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THE RELATIONSHIP BETWEEN TECHNOLOGY AND CROP YIELD: EVIDENCE FROM PAKISTAN

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ABSTRACT-The objective of this research paper is to study the relationship between agricultural technology and crop yield in Pakistan. Time series data for the period of 1981 and 2916 was used and Regression Model were applied to analyze data. Our statistical results show that new agricultural technologies have significant positive relationship with crop yield in short-run and long-run. Therefore, Government should introduce new technologies in agriculture sector to improve its productivity.

Keywords: Agricultural productivity, crop area, water availability, Seed.

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1. INTRODUCTION

1.1. Overview of Agriculture sector:

Since 1947, the biggest economic sector of Pakistan is agriculture and its share in GDP was 60%, which now has reduced to around 26% due to expansion of industry.Third and fourth generation technologies significantly contributed into agriculture production. Growing population has been increasing demand of food items. Now the modern age has changed the concept of old agriculture farming. Old concepts and techniques will become obsolete. Modernization had not possible without the using of fourth generation technique in agricultural sector. Agricultural productivity of Pakistan mainly depends upon the availability of water in time. There are few important crops such as wheat, rice, sugarcane, maize and cotton have 23.60 percent value addition of 23.60 in agriculture and 4.45 percent in GDP. All other crops are contributed 10.8 percent as a value addition in agriculture and 2.04 percent in GDP. As agriculture is one of the main sector the strength of the economy is at risk if it does not perform well. Agriculture production can be improved by the use of modern technology. The introduction of latest technologies and awareness as well as using them by farming are necessary for enhancing crop yield, which has been stagnant since long.

As a developing country, Pakistan has faced many problems due to climatic change. This can be highlighted by the example of flood 2010. There are few crops like sugarcane, wheat, rice and maize which poorly affected by this flood. Climate change has badly affected to Pakistan agriculture sector. The climatic change also badly affects the productivity of agriculture sector

and profitability of farmers. This is also one of the reason of high level of poverty in the rural areas because more than 42 percent population are attached with agriculture profession and their income depends upon it. In other countries private-public ownership contributed into high production of agriculture crops but this is not common in Pakistan. Use of tractor and information technology are also common in other countries. Information technology helps farmers to maintain record of their crop production and enable them to make cost and benefit analysis.

1.2 Main Research Problem:

Main research problem of this study is to find out the impact of technology on the crops yield in Pakistan.

1.3 Objective of study:

The objectives of this research paper are listed below:

1. To find out the causes of variations in agriculture productivity.
2. To investigate long run relationship between agricultural technology and agricultural productivity.
3. To suggest some policies to improve level of economic growth and to reduce poverty in Pakistan.

1.4 Significance of the research:

This research is significant in terms of its theoretical and practical contribution to the existing body of knowledge. A lot of work has already been done on this topic but there is sufficient space to conduct further research on it. We do hope that this research study will be helpful for policy makers to increase the crop yield by the technological factors. This study will also useful for research.

2. LITERATURE REVIEW:

Abbas, A, et al (2018) illustrate that food security is an important factor of agricultural sector for the improvement of Pakistan economy. In this paper, the authora used the ARDL approach to investigate data of particular crops productivity in Pakistan during of (1978 to 2016). The variables such as seed, fertilizer and availability of water were included in the studies. Currently, in Pakistan some small farmers could not purchase costly latest machineries. These machineries are included tube-well, tractors and other inputs due to highest prices. The study recommended that the government should supply these inputs to the farmers on subsidized rates.

Zahid, K.B, et al (2019) stated that the change of temperature has negative effect on agricultural production of major crops like rice, maize and wheat. In this paper, data (from 1981 to 2009) relating to rainfall and temperature was collected and its effect was measured on crop production. The findings shows that high precipitation during moon soon season have negative effect on crops yield. Policy makers should take proper measures for safety of crops during environment change.

Mehmood.Q, et.al(2018) study the factors which increased wheat yield in Pakistan. The poduction of wheat can be increased by the use of some inputs. These inputs such as; urea manure, DAP compost, irrigation method and number of wild plant s sprays, date of sowing, seed type and variety. The techniques used in this research study include analysis of variance, multiple regressions and descriptive statistics. These methods show that the input factors which has a positive effect on wheat crop yield significantly.

