IMPACT OF AGRICULTURAL MECHANIZATION DEVELOPMENT PROJECT ON YIELD OF MAJOR CROPS IN PUNJAB, PAKISTAN

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Muhammad Nadeem Ashraf

Declaration

I, **Muhammad Nadeem Ashraf**, a student of MS (Project Management), SPA at University of Management Technology, Lahore, solemnly declare that research work on the title **"Impact of Agricultural Mechanization Development Project on the Yield of Major Crops in Punjab, Pakistan"** is purely self-effort, except references which are quoted from the review of literature. I have cited proper references from journals, books, handouts and unpublished manuscripts. I am conscious of the fact that stating someone else research work in my research without quoting reference is illegal and is considered plagiarism. I declare that if it is found plagiarism beyond the limit specified by competent authority, my thesis may be rejected.

Lahore, December, 2018

Muhammad Nadeem Ashraf

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Abstract

Pakistan is an agriculture based economy. The agriculture precinct plays a pivotal part in the development of economy and core source to boost the economic growth of Pakistan. Despite its importance, per acre yield of agricultural crops is very low as compared to global bench mark. Majority of the farmers are small with land holding less than 5 hectares which is just a subsistence level farming actually. The shifting of farmers from subsistence to commercial level farming can only be accomplished through diffusion of modern, efficient and cost effectual technology in the farming system. Government of the Punjab has formulated a policy that focuses on the improvement of rustic community which is mainly reliant on agriculture. In this perspective "Agriculture Mechanization Development project" was implemented in all districts of Punjab to support the small and marginal farmers by provision of agricultural implements on 50 percent subsidized rates.

The current study was conducted for the impact assessment of farm implements given to the farmers in the mechanization project. The Punjab province was divided in three zones on the basis of agro-climatic conditions i.e. upper Punjab (rain fed areas) central Punjab (mixed cropping areas) and southern Punjab (wheat and cotton areas). Total of six districts, comprising of maximum beneficiaries were selected (two from each zone). Face to face structured interviews were conducted to get primary data from project beneficiaries (n=210). Paired t-test and regression analysis were applied for comparative analysis of major crops' yield prior to and after the mechanization scheme.

The data depicted that 87.67% respondents were satisfied form the scheme. Analysis showed that farming practices of the respondents were improved by timelines of farm operations and improved efficiency by the use of implements provided in the scheme which ultimately increased the farm production. The use of agricultural implements had also helped the farmers to overcome their labor constraints at peak seasons. The results of the study revealed that there was a significant increase on the yield of all major crops which means the agricultural mechanization development project had a positive impact on the yield of all crops being cultivated in Punjab province. The mean increase in yield of sugarcane crop was found maximum i.e. 30.769 mounds per acre, followed by maize 4.056 mounds and cotton 3.014 mounds per acre. Whereas mean increase in wheat and rice crops' yield were 2.181 mounds and 2.026 mounds per acre respectively.

It is suggested that agricultural mechanization and such other programs can be considered as efficient tool to fight against poverty, improve socio-economic level and income creating activities among rural communities. By considering the existing paradoxical economic position of the country as well as internal and external confronts, reliance on agriculture sector will further augment to advance the pace of national development. Therefore instant action is required to accelerate productivity and profitability of this segment both in horizontal and vertical ways. There is dire need of mapping of crop zones specific technologies in the province along with development of indigenous low cost agricultural machines, bringing research &development institutes under one umbrella by strengthening research linkages and encouraging reverse engineering of imported machines to enhance

poor farmers' access to the technology. Govt. of Punjab should chalk out comprehensive agricultural mechanization policy to ensure crop specific technology that should be technically feasible, economically viable and socially acceptable to promote its sustainability for the farming community of the province.

Key Words: Agricultural Mechanization, Development Project, Yield of Major Crops, Farm Implements

Chapter 1. INTRODUCTION

Agriculture – the jugular vein of the economy of Pakistan in general and Punjab in particular – needs particular treatment in terms of public policy reforms and long term strategies for overall rural development on sustainable basis. We have been confronting a dilemma situation in agriculture. On one hand, productivity of all major crops including fruits and vegetables is not increasing substantially at least at the level of matching to the rising population whereas on the other hand, our pace of productivity is substantially slower than that of rest of the world. The first and second parts of this chapter deal the scenario of agriculture and current status of mechanization in Pakistan, whereas implementation of mechanization development project has been discussed in the third part. Fourth and fifth parts present problem statement, research questions and research objectives, whereas significance of this study has been conversed in the last part.

1.1 Background

Agriculture sector plays a vital role in the economy of Pakistan. Agriculture contributes 19% with an annual growth of 3.81% in its GDP. Agriculture offers employment opportunities to 42.3% of the labor force and 62% of the rural population depends on this sector for their livelihood. Pakistan earns two third of its foreign exchange primarily by the export of agricultural products (Govt. of

Pakistan)**.** Agriculture is an imperative sector in which our means of life and business creativeness intermingle with each other. There are multiple functions in the economy of any nation and these functions include food security, poverty diminution, industrial uprising and financial escalation particularly in developing countries.

The importance of agriculture can be distinguished in economic field from three aspects; first, it supplies food to the nation; second, it is a mode to receive foreign exchange by exporting agricultural products; and third, it provides goods and services to indigenous industry and international market.

Population of Pakistan has increased more than 5 times, since its independence, whereas yield of wheat crop which is consumed as a staple food in Pakistan has increased only 3 times. Therefore, concrete efforts are required to be adopted to fulfill this gap between food demand and supply with a view to make sure self-sufficiency in food security in the country (Amjad, 2014)**.**

The agriculture of Pakistan is dominated by small land property due to elevated population density and about two third of its population is residing in rustic areas. The prevailing land fragmentation in the country is due to laws of inheritance. However, Agriculture sector has initiated its journey towards commercialization in the recent past but this segment has not so far become entirely self-supportive. The farming community in Pakistan is deficient in technical knowledge and is not appropriately prepared to tackle the modern agriculture and WTO scenario. Moreover, urbanization is decreasing the current area under agriculture. It has been

estimated that the farming area has been decreased by 0.23 million hectares in one decade from 2002-03 to 20012-13 in Pakistan (Govt. of Pakistan).

Similarly, the statistics of World View have also depicted the scarcity of farm land in future. It shows that there was one acre per person in 1960 whereas it will be less than one third of Acre per person in 2050 (The World Bank, FAO-Stat.).

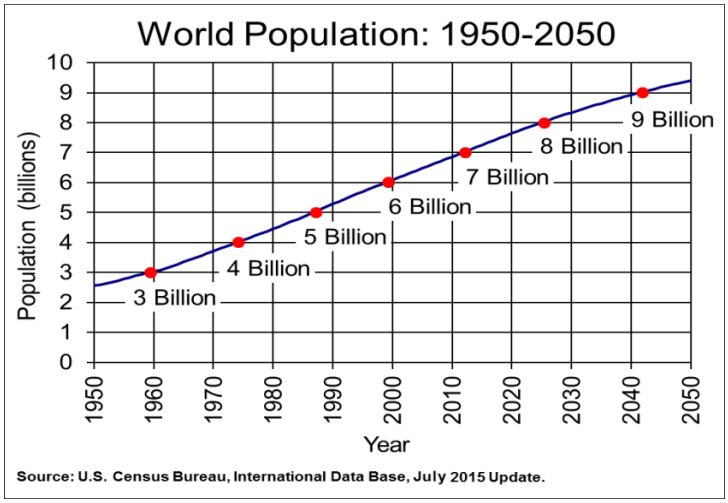


Figure 1.1 Comparison of cultivated land against world population

The contribution of main crops namely wheat, rice, cotton, sugarcane and maize in GDP of Pakistan is 7%. Currently Pakistan is the fourth major cotton producing country and ninth major wheat generating country in the world. However, agri. production in Pakistan is much lesser than other countries in the world. Sugarcane yield is 40% lesser, wheat & cotton yield is 20% lesser, rice is 40% lesser and milk production per animal is 90% lesser than the global benchmark (FAO, 2004; Govt. of Punjab 2011; GoP, 2013).

The agriculture of Pakistan also bears about 40-80% post-harvest losses. The shortage of capital, small farm holdings and fragmented land due to land tenure system, poor road and infrastructural facilities and stumpy attitude toward innovations are problems for non-adoption of agricultural mechanization in developing countries (IFPRI, 2010; Lamidi & Akande, 2013)

Agricultural productivity is affected by a many factors such as mechanical, biological, hydrological and chemical factors. General techniques to enhance production are expansion in farm area, use of quality inputs, cultivation of improved varieties and use of advanced farm implements. Agricultural production is dominated by crop production namely wheat, rice, sugarcane, cotton and maize in Pakistan. The busiest period of farming community is between April-June and Oct-Nov each year, when harvesting season of main crops overlaps with seed bed preparation for the subsequently crop. During this period the power and labour scarcity is felt most severely. In Pakistan, farmers carry on practice basically the same farming techniques with slight improvements in its technical and management sides (Amjad, 2014).

Several Agriculture scholars have concluded that the problem of less productivity could principally be associated with less technical efficiency. Production can be improved with better land preparation, in time completion of farm operations and use of seed drills.

In future, it is expected a broad gap between food requirements and its supplies. This gap can be abridged by improving production techniques with the help of

suitable farm machinery, introducing of new crop varieties, exploring potential irrigation methods, innovative sowing techniques and application of fertilizers by applying a mixture of FYM and inorganic fertilizers (Mehdi, 2011).

It has been estimated that one day delay in the cultivation of wheat after mid-November in Punjab, decreases net production by one mound per acre per day. The post-harvest losses in Agriculture are 20% because of their perish-ability, low shelf life, lack of cold storage facilities and transportation safety measures.

1.2 Agricultural Mechanization in Pakistan

Pakistan is one of those developing countries where agricultural mechanization has recently undergone speedy development. Medium and large scale farmers, who own tractors, majorly use machinery for farm operation and practices.

Unfortunately, agricultural productivity in Pakistan is very lower as compared to other neighboring countries. One reason of less agricultural productivity is deficient in use of farm mechanization. Agricultural mechanization means the use of machinery in various farming operations and practices such as sowing of crops, harvesting and threshing of crops; land leveling, applying watering and spraying to crops, removing of weeds and similar other agricultural operations. In fact, agricultural mechanization is considered as a combination of technology to ensure in time farm operations (Iqbal et al., 2015)

The farm power used in Pakistan and its neighboring countries is given as under:

Table 1.1 Horsepower used per hectare

Japan	7.00 hp per hectare
China	3.88 hp per hectare
India	2.50 hp per hectare
Pakistan	1.50 hp per hectare

(Aamir et al. 2015)

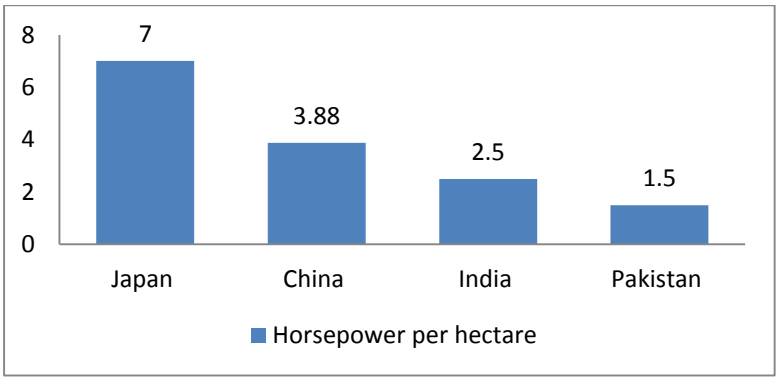


Figure 1.2 Horsepower used per hectare

Developing countries like Pakistan try hard to augment their agricultural production, where agricultural mechanization has been playing a vital part. Basically mechanization is a labor reduction technology that often enables to expand their farms where land is available as well as free up labor for other agricultural practices or other off-farm income generating activities.

Mechanized agriculture helps farmers to the highest degree in timely field operations and practices of crops cultivation and harvest yet in adverse climatic conditions, which results in good return and improve livelihood of the farmers. Pawlak et al., (2002) concluded that the use of appropriate agricultural mechanization techniques on a farm significantly increases the yield of plants and animals breeding.

Agricultural Mechanization may not be considered in loneliness. Actually, mechanization has unwrapped new avenues for human employment such as management and supervision on the other hand driving, servicing, maintenance and repair of machines. Farm mechanization assists operations which are to be completed in time like cultivation of crops, planting of crops in rain fed regions where these operations are to be completed in a short duration while the rain occurred and for harvesting and threshing of crops. It increases productivity and profitability due to in time completion of farm operations, excellent work done and efficient exploitation of inputs used.

In Pakistan, discerning farm mechanization is being experienced and only such practices have been mechanized for which there were acute shortage and constraints of labour or power. In this context, mechanization has assisted the farmers in increasing the cultivated area along with enhancement in the yield of major crops like wheat, rice and maize (GoP, 2006).

There were about 500 tractors in Pakistan at the time of its creation (Ansari, 1984). According to mechanization survey conducted in 2004, there were 401,700 tractors

in Pakistan (GoP). It is necessitated for the adoption of locality specific farm machinery by considering the small land holding and meager economic condition of farmers.

