Research Article

Challenges and Prospects of Farm Mechanization in Pakistan: A Case Study of Rural Farmers in District Peshawar Khyber Pakhtunkhwa

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Abstract | The current study assessed the mechanization challenges and scenario prevailing in rural area of district Peshawar of Khyber Pakhtunkhwa province in Pakistan. This study employed a multi stage sampling technique to gather data on the socio-economic features of the farmers and available machinery. A total of 240 rural farmers were randomly selected from two local union councils of provincial government Khyber Pakhtunkhwa Peshawar. The accumulated data were analysed using mean and standard deviation with an acceptance mean value of ≥3.00 and estimating logit model. Socio demographic features revealed that majority (52%) were in middle age group of 41-50 years, 64% were literate, while 68% respondents had farming as their income source and land owners were 64% with small landholding (46%). The study exposed that illiteracy of the respondents (4.10), *et al* system (3.98), lack of trained machinery operators (4.27), access of roads to the farm (4.45), adequate capital (4.00) and costly inputs (3.80) were some of the challenges plaguing the use of agricultural mechanization in the rural area. It was established that agricultural mechanization has significant role in boosting farm productivity, improving farmers' livelihood, ensuring economic growth, availability of off-seasonal farm produce, increasing income generating opportunities and reduction in time of operation among others. Logistic Regression indicated a highly significant ($p<0.01$) positive effect of key determinants including; income source (0.008), farm size (0.001), farming experience (0.004), extension visits (0.009), access to credit (0.002) and access to agricultural machines (0.006) on farm mechanization adoption. The study emphasized that government may make agricultural mechanization and farming resources available and reachable to the farmers in order to persuade farmers in using them to maximize production, arrange awareness trainings and subsidize costly agricultural inputs.

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Introduction

Agriculture is a fundamental part of Pakistan's economy contributing 18.5% to gross domestic product (GDP), providing employment opportunities to almost 38.5% population and providing raw material for different agro based industries (GoP, 2019). It is therefore, considered as a backbone in overall national development, food security and poverty reduction. Majority of the population i.e. 67% belongs to rural areas, and their livelihood directly or indirectly depends on agriculture (Sanaullah and

Pervaiz, 2019). It facilitates markets for industrial products like fertilizers, pesticides, tractors and other agricultural implements (GoP, 2019).

Mechanized farming is practiced and getting popularized around the world (McCauley, 2003), with the advent of technologies when the first steam tractor was manufactured in California, USA during the late nineties (Meij, 1960). Mechanized agriculture has been through difficult stages in less developed part of the world (Paman, 2016) but due to industrialization, many unprivileged countries have inclined towards technological agriculture (McCauley, 2003). Farm mechanization applies engineering and technology in farming situations in order to boost field productivity (Rahman and Lawal, 2003; Asoegwu and Asoegwu, 2007; Khalequzzaman and Karim, 2007; Akande, 2009; Gebiso, 2016). This encompasses the application and management of all mechanical procedures for field production, storing and processing (Sampath, 2014). Human, animal and mechanical elements are the three major power sources operating farm mechanization (Kic and Zewdie, 2013) in which mechanical power substitutes human and animal power (Saegusa, 1975). The efficient supply of mechanization inputs includes; manufacturing, distribution, repair, maintenance, management and utilization of agricultural tools and implements for effective field activities (Zangeneh and Banaeian, 2014).

Agricultural mechanization is the process whereby equipment, implements and machineries are utilized by farmers to increase food and agricultural production in order to solve drudgery problem in production (Folaranmi, 2014). Technological advancement is one of the important input coefficients that contributes more to the incremental production (Chidambaram, 2013). Agricultural mechanization is described as a major agricultural input where modern and technological power is introduced into real field operations increasing land and human labour productivity (Igbeka, 1984; Republic of Kenya, 2015). Reid (2011) noted that farm mechanization is one of the factors that has a significant effect on farming since the beginning of modern agriculture. The employment of machines has been one of the greatest improvements in the field of agriculture (Yohanna, 2004). The increased use of mechanical energy, modern equipment and apparatus are ought to be recognized to boost agricultural production (Kepner *et al*., 1978; Ayoade and Adetunbi, 2013). It is no secret that majority of agricultural production in developing countries come from small-scale farmers who heavily depend on manual tools as opposed to mechanical tools. Hence, in developing countries, to stabilize the economy, consideration for small farmers should be made as they are in the majority (Hoki *et al*., 1992; Yohanna, 2004).

