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The Impact of Agricultural Mechanization Development Project on the Yield of Wheat Crop: A Case Study of Punjab, Pakistan

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Abstract

A traditional method known as iron triangle (time, cost, quality) was used to evaluate the success of projects in the past. A project was assumed to be successful if it had been completed within time, did not overrun its allocated budget and its outcomes satisfied the predetermined criteria. However, to evaluate the impact of any project considering merely its success is not enough, the impact of its product should also be appraised. Therefore, this study was conducted to evaluate the effectiveness of the program “Agricultural Mechanization Development Project” recently implemented in Punjab, Pakistan. For this purpose, Punjab province was categorized into three zones on the basis of agro-climatic conditions. Two districts were randomly selected from each zone. Face to face structured interviews were conducted to collect primary data from beneficiary farmers (n=210). Regression analysis was applied to evaluate the significance of mechanization. The research findings revealed that improvement in technical efficiency through the use of agriculture mechanization program has a significant effect on the production of wheat crop. It is suggested here that ‘Agricultural Mechanization’ and other such programs ought to be considered efficient tools to fight poverty, bring improvement in socioeconomic conditions and promote income generating activities among rural communities.

Keywords: Agricultural Mechanization Development Project, project success, yield of wheat crop

Introduction

Agriculture contributes about 19% in Pakistan’s GDP and it has an annual growth rate of 3.81%. Agriculture provides employment for 42.3% of the urban labor force and 62% of the rural population (Pakistan Ministry of Finance, [2018](#)). It significantly contributes to the Pakistan economy including food security, poverty reduction, and revolution in the agro-based industrial sector.

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In Agriculture sector, major crops are wheat, rice, sugarcane, cotton and maize. The contribution of these major crops in the country's GDP is about 7%. Pakistan is the 9th largest wheat producing country in the world. Despite its importance, agricultural production in Pakistan is less than other countries of the world. In Pakistan, the yield of sugarcane is 40% lower, the yield of wheat and cotton is 20% lower, the yield of rice is 40% lower and milk production per animal is 90% lower than the global benchmark (Pakistan Bureau of Statistics, [2018](#); Pakistan Ministry of Finance, [2018](#); Iqbal et al., [2015](#)). A core reason behind low agricultural productivity in Pakistan is the lack of farm mechanization (Iqbal et al., [2015](#)).

Moreover, several agricultural scholars have concluded that the problem of low productivity could largely be related to low technical efficiency (Amare & Endalew, [2016](#); Verma, [2008](#)). Agricultural production can be improved with better seed bed preparation, managing the timeline of operations and precision in the distribution and placement of seed and fertilizer. In Pakistan, farmers continue to practice the traditional farming methods with very little technical and management improvements (Badar et al., [2007](#)). The comparison of farm power used per acre in Pakistan and neighboring countries is given in Table 1 below (Iqbal et al., [2015](#)).

Table 1

Comparison of Horsepower used Per Hectare

| Countries | Horsepower 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 |

Keeping in view the current perspective of farm mechanization, Punjab government devised a policy to establish centers for the development of rural areas. Various development projects such as the “Green Tractor Scheme”, provision of laser land leveler units and the distribution of improved seed among the farming community in Punjab played a significant role in boosting agricultural production in the province.

In the same way, “Agricultural Mechanization Development Project” was implemented during 2015-16 and 2016-17 to strengthen the agriculture sector. The aim was to provide tools namely rotavator, disc harrow, seed drill and chisel plough to farmers at 50% subsidized rates in order to augment farm productivity and profitability. It is apparent that in spite of the huge investment, the development sector projects are criticized mostly in developing countries. They are often completed behind the planned schedule, overrun cost and mostly do not achieve the set objectives (Khan et al., [2013](#)).

However, in the current scenario, project success should not be viewed merely within the narrow domain of time, cost and scope (Baccarini, [1999](#)). Project success is a multidimensional construct that includes both short term (project management success) and long term achievements of the project by measuring its effectiveness and impact on project beneficiaries (product success) (Johari, [2010](#); Müller & Jugdev, [2012](#)). Agriculture Mechanization Development Project was executed in Punjab while fulfilling the basic criteria of project success, that is, it was completed within its allocated time and budget. However, recent studies have argued that the traditional way of measuring project success is not enough. Indeed, it is imperative that the performance of this development project may be assessed based on a more holistic preview.