Table 1.2 No. of farm implements in Pakistan

Machinery/ Year	**1994**	**2004**	**% increase**
Tractor	252,900	401,700	59
Rotavator	15,594	47,919	207
Disc harrow	13,233	23,764	80
Seed drill	64,126	70,810	10
Chisel plough	6,535	8,515	30
Tube wells/ lift pump	454,200	931,000	105

(Govt. of Pakistan)

In future, a wide gap in food supplies and demands is expected, which can be countered by improving average yield of major crops through intensive use of farm machinery. It is obvious that the introduction and use of innovative farm techniques give boost to a cultivation processes by accelerating the cultivation, harvesting and threshing operations (PAMC, 2004).

Extension wing of Agriculture department is playing a vital role in modifying and improving technologies and their dissemination from laboratory to land (Rehmatullah et al., 2018).Agricultural Extension Wing is known to offer technical guidance, knowledge and latest information to the farmers and providing solution of farmer's problems as well (Baig & Aldosari, 2013).

Agricultural development is basically a dynamic and continuous process. There must be synergy in two-way flow among research, extension and farmers. There should be a proper and strong linkage between technology generation and technology transfer systems (Sharma, 2013).

1.3 Agricultural Mechanization Development Project in Punjab

Punjab province of Pakistan has a variety of land topography and widespread weather conditions, having different cropping zones. It plays a central position in the economy of Pakistan by adding almost 60% to agricultural production of the country. It is the main producing province of the country which covers about 69% of cropping area of Pakistan. However, it has been reported that land and water productivity in Punjab is two to three times lower as compared to global benchmark (World Bank 2005).

There were about 5 lacks tractors in Punjab in 2015. Tractors to farm machinery ratio is very meager which is given below:

- 95% have cultivators
- 20% have MB ploughs
- 15% have disc ploughs
- 5% have chisel ploughs
- 5% have rotavators
- 10% have disc harrows
- 10% have ridgers
- 22% have seed drills

(Govt. of Punjab, 2015)

Due to low farm power input in Punjab has resulted 15-20% losses in cereal crops and 40-45% losses in fruits and vegetables, this can be reduced by rising power availability to perform sowing, harvesting and post-harvest practices in time. Area of major crops cultivated in Punjab is given as under:

Table 1.3 Area of major crops in Punjab

Sr. No.	Crop	Area ('000' Acres)
1.	Wheat	16458
2.	Cotton	4486
3.	Rice	4291
4.	Maize	2246
5.	Sugarcane	1922

(Govt. of Pakistan)

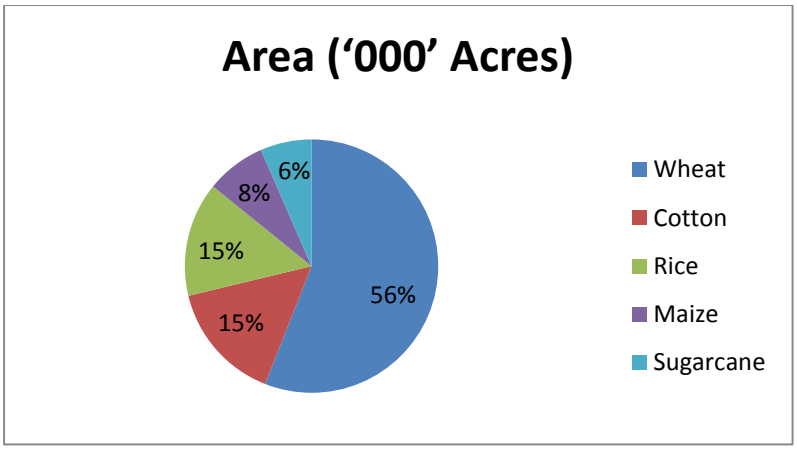


Figure 1.3 Cultivated area of major crops in Punjab

The introduction of suitable machines and implements to mechanize farm operations is need of the day to make cultivation process efficient and advance per

acre yield. The efficient employment of farm machinery saves energy, operational cost and time. The use of a variety of farm implements has increased yield and cropping intensity along with productivity improvement. The level of mechanization at big farms is adopted adequately but at small farms and service provider levels it is not only inadequate but also selective and limited. Most of the small farmers and service providers have ordinary cultivators for seed bed preparation. They are unable to buy implements for farm mechanizing their different agricultural operations which are essential to reduce labor, augment the efficiency of inputs applied and farm output to diminish the yield gap.

Government of Pakistan has accorded it as a huge priority and Rs. 341 billion have been allocated for a mega relief package i.e. Prime Minister's Agriculture Package aiming to introduce agriculture on scientific lines (Govt. of Pakistan, 2016).

Keeping in view the current perspective of farm mechanization, Punjab government has formulated a policy that focuses the growth of rural areas. Majority of the farmers in Punjab are undersized land holding and owners of such farms are almost subsistent farmers as yield of their major crops is fewer than progressive farmers. Various development projects such as distribution of 10,000 tractors under "Green Tractor Scheme", provision of 3000 laser land leveler units under "Punjab Irrigated Productivity Improvement Project (PIPIP)" and distribution of seeds of improved varieties among farming community in Punjab, which has momentous role in boosting farm productivity in the province.

Similarly Government of the Punjab introduced **"Agricultural Mechanization Development Project"** through ADP at a total cost of Rs.1183.600 million for a

period of two years i.e. 2015-16 & 2016-17, as an initiative of strengthening of agriculture sector with the following core objectives:

i. To reduce the gap between tractors and agricultural implements in Punjab province
ii. To enhance productivity and profitability of the farmers
iii. To improve revenue generating capacity of the farmers
iv. Capacity building of the farmers by imparting trainings and workshops

The project aim was to provide set of agricultural implements to the farmers at 50% subsidized rates to increase productivity and profitability by mechanization of farm operations for soil tillage, seed bed preparation, sowing, spraying and sugarcane harvesting. Under this project a set of implements i.e. Rotavator, Disc Harrow, Seed Drill and Chisel Plough were provided to the interested farmers having tractor of 50 HP and 6 acres of land in each rural union council of Punjab.

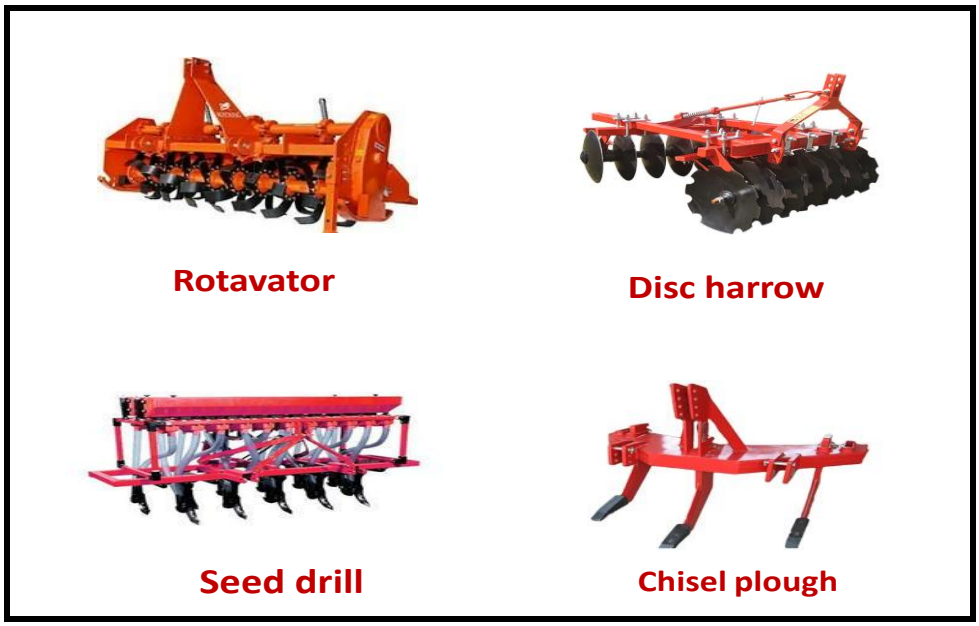


Figure 1.4 Implements provided in the Agricultural Mechanization Project

The implements provided in the scheme were primary tillage implements except seed drill. Basically mechanical tillage makes the soil more fine and favorable for plant growth, improves soil properties and provides favorable conditions for the development and growth of plants (Abolanle et al., 2015). Tillage brings change in soil structure and texture which increase infiltration, evaporation and water distribution in the soil (Schwartz et al., 2010). Good agricultural practices performed in the soil improve its physical and chemical properties which ultimately enhance the yield of crops (Abolanle et al., 2015; FAO, 2000).

1.4 Research Problem

The overall focus of research work on impact of development projects and project management has not been up to the mark in the world. Despite the importance of public sector projects in the developing countries, both public sector and the developing world have received little attention from project management researchers. Basically public sector projects are social projects designed and implemented by governments with the requirements to meet diverse demands of local communities. In spite of huge investment, Public sector projects tend to be completed behind the planned schedule, overrun cost and mostly did not achieve the set objectives (Farazi, 2010).

In Pakistan, strict financial control is practiced in public sector projects. The original cost of the project cannot exceed more than 4.5% of the total cost. If major change in scope of work is required or cost of the project increases more than 4.5%

than the original cost estimates, then the project has to be revised and approved from a competent forum (Khan & Sheikh, 2005). The causes of failure and not achieving the objectives of development projects in developing countries are improper monitoring, corruption, political interference, inconsistency due change of Government, bureaucracy, fluctuation in prices, lack of planning and delay in payments and release of funds (Isaac et al., 2015).A World Bank report (2007) stated that the average public sector project took three times more duration and two times more funds as originally planned. Further the data of Planning Commission of Pakistan shows 200% to 800% increase in budget for major infrastructure projects executed from 1993 to 2003 (Khan 2007).

A predictable tool namely "iron triangle" (time, cost, quality) is used to determine the success of the any project (Cleland & King, 1983; Kernzer, 2001; Lashbrooke, 1992; Turner, 1993). The project is assumed to be successful if it has been completed within time, did not overrun its allocated budget and its outcomes has satisfied the company's predetermined criteria.

The researcher of this dissertation is a scholar of Project Management, having earlier education in agriculture and vast experience in dealing with development projects in agriculture sector. Additionally, researcher has been member of monitoring team of different projects. Keeping in view the basic criteria of project success, Agricultural Mechanization Development Project of Punjab government is considered a successful project, as it has been executed and completed within stipulated time and cost. The project has been completed within its allocated budget of Rs.1183.600 million in two years 2015-16 to 2016-17. The core objective of the

project was to assist the farming community in increasing yield and decreasing cost of production of the crops. So the fundamental aim of this study is to assess the impact of Agricultural Mechanization Development Project on the production of major crops in Punjab, Pakistan.

Development projects are mostly criticized for their poor planning, unsuccessful implementation and ineffectiveness in developing world. Therefore it was needed to evaluate the effectiveness of program "Agricultural Mechanization Development Project" which has been successfully implemented in Punjab. The researcher has selected this study as it was directly relevant to the academic and professional carrier and has enough interest and expertise which actually will add to existing body of knowledge along with bridging current gaps in policy formulation of Agricultural mechanization in Punjab province in Pakistan.

1.5 Research Questions

1. Did Implementation of Agricultural Mechanization Development Project improve the yield of major crops (Wheat, Rice, Cotton, Maize, and Sugarcane) in Punjab?
2. Did relationship exist among farmer's demographic characteristics and technological factors on wheat crop production?

2.6 Research Objectives

1. To assess the impact of Agricultural Mechanization Development Project on the yield of Major Crops (Wheat, Rice, Cotton, Maize, Sugarcane) in Punjab.
2. To study the relationship among farmer's demographic characteristics and technological factors on wheat crop production

1.7 Research Significance

Mechanization contributes a lot in the agriculture sector as it enhances efficiency of inputs, completion of farm operations and practices in time, increase in farm production, and reduction in cost of production and improvement in quality of farm produce. The development projects are vital to assist the small and marginal farming community to adopt the latest farming practices and innovative technology at their farms. Keeping this fact in view, Mechanization development project to support the small and marginal farmers has been implemented successfully in the Punjab. The evaluation of usefulness of farm implements will further guide that which implements are required to the farmers in different zones of Punjab province.

This study will contribute in the existing related bodies of knowledge and will have a considerable impact on understanding the need of agriculture mechanization in developing countries. The findings of this study will also assist the Government

and other stakeholders to formulate policies for agricultural Mechanization technically feasible, economically viable and socially acceptable to promote its sustainability.

Chapter 2. LITERATURE REVIEW

This chapter has been divided into eight sections. Agricultural mechanization is a multidimensional term and diverse authors have defined it in different ways. Therefore, first section of this chapter describes various definitions of agricultural mechanization. The second section deals in demographic, socio- economic, technological and policy factors which have affect in the adoption of mechanization by the farming community whereas the impact of Agricultural mechanization has been described in third section. The forth section of this chapter prescribes different determinants in the low adoption process of farm mechanization by the farmers in developing countries. The different strategies which have been made earlier regarding encouragement of mechanization among farmers in various countries have been discussed in section five whereas section six deals the status of agricultural mechanization in Pakistan. The last two sections of this chapter describe research hypotheses and theoretical framework of this study respectively.

2.1 Agricultural Mechanization

Iqbal et al., (2015) stated that **a**gricultural mechanization involves the use of machines for development of land, land reclamation, sowing of crops, harvesting of crops, threshing of crops, watering to fields, removing of weeds, application of pesticides and further such farm activities. Actually mechanization is a use of

machines to complete the farm operation in time, which ultimately increases yield, reduces cost of production and crop losses and improve the quality of the produce.

Adnan et al., (2017) and Kepner, (2003) reported that farm mechanization is considered as a set of technological expertise to ensure augmentation in productivity by the introduction of timely field operations and quality of grain. The study also revealed that the agricultural mechanization has helped the farmers to fight against soil erosion, land degradation and effective land preparation to cultivate the crops (Braimah et al., 2017).