Increased field research, effective extension efforts and outreach activities are needed to boost agricultural productivity of the rural community (Sanaullah *et al*., 2020a). Agricultural development includes three approaches namely; bio-chemical, socio-economic, and engineering known as the trio of technologies (Mrema and Odigboh, 1993). In this triangle, the engineering approach is concerned with the provision of agricultural machines and equipment for field production and post-harvest systems for optimizing an economic growth and development (Ani and Onwualu, 2002; Ampratwum *et al*., 2004; Onwualu and Pawa, 2004).

Purpose of the study

The basic aim of the study was to scrutinize the challenges and prospects of rural farmers about the use of agricultural mechanization in rural area of district Peshawar. Specifically, the study seeks to:

- Identify farming operation stages where agricultural mechanization is being used.
- Determine the benefits on the use of agricultural mechanization by rural farmers.
- Determine the challenges plaguing agricultural mechanization in the rural area.
- Explore determinants affecting adoption of farm mechanization.

Research hypotheses

H_0: There is no significant effect of agricultural mechanization on agricultural productivity

H_0: There is no significant influence of different challenges on farm mechanization

Materials and Methods

Study locale

District Peshawar of Khyber Pakhtunkhwa was selected as study site for this research study. This region was chosen as there is substantial number of smallholder rural farmers who largely depend on agriculture as means of their livelihood.

Sampling design

Multistage sampling procedure was adopted to select the target respondents in the study area (Sanaullah *et al*., 2020a). At first stage, Town 2 and Town 4 were selected purposively from district Peshawar due to rural farmers in the area. At stage two, Lala and Mera Kachori Union councils (UCs) were selected randomly from Town 2 and Town 4, respectively. At stage third, out of the total twelve villages, two villages namely Tarnab and Lala Kaly were selected from UC Lala and village Jhagra Kaly was selected out of the total seven villages from Mera Kachori union council. In the final stage, 80 rural farmers were randomly selected through 40% sample selection procedure from each of the three chosen villages (each village population was almost 200), thus becoming the total sample size of 240 respondents.

Research instrument and data analysis

The prevailing study encompassed both primary and secondary data. A pre-defined interview schedule was used to gather cross sectional data (Sanaullah *et al*., 2020b). Efforts were made to keep it simple and understandable. The interview schedule contained both open-ended and closed ended questions to collect relevant desired information (Wingenbach *et al*., 2003; Sanaullah and Pervaiz, 2019). The collected data were analysed using Mean and Standard Deviation with an acceptance mean value of ≥3.00 and Logistic Regression using SPSS and Stata v. 12 soft wares.

Logit model

In this present study, logit model was used to identify the adoption behaviour of sampled respondents. The logit model that is constructed on logistic probability was estimated to investigate the adoption tendency of sampled respondents regarding agricultural mechanization. Logistic regression is more convenient to be applied as compared to other models due to its mathematical simplicity and easily assessing the adoption projection process (Adeogun *et al*., 2008). Theoretically, the estimated model applied to indicate elements inducing adoption of farm mechanization is described as:

$$L = \ln {}^{P_i}/_{(1-P_i)} + b_o + \sum b_j X_{ji} + U_i \quad \ldots (1)$$

Where;

L is a logit model, the (P_i/1- P_i) is the ratio of probability to adopt to the ratio of probability to not adopt the farm mechanization. The dependent variable is the farmer's adoption decision. The general model of adoption is:

$$P_i = f(B_0 + B_1X_1 + B_2X_2 + B_3X_3 + B_4X_4 + B_5X_5 + B_6X_6 + B_7X_7 + B_8X_8 + B_9X_9 + U_i) \quad \ldots (2)$$

The variables definition and measurement is shown below.