Literature Review

Iqbal et al. ([2015](#)) stated that agricultural mechanization involves the use of machines for the development of land, land reclamation, sowing of crops, harvesting of crops, threshing of crops, watering of fields, removal of weeds, application of pesticides and other such farm activities. Actually, mechanization is the use of machines to complete farm operations in time, which ultimately increases the yield, reduces the cost of production, crop losses and improves the quality of the product.

Adnan et al. ([2015](#)) argued that farm mechanization is based on technological expertise to ensure augmentation in productivity through managing the field operations and improving the quality of grains. The study also revealed that agricultural mechanization helps farmers to fight soil erosion, land degradation and also helps them in effective land preparation to cultivate the crops (Maurice et al., [2017](#)). Rehman et al. ([2015](#)) conducted a study in wheat farming areas which manifested that the yield of wheat and gross margin of profit was higher in mechanized areas as compared to traditional farming areas, whereas variable cost was higher in traditional farming.

Ali et al. (2018) found that effective and accessible farm mechanization is liable to contribute in agriculture and economic revolution. Farm mechanization has succeeded over the poorly planned systems in past that were unsuccessful to appraise demand and relatively abandoned by 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 road construction. The provision of agricultural machinery and equipment through improper government schemes is ineffective for the production growth of agriculture sector. However, forced farm mechanization is mostly linked with the displacement of tenants and local labor in conjunction with environmental deterioration. The demand of agricultural mechanization varies both within and across the countries, depending on the socioeconomic characteristics of the farming community, population density, prevailing agro-ecological conditions and market access.

Ghosh (2010) stated that farm mechanization depends on a number of demographical, socioeconomic and agronomical factors. Efforts should be made to strengthen these factors for the efficient use of modern farm machinery. Local customs, conventional habits, age of the farmer, lack of financial support from the government, less technical support from agro-based services, low literacy rate and the lack of support from credit providing institutions are major hurdles in properly benefiting from the use of modern farm machinery, especially for small and medium farmers. The above research concluded that the younger generation of farmers is more willing to accept and use modern techniques and machines at their farms. Ground realities demand the renewal and expansion of innovative institutions such as financing agencies, cooperatives and self-help to provide financial and technical support for small and marginal farmers, so that they may benefit to the maximum from modern mechanization in the agriculture sector.

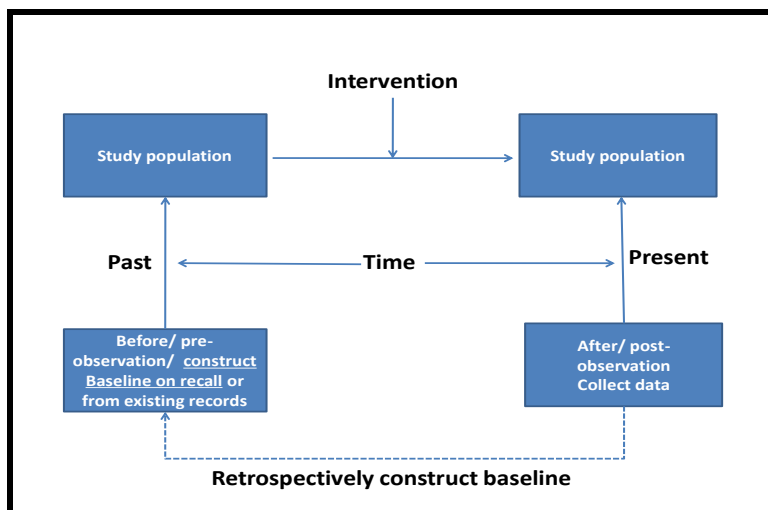
Materials and Methods

A survey was used to collect data related to the production of wheat crop in Punjab. Moreover, data was collected regarding the demographic characteristics of farmers and the effect of technological factors on the yield of wheat crop. A structured, pre-tested and validated questionnaire was used for the collection of the required information.

Non-experimental research design was used in this study. This design is mostly used to carry out by impact studies as recommended by the World Bank in which the comparison of a situation is made before and after the implementation of the intervention as depicted in Figure 1.

Figure 1

Pre/Post Intervention Impact



The population of this study was not homogenous all over the province because of the variations in socioeconomic conditions, size of land holding and the nature of crop cultivation. Hence, stratified random sampling technique was used. In this method, the heterogeneity in the population is reduced to achieve greater accuracy in estimates. Proportionate stratified sampling was applied in which the number of elements from each stratum was selected in relation to its proportion in the total population as depicted in Table 2.

