondents (49.2%) were 46+ years old (Table 2). Mean value for age (42.42 years) was upper level of respondents' age. 51.7% respondents had monthly income between Rs. 30001-40000. It was followed by 28.3% respondents who had income between Rs. 40000-50000 (Table 2). Mean value for income (Rs. 37833) was in the middle of income of respondents.

Mean and median values of age of farmers were almost comparable (Table 2). It showed that data were nearly symmetrical. On average, 8.47 of deviation from mean value (42.42 years) for age of the farmers was observed. Mean and median values for income of the farmers were almost comparable (Table 2). It showed that data were nearly symmetrical. On average, Rs. 7766 of deviation from mean value (Rs. 37833) for monthly income of the farmers was found.

Education is a prime indicator in any research. Majority of the respondents' education was primary (39.2%) and secondary level (25.8%). It showed that 65% farmers had low level of education (Figure 1). It is due to low literacy rate in villages, particularly those who are engaged in farming activities. 76.7% farmers had less than 19 acres own land (Figure 2). Only 23.3% of farmers had 20+ acres, revealing that small holding farmers were more in number in the study area.

Table 2. Frequency percentage of age and monthly income of farmers and their estimates of mean, median and standard deviation.

Variables		Frequency	Percentage
Age ($\bar{X}$ ± SD=42.42±8.47, Median=44.70)	15-25 years	02	01.7
	26-35 years	26	21.7
	36-45 years	33	27.5
	46 years or above	59	49.2
Monthly Income ($\bar{X}$ ± SD=37833±7766, Median=37097)	Rs. 20000-30000	16	13.3
	Rs. 30001-40000	62	51.7
	Rs. 40001-50000	34	28.3
	Rs. 50001+	08	06.7

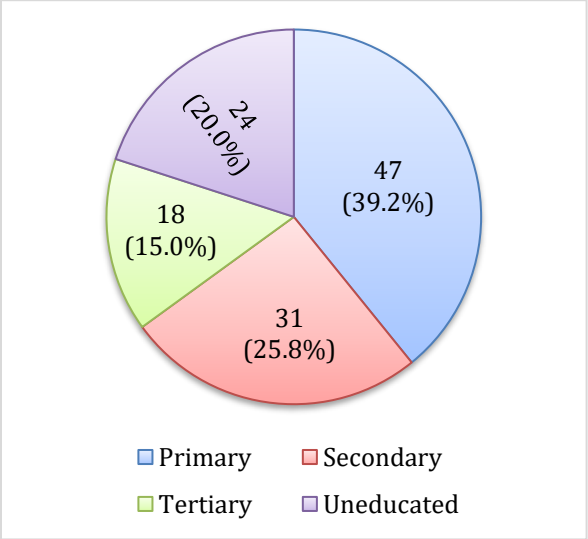


Figure 1. Frequency percentage of education of farmers

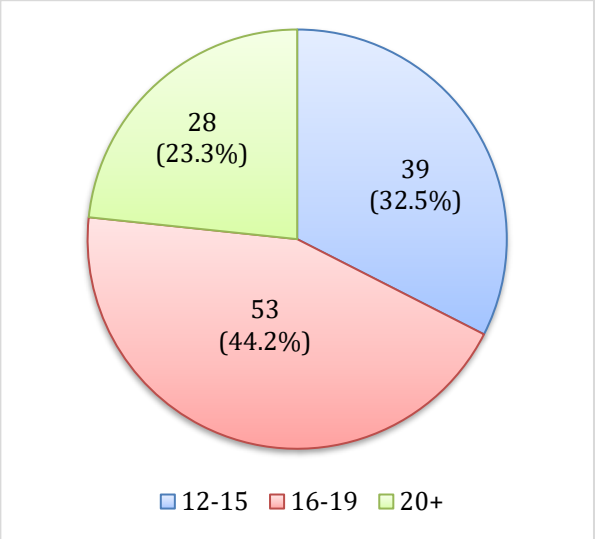


Figure 2. Frequency percentage of land holding of farmers

Majority of the respondents were youth (46+ year) which indicated that they were These results are almost in conformity with those of Nouman *et al*. (2013) who reported that 60% farmers were above 40-year age. 42.5% were illiterate and 37% had primary and secondary education level. On the contrary, 75% farmers earned Rs. 10,000 to 25,000 from agriculture and 30% had income of Rs. 25,000 to 50,000 from other sources. They further revealed that illiterate farmers were more inclined to get large number of agricultural credits as compared to educated persons.

