
IMPACT OF AGRICULTURE PRODUCTIVITY ON ECONOMIC GROWTH: A CASE STUDY OF PAKISTAN

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ABSTRACT

The present study investigates the impact of agriculture productivity on economic growth. The secondary source of data covering the time series period 1972 to 2012 is employed. We have used the auto regressive distributed lags method (ARDL) to estimate the economic growth. Different variables are used such as real gross domestic production per capita gross capital formation, employed labor force, inflation rate, trade, openness, agriculture value added. The inflation rate has negative effect on economic growth while all other variables are positively related to economic growth. The study concludes that big share of agriculture contribute more in economic growth and suggest that government should enhance employed labor force by increasing the higher education in both agriculture and industrial sector.

Key words: Agriculture productivity, GDP, ARD, Pakistan

1.INTRODUCTION

Agriculture sector is the largest sector of Pakistan's economy and has a special position by employing half of its labor force and producing one quarter (21.4%) of its GDP. The overall growth rate of the economy depends upon the growth rate of this sector. The development of agriculture is the key tool for poverty alleviation in rural areas. The empirical evidence gives suggestions that percentage of higher growth rate in agriculture on a regular basis

was a lasting impact on poverty reduction in Asia in the 1970s and 1980s. According to calculation Pakistan approximately needed 273% increase in fruits, 38% in Sugar, 20% in rice, 62% in wheat, and 69% in maize, 45% edible oil, and 15% cotton to his population. Agriculture sector provides employment opportunities in farming and non-farming sector. So, another important contribution of agriculture sector is the capital accumulation that can be made with the agriculture surplus. When agriculture surplus increases, the welfare of rural people will increase. [1].

It is emphases that Agriculture is foundation of Pakistan's economy. Pakistan has various kinds of natural resources. But, large quantity of cultivate land is the most important quality of our national wealth. Pakistan has fertile soil with the best and big irrigation system of the world for producing all kinds of agriculture goods. So, it provides base for economic development. It is assumed that contribution of agriculture in economic development can be in many ways as a livelihood, as an economic activity, and as a provider of environmental services, making the agriculture sector as a unique sector for the economic growth of a country. [2].

1.1 Main Research Question

The research problem of the study is to measure the impact of the agriculture sector productivity on economic growth of Pakistan during the period 1972-2012.

Objective of the Study

The objectives of the study are given below: -

- To check the significance of agricultural productivity.
- To measure the impact of agriculture productivity on Pakistan's economic growth.
- To find out major factors of agriculture productivity.
- To measure short-run behavior of agriculture productivity and its impact on Pakistan's economic growth.

2. LITERATURE REVIEW

A qualitative analysis was applied the assess involvement of agriculture exports in growth of economy of Pakistan, estimated the relationship between Gross Domestic Product and nonagricultural and agricultural exports for Pakistan, economic variables were used gross domestic product, consumer price index, total labor force, fixed capital formation,

agriculture exports and non-agriculture exports. A time series data was taken for the period of 1972 to 2008. Data were taken from the economic survey of Pakistan, international monetary fund, Pakistan bureau statistics, and state bank of Pakistan. Ordinary least square, Johansen co integration, vector error correction and granger causality models were used to measure the significance of the relationship of economic variables. Results show that the non-agriculture export has positive and significant effect on economic growth, while the agricultural exports have no effect on economic growth. Further gross domestic product and nonagricultural exports have bidirectional causality among each other. It was suggested that government of Pakistan take steps for structural change in agriculture exports into value added products [3].

Various attempts were made to investigate the dynamic interaction between agriculture productivity and economic growth in general term, tried to find out the relationship between agriculture and economic growth with time series analysis of fifteen developing and transition economies in Latin America, Asia and Africa. Economics variables were as follows real export, agriculture value added per worker, real GDP per capita, population as proxy for labor and gross capital formation per worker as proxy for capital. Data were taken from the World Bank development indicators and international monetary for the period of 1971 to 2006. Auto regressive distributed lag model and co integration was used to find out the empirical relationship among variables. Results declare that agriculture is an important factor for economic growth like an engine for economic development. Empirical evidence supports the roll of private and public resource allocation to agriculture and infrastructure development. It was suggested that trade openness impact is positive and favorable on GDP per capita [4].