Table 1

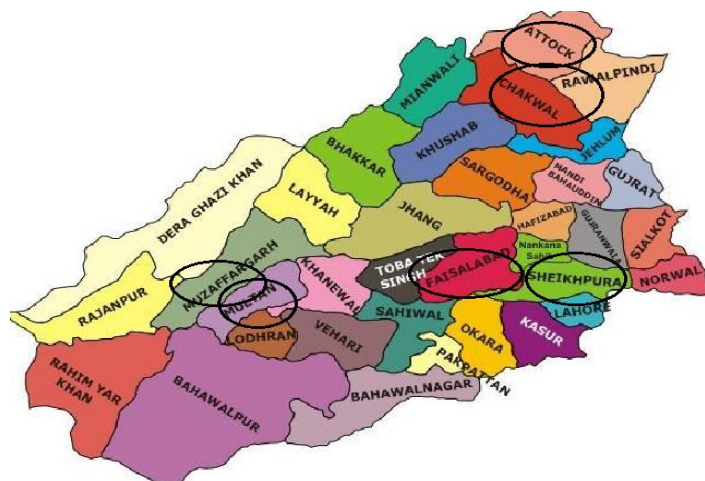
Breakdown of the Sampled Districts of the Study

| No. | Zone | District | Total No. of Respondnets | Sampled Proportion | No. of Sampled Repondents |
|-------|---------------|--------------|--------------------------|--------------------|---------------------------|
| 1. | Barani | Attock | 41 | 0.17 | 35 |
| 2. | zone | Chakwal | 29 | 0.12 | 25 |
| 3. | Mixed | Sheikhpura | 73 | 0.30 | 63 |
| 4. | cropping zone | Faisalabad | 29 | 0.12 | 25 |
| 5. | Cotton | Muzaffargarh | 32 | 0.13 | 28 |
| 6. | zone | Multan | 39 | 0.16 | 34 |
| Total | | | 243 | | 210 |

Wheat crop is cultivated all over the Punjab. Accordingly, the province was divided in three zones labelled as zone one (barani zone), zone two (mixed cropping zone) and zone three (cotton zone), as depicted in Figure 2. Six districts were randomly selected, two from each zone, including Attock, Chakwal, Sheikhpura, Faisalabad, Multan and Muzaffargarh.

Figure 2

Breakdown of Zones in District Punjab



At 95% confidence level, 201 responses that are 15% of the total population of study sample were derived using the rule of thumb. Data was collected through interviews from randomly selected beneficiary farmers. The reliability of the instrument was tested by applying reliability statistics. The value of Cronbach's alpha was 0.963 as depicted in Table 3. Face validity was verified by agriculture experts, whereas content validity was verified by pre-testing of the questionnaire.

Table 3

Reliability Statistics

| Cronbach's Alpha | Cronbach's Alpha Based | |
|------------------|------------------------|-------------|
| | on Standardized Items | No of Items |
| .963 | .963 | 11 |

In the first part of the questionnaire, the socioeconomic characteristics of farmers were assessed. In the second part, the usefulness of the given implements

was assessed through descriptive analysis. In the third part, paired *t*-test was applied to estimate the impact of the development scheme on the yield of wheat crop. Finally, in the last part, the relationship between the demographic characteristics of farmers and technological factors and its impact on the yield of wheat crop was assessed by applying regression analysis.

Results

Table 4

Paired Samples Test

| | Mean | Std. Deviation | Paired Differences | | T | Df | Sig. (2-tailed) |
|--|-------|----------------|--------------------|---|-------|-----|-----------------|
| | | | Std. Error | 95% Confidence Interval of the Difference | | | |
| | | | | Lower Upper | | | |
| Yield of Wheat after - Yield of Wheat before | 2.181 | 3.207 | .221 | 1.745 2.617 | 9.856 | 209 | .000 |

Table 5

Coefficients

| Model | B | Unstandardized Coefficients | | T | Sig. |
|-----------------------|-------|-----------------------------|-------|--------|------|
| | | Std. Error | Beta | | |
| (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 |

Note. a. Dependent Variable: Increase in the Yield of Wheat Crop

Discussion

The results revealed that there was a significant increase in the yield of wheat crop through the implementation of agricultural mechanization project. The mean increase was 2.181 mounds per acre. The study depicted that the 'Agricultural Mechanization Development Project' had a positive impact on the yield of wheat cultivated in the Punjab province.