Dependent variable

Yi = Adoption of farmer (1 for adoption, 0 for no adoption)

Independent variables

X_1= Age of the farmer (year); X_2= Education; X_3= Income source; X_4= Farm size (acre); X_5= Tenancy; X_6= Farming experience (year); X_7= Extension visits (1=yes, 0=otherwise); X_8= Access to credit (1=yes, 0= otherwise); X_9= Access to machines (1=yes, 0= otherwise); Ui= Error term.

Results and Discussion

Socio-economic information

Socio-economic attributes put impact on other features that's why this information is greatly needed (Ekanem *et al*., 2006; Agwu *et al*., 2008; Saadi *et al*., 2008; Jensen *et al*., 2009). Age, education, income source, tenancy, landholding and farming experience are presented in Table 1. Concerning age, Table 1 shows that majority (47%) respondents were recorded with age range of 41-50 years, 26% respondents were in the age category of 31-40 years, 16% respondents were recorded in old age category of 51 years and only 11% respondents were observed in the category of up to 30 years of age. Age is one the prominent demographic factors estimating a prediction while studying rural social sciences (Sanaullah and Pervaiz, 2019). Young people have high adoption rate to new innovations and extreme potential of decision making, especially in understanding and communication (Rogers, 2003). These results are close to that of Oladosu and Okunade (2006) where they reported that majority of the respondents belonged to middle category of age range that is 36-50 years in their study. In contrast, Sanaullah *et al*. (2020a) recorded in their study that majority i.e. 31% respondents were young having age range of 25-35 years.

Education is one of the key factors regarding agricultural knowledge, proper training, dissemination of agricultural information, recommended farming

practices, adoption of new and improved modern technologies (Anandajayasekeram, 2008; Aziz *et al.*, 2018; Sanaullah and Pervaiz, 2019). Regarding education, Table 2 depicts that 64% respondents were found literate and 36% respondents were recorded illiterate. Study findings are somehow close to out puts of Khan *et al.* (2009) with 83% literacy level, while in exact contrast to that of Sanaullah and Pervaiz (2019) where 64% farmers interviewed were illiterate.

Table 1: *Socio-economic characteristics.*

Particulars	Category	Frequency	Percentage
Age	Up to 30	28	12
	31-40	53	22
	41-50	124	52
	51 and above	35	14
	Total	240	100
Education	Illiterate	87	36
	Primary	60	25
	Middle	49	20
	Matric	30	13
	Intermediate and above	14	6
	Total	240	100
Income source	Farming	165	68
	Business	18	8
	Govt. servant	13	5
	Private jobs	20	9
	Labor	24	10
	Total	240	100
Tenancy	Owner	155	64
	Tenant	47	20
	Owner-cum-tenant	38	16
	Total	240	100
Landholding	Up to 3 acre	110	46
	3.1-6 acre	78	32
	6.1-9 acre	31	13
	9.1 and above acre	21	9
	Total	240	100
Farming experience	Up to 10 years	78	33
	11-20 years	65	27
	More than 20 years	97	40
	Total	240	100

Source: *Field survey, 2019.*

Rural people mostly depend on farming as their livelihood source; in addition they also search other means of living as well (IFAD, 2002). The rural community engages in farming and pay attention to their fields to maximize production (Sanaullah *et al.*, 2020a). Data in Table 2 display that 68% of the respondents got income from farming, own business (8%), government employees (5%), private jobs (9%), while only 10% of the respondents were observed as labours. The results are in correspondence with Ali (2015) where 76% had agriculture as their earning source. Verma *et al.* (2016) quoted agriculture as main occupation of people in their research area.