Verma, (2008) concluded that farm mechanization enhances the efficiency of time bound operations such as sowing, cultivation of crops in rain fed regions where these farm practices are mandatory to be done in short duration of time. The non-repeated operations for instance land leveling, land reclamation, terracing of land, eradication of weeds and wild shrubs are also efficiently done by mechanization.

Rehman et al., (2011) conducted study in wheat areas which depicts that the yield of wheat was higher in mechanized areas as compared to traditional farming whereas variable cost was higher in traditional farming. The gross margin was higher in mechanized farming.

Amjad, (2014) described that agricultural mechanization improves productivity of land and labour in addition to increase cropping intensity and cropping pattern and helping in timely crop cultivation, cultural practices, harvesting and reduction in post-harvest losses.

Akdemir, (2013) stated that agricultural mechanization involves the application of a variety of power sources and use of better farm implements and machinery for diverse farm techniques to amplify the productivity of land and labour through rightness of operations, efficient exploitation of farm inputs and up gradation in the quality of produce, security and relieve of farmers and cutback in the hammering of produce and hard work of farmers.

Balishter, (1991) stated that in an absolute expression, there is no decline in human labour service sowing to mechanization. Indeed, there is a swell that can be accredited to boost in the cropping intensity and change in cropping pattern from less labour demanding to more labour exhaustive crops. He further added that requirement for hired labour amplified whereas involvement of family labour in crop production decreased.

Ali et al., (2018) concluded that more effective and accessible farm mechanization is liable to contribute in agriculture and economic revolution. Farm mechanization triumph over past inundated with poorly-planned systems that were unsuccessful to appraise demand, relatively abandoned by the researchers and policymakers. The use of farm machinery is crucial to various farm operations specifically land development, harvesting and threshing of crops as well as off-farm functions for instance rural transport and roads construction. Whereas, forced farm mechanization is mostly linked with displacement of the tenants and local labor in conjunction with environmental deterioration. The demand of agricultural mechanization varies both within and across the countries, depending on socio

economic characteristics of farming community, population density, agro-ecological prevailing conditions and market access. The supply of farm implements and machinery through improper government schemes is inefficient that have also unpleasant outcome on the private supply chain improvement in mechanization.

2.2 Factors Effecting the Adoption of Farm Mechanization

Thepent and Chamsing, (2009) stated that more technical knowledge on repair and maintenance given to the farmers will increase the efficiency of farm machines, reduction in repair and maintenance cost and extend the machines life. Sarkar et al. (2013) further evaluated that degree of appropriate implements selection broadly depends on the nature of soil, topography and cropping pattern of the farmers.

Ayodele, (2012) depicted in his study that the age of the farmer may affect the probability of adoption of new technology positively or negatively. Most of the studies concluded that there is negative relation to farmer age and adoption of technology, as aged farmers mostly show reluctance in adoption of innovative implements and they prefer to rely on their traditional practices. The education level of the farmers has a positive relation to adoption of new technology. The study shows that educated farmers are more aggressive to know and adopt the new techniques as compared to the illiterate or less education level. The size of the farm land also has positive relation to adoption of innovative technology, however farming experience have negative relation to the adoption of new technology as the long experience gives more confidence on conventional practices. The provision of

extension services to the farmers has also positive impact on the adoption of new techniques and technology. Through extension services, the farmers get information about innovative farming implements, techniques, methods, new crop varieties etc. which increase the probability of their adoption based on the innovation-diffusion theory. The easy accesses to credit facilities and readily availability of implement and machines in the nearby markets also have a positive relation to the adoption of new technology. The Logistic Regression Model applied in the study analysis also depicts that the extension visits, access to machines and implements, age and educational level of the farmer are significant determinants in the adoption of new technology.

Raina et al., (2018) depicted that the State Jammu and Kashmir holds a vast potentiality to assume selective farm mechanization fairly than extensive mechanization. The farmers of the state tolerate complexities in due course completion of field operations and practices owing to lack of farm machinery akin to enhanced implements for tillage of land, sowing and planting of crops, inter-culturing, irrigation techniques, plant protection measures, harvesting and threshing of crops, drying and processing tools.

Ghosh, (2010) has presented in his study that farm mechanization depends on a number of demographical, socio-economic and agronomical factors. Efforts should be made to strengthen these and such other factors for efficient use of modern farm machinery. Local customs, conservative habits and age of the farmer, lack of financial support from the government, less technical support from extension

services, low literacy rate and lack of support from credit institution are the major hurdles to get proper benefit by the use of modern farm machinery especially for small and medium farmers. It has been concluded that young generation rather than old farmers are more willing to accept and use the modern techniques and machines at their farms. The ground situation demands on the renewal and expansion of innovative institutions like financing agencies, cooperatives and self-help to provide financial and technical support for small and marginal farmers to get maximum benefit from the modern mechanization in the agriculture sector.

2.3 Impact of Agricultural Mechanization

Amari, (2016) presented in his study that agriculture provides employment, income and staple food to its masses. Mechanization plays a vital role in up gradation of agriculture sector. The man power displacement due to tractorization in agriculture is very meager. Apart from this, the mechanization has opened many horizons for employment such as managerial, supervisory and driving opportunities along with services, repair and maintenance of machinery. Therefore the true selection of mechanization encourages man power, animals, and machines as a complements to each other. The use of mechanization in agriculture increases the use of inputs, efficiency, Cropping intensity and land utilization along with more productivity of labour. It enhances the yield and quality of produce by timeliness farm practices and use of inputs which ultimately reduces production cost and increase farm profit. There is more increase in off-farm labour as compared to on-farm labour due to

mechanization. Overall it can be said that mechanization saves time, give freedom from hampered work, improves social status, increases in production, appropriateness of agronomic operations, changes in cropping pattern, increases cropping intensity, improves intercropping and reduces cost of production. However on the other side farm mechanization also promotes burden of debt, fuel and repair costs, unemployment and more disparity in income. Ultimately it can be said that farm mechanization have a greater role in farming societies, the farmers should be aware, educated, skilled and financially powered for the right selection and use of machinery .

Thepent et al., (2009) concluded that the standardized farm machinery gives more benefit to the farmers. The local manufacturers were asked to compete the market against the imported machinery. The more utilization of machines at farm reduced cost of production, increased efficiency along with solving the problem of labour shortage at peak seasons. Due to more trend in using rice combine harvester and sugarcane harvester, the demand for high skilled operators has been enhanced.

Gupta et al., (2014) reported that a mechanization development project was implemented to support the small and trivial farmers in the state of Goa, India. The project brought significant impact by strengthening the groups of farming communities along with establishing new groups among them. The farming practices improved by timeliness of operation, improved efficiency, labour saving and one of the additional source of income by using the implements on rent on the land of non-groups farmers.

Braimah et al., (2017) revealed in his study that the agricultural mechanization has enhanced the supply of food by the increase of production. On the other hand employment has been created by mechanization on its operation, management, service and repair as well which has reduced the level of poverty in the region. Mechanization reduces the dependency on drudgery and alleviates the dependency on women, children and elders. The provision of mechanization as modernization of agriculture has played its role in enhancing of production and poverty reduction in the rural communities. The study has also depicted that there is positive relation between mechanization and expansion of land holding among small farmers. Most of the respondent farmers admitted that the use of tractor works as primary catalyst to expand the size of their farms. The farmers can plough the large area in less time and can conserve the rainfall water in a better way along with control of weeds effectively at their farms.

Pingali, (2007) gave argument in a study that the productivity impact of agricultural mechanization is evaluated in the terms of increase in yield, labour saving and expansion in land, increase in crop intensity, change in cropping pattern and upgrading the quality of produce. The use of tractors in the place of animal drift has not significant impact on yield; however area expansion and labour saving are significantly changed by tractorization. There is greater reduction in labour use for land preparation by 50% or more. The rice cropping intensity has been significantly increased in humid tropic areas; two to three crops of rice can be grown in the same land every year by the use of power tillers and threshers. The use of machines in harvesting, threshing and milling operation have also brought a significant impact

on labour saving during peak seasons, in time produce saving from bad weather by reducing post-harvest losses.

Sarkar et al. (2013) stated that adoption of mechanization creates capital cost to buy machinery and implements on one hand, whereas on the other hand it reduces the labour cost. As most of the farmers in Bengal are too poor, so it is not possible for every farmer to purchase the expensive farm implements. The study depicts that the ownership of expensive implements is fairly limited due to high capital cost and the machines are mostly used by the other farmers on rent basis to perform various farm practices and operations in the region, so the ownership and use of implements are two different aspects in farm mechanization. The farm practices by machines are performed at much faster rate as compared to animals which save valuable time. Farm mechanization increases crop yield, increases time efficiency, maintains timeliness of crucial operations in time, reduces drudgery, more land under cultivation and creates source of livelihood as well.

Verma, (2008) study concluded that the impact of tractorization on significant on the displacement of bullock labour that is about 60% whereas its impact on human labour is much less that is only 15%. It has also been concluded that human displacement at farm labour cannot be seen in isolation. As there arise many avenues for employment due to mechanization such as management, supervision, driving, servicing, repair and maintenance of the implements. It is concluded that farm mechanization increases, cropping intensity, land utilization, agricultural production and profitability due to completion of farm operation in time and

efficiently exploitation of inputs applied. It increases on-farm human labour slightly while the off-farm labour requirements on repair and services are increased at substantial rate.

Hormozi et al., (2012) stated that the impact of farm mechanization on production recital of rice growing farmers in Khuzistan Province in Iran. The puddling practices by mechanization as compared to other tillage practices have a significant and encouraging impact on the production of rice in the mountainous region. The coefficient of mechanization on harvesting stage is considerable. On the other hand, two stage harvesting is negative against multi stage harvesting. The correlation between index of farm mechanization and technical efficiency depicts a sturdy impact on technical efficiency of rice producing farmers due to appropriate farm operations. It is further recommended that mechanization may not be considered solely as an increase in technical efficiency.

Singh, (2006) reported in his study that productivity is positively correlated with potential unit farm mechanization, so increasing demand of productivity is the indication of the requirement of efficient mechanization in developing countries. More specifically, the efficient use of farm mechanization with good management practices of agriculture machinery is helpful for the sustainable production in Pakistan (Iqbal et al., 2015; Rehman et al., 2016).

The study of Raina et al., (2018) depicted that the use of mechanization technology would increase agricultural productivity in the state. Moreover, labour tied up with manual farm practices cannot be linked to privileged value activities as well. Rice-

wheat cropping pattern has latent ability to make available staple food security in the State. That's why priorities should be specified to these crops by the adoption of superior varieties along with farm mechanization. It has also been recommended in the study that in the hilly regions of the State, power tiller matching implements for seed bed preparation, sowing of crops, plant protection measures, harvesting and threshing of crops are suitable on undersized, uneven and undulated farm fields.

Diao et al., (2016) determined that farm mechanization expands farm size of small farmers along with shifting of cropping patterns from conventional staple crops to market leaning cash crops. The study further argues that this transition has unfavorable insinuation on the cultural aspects regarding food security, social life and climate variations.

2.4 Determinants in Low Adoption of Agricultural Mechanization

Lamidi et al., (2013)concluded that the fewer attitudes of farmers towards adoption and utilization of agricultural mechanization is one of the major hurdles in less production in spite of availability of improved technologies in the markets. In Thailand the small size of land holding is a big hurdle in using the large sized farm machinery. The shortage of finance is the main constraint to purchase the big and high capacity machinery (Thepent et al., 2009)

An International Conference on Agriculture and Natural Resources Engineering, Agricultural Mechanization held in Turkey (2013) emphasizes on the factors of low

adoption of agricultural mechanization by the farming community. The small and fragmented land holdings, improper selection of agricultural implements and tractors, improper and non-effective use of machinery, insufficient and expensive maintenance facilities of implements are the major constraints in adoption of farm mechanization.

Chandra, (2004) highlighted the constraints in the adoption of mechanization along with short term and long term strategies in agriculture sector. Agriculture is the back bone of Fiji economy for the last decades. Mechanization is not the solitary key to every setback in farm production and economic growth due to certain limitations such as lack of appropriate machines, lack of knowledge and skills to operate machines, lack of finance, rough topography of land, small, scattered and land tenure system in the country. There is also non-availability of repair and service shops in the remote rural areas.

Rehman et al., (2011) concluded that that by the use of mechanization less number of labour per hectare are required to complete the practices at farm as compared to traditional farming in which family labour is much affected. It has also been concluded that the repair and maintenance facilities of machines and implements are also limited in remote areas and are relatively expensive.

2.5 Strategies for Intensification of Agricultural Mechanization

It is need of the time that agricultural engineers should analyze actual need of the farmers to bring interventions specifically in value addition implements. The farmers should come together to make cooperatives, so that they can have more bargaining power in the purchase of inputs and implements and in the sale of their produce including financial assistance to their member farmers. Moreover, the registered cooperatives of farmers are more protected from the governments and the member farmers are able to purchase costly machinery such as tractor, combine-harvester etc. which individual farmer cannot afford. Further the agriculture machinery to hire should be available at subsidized rates to the farmers. There should be intensive campaigns at government level to persuade the farmers to adopt the innovative technologies at their farms (Lamidi et al., 2013).

An International Conference on Agriculture and Natural Resources Engineering, Agricultural Mechanization held in Turkey (2013) emphasizes that Government should make policies to support the farmers in purchasing the machinery to enhance yield and quality of their crops. This study also suggested that control actions should also be applied to evade the excessive use of inputs including chemical fertilizers to protect the environment.