The researchers examined the impact of key macro-economic variables on economic development after SAP structural adjustment program in Pakistan and attempted to explore some of the necessary factors for sustained economic development in Pakistan. Annual inflation, GDP per capita, financial openness proxies by foreign direct investment, credit to private sector as share of GDP for financial development proxy and trade openness as $\text{exports} + \text{imports} / \text{GDP}$ were taken as economic variables. A time series data 1991 q1 up to 2007 q4 were taken from the economic survey of Pakistan, international financial

statistics and Auto regressive distributed lag model was used to find the empirical relationship between variables. Results show that there exist some of the casual factors for sustained economic development in Pakistan after the Structural Adjustment Program. Long run relationship is confirmed by the ARDL F-statistics. Financial sector's development, trade openness, and remittances were positively correlated with economic development in the country; inflation and economic growth are correlated inversely in country.[5].

Awan and Vashma (2014) tried to find out the major determinant of agricultural sector and mutual relationship between agriculture economic development and GDP, how agriculture helped in economic development, 31 observation was used since 1980 to 2010. Gross domestic product and agriculture growth were taken as economic variables. Data were taken from the World Bank Meta data of Pakistan. Co integration and vector error correction model was used as econometric technique for measuring the variable relationship. Results show that there exists statistically significant and positive relationship between agriculture growth and GDP growth. It was suggested that the role of agriculture growth for GDP and economic growth is very essential [6].

Different authors tried to analyze the growth of agriculture sector in Pakistan and total factor productivity of agriculture growth in Pakistan by employing the Tornqvist- Theil index number methodology for the period of 1971 to 2006. Labor, land, fertilizer off take, capital, fodder, wheat and pesticide consumption are the inputs used in construction of agriculture input index, while output categories for index measuring were minor crops, major crops and important vegetables and fruits. Outputs and inputs categories data were collected from the various issues of Economic Survey of Pakistan and various issues of agriculture statistics of Pakistan.[7], Results shows that during the 70s decade total factor productivity growth rate was lowest and during the last six years 2001 to 2006 of the study total factor productivity was at his highest at 2.86 percent. Further results explained that share of total factor productivity growth in total agriculture output growth was 33 percent and during last six years of the study is measured by eighty three percent.[8].

Awan (2014) investigated key determinant of agriculture productivity growth, growth experience and their impact on economy growth in the selected seven economies and

compare their experience with seven advanced countries. Share of employment in agriculture, labor productivity in agriculture, the intermediate inputs ratio, and aggregate labor productivity were used as economic variables. A time series data were collected from the total economy database and conference board. A two sector model methodology was used to measure the economic behavior of variables. Results show that due to low agriculture productivity in the emerging economies and the income gap between emerging and advanced countries have negative effects on the economic growth in the selected emerging economies. [9].

The author examined the source of agriculture growth in China and the role of growth in contemporary market and the impact of institutional reforms. Labor, land, fertilizer, area irrigated, and power were used as input variables, stock of useable knowledge and research investment used as dummies variables. A new constructed data was use to analyze the agriculture research and stock of knowledge variables. Data were taken from the various issues of China agriculture yearbook, China statistical year book and China rural Statistical yearbook. Two way fixed effect model and quasi translog model were used to analyze the behavior of economic variables [9]. It was found that the contribution of traditional inputs in agriculture growth was little to contemporary while the contribution of modern inputs like power, fertilizer, and irrigation explained a major role in agricultural growth. It was suggested that still there exists a significant source of growth; it was just need to find out and promote these sources [10]

The study used 34 district level data of Punjab including the year of (1991 to 1999). Crop area in acres not irrigated, crop area irrigated, total fertilizer, rainfall in inches, short term loan by ADBP, Long term loan by ADBP used as variables. Data was taken from Agricultural statistics, Agricultural development Bank of Pakistan, and Punjab development statistics. [11]. OLS estimation, fixed effect techniques, and Random effect techniques used to estimate the data. The results show the negative growth rates in technical efficiency and total factor productivity is positively related with farm size. It was suggested that to save the economy from instability in output prices needs active participation of the trading corporation of Pakistan and protected farmers from dealers and seeds companies which are selling's uncertified seed and substandard products. [12].