Table 2: *Mean and standard deviation responses of rural farmers on various farm operation stages where mechanization is used.*

S. No	Particulars	WM	SD	Decision
1	Tillage operation	3.05	0.65	Agreed
2	Harrowing operation	4.00	0.66	Agreed
3	Planting activities	3.44	1.36	Agreed
4	Weeding	3.70	1.20	Agreed
5	Ridging	3.08	0.62	Agreed
6	Fertilizer application	3.32	1.22	Agreed
7	Harvesting	3.66	0.14	Agreed
8	Transportation	3.88	0.24	Agreed
9	Processing	3.48	1.00	Agreed
10	Storage	3.00	0.97	Agreed
Grand Mean and SD		3.49	0.80	

Source: *Field survey, 2019; WM: weighted mean; SD: Standard Deviation.*

In Pakistan, land tenure system is comprised of three kinds (Khan *et al.*, 2019). Large landholding farmers cultivate their own land, while small peasant farmers take land on tenant to meet their food requirements (Sanaullah and Pervaiz, 2019). Table 1 reveals that majority (64%) of rural farmers were owners, tenant (20%) and owner-cum-tenant (16%). Study outputs are in agreement with that of Aziz *et al.* (2018) where 70% farmers cultivated their own land, as owner cultivators are more inclined and motivated towards active agricultural activities (Sanaullah and Pervaiz, 2019).

The larger the land allocated to crops, the higher will be the probability to adopt innovative technologies and gain more yield (Chaudhary, 2006; Belay *et al.*, 2012; Sanaullah and Pervaiz, 2019). Data concerning landholding in Table 1 reveal that 46% farmers had up to 3 acres land, followed by 3.1-6 acre (32%), 6.1-9 acre (13%), while 9.1 and above acre (9%) in the study area. Study findings are in agreement with Ali *et al.* (2016) and Sanaullah *et al.* (2020a) where maximum number of the famers had less than 5 acres of land for

agricultural activities.

Farming experience is recognized as the time duration calculated in years that a person devotes to farming (Sanaullah *et al*., 2020a). Experience plays a prominent role in persuading adoption of technological modernizations (Agwu *et al*., 2008). A farmer may become un-attracted towards getting modern knowledge with the passage of time (Jensen *et al*., 2009), while on the other hand, a farmer may become more willing to accept innovations through getting experience in life (Sanaullah *et al*., 2020a). Data depicted in Table 2 revealed that more than 20 years of farming experience was gained by 40% sampled respondents, followed by up to 10 years of experience (27%) as supported by Sanaullah and Pervaiz (2019) who reported that 26% farmers were noted having obtained field experience of up to 10 years. The remaining 33% respondents were noted having 11-20 years of farming experience as agreed by Chuks (2014).

Farm mechanization used at various stages

Agricultural mechanization is the application of machines in the production process in agriculture ranging from land clearing, tilling, planting, harvesting among others, to maximize productivity, reduce time at work and meet up with food demand of the society (Amadi and Ekezie, 2016). Agricultural mechanization is of different types including the hand tools technology, manual work, animal drought technology, electrical power and renewable energy machine (Maharjan and Cheltri, 2006). These various powers are being used in different regions depending on the choice of the farmer, availability of sources, availability of farm power and the farm operation the farmer wants to carry out (Lohan *et al*., 2015). The basic importance of the use of these implements is to maximize productivity thereby increasing the input to farming activities hence intensifying productivity in the agricultural sector and meeting the high demand of agricultural products (Igbeka, 1984; Clarke, 2000).

The data for modern technology adopted in various farming type are presented in Table 2. Findings in Table 2 revealed that respondents agreed that tilling operation (3.05), harrowing operation (4.00), planting activities (3.44), weeding (3.70), Ridging (3.08) fertilizer application (3.32), harvesting (3.66), transportation (3.88), processing (3.48) and storage (3.00) respectively are various farm operation stages where agricultural mechanization can be used in the farming process. This study is complimented by Folaranmi (2014) and Rijk (2016) who noted that in this modern world of technology, there are machines which are used for various farm operations such as land clearing, planting and weeding, harvesting, processing, storage among others. These operations have different implements which are used to execute them at various levels which according to Rijk (2016) help in intensifying productivity in the agriculture sector and meeting the high demand of agricultural products (Bakht *et al*., 2008).

