

IMPACT OF TECHNOLOGY USE IN AGRICULTURE ON ECONOMIC GROWTH: EVIDENCE FROM PAKISTAN

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ABSTRACT-The main purpose of this study is to measure the “Impact of Technology use in Agriculture on Economic Growth: Evidence from Pakistan”. As agriculture sector is considered as the engine of growth, there are so many problems and hurdles in the development of this sector. The major problems of agriculture sector are: illiteracy, feudal system, inappropriate irrigation system, and traditional methods of cultivation, superstitions, less use of technology, fertilizers and low quality seed. We have used time series data for the period 1985-2015 to analyze the relationship between GDP and Agricultural technology. ARDL technique is used to analyze the data. GDP is taken as dependent variable whereas independent variables included labor force, fertilizers, agriculture machinery and energy consumption. Our results show that the labor force, agriculture machinery and energy consumption have positive and significant impact on GDP whereas fertilizers has negative effect.

Key words: GDP, Labour, Fertilizers, agri. Machinery, Energy Consumption.

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1. INTRODUCTION:

Pakistan is an agricultural- country and about 70% of the population is involved directly or indirectly in this sector. Hence, Agriculture sector plays a significant role in economic growth of the country. It is a dynamic source for industrial sector for providing raw materials and demand for industrial products. The past experiences show that the fluctuations in agricultural growth have corresponded to the fluctuation in the national economy. The share of GDP has decreased overtime due to expansion of industrial and service sectors; yet, its performance still has strong impact on economy. The important factors that may contribute to a higher agricultural growth include better provision of irrigation, seeds, pesticides, fertilizer and technology.

Ben. G. Brega (2014) defined agriculture as “Agriculture has its large coverage, i.e. as a science, practice, and for some other matters including business, legal matters and with new technologies etc. but in case of farming “Agriculture” is considered as an art of growing plants, crops, and livestock, more human needs and economic growth.”

1.1. Objective of study:

The objective of this paper is to investigate the impact of technology on economic growth in terms of Pakistan during the period of 1985-2015. Another objective is to analyze the importance of agricultural technology and its impact on economy and make suggestions for further improvement in agriculture production.

2. LITERATURE REVIEW:

Agriculture has a significant influence on economic growth of Pakistan. It contributes 24% to GDP of Pakistan. Nevertheless, agriculture is affected by the weather conditions. So the agriculture production is remains low because of above mentioned reason. Hence, technology is to be used to enhance the agriculture production and better quality of food production. Government of Punjab has a

wholehearted trial to facilitate the farmers to grow more and better agriculture production.

Thomas et al. (2007) observed that optimizing behavior of a producer organism's short-run ecology equilibrium be determined by the producer's usage of fertilizers and pesticides. It is founded that decisions on use of fertilizer, pesticides, and agro-film have diverse effects on crop pledge input, and are inclined by latter in different ways. According to Economic Survey of Pakistan 2015-16 by Ministry of Finance, importance of agriculture sector is inevitable as it provides food staple to nation, reduce poverty, employment to a great number of people, provides raw material to industrial sector, its contribution to recent GDP is 19.8 and has a great potential to earn handsome foreign exchange.

A.P. Ndesaulwa, (2016) investigated "The Impact of Technology and Innovation (Technovation) in Developing Countries: A Review of Empirical Evidence". The study tells the importance of technology innovation in agriculture by using the term Technovation. The achievement of Technovation is depending on technology, while innovation relies on local Products of any country, which change the world. It is proved empirically and practically that the developed countries today have had high growth rate because of advance technology and Research & Development (R&D). Lack of Capital is the major hurdle in the developing countries in adopting new technologies and innovations. Success of following technologies from developed or leader countries the management system has to be compatible, elastic and easy-going. The findings tell that the technology innovation has a dramatic impact on economic development of a country. It is criticized in case of developing countries on the basis of facts and figures, circumstances, high-tech technology adoption.

The study by Raza, Ali, and Mehboob (2012) conducted the role of agriculture sub-sectors using the secondary data from 1980-2010. Their findings tell that the agricultural sub-sectors add the major impact on economic growth of Pakistan.

Fisheries and forestry have low contribution yet it is important for the agricultural growth. Livestock has a major contribution in agriculture. Agriculture sector has a solid connection to the rest of the world. It is the largest buying for tractors, tube wells, fertilizers, pesticides, and further technical equipment. Hence the findings show that the agriculture sector is a starter of the growth of any economy. Therefore, agriculture sector is the initial stage of growth of any economy.