Gupta et al., (2014) stated that training and sensitization of member farmers about proper usage of implements was a missing factor of the project due to lack of time. The study also recommended that projects having allied infrastructure such as

access roads, irrigation system may also be executed in the state to amplify the actual output from mechanization.

Ayodele, (2012) recommended that policies may be formulated to increase extension visits to the farmers, make availability of implements and machines in markets at low prices which will increase the net income of the farming community and ultimately their better livelihood. Zangeneh et al., (2015) stated that in order to enhance the efficiency of mechanization, the farming system should be characterized especially to recognize potential resource constraints and to capture the variety of farming system.

Ali et al., (2018) concluded that subsidies under distinct circumstances can mob out private hiring services and bound the accessibility of such machines and technologies more appropriate for those countries. If subsidy is compulsory to be provided by governments, subsequently it should target those farmers who are competent to use farm machines efficiently and provide services to neighbor farmers' need. Ghosh, (2010)stated that ground situation demands that renewal and expansion of innovative institutions like financing agencies, cooperatives and self-help to provide financial and technical support for small and marginal farmers to get maximum benefit from the modern mechanization in the agriculture sector.

Diao et al., (2016) recommended that existing agricultural policy emphasizes to ensure context sensitivity for further forceful fight against food insecurity. The study depicts that farm mechanization efforts made in new green revolution initiative may be proved helpful to combat food security. The need of hour is

making such inclusive policy toward incorporating indigenous farming system and the utilization of innovative technologies. Specifically it is important to encourage the farming and sustainability of home staple crops. Such kind of sensitivity related to the characteristics of local community is fundamental for the suitability and sustainability of recent farming technologies.

2.6 Agricultural Mechanization in Pakistan

World Bank's Report (2012) revealed that Pakistan's economy has developed from a low income to a lower middle-income developing economy, GDP per capita has been amplified from US dollar 294 in 1980 to US dollar 1,017 in 2010 along with reduction in poverty level as well. Furthermore, Pakistan has practiced incredible development-oriented structural transition in its economy, the share of agriculture has turned down from 53% in 1947 to 21.2% in 2010, part of industry has remarkably increased from 9.6% in 1949-50 to 25.4% in 2010, whereas share of the services has increased from 37.2% in 1950 to 53.4 % in 2010 (Anjumet al., 2017).

Rehman et al., (2011) stated that despite the availability of improved technologies in markets, there is low yield per acre due to less use of agricultural mechanization by our farmers. In this context the use of machines in Pakistan is very less, limited to tractorization only.

Iqbal et al., (2015) concluded that adoption of machines is mostly indigenous and very selective due to small land holding and poor economic circumstances of the farmers. Unfortunately the quality of locally manufactured implements is low due to poor layout of workshops, lack of managerial and technical skills, poor designs, indecent manufacture techniques, not having superior raw material. Pakistan requires efficient utilization of its resources to make its agricultural product competitive in the international market. The cost of production of many crops is higher due to conventional farm practices and high prices of inputs. The intensive use of farm machinery can increase the yield and quality of the product. With the passage of time, the land-to-man ration is decreasing and food requirements are increasing. It is admitted fact that the use of machinery not only accelerates the cultivation process of crops but also enhances the harvesting and threshing processes as well. The efficient use of inadequate farm resources and farm machinery is imperative to make tactical planning for the upcoming.

2.7 Research Hypothesis

H-1A: There is significant increase in the yield of wheat crop by the use of implements

H-1B: There is significant increase in the yield of Rice crop by the use of implements

H-1C: There is significant increase in the yield of Cotton crop by the use of implements

H-1D: There is significant increase in the yield of Maize crop by the use of implements

H-1E: There is significant increase in the yield of Sugarcane crop by the use of implements

H-2A: There is significance relationship between farmer's age and yield of wheat crop

H-2B: There is significance relationship between farmer's educational level and yield of wheat crop

H-2C: There is significance relationship between farmer's experience and yield of wheat crop

H-2D: There is significance relationship between size of land holding and yield of wheat crop

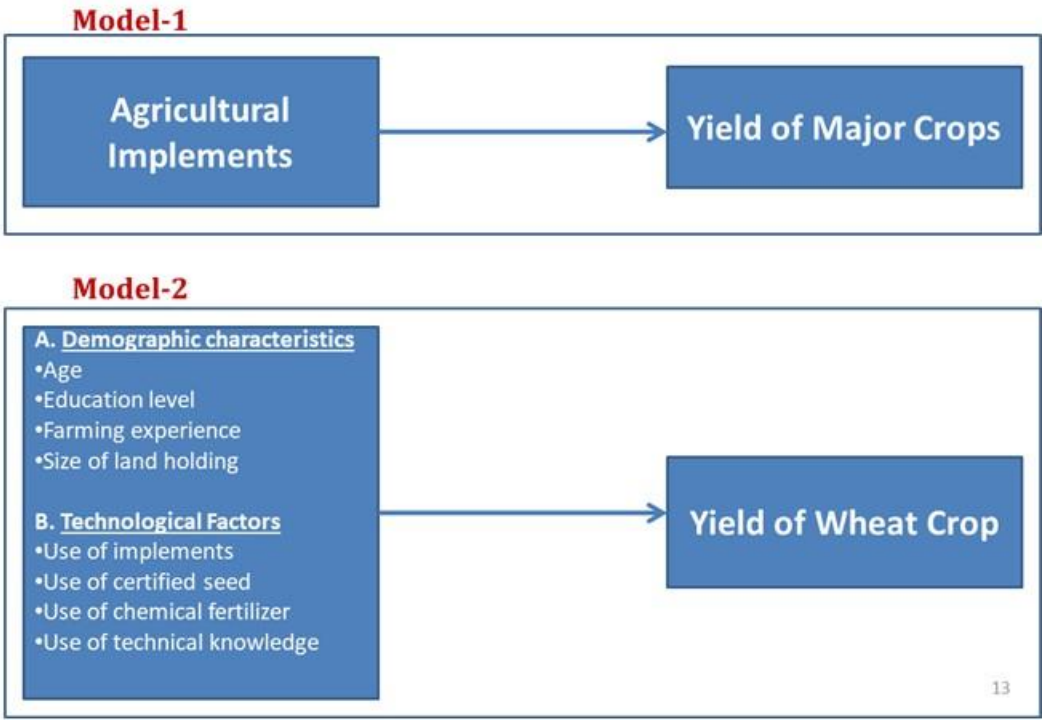
H-2E: There is significance relationship between technical knowledge and yield of wheat crop

H-2F: There is significance relationship between use of implements and yield of wheat crop

H-2G: There is significance relationship between use of certified seed and yield of wheat crop

H-2H: There is significance relationship between use of chemical fertilizer and yield of wheat crop

2.8 Theoretical Framework



Chapter 3. RESEARCH METHODOLOGY

Methodology is the central part of any research which guides the researcher to collect, analyze, interpret of data and complete the process of research. Basically, methodology is a "blueprint" of research that facilitates the researcher to come up with the solution to the problems and issues come across during the process of research (Nachmias, 1992).

This chapter elaborates methods, instruments, and techniques of collection and analysis of data which is particularly used for testing of hypothesis. The objective of this research is to assess the impact of agricultural mechanization development project on the yield of major crops in Punjab, Pakistan. With the aim to accomplish objectives of the study, an intended plan is taken into consideration the area and number of respondents in three different zones of Punjab province, as lacking of these contemplations it would be a wasted attempt. It is, therefore, crucial to describe these facets comprehensively to formulate the study further scientific and focused. The study is based on primary information. Widespread fieldwork is carried out for the collection of data through a structured questionnaire. The questionnaire includes questions on demographic and socio-economic distinctiveness of the respondents along with yield of major crops.

Diverse econometric models and techniques have been applied by researchers to analyze the impact of different variables on the production of crops. The researcher has evaluated the usefulness of given implements in development scheme and assessed its impact on the yield of major crops. Hence, the present study is carried

out in three main steps. Firstly the socio-economic characteristics of respondents have been described. In the second step, the usefulness of given implements is assessed by using descriptive analysis whereas in the last step, paired t-test has been applied to estimate the effectiveness of farm mechanization on the yield of major crops in the study area.

3.1 Research Design

Research design of the study outlines is the fundamental approach that researcher use to answer research question(s) (Polit, 2010). It is imperative that the researcher should choose the best suitable design to accomplish the objectives of the study (Parahoo, 2006). Quantitative approach has been selected as a suitable research method in this study. An explanatory research design outlined by LoBiondo-Wood & Haber (2006) is selected for this study. Moreover farmer's demographic characteristics, usefulness of implements and yield of their major crops have been surveyed in this study.

Only non-experimental method has been applied in this study which is mostly used to carry out impact studies endorsed by World Bank, which evaluates the conditions before and after the intervention (Baker, 2001).This study was reliant upon survey method to get precise information about respondents.

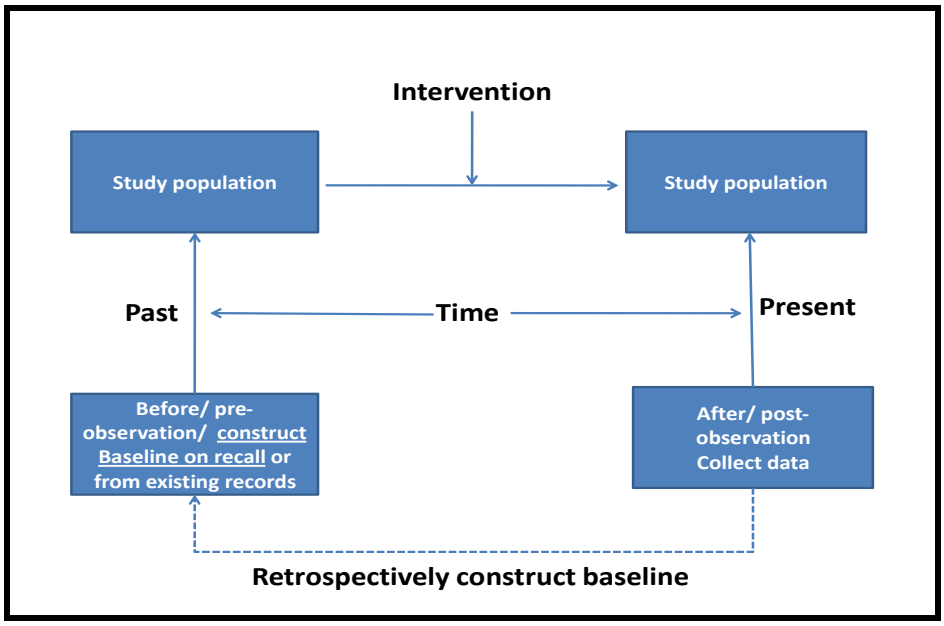


Figure 3.1 After-only non-experimental study design

3.2 Variables of the Study

The primary data has been collected from a sample of 210beneficiary farmers, selected from six districts of Punjab, namely Attock, Chakwal, Sheikhpura, Faisalabad, Multan and Muzaffargarh, who were given implements through Agricultural Mechanization Development Project on 50 percent subsidized rate. Stratified sampling method was applied for the selection of farmers. The data was collected by using a structured questionnaire adapted from Okunade (2007). The questionnaire consists of variables regarding farmer's demographic characteristics like age, level of education, farming experience, size of landholding, number of implements and yield of major crops before and after the project implementation.

3.3 Research Population

Punjab is the highest populated province of Pakistan with a total population of 110.01 million covering a land area of about 140, 914 square kilometers in lieu of the second largest province in Pakistan (Pakistan Bureau of Statistics). In this Study population is defined as “the total number of units from which data can potentially be collected” (Parahoo, 2006). The population in this study is comprised of all the beneficiary farmers who have received implements on 50 percent subsidy from development project in all districts of Punjab.

The researcher obtained district-wise lists of all beneficiary farmers who have got the implements from the Agriculture Department. There are 36 districts in Punjab, whereas the data for this study is composed from 6 districts; 2 district each from upper, central and southern zones of Punjab.

3.4 Sampling

Sampling is the procedure by which researcher decides on a proportion of the study population to represent the whole unit. Furthermore, it is more practical and cost-effective to work with samples rather than with all besieged population (Polit, 2010).