Benefits from modern farm mechanization

Farm mechanization is a striking constituent of technological transformation in unprivileged countries of the world (Kolawale, 1974; Donovan *et al*., 1986; Yohanna *et al*., 2011). Agricultural innovation is an integral part contributing to increased farm production (Chamsing and Singh, 2000; Ghosh, 2010; Sims and Kienzle, 2017). Current farming system is profoundly reliant on field mechanization, where tools, power sources and associated controlling processes are applied in the production of food and non-food items (Leiva and Morris, 2001). Agricultural mechanization provides base for the development of many other aboriginal industries (Sakai, 2013). Farm mechanization is one of the many contributing efforts boosting field productivity and income (Bell and Johnson, 1986). Hence, the mechanization plays an indispensable role in agriculture (Vatsa and Saraswat, 2008) and has significant impact on economic growth as well as human development (Self and Grabowski, 2007).

Table 3 revealed that respondents agreed that; ensuring increased productivity (3.67), ensuring food security (3.44), reduce timeliness of operation (3.51), availability of off-seasonal farm produce (3.86), ensuring economic growth (4.30), improving farmers' livelihood (4.45), eliminating drudgery (3.00) and increasing income generating opportunities (3.58) were some of the benefits that farmers got as a result of their use of agricultural mechanization in the farming operations. Faborode (2001), Tiwari *et al*. (2012), Lamidi and Akande (2013), Lawal (2013) and Mbanasor and Onwusiribe (2014), stressed that agricultural mechanization is beneficial in that it boosts increase in food production, reduces drudgery, improves timeless and precision operation, increases sustainable development of food system

resulting in improved income, ensures increase in productivity among other numerous benefits. It means when farmers resolve to the use of agricultural mechanization in the agricultural sector, there will be massive production of goods that will meet the food demand of consumers in the market and even in the long run, storage and preservation of farm produce is ensured as there are sophisticated farm implement used for the preservation of food to avoid spoilage and wastage. Farm mechanization improves product quality, decreasing labour hard work, generating smart jobs and increasing agricultural income (Sims and Kienzle, 2006; FAO, 2008; Mehta and Pajnoo, 2013).

Table 3: *Mean and standard deviation responses of rural farmers on the benefits of the uses of farm mechanization.*

S. No	Particulars	WM	SD	Decision
1	Ensuring increased productivity	3.67	0.99	Agreed
2	Ensuring food security	3.44	0.67	Agreed
3	Reduces timeliness of operation	3.51	0.64	Agreed
4	Availability of off-seasonal farm produce	3.86	1.00	Agreed
5	Ensuring economic growth	4.30	1.78	Agreed
6	Improving farmers' livelihood	4.45	0.90	Agreed
7	Eliminating drudgery	3.00	1.10	Agreed
8	Increasing income generating opportunities	3.58	0.72	Agreed
Grand Mean and SD		3.72	0.97	