Atteqa et al (2015) conducted ARDL method taking time series data from 1972-2012. The findings tell that the employed labor force, agriculture value added. Trade openness has a positive relationship with GDP, while inflation rate has a negative relationship with GDP. High use of fertilizers, tube wells, pesticides, and heavy machinery in cultivation generates high yields of agricultural production, and develop the manufacturing sector of economy. Government should educate the people both in agriculture and industrial sectors and enhance Research & Development for cost reduction and rise in production.

In the study of the Agriculture and National Resource team of UK (DFID) along with Rob Tripp of ODI London. The study investigates the technology contribution for the pro-poor agricultural production. Due to technology the prices of the agricultural and industrial goods have been reduced but situation of getting benefits among consumers and producers varies because of local economies and trade patterns. Technology adoption would be preferred if the producers get maximum benefits. Producers will invest only there where they would get more benefits than costs. Regarding this case of benefits, the availability of markets for outputs and inputs can help the producers or investors. As agricultural technology considers many, and at times conflicting object, therefore to achieve success careful planning is needed. Still there is an issue of low agricultural productivity in South and East Asia countries. The Asian countries industrialization was developed by the increase in agriculture productivity (Timmer, 1988). Though this paper is not fully successful in defining the agricultural technology It tells bio-technology, new ways of producing

crops, improved and better management regarding crops, external inputs (bio-control and veterinary products, chemicals etc.), agriculture sub-sectors like fisheries and livestock, and internal inputs (soil improvements, organic matter, etc.). Yet, a number of studies recommended that agricultural technology has a positive impact on economic growth of developing countries.

Another study by J. Raza et al (2014) tells the determinants of agricultural outputs of Pakistan. As the agriculture sector is considered as the “growth engine” of economy, the census in 1988 tells the population was 130 million with growth rate of 2.6%. Every year 3.4 million of people entered to this sector. Agriculture sector is also a major market for the agricultural products like, tractors, fertilizers, pesticides, and agricultural equipment. As agriculture grows-industrial and other sectors grow as well. Every country aims to gain development according to its circumstances. The findings tell mechanization is inevitable for agriculture development. Heavy machinery, skilled labor, better seeds, and irrigation system are the determinants of agri. Advancement. Study also shows the insignificance of fertilizers because the farmers have less knowledge about the appropriate use of fertilizers. Government should aware the farmers with modern techniques of cultivation.

M. Ahmed et al (2004) conducted science and technology based agriculture of Pakistan. An appropriate technology adoption, as it is affected by information, infrastructure, better inputs and capital etc. and the proper use of pesticides and fertilizers as they affect the national environment and health. Government should educate the farmers and finance them as well.

Javed et al (2010) analyzed by using Ordinary Least square, Johnson's Co-integration and Error Correction methods. The finding tells agricultural technologies and knowledge has been distributed by the public institutions in a great deal. The use of fertilizers, pesticides, tractors, and tub well increase the economic growth. These factors have a positive relationship between agricultural technology and economic

growth. The public sector should educate the farmers and encourage them to cope up with new technologies.

C. Didier Y' Elogniss'e Alia (2017) studied and defined that the agricultural inputs, hybrid seeds, tractors, fertilizers, fertilizers and herbicides in African agriculture speed up the production. It analyzed that the effectiveness of two policies, subsidies on inputs and land reforms may increase the yield of agriculture. Empirically proved testing hypothesis that subsidizing only one input or promote the use of other inputs. Subsidies on fertilizers encourage maize producers and discourage the manure producer.

Ilemone et al (2010) conducted through descriptive and inferential statistical analysis, drawing household survey of 2009-2010 while descriptive analysis using frequency, means and percentage. It is found that improved and advanced technology in agriculture of Cassava is positive.

C. Aker (2010) has analyzed that the high agri. production can be achieved by using advanced technologies, fertilizers, pesticides, and improved seeds. The use of Information and Communication Technology (ICT) can play a useful part in high yield crops in developing countries. Yet, adoption of technology in developing countries is still questionable because of impact, sustainability and limited scale. Apart from this, still it is important for the agriculture sector.