As the study population was not homogenous in all districts of Punjab so stratified random sampling was taken. By this method the heterogeneity in the population was reduced to achieve greater accuracy in estimates. Proportionate stratified

sampling is applied in which number of elements from each stratum has been selected in relation to its proportion in the total population. Six districts were randomly selected, two from each zone, named as Attock and Chakwal from upper Punjab, Sheikhpura and Faisalabad from central Punjab and Multan and Muzaffargarh from southern Punjab. The respondents in each district selected for this study have alike distinctiveness with respect to topography of land, demography, economic, social and cultural surroundings of farmers. The map of study areas is shown in Figure 3.2

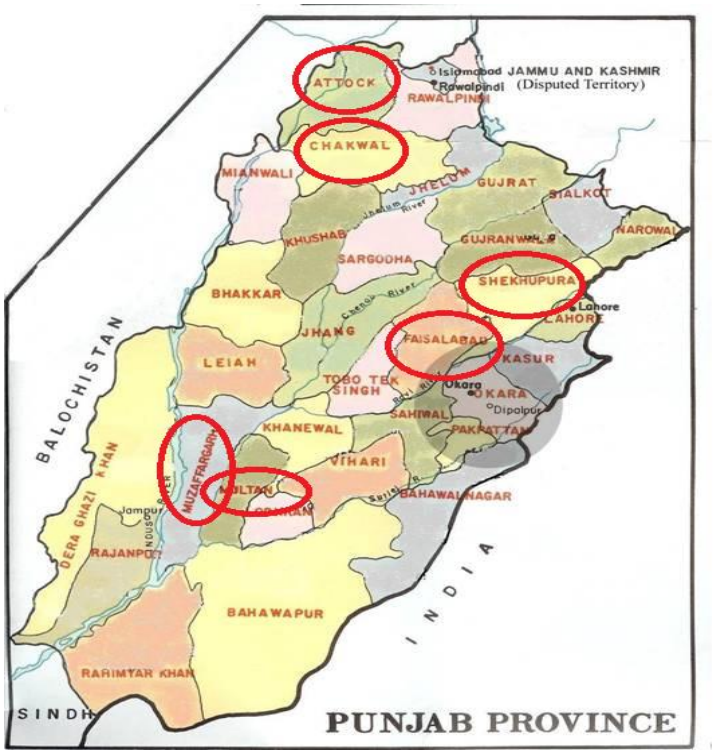


Figure 3.2 Sampled districts

As the population is finit and clear sampling frame is available, so random sampling has been used to select the respondents (Patton, 2002). The beneficiary farmers are

selected to get their feedback. Proctor, (2010) said that in quantitative research the size of the sample must be premeditated at the design phase. According to Polit & Beck (2010) quantitative researchers ought to choose the largest feasible sample so that it could represent the target population. In this study Punjab province has been divided into three zones on the basis of agro-climatic conditions and cropping pattern i.e. upper Punjab (barani zone), central Punjab (mixed cropping zone) and southern Punjab (cotton zone). Six districts were selected; two from each zone and stratified sampling on proportionate basis from each district for interview was selected.

At 95 percent confidence level, 210 sample size has been calculated as recommended by Cohen, (1988), Rule of Thumb which makes the overall 15% of the total population of study area.

Table 3.1 Breakdown of the sampled districts of the study

No.	**Zone**	**District**	**Total No. of respondnets**	**Sampled Proportion**	**No. of Sampled repondents**
1.	Upper punjab	Attock	41	0.17	35
2.		Chakwal	29	0.12	25
3.	Central punjab	Sheikhpura	73	0.30	63
4.		Faisalabad	29	0.12	25
5.	Lower punjab	Muzaffargarh	32	0.13	28
6.		Multan	39	0.16	34
Total			**243**		**210**

3.5 Data Collection

Parahoo (2006) stated that in quantitative research, the data are collected to categorize and illustrate the characteristics, attributes, behaviors and behavior of the populations. Lacey (2010) further said that data gathering ought to be purposeful, organized and repeatable. Moreover, Robson (2007) said that a researcher should employ the simplest form of data collection to obtain reply of the research question and ought to avoid collecting unnecessary data. By keeping all these and such other conditions, a structured questionnaire has been used as data collection instrument for this study.

Face to face interviews were conducted for the purpose. Data was collected during interviews from selected samples among farmers, who have received implements in the development project on 50 percent subsidized rates. Assistance was taken from Agriculture Extension agents in the area to reach the farmers. Data collected include farmers' demographic and socio-economic characteristics such as age, education level, family size, farm size and farming experience

3.6 Questionnaire

A questionnaire is an instrument used to gather data from respondents according to a written set of questions. A questionnaire collects information on demographical characteristics, behavior, knowledge and experience of respondents (Parahoo, 2006). Moreover, it is a swift and expedient tool of collecting the desired and

standard information (Jones & Rattray, 2010). According to Polit and Beck (2010) a structured questionnaire uses a quantitative self-report method, which has been used to collect data in this research. The questionnaire of this study is comprised of three parts; part first consists of demographic questions of respondents such as age, level of education, size of land holding and experience of farming; part second consists of questions regarding usefulness of implements whereas third part comprised questions about yield of major crops before and after the implementation of the project.

3.7 Reliability and Validity

In research, Validity and reliability are imperative concepts that capture the measurement properties of a survey, questionnaire or another type of measures.

3.7.1 Reliability of questionnaire

Reliability statistics is considered as an important tool for additional use of statistics tests such as factor analysis, correlation and regression analysis models. The result of reliability statistical test is given in Table:

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.963	.963	11

Cronbach's Alpha is used to determine the reliability of an instrument. In the current study, initially total 18 items were added and their reliability value was 0.584. As this value is considered low, this depicts that instrument's reliability is not up to the mark. Following 7 items were omitted step wise to obtain the desired value of Cronbach's Alpha (0.963). This value shows that the instrument is completely reliable and can be used for further statistical models.

a) Availability of labour
b) Use of pesticides
c) Availability of credit
d) Prevailing market price of the produce
e) Use of farm yard manure
f) Other source of income
g) In time sowing of the crop

3.7.2 Validity of questionnaire

Validity refers to the credibility or believability of the research. Validity of a research instrument depicts whether the findings are genuine and close to the real value. The face validity was verified by agriculture experts whereas contents validity was verified by pre-testing of the questionnaire. The structured questionnaire was pre-tested to make necessary amendments prior to collect the requisite information from study population with the help of pre-visit in the project area. Questionnaires were pre-tested from 5 respondents in the study population,

on the basis of their responses, necessary amendments were made to finalize the questionnaire.

3.8 Data Analysis

The data was analyzed by applying paired t-test and regression analysis techniques to appraise the effectiveness of the program. Subsequent to collect the results of the survey, the entire data were coded directly on the questionnaires and then entered into a computer. Several analyses techniques were applied for data of this study. Descriptive statistic methods for instance sums, means, percentages and frequency distributions were applied to analyze primary data. The mean yield of each crop before and after project implementation was calculated which is a vital indicator to determine the usefulness of the program.

Table 3.2 Summary of research methodology

Nature of Investigation	Explanatory study
Research Design	Non-experimental study design (After-only study design)
Unit of Analysis	Individual farmers who received implements in Project
Population of interest	Project beneficiaries
Population size	1364 (Heterogeneous)

Sample size	210(Cohen, 1988; Rule of thumb)
Sampling method	Stratified Random Sampling is used to carry out impact study as recommended by World Bank (Baker, 2001)
Data Collection	• Survey Technique • Structured questionnaire
Reliability	Cronbach's Alpha 0.963
Validity	• Verified face validity by experts and • Construct validity by pre-testing
Data Analysis	• Paired T-Test analysis • Regression Analysis

Chapter 4. RESULTS AND DISCUSSION

The core purpose of this study was to appraise the impact of Agricultural Mechanization Development Program on the yield of major crops namely wheat, rice, cotton, maize and sugarcane in Punjab province of Pakistan. Additionally, the usefulness of implements given to the respondents was assessed along with demographic and technological factors. Therefore, the current chapter is divided into four main parts namely results, discussions and conclusions. The first three part deal the demographic characteristics of respondents; usefulness of implements; impact of mechanization project on the yield of major crops and relationship of mechanization with other factors on the yield of wheat crop while conclusions have been presented in the last part.

4.1 Results

4.1.1 Demographic characteristics of farmers

The demographic characteristics of farmers such as age, level of education, size of land holding and farming experience have affect in the adoption of modern farming practices and use of innovative machines at their farms. Farmers' socio-economic variables such as farmer's education, farming experience, dependency burden of family members, ownership status of machines and external support have their

influence on the adoption of farm mechanization. This section deals with four basic demographic characteristics of the respondents.

4.1.1.1 Age of farmers

The age of farmer is an important demographic variable regarding adoption of new technology particularly in developing countries. Age affects the approach of farmer, as young are relatively more vigorous and healthy which leads more willingness to adoption of new technology. It has been anticipated that middle aged people have more technical knowledge regarding production of crops. It has also been concluded that young generation is more ready to accept and use the modern techniques and machines at their farms rather than old one. The age of the respondents has been presented in four groups as depicted in the following table:

Table 4.1 Age of the farmers

Age of farmers	**Frequency**	**%age**
up to 40 Years	23	11
41-50 Years	98	47
51-60 Years	78	37
above 60 Years	11	5

Results show that maximum respondents (47%) were in the age group of 41 to 50 years whereas 11 respondents were of the age above 60 years. Only 11 percent farmers were found young up to the age of 40 years whereas 37 percent were in the age category of 51 to 60 years.

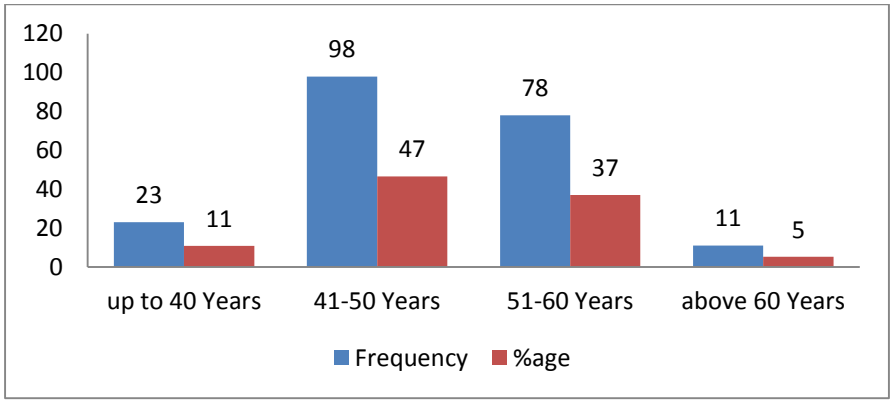


Figure 4.1 Age of the farmers

4.1.1.2 Education level of farmers

Level of educational represents the formal educational of the respondents. For current study the educational level was divided into seven sub-groups namely, illiterate, literate, primary, middle, matric, inter and above inter.

Table 4.2 Education level of the farmers

Education level	**Frequency**	**%age**
Illiterate	18	9
Literate	44	21
Primary	60	29
Middle	40	19
Matric	36	17
Inter	8	4
Above Inter	4	2

Results of the study depicts that maximum respondents had primary education level, whereas above inter level were less in number. The calculation shows that there were 44 respondents having literary skills only, they can just read and write to some extant but could not reach at the primary level. 60 respondents have primary level of education whereas 40 farmers had got middle education. The data also depicts that 4 respondents had intermediate level of education whereas 4 respondents were found above inter level, which is only 2 percent. It has also been concluded that 18 farmers which is 9 percent were found illiterate that they were unable to read and write.

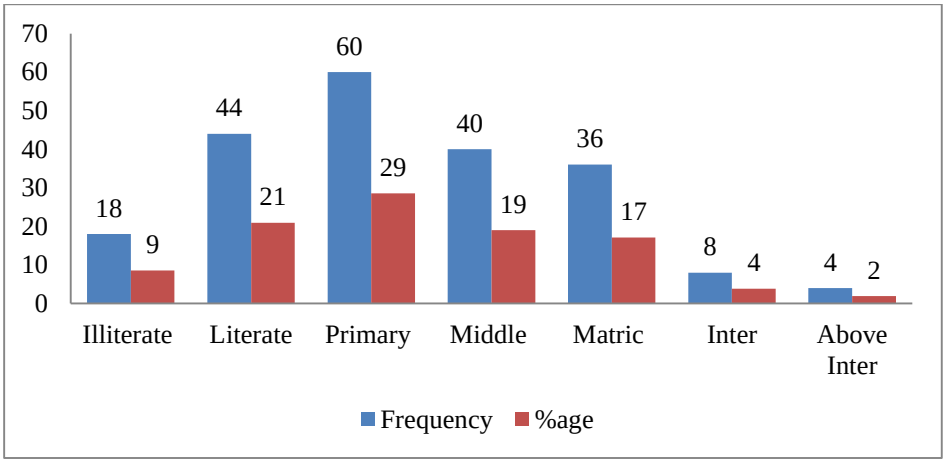


Figure 4.2 Farmer's educational level

4.1.1.3 Size of land holding of the farmers

The size of landholding is also a key demographic factor, as it is considered a sign of social position in our society which aids the farmer to access and acquire of inputs and machinery along with easy entrance to agriculture credit (Hussain & Thapa, 2012; Saqib et al., 2016).

The farmers have been divided into three categories i.e. small scale farmers having their farm size up to 5 acres, medium scale farmers having farm size from 6 to 10 acres and large scale farmers having farm size above 10 acres in this study. The following table presents the farming size of the respondents.

Table 4.3 Size of land holding

Size of land holding	**Frequency**	**%age**
1 to 5 acres	61	29
6 to 10 acres	113	54
Above 10 acres	36	17

Majority of the respondents were medium scale farmers. It has been observed that there was more mechanization adoption trend among farmers having larger landholdings. The data given in the above table presents that 29 percent farmers were small, having their size of farming up to 5 acres only, whereas, 54 percent have their farm size from 6 to 10 acres. This category of farmers is majorly prevailing in the Punjab. However, the farmers from the study data having their farm size greater than 10 acres were 17 percent only.