Nazir et.al (2013) analyzed the factors which has greatly effect on the sugarcane crop production in Pakistan. The data was taken from 387 farmers

of three provinces; Punjab, Sindh and KPK for period of 2007-08. Cobb-Doulas production function was used for the calculation of MVP. The coefficient of determination, R^2 value was 0.9249. The value of F has 666.94 and the level of significance is 5%. It shows that the regression model has goodness of fit. The low production of sugarcane has many reasons such as high prices of inputs, low price of crops, high expenditure and neglect of technical methodology. To increase the production of sugarcane crop Government should raise take steps to enhance profits of sugarcane farmers.

NDMA, (2014) examined the effects of monsoon floods in Pakistan. In Pakistan, farmers have faced many natural hazards which have affected the crops yield. These problems are more but such as; storms, heavy rain, drought and floods mostly affect crops yield in Pakistan. Recently, there are three huge monsoon floods which have affected the Pakistan's agriculture sector badly. In the years of 2010, 2011 and 2014, Pakistan faced three devastating floods. These monsoon floods have damaged the agricultural crops, livestock, forestry and fisheries. These floods have also damaged primary transportation such as; tube wells, water channels, seed stock, shelters, private objects, stored fertilizer, animal living places, and agricultural technology.

3. METHODOLOGY:

The data source and methodology used in this study is presented in this section and analyzed the impact of agriculture technology in crop yield in Pakistan. Crop yield is dependent variable while independent variables include production of tractors, water availability, improved seed, credit distribution and crop area are taken as independent variables. The model of study is given in the following:-

Y= f (GDP, Production of tractors, Water Availability, Improved Seed,

Credit Distribution, crop Area)

3.1 Econometric Model:

The econometric model of this study is given below:

$$Y= B_0 X_{1\beta 1}X_{2\beta 2}X_{3\beta 3}X_{4\beta 4}X_{5\beta}{}^{5}e_{\mu i} \quad (1)$$

Taking the natural logarithm of eq. (1) and considering the five explanatory variables, the Eq. (1) converts to the following form:

$$LnY = \beta_0+\beta_1 LnX_1+\beta_2 LnX_2+\beta_3 LnX_3+\beta_4 LnX_4+\beta_5 LnX_5+\mu \quad (2)$$

Where,

β_0 = Natural log of B_0 =Intercept.

LnY = Natural log of (AGDP) Share of Agriculture in Gross Domestic Product per Year in (million rupees).

LnX_1 = Natural log of Cultivated area (in million hectare).

LnX_2 = Natural log of Water Availability (in million acre feet).

LnX_3 = Natural log Production of tractors (in Nos).

LnX_4 = Natural log of better seeds allocation (in 000 tones).

LnX_5 = Natural log of credit allocation (in million Rs.)

β_1, β_2, β_3, β_4 = Output elasticities and μ = error term.

3.2 Selected Variables:

- Gross Domestic Product
- Improved seed
- Production of tractors
- Water Availability
- Credit Allocation
- Cultivated Area

3.3 Study period:

The period of study is spread over 36 years (1981-2016).

3.4 Data and Sources:

The data was collected about major crops like cotton, wheat, maize, rice and sugarcane from different agricultural Pakistan Economic survey, Bureau of Statistics in Pakistan, State Bank of Pakistan, World Bank, Statistical Yearly Books and relevant research articles.