Source: *Field survey, 2019; WM: weighted mean; SD: Standard Deviation.*

Challenges faced by rural farmers

Despite these benefits recorded by researchers, the fact is that majority of the farmers have not really key into this system or techniques as majority are subsistence farmers who cultivate about less land usually scattered over a wide range area and due to financial constraints. FAO (2009) noted that most farmers tend not to welcome the idea of the use of machine in farming which may be attributed to some challenges affecting them in farming including affordability, availability, and lack of maintenance and repair service. El-Hossary (1988) stressed that fragmentation of land, drainages and narrow access roads to farm pose a serious restriction to the use of mechanization. According to Rijk (2016), most farmers raised issues that mechanization has replaced labour thereby putting some farmers out of work, high capital is required for mechanized farming, agricultural mechanization is a male-dominated technology, farm areas are in fragment therefore cannot encourage the use of machine among others. Lamidi and Akande (2013) noted that land tenure system and access to capital have a major setback to the use of mechanization by farmers in Nigeria. Onyema (2010) and Odigboh (2000) reported that despite the heavy benefits in mechanization techniques, Nigeria farmers has access to only less than 1% of this conventional power, due to land tenure system, scarcity of machinery, illiteracy of the farmers, lack of maintenance technicians, inconsistent government policies, poor infrastructure, poverty and inaccessibility to credit, shortage of spare parts, prevailing agronomic practices and lack of trained machinery operators.

Table 4 revealed that rural farmers agreed that; *et al* system (3.98), illiteracy of the respondents (4.10), lack of capital (4.00), costly inputs (3.80), scarcity of machinery (3.04), lack of trained machinery operators (4.27), lack of access road to the farm (4.45), lack of maintenance and repairs (3.90) and poor extension activities (3.68) were some of the challenges bedevilling agricultural mechanization in the study area. This study is agreed by El-Hossary (1988), Odigboh (2000), FAO (2009), Onyema (2010), Lamidi and Akande (2013), Chidambaram (2013) and Rijk (2016) who affirmed that, lack of maintenance and repairs, fragmentation, high capital requirement, land tenure system, lack of agricultural machinery, higher cost of machinery and illiteracy of the farmers among other factors are some of the challenges bedevilling agricultural mechanization in rural areas. Manju (2004) reported that poor financial condition (92%), inadequate repair and maintenance facility (90%), lack of risk bearing capacity (90%), lack of motivation and cooperation (60%), are some of the major restraints in the adoption of advanced machinery. Similarly, lack of latest agricultural knowledge and costly inputs are the main limitations in the adoption of improved farming practices (Sanaullah *et al*., 2020a). Lohan *et al*. (2000) reported that 35% of the farmers regard capital as the major constraint in farm mechanization.

Modern farming versus traditional farming

Aurangazeb and Khan (2007) had studied the causes and effects of mechanization in Pakistan by classifying the farms as traditional and mechanized. Mechanized farms are those where the farmers generally use agricultural machinery and do not use the traditional methods of cultivation or use it but very rarely. Traditional farms are those where the farmers

do not use machinery often or use it but sparsely (Rahman, 2011). Priyanto (1997) and Munack and Speckmann (2001) stated that modern farming is that farming which is market oriented and efficiently utilizing production inputs like seed, fertilizer and machinery etc. to attain more production. The introduction and use of scientific innovation and mechanization is what can modernize traditional farming (Ahmed, 2013). Feeble old farming technology can have several unwanted impacts on overall productivity. Productivity is usually low in developing countries because farmers usually use traditional means when cultivating their farms (Sanaullah *et al*., 2020a). Hence, if we continue to use traditional farming practices and means and don't follow and adopt new technologies, our food production will remain inactive and laidback. Technology is closely related to land in that land is scarce and can't be produced. This is another reason of less agricultural output (Masood *et al*., 2012).

Table 4: *Mean and standard deviation responses of rural farmers on the challenges bedevilling agricultural mechanization in the rural areas.*

S. No	Particulars	WM	SD	Decision
1	*Et al* system	3.98	0.36	Agreed
2	Illiteracy of the respondents	4.10	1.54	Agreed
3	Lack of capital	4.00	1.30	Agreed
4	Costly inputs	3.80	0.90	Agreed
5	Scarcity of machinery	3.04	0.40	Agreed
6	Lack of trained machinery operators	4.27	1.50	Agreed
7	Lack of access road to the farm	4.45	0.40	Agreed
8	Lack of maintenance and repair	3.90	1.42	Agreed
9	Poor extension activities	3.68	0.72	Agreed
Grand Mean and SD		3.91	0.94	