Land Related Technologies

P-value showed that there was positive relationship between distribution of farmers regarding knowledge of laser land leveling technology (Table 3). On the other hand, using this technology by farmers had no relationship between users and non-users. Majority of the farmers (73.3 %) knew about laser land leveling technique while only 56.7% of the farmers were using this technique for leveling their land (Table 3). With the use of Bulldozer, the culturable wasteland is developed and the resulting enhancement of food is increased. Both knowledge and practices of bulldozer had negative relationship between distribution of farmers (Table 3), showing thereby that it was not popular among farmers. Data showed that only one-fourth of the farmers (26.7%) knew about the bulldozer land leveling technique while 11.7% of the farmers adopted this technology. Farmers knowledge and practice towards rotavator technology were high as compared to laser and bulldozer leveling technologies. Relationship between distribution of farmers for knowledge as well as practice was found positive, revealing that majority of the farmers not only knew this technology but also

adopted it. 87.5% of the farmers were well aware of rotavator technology. Likewise, 80.8% farmers had adopted this technique.

In a study done by Behera *et al*. (2014), 62% respondents reported the unavailability of improved farm implements and their service provider as the major problem for poor adoption of farm mechanization. In our study, most of the farmers were well aware of laser land levelers and using it for precision leveling of their land. Rotavator is a common implement to pulverize the soil. It is being used at large in study area. Bulldozer is mostly used in low hilly areas where gullies are found. The study area has flat lands. This is reason that most of the farmers are not practicing this implement for land leveling.

Table 3. Distribution of farmers regarding land related technologies.

Knowledge Regarding Technologies		n (%)	Z value (P value)	Practices Regarding Technologies		n (%)	Z value (P value)
Know about Laser Land Leveling	Yes	88(73.3)	5.11 (0.000)	Use Laser Land Leveling	Yes	68(56.7)	1.46 (0.144)
	No	32(26.7)			No	52(43.3)	
Know about Bulldozer Land Leveling	Yes	32(26.7)	-5.11 (0.000)	Use Bulldozer Land Leveling	Yes	14(11.7)	-8.40 (0.000)
	No	88(73.3)			No	106(88.3)	
Know about Rotavator	Yes	105(87.5)	8.22 (0.000)	Use Rotavator	Yes	97(80.8)	6.76 (0.000)
	No	15(12.5)			No	23(19.2)	

Seed Related Technologies

A strong positive relationship between distribution of farmers regarding knowledge and using of hybrid seeds showed high popularity of hybrid seeds among farmers (Table 4). 80.8% of the farmers not only knew about hybrid seeds but 77.5% of them were using hybrid seeds of the crops. On the other hand, although farmers knew about Bt cotton seed and seed driller, but they were less than 50% (Table 4). As a result, same was the case with growing Bt cotton seed and using seed driller. The level of knowledge and practice regarding broadcast seeder showed non-significant relationship between distribution of farmers, showing that farmers were equal in number for both knowledge and practice of this technology (Table 4).