It is estimated the impact of supervised agriculture credit on small income farmers, and try to increase their farm income in the study area and also conducted the effect of credit on land use and cropping intensity of the project area. Primary data was collected the year of (1997 to 1998) through the interviews. Farm income, Yield per acre of respective crop, operational holding, number of animals, used as variables and a multistage random sampling technique was applied in project area. T test, percentage analysis and multiple regressions was used for statistical estimation. [13].

3.RESEARCH METHOD AND ANALYSIS

Resent study is based on the Impact of agriculture productivity on economic growth in Pakistan for a period of 1972 to 2012. Gross domestic product per capita is taken as dependent variable and the explanatory variables are as follows employment labor force, inflation rate, and trade openness, gross capital formation per worker as proxy for capital and agriculture value added. All the economic variables are taken as annual growth percentage. A time series data of all economic variables is taken from the economics surveys of Pakistan, handbook statistics of Pakistan (State Bank of Pakistan) and World Bank Metadata of Pakistan.

Table 1 summarizes the independent and dependent variables in the study.

Variables	Description of the variables	Measurement Unit
<i>Dependent variable</i>		
GDPC	Real Gross domestic production per Capita	Annual growth (%)
<i>Independent variables</i>		
GCF	Gross capital formation	Annual growth (%)
ELF	Employed labor force	Annual growth (%)
TOP	Trade openness	Annual growth (%)
INF	Inflation rate (CPI)	Annual growth (%)
AGR	Agriculture value added	Annual growth (%)

3.1 Econometric issues.

This section deals with some basic econometric issues like stationarity of data, auto regressive distributed lags model and bound testing procedure. Augmented Dickey and Fuller (ADF) test is used to check the order of integration. The use of ARDL model should be justified on the basis of ADF test i.e. if all variables are integrated in different orders such as I(0) and I(1) only then auto regressive distributed lags model (ARDL) can be used. Otherwise if all variables are integrated on I (0) then usually simple ordinary least square method (OLS) is used. Whereas, Johanson co-integration technique is used if variables are integrated on I (1). Table 2 presents the results of ADF test.

Table 2. Augmented Dickey Fuller Test

Variables	At level		At 1stdifference		
	Intercept	Intr. & trend	Intercept	Intr& trend	Integratio n
GDPC	-5.564	-	-	-	I(0)
ELF	0.922	-0.577	-5.98*	-	I(1)
INF	-3.23	-3.313	- 7.583*	-	I(1)
TOP	-14.15*	-	-	-	I(0)
GCF	-6.09*	-	-	-	I(0)
AGR	-7.925	-	-	-	I(0)

Source: Author's calculations.

A mix trend of integration is shown by the above table. Some variables as gross domestic production per capita, trade openness, gross capital formation and agriculture value added are integrated at level, whereas, employment labor force and inflation rate are integrated at 1st order. So the results of above table show that variables are integrated at different order, so it is justified to use ARDL method.

3.2 Econometric Model

The estimated equation to see the impact of agriculture productivity on economic growth is as follows

$$GDPC = \beta_0 + \beta_1GCF + \beta_2ELF + \beta_3TOP + \beta_5INF + \beta_6AGR + \varepsilon_i$$

Whereas:

ε_i = distributed term

β_0 = intercept term

$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6$ = slope coefficient

Whereas, unrestricted vector error model in presented as below.

General ARDL equation;

$$\Delta(GDPC)_t = \gamma_0 + \sum_{i=1}^a \gamma_1(GDPC)_{t-i} + \sum_{i=0}^b \gamma_2(GCF)_{t-i} + \sum_{i=0}^c \gamma_3(ELF)_{t-i} + \sum_{i=0}^d \gamma_4(TOP)_{t-i} + \sum_{i=0}^e \gamma_5(INF)_{t-i} + \sum_{i=0}^e \gamma_6(AGR)_{t-i} + \gamma_7(GDPC)_{t-1} + \gamma_8(GCF)_{t-1} + \gamma_9(ELF)_{t-1} + \gamma_{10}(TOP)_{t-1} + \gamma_{11}(INF)_{t-1} + \gamma_{12}(AGR)_{t-1} \dots \dots \dots \quad (1)$$

Equation 1 is the ARDL equation which shows the short run and long run relationship between dependent and explanatory variable. γ_0 is the intercept term and the short run coefficient of variables are $\gamma_1, \gamma_2, \gamma_3, \gamma_4, \gamma_5, \gamma_6$ and the long run coefficients of the variables are as follows $\gamma_7, \gamma_8, \gamma_9, \gamma_{10}, \gamma_{11}, \gamma_{12}$ whereas, ε_t is the disturbance term and it includes all the ignored variables in the equation.