Another study by The Dupont Advisory Committee on Agricultural innovation and productivity for the 21st Century presented the role of technology in agriculture sector. It is analyzed that the agricultural production is comparatively low. Smallholder farmers of the developing economies are responsible for 80% of food in their respective region, have the same gains. Most of them are women, low access to modern tools, e.g. mobile technology, modern irrigation methods, postharvest loss solution, fertilizers and improved seeds are needed to meet that success. Through the massive use of these tools and investment on inputs the extensive problems of hunger,

poverty, postharvest and food wastage and malnutrition can be achieved all over the world.

3. METHODOLOGY:

The data source and methodology used in this study is presented in this section and analyzed the impact of technology in agriculture on economic growth of Pakistan.

$Y = f(\text{GDP, Labour, Fertilizers, Agri. Machinery, Energy Consumption})$

3.1 Econometric Model:

$$Y = b_0 + b_1X_1 + B_2X_2 + B_3X_3 + B_4X_4 + \mu_t$$

Where;

Y= Gross Domestic Product

X1= Labour

X2= fertilizers

X3= agri. Machinery

X4= energy consumption

μ =Error term

3.2 Selected variables:

- Gross Domestic Product
- Labour force
- Fertilizers
- Agri. Machinery
- Energy consumption in agri.

3.3. Study period:

The period of study is spread over 31 years (1985-2015).

3.4 Data and source:

The researcher has used secondary data and collected the data from Hand Book of Statistics, Economic Survey of Pakistan, and Statistics Bureau of Pakistan.

4. RESULTS AND DISCUSSIONS:

We used secondary data of GDP, main crops, fertilizers and tractors. The data was for the period 1985-2015. We applied the Augmented Dickey Feller Test to check stationarity in the data.

4.1 Descriptive Statistics

The descriptive statistics our selected variables and their values are shown in Table 1:

Table 1: Descriptive Statistics

	Ln (GDP)	Ln (labor)	Ln (FER)	Ln (Energy C)	Ln (Mach)
Mean	15.55448	4.237849	11.94736	11.92647	4.047346
Median	15.54797	4.254335	12.02858	12.38976	3.836868
Maximum	16.18054	4.284138	12.33912	12.70808	5.276072
Minimum	14.84530	4.099995	11.51080	10.05608	2.778819
Std. Dev.	0.399718	0.043951	0.278051	0.807221	0.598579
Skewness	-0.082536	-1.686931	-0.418506	-1.016507	0.279316
Kurtosis	1.833121	5.898922	1.732063	2.585616	2.473421
JarqueBera	1.793937	25.55781	2.981491	5.560440	0.761250
Probability	0.407804	0.000003	0.225205	0.062025	0.683434

The descriptive statistics has shown that average GDP growth is 15.55448 with standard deviation of 0.399718. The average growth of Labor is 4.235722 and standard deviation is 0.047294. The average Energy Consumption in Agriculture) is 11.92647 with standard deviation of 0.807221. The average use of fertilizer is 11.94736 with standard deviation of 0.278051. The average Machinery used in

Agriculture is 4.044344 with standard deviation of 0.598579. All the variables are negatively skewed. Kurtosis statistic of the variables show that Labor is leptokurtic (long-tailed or higher peak) and other variables are platykurtic (short tailed or lower peak). A Jarque–Bera test shows that the residuals of Labor are not normally distributed while all other variables are normally distributed.

4.2 Empirical results:

In statistics, a unit root test checks whether a time series variable is non-stationary and possesses a root. The null hypothesis is generally defined as the presence of a unit root and the alternative hypothesis is either stationarity, trend stationarity or explosive root depending on the test used.

The results of Unit Root Test are shown in Table 2:

Table 2: Unit Root Results:

Variables	Augmented Dickey Fuller Test (at 5%)	Augmented Dickey Fuller Test (at 1 st difference)
Lngdp	0.2814	0.0307
Lnlabor	0.6217	0.0000
Lnfer	0.9610	0.0001
Lnmach	0.4370	0.0001
Lnenergyc	0.1360	0.0009

Table 2 presents the results of Unit root (ADF) test that indicates, variable Ln (GDP) has a unit root (Not Stationary), but after taking first difference GDP becomes stationary at 5% level of significance. Ln (Labor) is stationary at 10% level of significance. Ln (ENRGC) is stationary at 1% level of significance after taking first difference.