In modern agriculture, hybrid seed production is predominant. About the last half of 20th century, hybrid seed is one of the main contributors to impressive rise in agricultural output. Our study also emphasized on improved hybrid. Interestingly, 80.8% farmers were aware of hybrid seeds, but 77.5% farmers were cultivating them. This may be due to costly seed for small land holders. In a study of Singh and Yadav (2014), the farmers stated that the key limitations for low rice production yields were unavailability of improved seed and unavailability of appropriate information. However, the results showed that to increase farmers awareness of the technology through various sources of information and to reduce the adoption gap would enhance their level of technical knowledge. Biotechnology increases ability of breeders to make improvements in livestock and crops. Biotechnology makes possible improvements that are not possible with the traditional crossing of interrelated species alone. In our study, 54.2% farmers had no knowledge of Bt-cotton which ultimately affected its usage. This technology is almost new in our country. Further, Bt seed is required to purchase for every year. These may be the reasons for low interest of farmers. Seeds are utmost necessary to distribute in rows with seed drill machines. It gives out plants to get sufficient and equal amount of nutrients, water from the soil and sunlight. Unfortunately, farmers in the study area are more or less 50% using these implements.

Weed Related Technologies: A strong negative relationship between distribution of farmers for both Mechanical Weeder and Paddy Weeder showed that knowledge of these technologies were very low in the study area (Table 5). Similar was the case with adoption of these technologies because of lack of knowledge. On the other hand, 86.7% of the respondents knew about subsoiler and 77.5% of the respondents were using the subsoiler mechanism (Table 5).

Table 4. Distribution of farmers regarding seed related technologies.

Knowledge Regarding Technologies		n (%)	Z value (P value)	Practices Regarding Technologies		n (%)	Z value (P value)
Know about Hybrid Seed	Yes	97 (80.8)	6.76 (0.000)	Use Hybrid Seed	Yes	93 (77.5)	6.02 (0.000)
	No	23 (19.2)			No	27 (22.5)	
Know about Bt-Cotton Seed	Yes	55 (45.8)	-1.10 (0.273)	Use BT-Cotton Seed	Yes	53 (44.2)	-1.28 (0.201)
	No	65 (54.2)			No	67 (55.8)	
Know about Seed Driller	Yes	53 (44.2)	-1.28 (0.201)	Use Seed Driller	Yes	51 (42.5)	-1.64 (0.100)
	No	67 (55.8)			No	69 (57.5)	
Know about Broadcast Seeder	Yes	61 (50.8)	0.18 (0.855)	Use Broadcast Seeder	Yes	58 (48.3)	-0.37 (0.715)
	No	59 (49.2)			No	62 (51.7)	

Weed is a plant that competes with crops for light, nutrients, and water. Removal of unwanted plants in the field crops is possible through weeding. Mechanical weed control reduce drudgery involved in manual weeding. It is very effective in breaking soil crust, killing weeds, maintaining water intake capacity and ensuring soil aeration. Our study explored that it was not popular among farmers of the study area. High cost and lack of transfer of technology might be the causes of its adoption. Southern Punjab is mostly cotton growing area. This was the main reason that farmers did not know about Paddy weeder, while subsoiler was more popular to use. Nagaraj *et al*. (2013) analyzed the level of knowledge of farm mechanization by paddy growers. They described that most respondents of paddy grower had a moderate level of knowledge about farm mechanization practices.

Table 5. Distribution of farmers regarding weed related technologies.

Knowledge Regarding Technologies		n (%)	Z value (P value)	Practices Regarding Technologies		n (%)	Z value (P value)
Know about Mechanical Weeder	Yes	18 (15.0)	-7.67 (0.000)	Use Mechanical Weeder	Yes	12 (10.0)	-8.76 (0.000)
	No	102 (85.0)			No	108(90.0)	
Know about Paddy Weeder	Yes	34 (28.3)	-4.75 (0.000)	Use Paddy Weeder	Yes	07 (5.8)	-9.68 (0.000)
	No	86 (71.7)			No	113(94.2)	
Know about Subsoiler	Yes	104 (86.7)	8.23 (0.000)	Use Subsoiler	Yes	93 (77.5)	6.02 (0.000)
	No	16 (13.3)			No	27 (22.5)	

Water Related Technologies

The farmer level of knowledge regarding sprinkler, drip irrigation system and solar water pump system was very low (Table 6). They could afford these technologies but due to lack of knowledge, a minority of the farmers were using these technologies.