After regressing ARDL equation, we apply the Wald test (F-Statistics). The Wald test (F-Statistics) is used to establish the long run relationship between dependent and independent variables.

3.3 Null Hypothesis

$$H_0 = \gamma_7, \gamma_8, \gamma_9, \gamma_{10}, \gamma_{11}, \gamma_{12} = 0$$

(As no long run relationship exists)

3.4 Alternative Hypothesis

$$H_1 = \gamma_7, \gamma_8, \gamma_9, \gamma_{10}, \gamma_{11}, \gamma_{12} \neq 0$$

(A long run relationship exists)

If the F-statistics value is greater than the tabulated value then the null hypothesis is rejected and alternative is accepted, whereas if the F-statistics value is less than the tabulated value than null is accepted and alternative is rejected.

3.5 Long Run Relationship

The long run relationship between dependent and independent variable is shown in the following equation.

$$(GDPC)_t = \alpha_0 + \sum_{i=1}^{z1} \alpha_1 i(GDPC)_{t-i} + \sum_{i=0}^{z2} \alpha_2 i(GCF)_{t-i} + \sum_{i=0}^{z3} \alpha_3(ELF)_{t-i} + \sum_{i=0}^{z4} \alpha_4(TOP)_{t-i} + \sum_{i=0}^{z5} \alpha_5(INF)_{t-i} + \sum_{i=0}^{z6} \alpha_6(AGR)_{t-i} + \varepsilon_t \dots \dots \dots \quad (2)$$

In the above table the lag term of gross domestic product per capita is included in order to adjust the data.

3.6 Short run relationship

The short run relationship between dependent and independent variables is shown by equation 3rd. In this equation the error correction term lagged (ECM)t-1 is added to adjust the results.

$$\Delta(GDPC)_t = \gamma_0 + \sum_{i=1}^{k1} \gamma_{1i}(GDPC)_{t-i} + \sum_{i=0}^{k2} \gamma_{2i}(GCF)_{t-i} + \sum_{i=0}^{k3} \gamma_{3i}(ELF)_{t-i} + \sum_{i=0}^{k4} \gamma_{4i}(TOP)_{t-i} + \sum_{i=0}^{k5} \gamma_{5i}(INF)_{t-i} + \sum_{i=0}^{k6} \gamma_{6i}(AGR)_{t-i} + \lambda(ECM)_{t-1} + \varepsilon_t \dots \dots (3)$$

(ECMt-i) Error correction model shows the short run effect on X and Y variable, long run effect on X and Y variable and speed of adjustment.

$$\Delta P_t = \gamma + \delta \Delta_{t-1} + \lambda (ECM_{t-1}) + \varepsilon_t \dots \dots (4)$$

ECMt-i error correction term is shown by equation 4, in this equation δ showing the short run effect and λ showing the speed of adjustment. The disequilibrium value is shown by the error correction term.

3.7 Bound Test for Co-integration:

Bound test for co-integration shows the long run relation between variables with the help of the Wald test. The results show the long run relationship exists with variables.

The results of bound testing for co- integration are summarized in table (5.3).

Table 3. Bound Test for Co-integration

Equation	F-Statistics Calculated	Lower Bound Critical Value	Conclusion
Equation (1) GDPC / ELF, INF, TOP,GCF, AGR	2.98 [0.099]	2.75 (90%)	Co-integration exist

Source: authors’ calculation, note computed F-statistics:2.98 (significance at 1% marginal values). Critical values at k = 6-1= 5 is cited from person et al (2001), case v: unrestricted intercept and unrestricted trend. The numbers in parenthesis is shows the probabilities of F-statistics.