Table 3: Optimal lags

Lag	logL	LR	FPE	AIC	SC	HQ
0	59.92545	NA	1.18E-08	-4.068552	-3.828582	-3.997196
1	188.0799	199.3514	5.87E-12	-11.70962	-10.2698	-11.28149
2	223.3225	41.76901 *	3.40E-12	-12.46833	-9.828666	-11.68342
3	264.2494	33.34786	1.98E-12	-13.6481	-9.808588	-12.50642
4	333.1343	30.61548	4.33e-13*	-16.89883	-11.85947	-15.40037
	*indicates lag order selected by the criterion					

LR: LR test statistic (each test at 5% level)

FPE: Final prediction error.

HQ: Hannan-Quinn information criterion.

SC: Schwarz information criteria.

Table 4: Bound Test Results

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
Asymptotic: n=1000				
F-statistic	5.091305	10%	2.2	3.09
k	4	5%	2.56	3.49
		2.5%	2.88	3.87
		1%	3.29	4.37
		Finite Sample: n=35		
Actual Sample Size	27	10%	2.46	3.46
		5%	2.947	4.088
		1%	4.093	5.532
Finite Sample: n=30				
		10%	2.525	3.56
		5%	3.058	4.223
		1%	4.28	5.84

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	5.091305	10%	2.2	3.09
k	4	5%	2.56	3.49
		2.5%	2.88	3.87
		1%	3.29	4.37

F-Statistic for Testing the Existence of Long-Run Relationship:

Order of lag	F-statistics
4	5.091305

Results of long-run relationship are receptive to lag-length selection in the model (Bahmani-Oskooee,2000). The above table presents the computed F-statistic to select optimum lag. According to Pesaran et al. (2001), with lag of order 4 the upper bound value at 95% significance level is 5.091305 respectively. We used Schwarz Bayesian

Criterion (SBC) to select the optimal lag length of variables included in the ARDL model.

Table 5: Error Correction Model

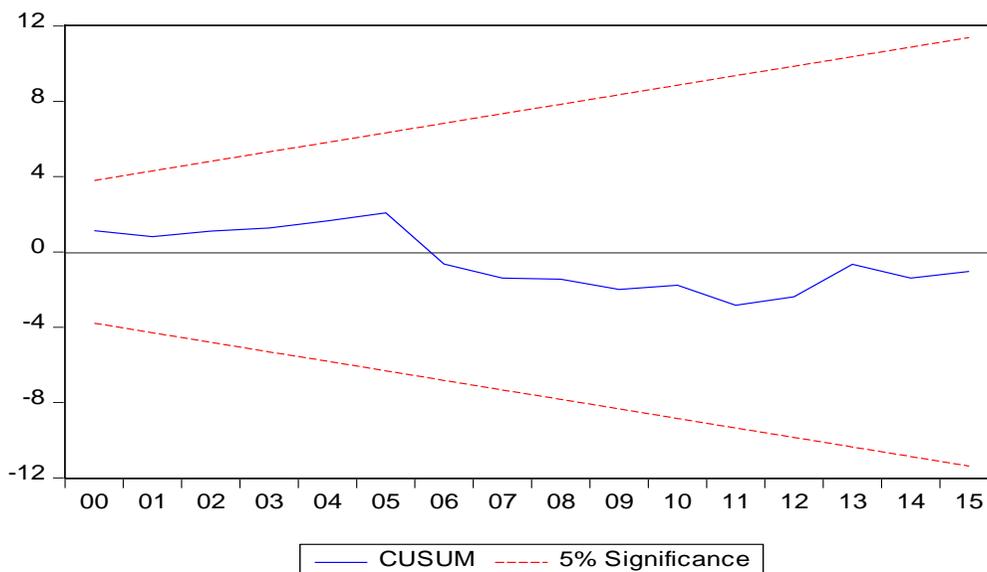
ECM Regression				
Case 2: Restricted Constant and No Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNGDP(-1))	-1.080853	0.201364	-5.367667	0.0030
D(LNGDP(-2))	-0.377502	0.138946	-2.716905	0.0419
D(LNLABOR)	0.038219	0.100184	0.381491	0.7185
D(LNLABOR(-1))	-0.759630	0.123611	-6.145338	0.0017
D(LNLABOR(-2))	-0.180214	0.206111	-0.874352	0.4219
D(LNLABOR(-3))	-0.416774	0.187248	-2.225788	0.0766
D(LNFER)	-0.072617	0.023629	-3.073180	0.0277
D(LNFER(-1))	-0.221445	0.032952	-6.720205	0.0011
D(LNFER(-2))	-0.163555	0.046098	-3.547999	0.0164
D(LNENERGY_C)	-0.053448	0.009534	-5.605787	0.0025
D(LNENERGY_C(-1))	0.033144	0.008687	3.815201	0.0124
D(LNENERGY_C(-2))	-0.016975	0.009783	-1.735249	0.1432
D(LNMACH_)	0.034834	0.004841	7.196119	0.0008
D(LNMACH_(-1))	0.082401	0.011368	7.248236	0.0008
D(LNMACH_(-2))	0.067241	0.011731	5.732029	0.0023
D(LNMACH_(-3))	0.024256	0.008299	2.922687	0.0329
CointEq(-1)*	-0.094307	0.012065	-7.816371	0.0005
R-squared	0.949670	Mean dependent var	0.042766	
Adjusted R-squared	0.869141	S.D. dependent var	0.018096	
S.E. of regression	0.006546	Akaike info criterion	-6.953926	
Sum squared resid	0.000428	Schwarz criterion	-6.138029	
Log likelihood	110.8780	Hannan-Quinn criter.	-6.711317	
Durbin-Watson stat	2.556780			