Source: *Field survey, 2019; WM: weighted mean; SD: Standard Deviation.*

Figure 1 illustrates frequency distributing of sampled respondents regarding their way of farming. The study outputs indicate that more than half (56%) of the respondents used to apply modern agricultural tools in their farming operations as compared to 44% of the respondents who used traditional modern practices in their fields. The pie chart shows positive transitional behaviour of the respondents towards the adoption of modern mechanized farming. It is due to the reason that the study area is near to two important agricultural research stations: Agricultural Research Institute Tarnab and Nuclear Institute for Food and Agriculture (NIFA). But the reason behind not using of modern farming technologies by all the respondents is that mostly small rural farmers cannot afford the expensive modern technology (Lohan *et al*., 2000; Manju, 2004), they are mostly tenant (Lamidi and Akande, 2013) who cannot take risk of buying modern expensive tools and majority are unaware of the modern farming technologies and practices (Rijk, 2016). Rural farmers are mostly unaware of the importance of improved technologies and mechanized farming practices which affects farm productivity (Sanaullah *et al*., 2020a).

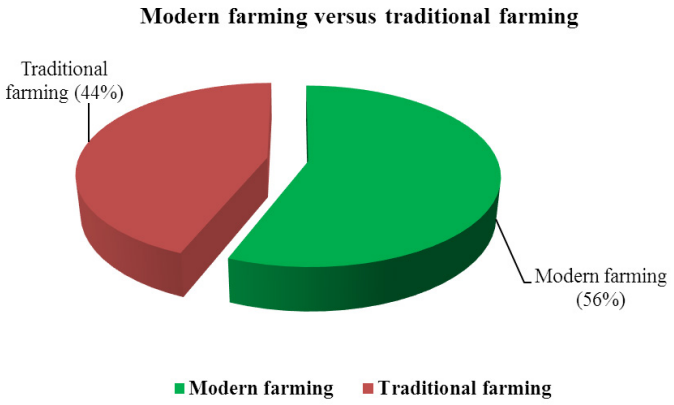

Figure 1: *Classification regarding modern and traditional farming.*

Table 5: *Regression coefficients for the determinants of adoption of farm mechanization.*

Variables	Coefficient	Std. Error	Z values	P-values
Age	0.016	0.012	0.50	0.516
Education	0.032	0.041	0.03	0.881
Income source	2.120	0.015	3.75	0.008***
Farm size	1.546	0.002	2.58	0.001***
Tenancy	-3.890	0.009	-2.78	0.011***
Farming experience	0.856	0.005	3.82	0.004***
Extension visits	2.010	0.015	2.97	0.009***
Access to credit	2.113	2.328	0.90	0.002***
Access to machines	0.619	0.003	3.50	0.006***
Constant	-18.934	5.753	-3.21	0.001

**** indicates significance level at 1% probability; Log likelihood = -13.967532; LR chi² = 186.58 illustrates goodness of fit for the model; Probability > chi= 0.000 reveals significance level; Pseudo R²= 0.8552 depicts variation in data.*

Regression model for the adoption of farm mechanization

Logistic regression was constructed and applied in order to identify the impact of different tested variables on the adoption of farm mechanization (Luo and

Escalante, 2015). The tested results were depicted in Table 5 where six out of nine variables that are; income source, farm size, farming experience, extension visits, access to credit, and access to machines were found having statistically high significant positive influence on farm mechanization adoption. Tenancy had negative significant effect, while age and education were statistically tested non-significant. The LR figure reveals goodness of fit of the model; Z and P values indicate significance status, while each coefficient is a partial slope which expresses variation in logit because of the variation in independent variable.