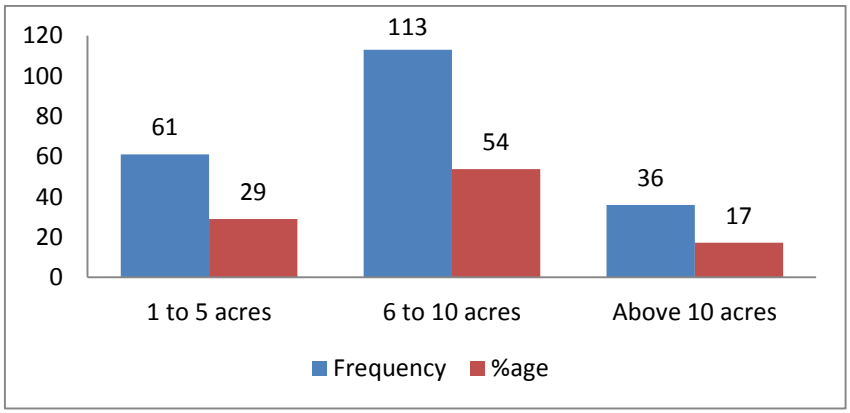


Figure 4.3 Size of land holding of farmers

4.1.1.4 Farming experience

Following table illustrates farming experience of the respondents. The farming experience has been divided into five categories.

Table 4.4 Farming experience of the farmers

Experience in years	Frequency	%age
Up to 5	11	5
5 to 10	23	11
11 to 15	42	20
16 to 20	86	41
Above 20	48	23

The table depicts that maximum respondent (41 percent) in the study data have farming experience from 16 to 20 years. 23 percent farmers have experience more than 20 years, whereas only 5 percent respondents have farming experience less than 5 years.11 percent respondents were having farming experience from 5 to 10 years whereas 20 percent of farmers have 11 to 15 years of farming experience.

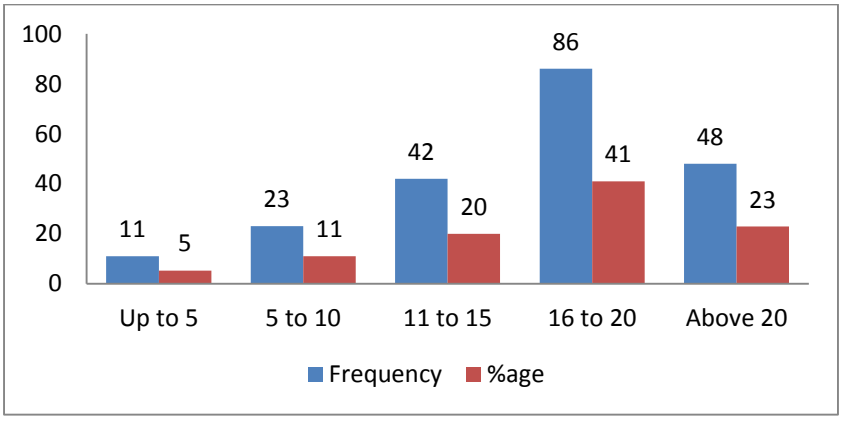


Figure 4.4 Farming experience of the farmers

4.1.2 Usage of farm implements

A set comprising of four agricultural implements namely rotavator, disc harrow, chisel plough and seed drill was provided to the farmers in the project. Generally it is considered that seed drill is not successful in rice stubbles and similarly chisel plough is used to break the hard pan of soil and increase the seepage of water which is not suitable for rice crop. But now farmers have changed their views. However the challenge still prevails for small farmers to receive services timely, as most farming operations are required to be done in time, if delay occurs then the efficiency of inputs provided decreases which ultimately leads to reduce yield of the crops.

4.1.2.1 Usage of rotavator

Rotavator is basically a secondary tillage implement but it can be used as a primary tillage implement. Rotavator is widely used for removing weeds and conservation of fertility of soil. It comprises a number of curved blades which are fitted on a horizontally revolving shaft. Rotavator is used to cut, churn and pulverize the soil. It also incorporates fertilizers and crop residues into the soil. Rotavator generally operates up to a depth of 6 inches. It is usually used to destroy the stubbles of cotton, rice and other crops. Following table illustrates usefulness of rotavator by the respondents.

Table 4.5 Usage of rotavator

Usefulness	Upper Punjab		Central Punjab		Southern Punjab	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Yes	52	87	87	99	59	95
No	8	13	1	1	3	5
Total	**60**	**100**	**88**	**100**	**62**	**100**

Data given represents that 87 percent of farmers in the upper Punjab said that rotavator was very useful implement.99 percent, the highest fraction of farmers was from satisfied about the utility of this implement in central Punjab; whereas 95 percent respondents were agreed regarding the usefulness of rotavator machine given to them by the development scheme.

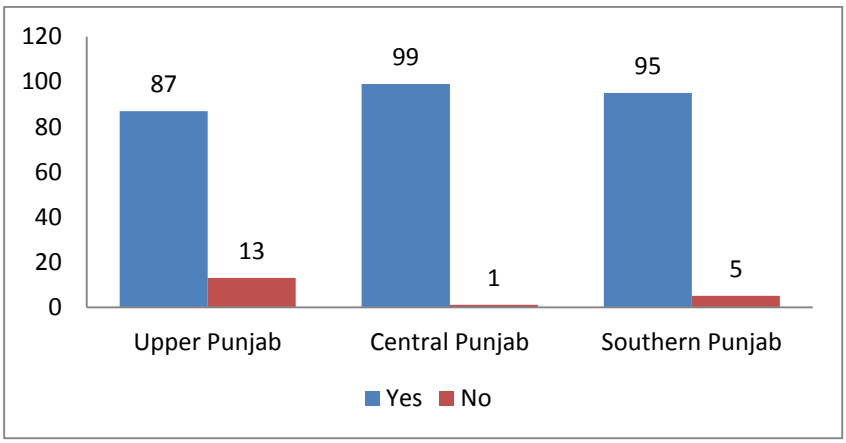


Figure 4.5 Usage of rotavator

District-wise usage of rotavator is given in the following table:

Table 4.6 District-wise usage of rotavator

Name of District			Frequency	Percent	Valid Percent	Cumulative Percent
Attock	Valid	No	5	14.3	14.3	14.3
		Yes	30	85.7	85.7	100.0
		Total	35	100.0	100.0	
Chakwal	Valid	No	3	12.0	12.0	12.0
		Yes	22	88.0	88.0	100.0
		Total	25	100.0	100.0	
Faisalabad	Valid	Yes	25	100.0	100.0	100.0
Multan	Valid	No	3	8.8	8.8	8.8
		Yes	31	91.2	91.2	100.0
		Total	34	100.0	100.0	
Muzaffargarh	Valid	No	3	10.7	10.7	10.7
		Yes	25	89.3	89.3	100.0
		Total	28	100.0	100.0	
Sheikhpura	Valid	No	1	1.6	1.6	1.6
		Yes	62	98.4	98.4	100.0
		Total	63	100.0	100.0	

4.1.2.2 Usage of disc harrow

Disc Harrow is a secondary tillage implement. It consists of two gangs of discs. It is used to break, cut and pulverize the soil along with cutting and incorporation of crop residue into the soil up to a depth of 5 inches. Disk harrow is widely used to remove weeds and conserve soil fertility. It is usually used to destroy the stubbles of rice crop. Following table illustrates usage of disc harrow by the respondents.

Table 4.7 Usage of disc harrow

Usefulness	Upper Punjab		Central Punjab		Southern Punjab	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Yes	52	87	82	93	59	95
No	8	13	6	7	3	5
Total	**60**	**100**	**88**	**100**	**62**	**100**

The use of disk harrow has been a productivity enhancing practice reported by most of the farmers. It is evident from the results that maximum usefulness of disc harrow is found in southern Punjab whereas minimum utility in upper Punjab districts.87 percent of respondents from upper Punjab gave their positive response regarding usefulness of disc harrow; while 93 percent from central Punjab showed same response. However, 95 percent of respondents in southern Punjab were found satisfied and positive about the utility of disc harrow at their farm.

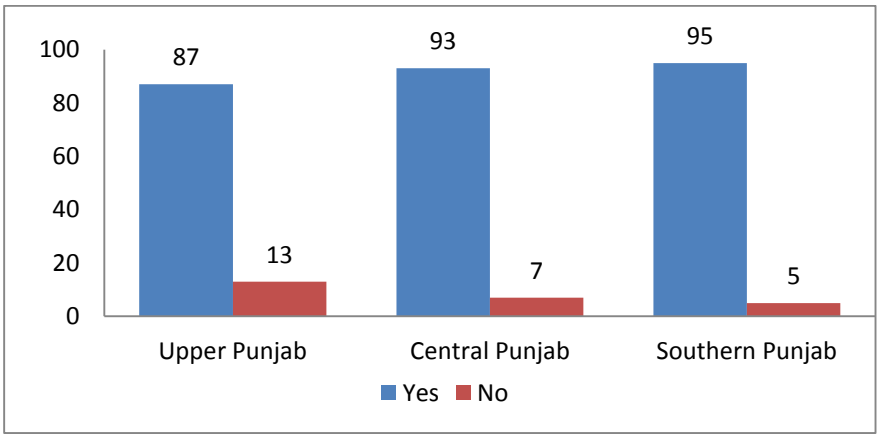


Figure 4.6 Usage of disc harrow

District-wise usage of disc harrow is given in the following table:

Table 4.8 District-wise usage of disc harrow

Name of District			Frequency	Percent	Valid Percent	Cumulative Percent
Attock	Valid	No	5	14.3	14.3	14.3
		Yes	30	85.7	85.7	100.0
		Total	35	100.0	100.0	
Chakwal	Valid	No	3	12.0	12.0	12.0
		Yes	22	88.0	88.0	100.0
		Total	25	100.0	100.0	
Faisalabad	Valid	No	2	8.0	8.0	8.0
		Yes	23	92.0	92.0	100.0
		Total	25	100.0	100.0	
Multan	Valid	No	2	5.9	5.9	5.9
		Yes	32	94.1	94.1	100.0
		Total	34	100.0	100.0	
Muzaffargarh	Valid	No	1	3.6	3.6	3.6
		Yes	27	96.4	96.4	100.0
		Total	28	100.0	100.0	
Sheikhpura	Valid	No	4	6.3	6.3	6.3
		Yes	59	93.7	93.7	100.0
		Total	63	100.0	100.0	

4.1.2.3 Usage of seed drill

Seed Drill is used for sowing of wheat and other crops in rows. It maintains seed rate, ensures continuous dropping and proper placement of seed at desired depth. Following table depicts usage of seed drill by the respondents.

Table 4.9 Usage of seed drill

Usefulness	Upper Punjab		Central Punjab		Southern Punjab	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Yes	43	72	80	91	57	92
No	17	28	8	9	5	8
Total	**60**	**100**	**88**	**100**	**62**	**100**

The results give a picture that high usefulness of seed drill is found in the districts of southern Punjab while minimum in the districts of upper Punjab. 72 percent respondents from upper Punjab gave positive response regarding usefulness of seed drill. There were 91 and 92 percent of farmers satisfied from the usefulness of seed drill in districts of central and southern Punjab respectively.

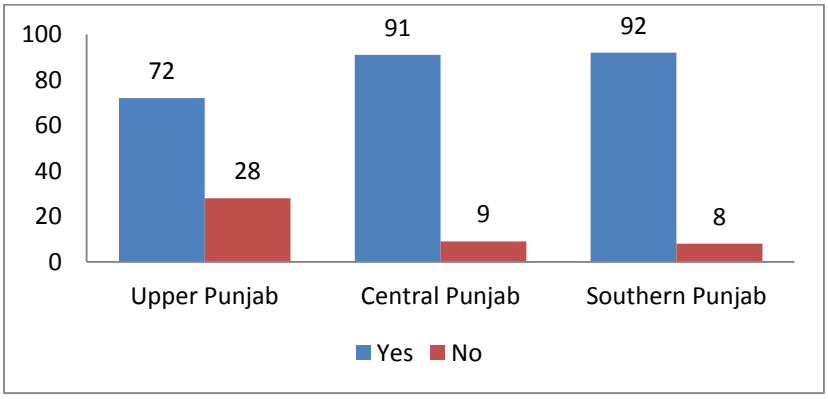


Figure 4.7 Usage of seed drill

District-wise usage of seed drill is presented in the following table:

Table 4.10 District-wise usage of seed drill

Name of District			Frequency	Percent	Valid Percent	Cumulative Percent
Attock	Valid	No	12	34.3	34.3	34.3
		Yes	23	65.7	65.7	100.0
		Total	35	100.0	100.0	
Chakwal	Valid	No	5	20.0	20.0	20.0
		Yes	20	80.0	80.0	100.0
		Total	25	100.0	100.0	
Faisalabad	Valid	No	1	4.0	4.0	4.0
		Yes	24	96.0	96.0	100.0
		Total	25	100.0	100.0	
Multan	Valid	No	3	8.8	8.8	8.8
		Yes	31	91.2	91.2	100.0
		Total	34	100.0	100.0	
Muzaffargarh	Valid	No	2	7.1	7.1	7.1
		Yes	26	92.9	92.9	100.0
		Total	28	100.0	100.0	
Sheikhpura	Valid	No	7	11.1	11.1	11.1
		Yes	56	88.9	88.9	100.0
		Total	63	100.0	100.0	

4.1.2.4 Usage of chisel plough

Chisel plough is a primary tillage implement. It is a multi-shank implement which is commonly used to break the hardpan which is often developed in the soil due to continuous functioning of shallow depth implements. The function of chisel plough is to rip, rupture or shatter the soils up to a depth of 24 inches. This implement is

useful in providing deeper pulverized root zone. The farmers are aware of the benefits of chisel plough which is used to break large clods that ultimately increase yield. It is also used as mulch tillage where crop residues are mixed up with the soil. Following table presents usage of chisel plough by respondents.