For last many years, farmers are facing a severe shortage of irrigation, which badly affects agricultural productivity. Water related technologies are somewhat novel and costly, making hindrance to adopt. Government should come forward to announce subsidy for gainful growing of vegetables in that area. Likewise, Indhumathi *et al*. (2017) examined that most of the farmers were using traditional irrigation techniques. They recommended that modern irrigation techniques should be promoted in raising crop yield and saving a lot of water.

Cultivation Related Technologies

Negative value about knowledge of tunnel cultivation showed that less than 50% farmers (42.5%) were familiar with this technology. Surprisingly, those who knew these technologies, were not adopting it and only 15% farmers were using tunnel technology. Almost all farmers (92.2%) were well informed about Cultivator and 91.7% were using it (Table 7). Only 40.8% farmers were aware of cultipacker. As regard usage of cultipacker, even a smaller number of farmers (33.3%) were using it.

Table 6. Distribution of farmers regarding water related technologies.

Knowledge Regarding Technologies		n (%)	Z value (P value)	Practices Regarding Technologies		n (%)	Z value (P value)
Know about Sprinkler Irrigation System	Yes	33(27.5)	-4.93 (0.000)	Use Sprinkler Irrigation System	Yes	09(7.5)	-9.31 (0.000)
	No	87(72.5)			No	111(92.5)	
Know about Drip Irrigation System	Yes	36(30.0)	-4.38 (0.000)	Use Drip Irrigation System	Yes	6 (5.0)	-9.86 (0.000)
	No	84(70.0)			No	114(95.0)	
Know about Solar Water Pump System	Yes	55(45.8)	-1.10 (0.273)	Use Solar Water Pump System	Yes	13(10.8)	-8.58 (0.000)
	No	65(54.2)			No	107 (89.2)	

Many vegetables such as tomatoes, cucumbers, chillies, sweet peppers and watermelons can be planted in high tunnels during the winter (off-season), but more than 50% farmers are unaware in this area. Ironically, Government is not giving attention in dissemination this type of cultivation through offering subsidy to minimize preliminary cost of establishing tunnels. In our study, almost all farmers were using cultivator but only 40.8% farmers knew about Cultipacker. Cultivator is a common implement to use by the farmers in Pakistan. That was the reason that almost all farmers knew about it. Cultipacker is not popular because it is used as an alternative of other implements in Pakistan. Mehta *et al*. (2019) revealed that Indian farmers preferred power tillers over conventional equipment. Power tiller is walking tractor generally used for rotary cultivation in puddled soil and can replace the animal power more effectively.

Table 7. Distribution of farmers regarding cultivation related technologies.

Knowledge Regarding Technologies		n (%)	Z value (P value)	Practices Regarding Technologies		n (%)	Z value (P value)
Know about Tunnel Cultivation	Yes	51(42.5)	-1.64 (0.100)	Use Tunnel Cultivation	Yes	18(15.0)	-7.67 (0.000)
	No	69(57.5)			No	102(85.0)	
Know about Cultivators	Yes	119(99.2)	10.77 (0.000)	Use Cultivators	Yes	110(91.7)	9.13 (0.000)
	No	01(0.8)			No	10(8.3)	
Know about Cultipacker	Yes	49(40.8)	-2.01 (0.045)	Use Cultipacker	Yes	40(33.3)	-3.65 (0.000)
	No	71(59.2)			No	80(66.7)	

Pesticide Related Technologies

More than 90% of the farmers were not only aware of insecticides and fungicides but also were using them to protect their crops from insects and diseases (Table 8). Likewise, 90.8% farmers knew about tractor mounted sprayer but only 45% were using it (Table 8).

In 20th century, insecticides are considered a major factor to increase agricultural productivity. Findings of Javed *et al*. (2010) disclosed that there was empirical association between agricultural growth and pesticides during the period 1971-2007. They further described that the use of fertilizers, pesticides, tractors, and tube-well increased the economic growth of farmers. This shows that information about pesticides for farmers and their use are utmost necessary for agricultural growth. Although more than 90% farmers were well aware of tractor mounted sprayer, but its adoption was low. They preferred common sprayers instead of tractor mounted sprayer.