4. RESULTS AND DISCUSSIONS:

4.1 ADF Test:

The results of ADF test is shown in Table 1:

Table 1: Results of ADF and unit root tests:

	At level		First Difference	
Variables	t-statistics	t-statistics	critical values	
LnAGDP	0.643900(0.9889)	1% -3.639407	-9.147634(0.0000)	1% -4.252879
	5% -2.951125	5% -3.548490		
		10% -2.614300		10% -3.207094
LnCD	-2.131333(0.2346)	1% -3.689194	-3.988719(0.0198)	1% -4.284580
		5% -2.971853		5% -3.52882
		10% -2.625121		10% -3.215267
LnCROPEDA	-2.192471(0.2124)	1% -3.632900	-8.599649(0.0000)	1% -4.252879
		5% -2.948404		5% -3.548490
		10% -2.612874		10% -3.207094
LnPTRS	-1.337118(0.6012)	1% -3-632900	-5.876480(0.0001)	1% -4.252879
		5% -2.948404		5% -3.548490
		-2.612874		10% -3.207094
LnDISEED	2.211354(0.9999)	1% -3.646342	-7.260620(0.0000)	1% -4.262735
		5% -2.954021		5% -3.552973
		10% -2.615817		10% -3.209642

LnWA	-2.487444(0.1270)	1% -3.632900	-9.163719(0.0000)	1% -4.252879
		5% -2.2648404		5% -3.548490
		10% -2.612874		10% -3.207094

Note: *** shows 1%, 5%, and 10% of significance level

4.2 Unit Root test:

Table 2: P-P unit root test (including trend and intercept).

	At level	First difference		
Variables	Adj. t.Stat	Critical values	Adj. t.Stat	Critical values
LnAGDP	1.074157	1% -3.632900	-26.31345	1% -4.252879
	(0.9965)	5% -2.948404	(0.0000)	5% -3.548490
		10% -2.612874		10% -3.207094
LnCD	1.352668	1% -3.632900	1.656616	1% -4.252879
	(0.9984)	5% -2.948404	(1.0000)	5% -3.548490
		10% -2.612874		10% -3.207094
LnCROPEDA	-2.121695	1% -3.632900	-8.581990	1% -4.252879
	(0.2378)	5% -2.948404	(0.0000)	5% -3.548490
		10% -2.612874		10% -3.207094
LnPTRS	-1.343304	1% -3.632900	-5.880518	1% -4.252879
	(0.5983)	5% -2.948404	(0.0001)	5% -3.548490
		10% -2.612874		10% -3.207094
LnDISEED	1.024799	1% -3.632900	-10.01305	1% -4.252879
	(0.9960)	5% -2.948404	(0.0000)	5% -3.548490
		10% -2.612874		10% -3.207094
LnWA	-3.631532	1% -3.632900	-15.1961	1% -4.252879
	(0.0100)	5% -2.948404	(0.0000)	5% -3.548490
		10% -2.612874		10% -3.207094

Note: shows 1%, 5%, and 10% of significance level.

In this paper, ADF and P-P unit root tests were applied to know about the stationary of each variable. The expected results of these unit root tests have

shown in Table 1 and table 2. In these table shows that stationary level did not attain of all variables at their level form. Though, after taking the first difference 1 (1), all variables became stationary. As indicating the values of the ADF t-Statistic, and P-P Adj. t-statistic are greater than the critical values at 5% level of significance. In hypothesis testing, a critical value compared to the t-statistics to determine whether to reject the null hypothesis. If the absolute value of test statistics is greater than the critical value, then we can declare statistical significance and reject the null hypothesis. The T-statistic is used to support or reject the null hypothesis.

4.3 Regression Analysis:

Table 3: Results of Regression analysis

Dependent Variable: ln(AGDP)
Method: Least Squares
Sample: 1981-2016 included observations: 36

Explanatory variables	Coefficient	Std. Error	t- Statistics	Prob.
C	- 8772.072	5792.806	1.514304	0.1404
LnCROPEDA	540.0175	398.7827	1.354165	0.1858
LnWA	124.4663	40.96000	3.038728	0.0049
LnPTRS	0.069325	0.022626	3.063693	0.0046
LnDISEED	17.07085	9.600021	1.778210	0.0855
LnCD	0.015202	0.005938	2.560213	0.0157
R-squared	0.971013	Adjusted R-squared	0.966181	
F-statistic 2	00.9863	Prob(F-statistic)	0.000000	
Durbin-Watson stat	2.692045			