4. FINDINGS AND RESULTS

4.1 Long run Model

The results of long run model are given in table 4.

Table 4 Long run Model

Estimated Long Run Coefficients using the ARDL Approach			
ARDL(0,0,2,2,0,0) selected based on Schwarz Bayesian Criterion			
Dependent variable is GDPC			
38 observations used for estimation from 1974 to 2011			
Regressor	Coefficient	Standard Error	TRatio[Prob]
ELF	.10773	.041150	2.6181[.014]
INF	-.18027	.065687	2.7444[.011]
TOP	.14433	.083433	1.7299[.095]
GCF	.011129	.044614	.24945[.805]
AGR	.23586	.067059	3.5172[.002]
C	1.6021	1.0498	1.5261[.139]
T	-.10722	.033234	3.2262[.003]

Source: Author's calculation (Microsoft 4.1)

In the long run period the relation between variables is discussed as, the value of coefficient shows one-unit increase in employed labor force is cause a 0.10-unit increase in GDP growth and it is statistically significant. At the same time, one-unit increase in inflation rate is cause a -0.18-unit decrease in GDP growth and it is statistical significant. The value of coefficient shows the one-unit increase in trade openness is cause 0.14-unit increase in GDP growth and it is statistically significant. The value of coefficient shows one-unit increase in gross capital formation is cause a 0.01-unit increase in GDP growth and it is statistically insignificant. The value of coefficient shows the one-unit increase agriculture value added is cause a 0.23-unit increase in GDP growth and it is statistically significant.

4.2 Short Run Model

The Result of short-run model are shown in Table 5.

Table 5 Error Correction Representation for the Selected ARDL Model
ARDL(0,0,2,2,0,0) selected based on Schwarz Bayesian Criterion
Dependent variable is dGDPC

38 observations used for estimation from 1974 to 2011			
Regressor	Coefficient	Standard Error	Ratio[Prob]
dELF	.10773	.041150	2.6181[.014]
dINF	-.060404	.066935	.90243[.375]
dINF1	.16295	.056626	2.8777[.008]
dTOP	.014659	.052723	.27804[.783]
dTOP1	-.054739	.027147	2.0164[.053]
dGCF	.011129	.044614	.24945[.805]
dAGR	.23586	.067059	3.5172[.002]
dC	1.6021	1.0498	1.5261[.138]
dT	-.10722	.033234	3.2262[.003]
ecm(-1)	-0.78	0.56	-4.74 [.004]

ecm = GDPC -.10773*ELF + .18027*INF -.14433*TOP -.011129*GCF .23586
*AGR -1.6021*C + .10722*T

Source: Author's calculation (Microsoft 4.1)

Table 5 shows that the employed labor forces, trade openness and agriculture productivity variables are positively significant relation with the GDP growth, while the inflation and gross capital formations are respectively insignificant relation with the GDP growth. In long run inflation was significant but in short run inflation is insignificant while all other variables are highly significant in short run period.

4.3 Stability test:

We estimate the CUSUM stability test in auto regressive distributed lags method (ARDL) to show the stability of the data. Our variables, data are stable because the cumulative sum of recursive residuals CUSUM graph is within the limits of 5% significance level and cumulative sum of square of recursive residuals CUSUMSQ graph is also within the limits of 5% significant.