Harvester Related Technologies

Almost all farmers were familiar with combined harvester (99.2%) and tractor-mounted reaper (98.3%), resulting in strong positive relationship of distribution of farmers for both technologies (Table 9).

The combined harvesting mechanism takes an hour per acre while manual harvesting takes much time and more labour i.e., 12 to 14 persons are required to complete the same task in full-day, excluding threshing. Same is the case with tractor mounted reaper. The perfect alternative is tractor mounted reaper working in

combination with high-performance thresher. These implements are now easily available on rent basis in most of the villages. Mehta *et al*. (2019) stated that most of the farmers in India focused on combine harvesters instead of manual harvesting in India.

Table 8. Distribution of farmers regarding pesticide related technologies.

Knowledge Regarding Technologies		n (%)	Z value (P value)	Practices Regarding Technologies		n (%)	Z value (P value)
Know about Insecticide	Yes	112(93.3)	9.49 (0.000)	Use Insecticide	Yes	109(90.8)	8.95 (0.000)
	No	08(6.7)			No	11(9.2)	
Know about Fungicide	Yes	112(93.3)	9.49 (0.000)	Use Fungicide	Yes	112(93.3)	9.49 (0.000)
	No	08(6.7)			No	08(6.7)	
Know about Tractor Mounted Sprayer	Yes	109(90.8)	8.95 (0.000)	Use Tractor Mounted Sprayer	Yes	54(45.0)	-1.10 (0.137)
	No	11(9.2)			No	66(55.0)	

Table 9. Distribution of farmers regarding harvester related technologies.

Knowledge Regarding Technologies		n (%)	Z value (P value)	Practices Regarding Technologies		n (%)	Z value (P value)
Know about Combined Harvester	Yes	119(99.2)	10.77 (0.000)	Use Combined Harvester	Yes	59(49.2)	-0.18 (0.855)
	No	01 (0.8)			No	61(50.8)	
Know about Tractor Mounted Reaper	Yes	118(98.3)	1.59 (0.000)	Use Tractor Mounted Reaper	Yes	63(52.5)	0.55 (0.584)
	No	02 (1.7)			No	57(47.5)	

Extension Contact, Credit Access, and ICT Related Variables

Negative Z-values regarding Extension Department and ICT showed that most of the farmers were unaware (Table 10). 29.2% farmers knew about the Agriculture Extension Department and just 12.5% farmers got services from Agriculture Extension Department. Likewise, only 15.8% farmers knew about ICT and similar %age of farmers got update through ICT like weather update, market information etc. On the other hand, strong positive relationship between distribution of farmers about knowledge of agriculture loan scheme from ZTBL or other commercial banks was found (Table 10). 70.8% farmers knew about agriculture loan scheme, but only 41.7% farmers utilized it into getting farm mechanization.

The agricultural extension can generally be characterized as delivery of information about new technologies to farmers. The role of extension services is vital in facilitating farmers on how to improve their crop productivity. Unfortunately, role of extension workers and their service delivery were observed limited. Agriculture Extension Department needs to get trained with new technologies and mobilize their workers for transfer of these technologies to farmers. Agriculture loan is meant for the cost of inputs to be incurred on the acquisition of the pesticides, seeds, fertilizers, other material and service charges. Farmers were well aware of loan schemes offered by different commercial banks, but they hesitated to get this opportunity. Using ICT tools, farmers can obtain current, accurate and relevant technical information on Good Agronomic Practices (GAP) from land survey to post-harvest management technique in order to capture their agricultural potential. Timely weather forecast information also helps to prevent total crop failures. Our study showed that this department was weak and unfocussed. Only 15.8% farmers got benefits of ICT.

Table 10. Distribution of farmers regarding extension contact, credit access, and ICT related variables.