Table 4.11 Usage of chisel plough

Usefulness	Upper Punjab		Central Punjab		Southern Punjab	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Yes	49	82	73	83	50	81
No	11	18	15	17	12	19
Total	**60**	**100**	**88**	**100**	**62**	**100**

The results illustrate that 82 percent of respondents of upper Punjab are in favor of chisel plough whereas 83 percent of farmers from the districts of central Punjab are in favor of provision of this implements. The data represents that 81 percent farmers from southern Punjab were found satisfied regarding the use of chisel plough.

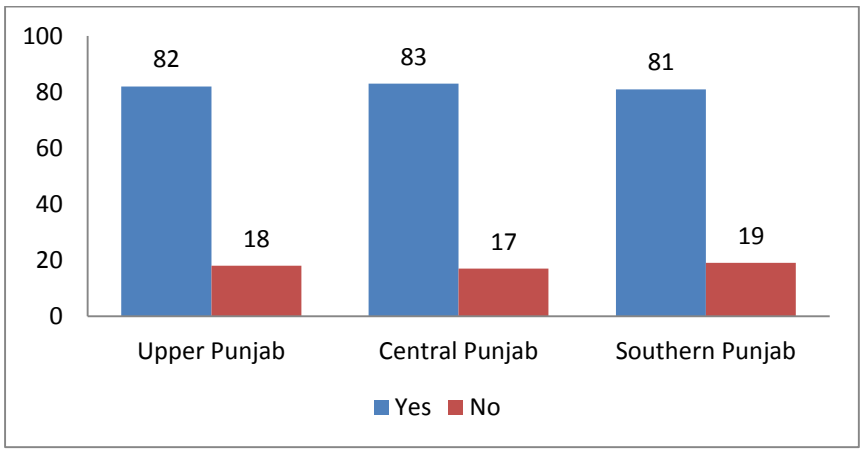


Figure 4.8 Usage of chisel plough

Table 4.12 District-wise usage of chisel plough

Usage of Chisel Plough

Name of District			Frequency	Percent	Valid Percent	Cumulative Percent
Attock	Valid	No	6	17.1	17.1	17.1
		Yes	29	82.9	82.9	100.0
		Total	35	100.0	100.0	
Chakwal	Valid	No	5	20.0	20.0	20.0
		Yes	20	80.0	80.0	100.0
		Total	25	100.0	100.0	
Faisalabad	Valid	No	6	24.0	24.0	24.0
		Yes	19	76.0	76.0	100.0
		Total	25	100.0	100.0	
Multan	Valid	No	6	17.6	17.6	17.6
		Yes	28	82.4	82.4	100.0
		Total	34	100.0	100.0	
Muzaffargarh	Valid	No	6	21.4	21.4	21.4
		Yes	22	78.6	78.6	100.0
		Total	28	100.0	100.0	
Sheikhpura	Valid	No	9	14.3	14.3	14.3
		Yes	54	85.7	85.7	100.0
		Total	63	100.0	100.0	

Respondents were of the view that rotavator, disc harrow and seed drill can be used successfully and seepage of water can be reduced which is necessary for good cultivation of crops. About 88% of respondents were of the view that implements given in the scheme were useful.

4.1.3 Impact of mechanization development project on the yield of major crops

Agriculture in Pakistan is supported by major crops namely wheat, rice, cotton, sugarcane and maize which comprises about 24% of the value addition in general and 4.67% in national GDP.

4.1.3.1 Wheat

Wheat is used as a staple food in Pakistan and its share in GDP is about 1.9 percent and 9.6 percent in the value addition (GOP, 2017). The research also depicts that mechanization plays a considerable job in the increase of wheat yield (Ahmad et al., 2015; Bashir et al., 2010; Jan et al., 2017). In rustic areas of Pakistan, majority of the small land holders grow wheat for their survival (Asim et al., 2015). In the study area, the farmers produce wheat for their domestic use and to earn money as well. Wheat crop is vital food for the population and it has remained at a fundamental place in agricultural policies of each government in Pakistan.

Table 4.13 Mean increase in the yield of wheat crop

Name of district	Mean increase (mounds per acre)
Attock	3.029
Chakwal	2.429
Faisalabad	1.4
Sheikhpura	2.886
Multan	1.857
Muzaffargarh	1.771

Table presents the increase in yield of wheat crop in sample districts. It is evident that maximum increase is 3.029 mounds per acre in district Attock whereas increase in yield of wheat in district Faisalabad is minimum 1.400 mounds per acre. It is also evident that increase in yield of wheat crop is 2.886 mounds in Sheikhpura, 2.429 mounds in district Chakwal, 1.857 mounds in Multan and 1.771 mounds per acre in district Muzaffargarh. The data shows that the yield of wheat crop in all districts has increased by the use of mechanization.

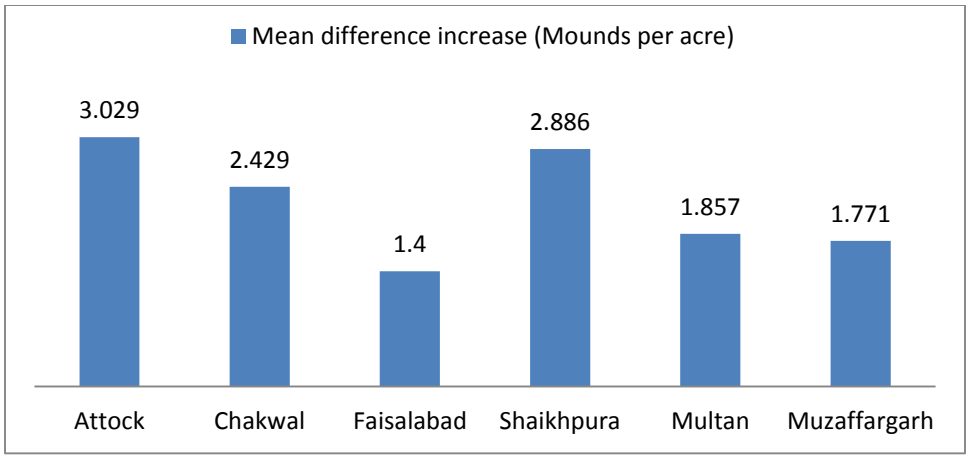


Figure 4.9 Mean increase in the yield of wheat crop

4.1.3.2 Rice

Rice crop is also imperative food crop after wheat and a major source to get foreign exchange after cotton in Pakistan. Pakistan is the 4th largest rice producer in the world. Rice adds 0.6% in GDP and makes up 3.1% value addition in agriculture sector.

Table 4.14 Mean increase in the yield of rice crop

Name of district	Mean increase (mounds per acre)
Sheikhpura	1.886
Faisalabad	3.5

Table shows that rice crop is cultivated majorly in Sheikhpura and Faisalabad districts from the sampled districts. The mean increase in yield per acre is 1.886 mounds in district Sheikhpura whereas 3.500 mounds in Faisalabad per acre.

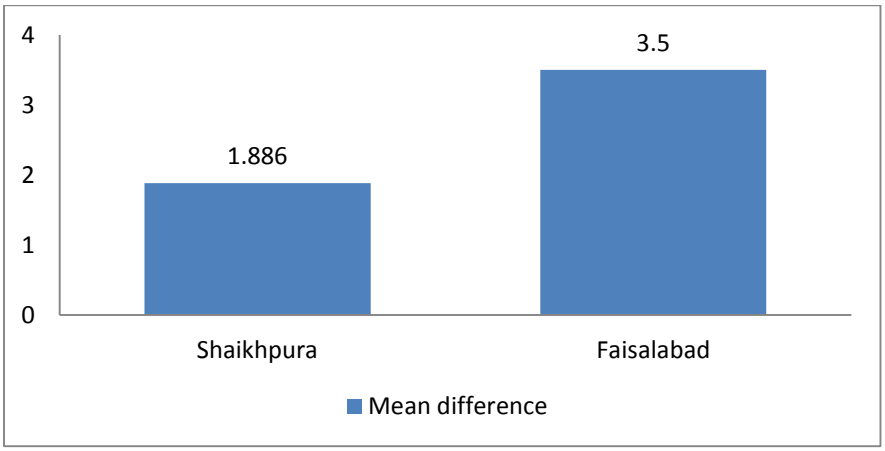


Figure 4.10 Mean increase in the yield of rice crop

4.1.3.3 Cotton

Cotton crop is the core cash and fiber crop of Pakistan. Pakistan is the 4th largest producer and 3rd largest consumer of cotton. The cotton industry of Pakistan plays a pivotal role in its economy. It possesses a significant role in the foreign exchange

earnings for the country. It contributes 55% in the resources of earning, 8.2% in the value addition and 2% in GDP of the country. Cotton provides raw material to textile industry which contributes 46% to the total manufacturing and 40% to the employment. Pakistan is the 3rdlargest exporter of raw cotton and its share in the global textile industry is about 9%.

Table 4.15 Mean increase in the yield of cotton crop

Name of district	Mean increase (mounds per acre)
Faisalabad	2.5
Multan	1.586
Muzaffargarh	1.586

Multan and Muzaffargarh are the major cotton crop districts whereas cotton is cultivated in some areas of district Faisalabad also. The data collected from the respondents shows that the impact of mechanization project is more on the yield of cotton in district Faisalabad as compared to others. The mean increase in yield of cotton per acre is more in District Faisalabad 2.500 mounds whereas in increase in yield 1.586 is same in both other districts.

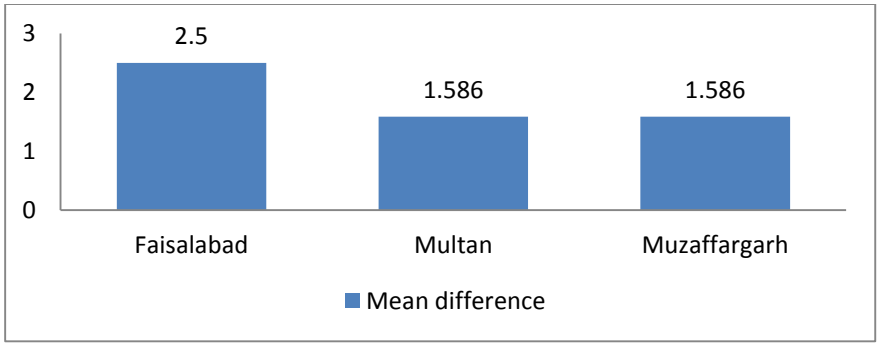


Figure 4.11 Mean increase in the yield of cotton crop

4.1.3.4 Maize

Maize crop is also consumed as food crop and numerous other processed products are manufactured from it. It gives about 2.2% in value addition in agriculture and around 0.4% in GDP. Maize is also cultivated as imperative commercial crop in Pakistan. Pakistan is the 4th largest producer of maize. Maize food is not merely consumed by human but also used to manufacture feed for livestock in addition to poultry along with extraction of edible oil.

Table 4.16 Mean increase in the yield of maize crop

Name of district	**Mean increase (mounds per acre)**
Attock	2.75
Chakwal	4
Faisalabad	4.333
Multan	4.75
Muzaffargarh	4.5

Maize crop is partially cultivated in all sampled districts of the study. However the data given in the above table shows that there is an increase in yield of maize crop in all sample districts. One district each in upper and central Punjab and both districts in southern Punjab show mean increase per acre in more than 4 mounds whereas only 2.75 mounds per acre increase in district Attock.

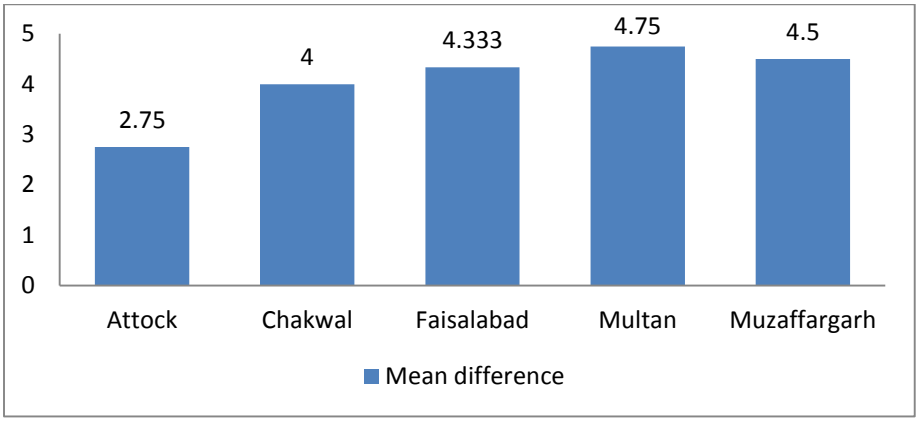


Figure 4.12 Mean increase in the yield of maize crop

4.1.3.5 Sugarcane

Sugarcane crop is also highly significance cash crop and fundamental for sugar industry in Pakistan. It has considerable impact on economy of the country. Sugarcane is the second largest cash crop of Pakistan which contributes about 3.6% in GDP of the country. Pakistan is the 5th largest producer of the sugarcane in the world.

Table 4.17 Mean increase in the yield of sugarcane crop

Name of district	**Mean increase (mounds per acre)**
Faisalabad	24
Multan	40
Muzaffargarh	32

The result shows that sugarcane crop is majorly cultivated in only three districts of study area. There is an increase in yield of sugarcane crop in all districts. There is maximum increase in the yield of sugarcane i.e. 40 mounds in district Multan whereas 32 mounds in Muzaffargarh and only 24 mounds per acre in Faisalabad district.