Moreover, the survey predicted that the yield of wheat crop depended on diverse factors such as the age of farmer, educational level of farmer, size of land holding, farming experience, use of farm machinery, use of certified seed and use of chemical fertilizers. The results showed that education, technical knowledge, use of farm implements, certified seed and size of farm had a positive and significant impact. However, the age of farmer had a negative impact on the yield of wheat crop; a finding was also supported by other researchers (Ghosh, [2010](#); Lamidi & Akande, [2013](#); Maurice et al., [2017](#); Owombo et al., [2012](#); Rasouli et al., [2010](#); Yamin et al., [2011](#)). Moreover, the results indicated that the use of chemical fertilizer and farming experience of the farmers had no significant impact on the production of wheat crop in the sampled districts of the Punjab province.

It is evident from the results that the educational level of farmers not only develops their efficiency but also enhances their ability to understand and adopt innovative farming techniques and practices. Better seed bed preparation through the use of machinery enhances the germination rate and the number of spikes per plant, which ultimately increases per acre yield of the wheat crop (Amare & Endalew, [2016](#))

It is also apparent from the results that the age of farmer had a negative impact on the yield of wheat crop which indicates that aged farmers are less active and take less interest in the adoption of modern farming practices and advanced technology. Contrarily, the educational level of farmers had a positive and significant impact due to the fact that educated farmers tend to have a broader vision regarding innovative technologies and farm practices. Additionally, the use of certified seeds had a significant impact on the production of wheat due to the fact that certified and hybrid seeds have more vigor and a greater yield capacity as compared to domestic seeds (Badar et al., [2007](#)).

The results of this study manifested that the use of farm machinery had an enormous impact on the yield of wheat crop. It stipulates that greater access to agricultural machinery assists farmers in farm expansion and also facilitates them

to overcome labor constraints during peak crop seasons. Resultantly, farm operations and practices are completed in time through the use of farm machinery, which conserves the moisture available in the soil. Better land preparation increases the efficiency of applied inputs which ultimately increases the yield of wheat crop (Hormozi et al., [2012](#); Amare & Endalew, [2016](#)). It is apparent that mechanized farmers are relatively more vibrant and invest more in purchasing improved seed varieties; therefore, they get a high yield. Similarly, mechanized agronomic practices and the use of improved inputs had a positive and significant impact on the yield of wheat crop which is analogous to the results of various studies (Akdemir, [2013](#); Amare & Endalew, [2016](#); Lamidi & Akande, [2013](#); Thepent & Chamsing, [2009](#); Owombo et al., [2012](#); Rahman et al., [2011](#); Rizwan et al., [2017](#); Verma, [2008](#); Yamin et al., [2011](#)).

Besides, it is worth mentioning that the level of farmers' contacts with the staff of agricultural extension during project execution increased the awareness pertaining to farm machinery, technical knowledge, innovative technology, improved seed varieties, new techniques of crop sowing and advanced methods to eradicate weeds, which ultimately led to increased farm production. It was also observed that there was greater adoption of innovative techniques and practices at farms where there were frequent visits of extension agents. Therefore, an amalgam of all these factors contributed in the greater yield of wheat crop (Khan, [2017](#); Owombo et al., [2012](#)).

Conclusion and Recommendations

The analysis proved that farming operations and the practices of respondent farmers were improved by meeting the timelines of operations. Improvement in technical efficiency through the use of farm machinery provided in the development scheme increased the yield of wheat crop. The use of farm machinery had a positive impact on the production of wheat crop in the study area which depicts that greater access to agricultural machinery helped farmers to overcome their labor constraints during peak seasons. This was due to the fact that farm operations and practices were completed in time through the use of machinery which conserved the moisture available in the soil, warranted better land preparation and increased the efficiency of applied inputs, which ultimately increased the yield of crops.

It is concluded here that 'Agricultural Mechanization Development Project' had a significant impact on the yield of wheat crop. Therefore, this project and other such programs ought to be considered efficient tools to fight poverty, improve socioeconomic status and enhance income generating activities among

rural communities. Keeping in view the current paradoxical economic situation of the country as well as internal and external challenges, dependency on the agriculture sector will further increase in order to improve the pace of national economic growth. Therefore, immediate actions are required to accelerate the productivity and profitability of this sector, both in horizontal and vertical directions. Moreover, the government of Punjab province should devise a comprehensive agricultural mechanization policy. Various programs and projects may be initiated in collaboration with different research and training institutes to enhance awareness about farm mechanization among the farming communities.

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