Knowledge Regarding Technologies		n (%)	Z value (P value)	Practices Regarding Technologies		n (%)	Z value (P value)
Know about Extension Department	Yes	35(29.2)	-4.56 (0.000)	Get services from Extension Department	Yes	15(12.5)	-8.22 (0.000)
	No	85(70.8)			No	105(87.5)	
Know about ICT	Yes	19(15.8)	-7.49 (0.000)	Get update through ICT	Yes	19 (15.8)	-7.49 (0.000)
	No	101(84.2)			No	101 (84.2)	
Know about agriculture loan scheme	Yes	85(70.8)	4.56 (0.000)	Get loan for farm mechanization	Yes	50 (41.7)	-1.83 (0.034)
	No	35(29.2)			No	70 (58.3)	

65.9% respondents agreed/strongly agreed that farmer educational level influenced adoption of technology (Figure 3). Likewise, 67.5% respondents agreed/strongly agreed that cost of technology and availability of cash influenced the adoption of technology. 58.3% respondents agreed/strongly agreed that availability of credit facilities like soft loans influenced the adoption of technology. A reason number of respondents (34.2%) were neutral or disagreed that availability of credit facilities was the reason for adoption of technology. 70.9% respondents were in favour that lack of knowledge towards farm technologies influenced the adoption of technology. 50% respondents emphasized on training of farmers on agricultural technology but 27.5% reflected that technology training was not essential in order to adopt it. A huge number of farmers responded that Extension Officers were not always available to give updated information on modern technologies to them. 57.5% respondents agreed/strongly agreed that poor road structure and scarcity of water were the main causes of non-adoption of agricultural technology, which ultimately affected crop production (Figure 3).