The above tables show the long run and short run relationship between variables. Our results show that there is an insignificant relationship between ln (ENRGC) and ln (GDP). There is negative and insignificant relationship between ln (LF) and ln (GDP). It implies that if I unit increase in NLF it will increase in GDP reveals that ln (ENRGC) is the most significant factor of GDP in Pakistan. The effect of ENRGC is

significant at one percent level of significance. The coefficient (0.251744) of \ln (ENRGC) shows that one unit increases in ENRGC leads to over 1 percent increase in GDP. The results presented in this study shows the significance of employed labor force, and energy consumption in agriculture, which further leads to increase in GDP of Pakistan. Error correction model shows the short run relationship between variables. The value of R^2 model of the study is excellent as it shows that 86 percent variation in dependent variable is caused due to variation in independent variable while the rest of 8 percent variation is due to error term and is unexplained. It means that the model explains 86 percent variation due to one unit change in predictors.

We have tested the stability of the selected ARDL based Error Correction Model using cumulative sum of recursive residuals (CUSUM) testing technique presented by Brown et al. (1975). CUSUM plot has been shown in Figures1. Since the plot remains within critical bounds at 5 percent level of significance, hence the model is structurally stable and robust.

Figure 1: Stability of the model



5. CONCLUSIONS:

The main objective of this study was to analyze the impact of agricultural technology on the GDP of Pakistan. To calculate the results, we have applied the method of ARDL estimation technique to show the relationship between GDP and labour, fertilizers, agri. Machinery and energy consumption in agriculture sector. The

results were drawn through E-views 10, which show that the labor, fertilizers, agri. machinery, energy consumption have substantially share to in Agriculture sector and GDP. However, fertilizers have negative impact because the farmers use it excessively. Although pesticides and fertilizers are not environment friendly, but they are still widely used to increase crop yield. Our country's crop yield is low as compared to other developing countries due to illiteracy of farmers, lack of use of latest agriculture technology.

6. RECOMMENDATIONS:

On the basis of above conclusions, we would like to make the following recommendations: -

1. Government should take measures and make appropriate policies according to the country situation to so that better production of crops may be achieved.
2. Government should educate, train the farmers and provide them better health facilities.
3. Necessary financial support or loans may be provided to the farmers to enable them to purchase tractors, fertilizers and pesticides.
4. More Research and Development centers should be opened to guide the farmers to use inputs efficiently and economically.
5. New scientific agriculture technologies should be introduced.
6. Proper and appropriate market structure and infrastructure may be developed.
7. Check and balance mechanism may be developed to control prices of fertilizers and pesticides.

8. Uninterrupted electricity may be supplied so that the farmers may cultivate and harvest the crops at proper time.
9. More training and vocational institutes should be opened to enhance the skill of labour force working in different sectors particularly in agriculture sector.

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CONTRIBUTION OF AUTHORS AND CONFLICT OF INTEREST

This research work was carried between collaboration of two authors.

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Author 2: Prof. Dr. Abdul Ghafoor Awan has his first Ph.Ds in Economics from Islamia University of Bahawalpur-Pakistan and second in Business Administration from University of Sunderland, U.K. He contributed in this research paper by way of guiding author first about title selection, data collection and statistical technique. He edited and gave final shape to the manuscript. In order to know about his fields of research please look at his Web of Science Researcher ID [M-9196 2015](#) or his [profile at Google scholar](#).

Both authors read the manuscript carefully and declared no conflict of interest with any person or institution