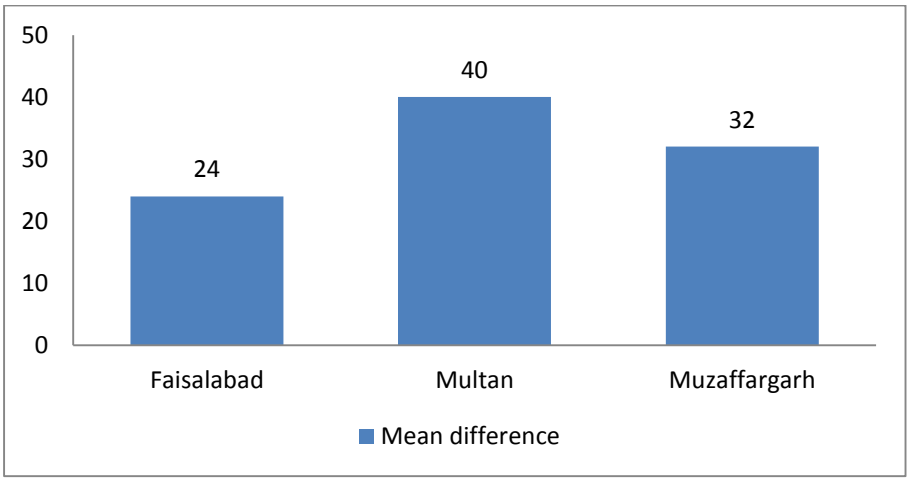


Figure 4.13 Mean increase in the yield of sugarcane crop

4.1.4 Paired Samples Test

Table 4.18 Paired samples test

Paired Samples Test

		Paired Differences					T	Df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Yield of Wheat after - Yield of Wheat before	2.181	3.207	.221	1.745	2.617	9.856	209	**.000**
Pair 2	Yield of Rice after - Yield of Rice before	2.026	1.547	.248	1.524	2.527	8.176	38	**.000**
Pair 3	Yield of Cotton after - Yield of Cotton before	3.014	2.619	.309	2.398	3.629	9.765	71	**.000**
Pair 4	Yield of Maize after - Yield of Maize before	4.056	1.162	.274	3.478	4.633	14.811	17	**.000**
Pair 5	Yield of Sugarcane after - Yield of Sugarcane before	30.769	18.010	4.995	19.886	41.653	6.160	12	**.000**

Survey results present that there is a considerable enhancement in yield of all major crops. The mean increase in the yield of sugarcane is maximum i.e. 30.769 mounds followed by maize 4.056 mounds and cotton3.014 mounds per acre. Whereas mean increase in wheat and rice crops are minimum i.e. 2.181 mounds and 2.026mounds per acre.

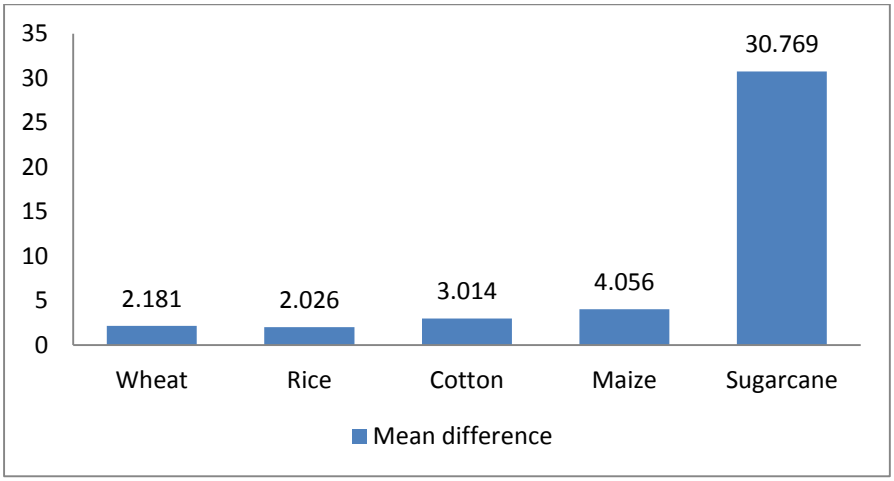


Figure 4.14 Mean increase in the yield of major crops

4.1.5 Regression analysis of demographic and technological factors on the yield of wheat crop

Regression analysis is a form of inferential statistics. The p-values help to determine whether the relationships observed in sample also exist in the larger population or not. The p-value for each independent variable tests the null hypothesis that the variable has no correlation with the dependent variable. If there is no correlation, there is no association between the changes in the independent variable and the shifts in the dependent variable. The p-values for the coefficients indicate whether these relationships are statistically significant or not? On the other hand, p-value that is greater than the significance level, indicates that there is insufficient evidence in the sample to conclude that a non-zero correlation exists. The sign of a regression coefficient tells whether there is a positive or negative correlation between each independent variable and the dependent variable. A

positive coefficient indicates that as the value of the independent variable increases, the mean of the dependent variable also tends to increase. A negative coefficient suggests that as the independent variable increases, the dependent variable tends to decrease.

Table 4. 19 Regression analysis

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.766	.324		2.361	.019
	Age of Farmer	-.029	.005	-.169	-6.261	.000
	Education	.071	.020	.068	3.539	.000
	Farming Experience	.019	.047	.007	.393	.694
	Use of Fertilizer	.064	.040	.023	1.585	.115
	Technical Knowledge	.687	.046	.625	15.095	.000
	No. of Implements	**.066**	**.028**	**.054**	**2.376**	**.018**
	Use of Certified Seed	.101	.043	.035	2.345	.020
	Farming Size	.092	.034	.083	2.727	.007
a. Dependent Variable: Increase in yield of wheat crop						

Table shows the relation of variables on which yield of wheat crop depends. Age of farmer, education level, technical knowledge, use of farm machinery, use of certified seed and size of farm have significant impact on the yield of wheat crop. Data also indicates that use of chemical fertilizer and farming experience of the respondents has no significant impact on the production of wheat crop in sampled districts.

4.2 Discussion

The results of the study have depicted that age of farmer has negative impact on the production crops, which indicates that the aged farmers are less active and take less interest in modern farming practices and adoption of advanced technology. The education level of farmer also has significant impact, as educated farmer have more vision regarding innovative technologies and farm practices. Use of certified seed has also a great impact on the production, as certified and hybrid seeds are more vigorous and have more yield capacity as compared to domestic seeds.

Moreover, the educational level of the farmer not only increases the efficiency of the farmers but also enhances their ability to understand and adopt innovative farming techniques. More germination rate and more number of spikes per plant of wheat produce more yield. Moreover, it is considered that farmers who had more experience of farming might be more efficient and productive through trial and error (Olagunju & Adeyemo, 2007). Level of contacts with the agricultural extension staff has a positive impact on the use of implements and ultimately the farm yield. It has been observed that there is greater adoption of innovative techniques and practices at farms where there are frequent visits of extension agents.

It has been observed that the farmers which have large size farms are more modern, more progressive and have innovative agricultural machinery at their farms; whereas the small farmers are not able to purchase the latest farm machinery due to low economic power. It has also been observed that tractor owners and farm

implements operators mostly avoid long traveling to plough a few acres of a small farmer. This behavior of machinery owners has becomes a substantial obstacle especially for small land holders to get access to the tractor services at their farms in time.

The experience of an individual plays a significant role in the performance wherever he or she works, especially the technical works where experience is required. Similarly the experience of farming is of vital for performing agricultural practices and operating the agricultural machinery in the field.

Owning implements help farmers for proper land development and seed bed preparation in time. Moreover, availability of farm machines motivates the farmers to purchase improved seed varieties, pesticides and fertilizers. Results of study show that more access to agricultural machinery has helped to expand their farms along with facilitating farmers to overcome their labor constraints at peak seasons. The reason is that farm operations and practices are completed in time by the use of machinery, which conserves available moisture in the soil, better land preparation, increases in the efficiency of applied inputs which ultimately increases the yield of cultivated crop.

The mechanized farmers invest more in purchasing improved varieties and chemical fertilizers, therefore they get high yield of wheat crop. These results are similar to the findings of Ahmad et al. (2015); Hussain et al. (2012) and Saqib et al., (2016). Likewise, the main agronomic practices and use of improved inputs have positive and significant impact on the yield of wheat crop as depicted in

regression analysis. The results of this study are analogous to the results of Bashir et al., (2010); Buriro et al., (2015) and Ogundari (2008).

Most of the farmers were of the view that level of soil fertility has increased by farm mechanization. By the adoption of mechanization at farm the animal draft power has been decreased. Some respondents were of the view that they have started to use undue chemical fertilizers instead of compost, which have created toxicity in soil. Mechanization puts an immense impact on socio-economic situation characteristics of the farming community and environment of the country. It enhanced farm productivity by the judicial use of available inputs. In addition, it reduced the human labor and enhances the yield.

The results of the study have also depicted that the farmers which have got implements in the study scheme have more contact with extension staff of agriculture department, which gave updated information about new seeds, new techniques of sowing, use of pesticides and advanced methods of weeds eradication. So it is concluded that all these factors have contributed in the yield of wheat crop. The data have also depicted that farming experience of the respondents and use of chemical fertilizer has no significant impact on the yield of wheat crop.

4.3 Conclusion

The association of agriculture sector is significant for the development of Pakistan. Agriculture plays a prominent role in the economy as well as it is the core source for the economic growth of Pakistan. However, it is facing issues such as stumpy

production, food insecurity, incompetent management and complex agriculture system. Due to low per acre yield of its major crops, Pakistani agricultural produce could not compete at international markets. Therefore, public as well as private sector should be harmonized to bring improvement in agriculture sector. The use of modern and advanced technologies is need of the day to strengthen agriculture sector.

Subsistence farming in Pakistan can be converted into commercial farming by means of diffusion of modern, efficient and cost effective technology in the farming system. It does not merely increase on-farm income and labour efficiency but in addition to generate off-farm employment opportunities in manufacturing, supply and repairing of agricultural machinery as well. Mechanization possesses generally encouraging results on the growth of rural areas. Selective use of machinery should be adopted so that it can increase technical efficiency of small land holders by the increase of labour and land productivity.

Furthermore, there is an immense scope for the development of agricultural department to introduce more projects for promotion of mechanization. Agro industries corporations, private machine owners and co-operative societies may introduce custom hiring centers, so that small farmers can use the farm machines on payment basis. Agricultural machinery exhibitions may also be held to encourage the farming community to know about innovative techniques, advanced technologies and the importance of farm mechanization (Shoba et al., 2018).

The analysis of this study has confirmed that farming operations and practices have been improved due to timeliness of operation and improved efficiency by the use of implements which ultimately increase the yield of major crops. Therefore, it has been concluded that Agricultural Mechanization Development Project brought significant improvement in the yield of major crops in all districts of Punjab province. Data of the study have depicted that more access to agricultural implements has helped the farmers to overcome their labor constraints at peak seasons. The reason is that farm operations and practices were completed in time by the use of machinery, which conserved available moisture in the soil, did better land preparation and increased efficiency of applied inputs which ultimately increased the yield of cultivated crops.

In addition, mechanized farmers have invested extra to purchase improved varieties and other farm inputs, consequently they get high yield of their crops. The results of this study are analogous to the findings of Ahmad (2015); Bashir (2010); Buriro (2015); Hussain (2012); Jaforullah (2008) and Saqib (2016). Therefore, Agricultural Mechanization and such other programs can be considered as an efficient tool to fight against poverty and develop socio-economic level and income generating activities among farming communities. By considering the current paradoxical economic situation of the country in addition to internal and external challenges, dependency on agriculture segment will promote the cadence of national development. Thus an instant action is required to hasten the productivity and profitability of agriculture quarter both in horizontal and vertical directions.

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Questionnaire

(Thank you for participating in this survey. The purpose of this study is to assess the impact of Agricultural Mechanization Development project on the yield of major crops and farmers' demographic characteristics along with technological factors on the yield of wheat crop in Punjab)

Date of interview:		Time of interview:	
Location:		Name of District:	

1.	Name of the Respondent	
2.	Contact No.	
3.	Age of respondent	
4.	Education Level	
5.	Farming experience	
6.	Size of land holding	

Please provide your opinion on the following questions based on your experience and select any one from the five given options:

1-Strongly Disagree, 2-Disagree, 3-Neutral, 4-Agree, 5-Strongly Agree

		1	2	3	4	5
7.	Do you think that farming experience has impact on yield of wheat crop?					
8.	Do you think that age of farmer have impact on yield of wheat crop?					
9.	Do you think that off-farm source of income have impact on yield of wheat crop?					
10.	Do you think that educational level of farmer has impact on yield of wheat crop?					
11.	Do you think that family size of farmer have impact on yield of wheat crop?					
12.	Do you think that size of land holding has an impact on yield of wheat crop?					
13.	Do you think that use of implements has impact on yield of wheat crop?					

14.	Do you think that use of chemical fertilizer has impact on yield of wheat crop?					
15.	Do you think that technical knowledge of farmer has impact on yield of wheat crop?					
16.	Do you think that use of certified seed has impact on yield of wheat crop?					
17.	Do you think that availability of labour has impact on yield of wheat crop?					
18.	Do you think that use of pesticides have impact on yield of wheat crop?					
19.	Do you think that availability of credit has impact on yield of wheat crop?					
20.	Do you think that visits of Extension staff have impact on yield of wheat crop?					
21.	Do you think that availability of irrigation water have impact on yield of wheat crop?					
22.	Do you think that size of land holding have impact on yield of wheat crop?					

	Major Crops	**Yield before project (mounds/acre)**	**Yield after project (mounds/acre)**
23.	Wheat		
24.	Rice		
25.	Cotton		
26.	Maize		
27.	Sugarcane		