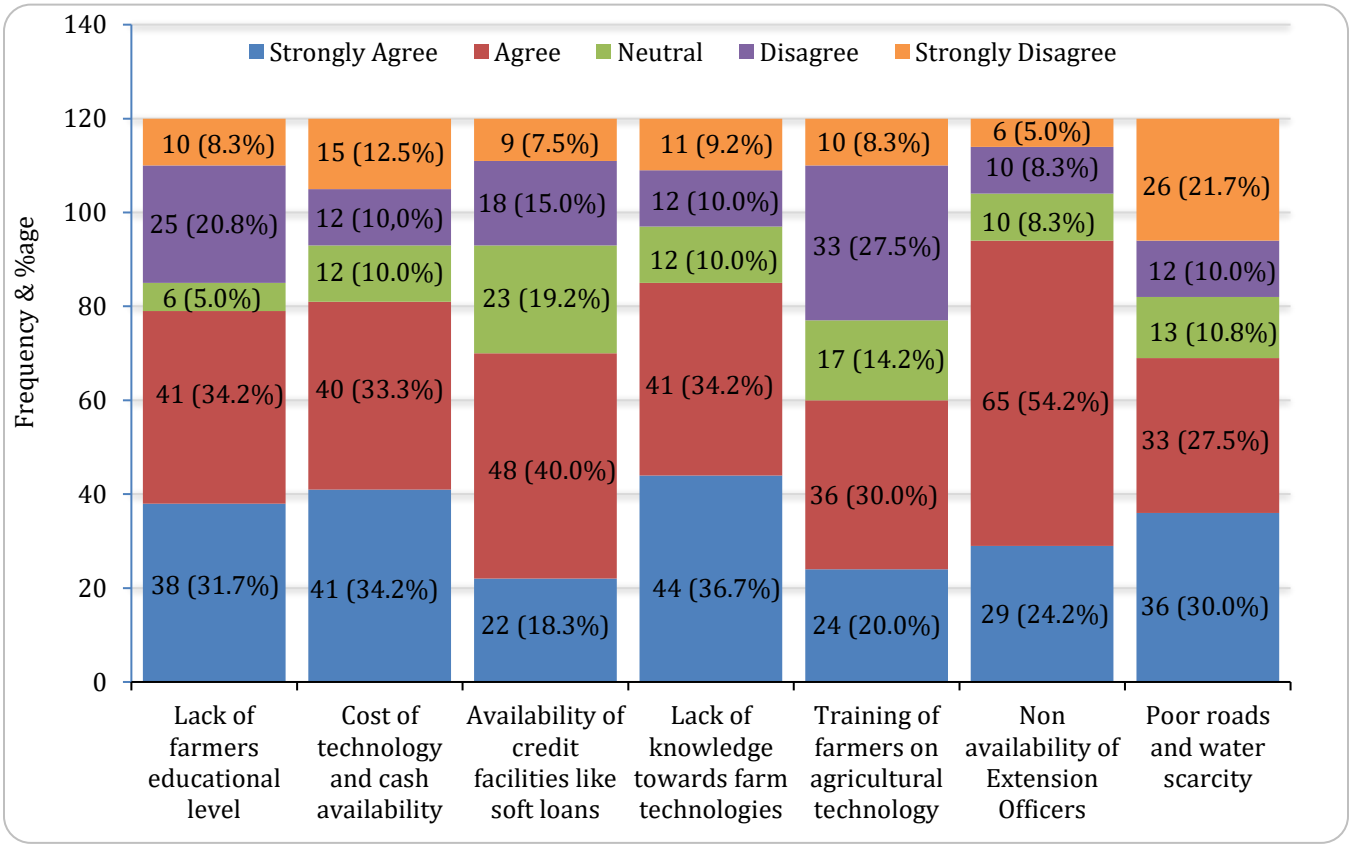


Figure 3. Distribution of farmers regarding factors affecting the adoption of farm technologies.

In developing agricultural industry, technology plays a big role. Over the years, technology has proved to be extremely useful in agricultural sector, but it also seems that some factors which influence the adoption of the technology, need to be considered. Altalb (2015) explained the process of transferring and implementing agricultural technology to the farmers. His findings revealed that the agricultural extension was farmer educational process, purpose at developing agricultural knowledge and skill, in addition to enhance the quality and quantity of agricultural production. Consequently, Agricultural extension workers perform a significant role in the transmission of agricultural technologies to the farmers. Sjakir (2015) revealed that the incorporated farmer field school program improved the knowledge of the farmers and that extension services were effective in transfer of technological skills. Our study showed lack of activities of extension workers in disseminating the modern and updated agricultural technologies, which was badly affecting the crop production in the study area. Kudi *et al*. (2010) narrated that factors influencing the adoption of improved maize varieties were household size, level of education, interaction with extension agents, and access to credit. They recommended to subsidize input costs and make efforts to make credit available to farmers.

CONCLUSION

Farmers had less knowledge about modern agriculture techniques in Southern Punjab due to low level of knowledge. Although hybrid seed was popular, but promotion of Bt-cotton needs due attention. Maximum number of farmers did not know about mechanical weeder, which is a time and labour saving technique. Modern irrigation techniques like sprinkler, drip irrigation system and solar water pump system needs to be promoted in enhancing crop yield and saving plenty of water. Growing of off-season vegetable in tunnels is a profitable technique but majority of farmers were unaware of this technology. Use of insecticides/fungicides is a common practice. ICT also needs due attention in the study area as maximum farmers had no idea of it. Majority of the respondents agreed that cost of technology, educational level and lack of knowledge of farmers were the main hindrance towards technology transfer and farm mechanization. Extension workers also need to be equipped with modern and updated agricultural technologies. Scarcity of water was also a limiting factor for successful crop production. This study is limited to District Layyah and D.G Khan. It is suggested to do further research in all over the Punjab as well as other Provinces of Pakistan to measure the farmer's knowledge and practices towards technology transfer and farm mechanization.

AUTHORS' CONTRIBUTION

Dr. Muhammad Musa analyzed data and wrote the manuscript. Muhammad Zain Kazmi designed and conducted the research study. Dr. Falak Sher supervised the research study and edited the manuscript. Iftikhar Haider helped in collecting data. All authors read and approved the final draft for publication.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interests regarding the publication of this manuscript.

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