Table 5 reveals that income source had highly significant positive effect on adoption, means that one-unit increase in earnings from farming, the logit in favour of farm mechanization adoption will rise by 2.120 units. Farm size was highly significant, indicating that increase in farm size by one acre increases the probability of adoption by 1.546 units. Large landholders have more financial resources and are financially stronger than small landholders which enable them purchase and use improved costly technologies (Ghosh, 2010). Farming experience was recorded having highly significant effect on farm mechanization adoption; it means that one-year increase in farming experience would increase the adoption probability by 0.856 units. These results are concord with that of Mihiretu (2008) who stated that farming experience has a significant effect on advanced technologies adoption. Extension visit was significant and positive, a unit increase in the access to extension visits increases the log odds of impact on adoption of mechanization by 2.010 units. This infers that frequent extension visits would persuade the rural farmers to adopt innovations (Kidane, 2001; Abrhaley, 2007; Nhemachena and Hassan, 2007; Ghosh, 2010; Krishna, 2014; Sanaullah *et al*., 2020a). Similarly, access to credit was noted having highly significant positive impact on adoption behaviour, means that a unit increase in access to credit increases the likelihood of adoption by 2.113 units as agreed by Ghosh (2010). The access to machines by farmers was significant and positive, a unit increase in the access to machines increases the log odds of impact on adoption of mechanization by 0.619 units. The more the access to agricultural tools and technologies, the higher would be the tendency towards mechanization adoption (Krishna, 2014). Tenancy was negatively significant exploring that increasing chance of a farmer towards tenant condition; the probability of adoption will decrease. Tenant farmers cannot take risk of buying modern costly inputs which impedes their probability of adoption. Age and education were found to have non-significant influence on farm mechanization adoption. Dereje (2006), Rahmeto (2007) and Krishna (2014) also affirmed the non-significant association of age with adoption of innovations. Garforth (1993) supported our results stating that education had non-significant impact on likelihood of the farmers to adopt modern technologies; however, other researchers like Mahdi (2005), Taha (2007), Addis (2007) and Krishna (2014) opposed the findings quoting that education has significant impact on adoption of technology.

Conclusions and Recommendations

It has been reported that majority of the small scale farmers in the country are unable to afford basic production technologies and costly agricultural inputs due to poverty and limited access to credit resulting in low crop yields. Technology transfer plays a dynamic role in agricultural development. Transformation requires that rural farmers should be persuaded to adopt and be willing for the change. They need to be prepared mentally and physically with the constant effort of the government and other line agencies like extension. Most farmers are aware of and know about modern farming technologies but due to certain reasons cannot adopt and apply them in their fields. It was concluded that agricultural mechanization can be used by rural farmers to perform various farm operations ranging from tilling, planting, harvesting, and storage among other operations. It was also deduced that there are many advantages that are obtained from the application of agricultural mechanization in that it ensures increased productivity, reduces time spent in the farm, preserve the quality of production and increasing income generating opportunities. Furthermore, the study also established that agricultural mechanization is not widely practiced in rural areas of district Peshawar which is attributed to land tenure system, scarcity of implements, lack of capital to hire machines, lack of trained machinery operators and access to extension services are the main challenging factors that make farmers in the study area not to be using agricultural mechanization in their farming process. The study strongly confirms the positive effects of income source, farm size, farming experience, extension visits, access to credit and machineries on the adoption of modern farm

mechanization. The situation demands construction of innovative institutions like co-operatives and self-help groups for providing better financial support to the small and marginal farmers supporting them in modernizing their field operations so as to achieve more advantages from technological development in the agricultural sector. The government should take a palliative measure as to make agricultural machineries available and affordable to rural farmers. There should be a well-organized workshop for farmers where they should be trained on how to operate different farm implements at various stages of farm operations. This will help to encourage rural farmers on adopting agricultural mechanization as a modern technique in boosting productivity.

Novelty Statement

Farm mechanization has significant contribution in agricultural devel-opment, but rural farmers face several technological problems that's why the current study investigated farmers' perception regarding use and challenges of mechanized technologies in their farming systems.

Author's Contribution

Sanaullah: Designed and conducted the research, analyzed the data and wrote first draft of the manuscript.
Abdul Basit: Helped in data collection, statistical analysis and write up.
Inayat Ullah: Helped in data feeding and incorporated references.

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

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