Figure 1 Plot of Cumulative Sum Of Recursive Res

Plot of Cumulative Sum of Recursive Residuals

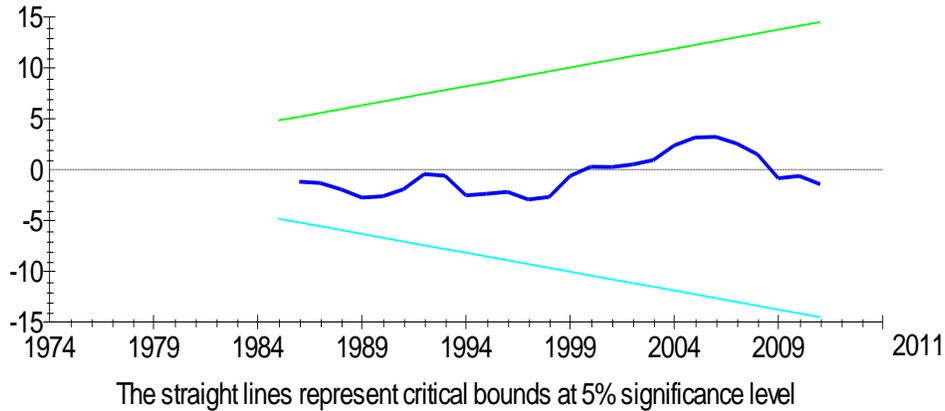


Figure 2 Plot of Cumulative Sum of Squares of Recursive Residuals

Plot of Cumulative Sum of Squares of Recursive Residuals

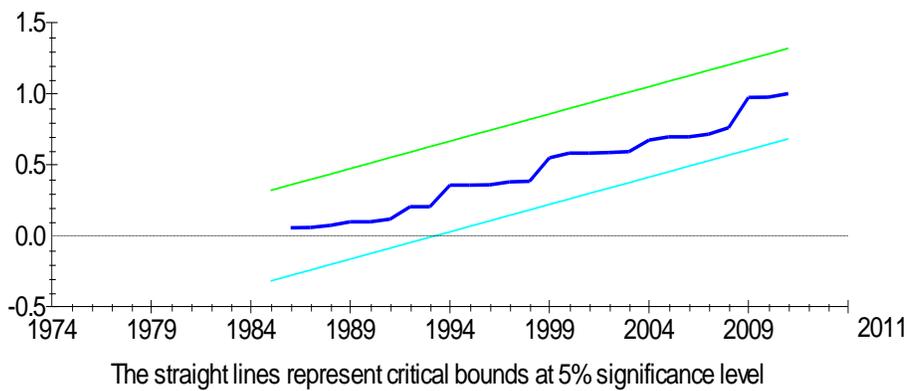


Table 6. Model Summary

R-Squared	.76878	R-Bar-Squared	.68314
S.E. of Regression	1.3456	F-stat. F(9, 28)	9.9746[.000]
Akaike Info. Criterion	-69.7074	Schwarz Bayesian Criterion	78.7141
DW-statistic	2.0203		

R-squared value .76878 shows that our independent variables have 76% impact on dependent variable while the other 24% is the residual value or not included in the model. The probability value of F- statistics is below the 5% which shows the overall significance of the model. D- Statistics value 2.0203 which is near about 2 so we can conclude that there is no autocorrelation in our model.

Table 7 Diagnostic Tests

Test Statistics	LM Version	F Version
Serial Correlation	CHSQ(1)= .014643[.904]	F(1, 26)=.010022[.921]
Functional Form	CHSQ(1)= 1.1227[.289]	F(1, 26)= .79153[.382]
Normality	CHSQ(2)= .19879[.905]	Not applicable
Heteroscedasticity	CHSQ(1)= 3.1105[.078]	F(1, 36)= 3.2095[.082]

Source: Author's calculation (Microsoft 4.1)

Diagnosing testing results shows the nonexistence of serial correlation and heteroscedasticity,

5.CONCLUSIONS

In this study four variables employed labor force, trade openness, and agriculture value added are positively significant except inflation rate, and it is negatively significant. While gross capital formation is statistically insignificant. Results shows that economic growth of a country can be increased due to increasing in employment labor force, higher level of trade openness, a positive trend in agriculture value added and decrease in the prices of the inputs. Government of Pakistan start to take the steps to enhance the employments of labor force and provide the job opportunities, volume of trade and agriculture value added productivity improved.

Share of agriculture in GDP can be doubled in Pakistan because Pakistan is an agriculture country and have a very much potential in his agriculture sector. Revolutionary steps are needed in agriculture sector of Pakistan. Agriculture productivity will promote the industrial sector productivity and will enhance the employment opportunities in a country.

6. POLICY RECOMMENDATIONS

Government of Pakistan should take measure to enhance the employment of labor force in a country with the help of higher education in both agriculture and industrial sector.

There should be measures on the circulation of money because it directly affects the general price level of goods in country.

Productivity of agriculture and its value added portion needed to enhance at higher level with the help of new agriculture technologies and the provision of good seeds and other agriculture inputs.

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