The regression analysis results have shown in Table-3. The overall significance level of the model could be seen into different coefficients. The

value of the R^2 is (0.971) that is highly significance. This study indicated that the total 97% variation in dependent variable (crop yields) is on account of variation in in the independent variables. The value of the F-statistic is (200.9863) that is very significance. The coefficient production of tractor is (0.069325) it means that if one unit of tractor increases it will increase agricultural productivity by 0.069 percent. Correspondingly, using better seed has a coefficient value of (17.07085) it means that if one unit of better seed is used it will likely to enhance agricultural productivity by 17.07 percent. Furthermore, credit disbursement has also positive effect on agricultural production. The coefficient value of agriculture credit is (0.015202), which means that if one unit of credit allocation increases it will likely to increase agriculture output by 15 percent. Similarly, the water availability is also an important factor and shows the positive effect on agricultural production. The coefficient value of water availability is (124.4663). It shows if one unit of water availability increases then the agriculture production will also increase by 124.46 percent. It means water availability has significant impact on crop production. In a same way, agricultural cropped area has also show positive impact on agricultural production. The co-efficient value of agricultural cultivated area is (540.0175), which means if one unit of area increases it will increase agricultural productivity by 540.01 percent. This result shows that there is a positive and significant relationship between dependent and independent variables. These technological variables such as, production of tractors, better seed allocation, credit disbursement, cultivated area and water accessibility have significant positive impact on agricultural productions as well as crop yields.

5. Findings of Study

We briefly discuss the findings of our study. The coefficient of independent variable has positive impact on dependent variable that is (AGDP) agricultural gross domestic product in both long and short run. It means that when (AGDP) increased in a country then the level of poverty could be reduced. In this study, we find that technical variables contributed 97% (AGDP) in Pakistan. The production of tractor has contributed 0.069 percent in AGDP. The variable of better seed allocation is contributed 17.07 percent. The contribution of credit distribution is 15 percent. Water availability has contributed 124.46 percent. The variable of agricultural cultivated area has contributed 540.01 percent. The value of R square is 0.971 which is highly significance. The value of F-statistics is 200.9863, indicating that explanatory variables in the model collectively have significant influence on the AGDP of Pakistan. Agricultural output has increased substantially during 1981 to 2016 due to use of various agriculture technologies We suggested that agricultural production can be improved by the improvement of further in these technologies and generating awareness among farmers..

6. Conclusion

Agricultural sector was the main sector of Pakistan's economy since its inception. But its shares gradually decreased with the expansion of industry in the country. In this study, we analyzed the role of technological advancements and their application in agriculture sector and in turn their impact on crop yields during the period of 1981-2016. From the above results and discussion, we can draw the conclusion that agriculture is still a vital sector of Pakistan's economy because more than 42% labour is involved in it and it is major producer of raw material for agro-based industry and textile sector.

Although agriculture production has substantially increased during the study period, yet the yield of crops has not increased in the same ratio due to low credit disbursement, use of poor quality seed, high prices of tractor and other inputs and low prices of agriculture products kept this sector not moving fast. The low grow in this sector has not eradicated poverty spreading in the rural areas of the country. Similarly, the government has not provided education, health and sanitation facilities in the rural areas and due to these factor the health of farmers are not good.

7. Policy Recommendations:

On the basis of current study, the following policy recommendations are made:

1. It is recommended that government should increase the number of tractors in the country and their prices should be kept low so that the farmers could purchase them and use them on large scale. Government should provide subsidy on the purchase of tractors.

2.Government should create knowledge and awareness about the use of quality seed in order to enhance crop yields and also take policy initiative to keep the prices of agriculture inputs at affordable level.

3.Government should improve irrigation system in Pakistan in order to increase water availability for agricultural crops.

4. Agriculture Development Bank and other financial institutions must be directed to provide loans to farmers on easy terms on long term basis so that the farmers plan their crops cultivation accordingly.

5. The prices of crops must be kept high in order to encourage the farmers to produce more crops and enhance their yields.

6. Seminars, corner meetings and media campaign should be launched to create awareness about new agriculture technologies and motivate the farmers to use them.

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CONTRIBUTION OF AUTHORS AND CONFLICT OF INTEREST

This research work was carried out in collaboration between two authors.

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