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Examining the Impact of Agriculture Sector Components on Economic Growth of Pakistan's Economy: an Econometric Analysis

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Abstract
The study aimed at assessing the impact of Agriculture Sector Components in terms of Total Cropped Area, Wheat Production, Rice Production, Sugarcane Production, Cotton Production, Fertilizer Offtake and Credits disbursed on economic growth of Pakistan **(**GDP_t**)** from 1994-95 to 2020-21. In this regard, Economic analysis was performed by employing econometric techniques and tests i.e Augmented Dickey Fuller (ADF) Test, Ordinary Least Square (OLS) Regression, Autoregressive Distribute Lags (ARDL) Model, Bound Test, Error Correction Mechanism (ECM), Variance Inflation Factor (VIF), Heteroscedasticity Test, Lagrange Multiplier (LM) Test, Normality Test, Granger Causality Test, Impulse Response Function and Wald Test. Findings revealed that respective variables *(*$LGDP_t$*,* A_t*,* TCA_t*,* W_t*,* R_t*,* S_t*, Ct, FOt,* CD_t*)* were stationary at level I(0) and I(1) order of integration in the model. OLS regression followed by ARDL indicated positive and significant impact of Agriculture Sector (A_t) and Sugarcane Production (S_t) on GDP Growth Rate of Pakistan ($LGDP_t$) over a period of time 1994-95 to 2020-21. F-value of Bound Test (3.89) was greater than upper bound critical value revealing long run relationship established between tested variables in the model. The value of Co-integrating equation was negative, depicting speed of adjustment; hence variables will adjust positively towards their long-run equilibrium. No serial correlation, no severe multicollinearity after removal of three highly collinear variables i.e RP_t*,* FO_t *and* CD_t, from the model and normally distributed sample data was witnessed in the model. Findings revealed uni and bi-directional causal relationship between tested variables. Impulse Response Analysis indicated

negative as well as positive responses; shock to GDP noticed symmetric impact on tested variables in short as well as in long run. Wald test confirmed the significance of independent variables *($LGDP_t$, A_t, TCA_t, W_t, R_t, S_t, Ct, FOt, CD_t)* for a model. The study may look into consideration the significance contribution of Agriculture sector components towards GDP growth rate of Pakistan. Hence, it is mandatory on the part of Government and also responsibility of the Private Sector to introduce latest and novel agricultural technologies and innovations making sure practically applicable to help solve growing concerns of farming community such as modest farm mechanization practices, improved seeds, advanced processing units, standardization of agriculture, quality delivery services right from seed bed preparation till the disposal of final product, provision of agriculture credits in kind depending upon the dire need of farmers on subsidized rates, correct usage of fertilizers and farm yard manures for improved soil fertility status, plant protection measures through integrated pest management thresholds etc for bringing about structural change of revolutionary improvements in the field of agriculture industry, which will ultimately results in boosting economic growth of economy at large.
Keywords: Agriculture Sector Components**,** GDP, co-integration, economic Growth.

INTRODUCTION

Agriculture is recognized as one of the major contributing sector for making sure the food availability in the country. It is providing rice, wheat, sugarcane, cotton etc to the growing population day by day. Agriculture and subsectors of Agriculture had a significant impact on economic growth (Jatoi, 2021). The Agriculture Sector is one of the major contributing source of rural employment in Pakistan, whereas contribution of industrial and service sectors towards rural employment is limited (Ajmair, 2014). In Pakistan's economy, Agriculture, Manufacturing, Industrial and Services Sector played crucial roles by making a significant contribution to the GDP. There is need to initiate comprehensive farmer support services, strengthening linkages of farm and non-farm sectors for the promotion of rural SMEs to serve as the foundation for agricultural and rural development (Abdelgawwad and Kamal, 2023). Agriculture is recognized as one of the major contributing sector for making sure the food availability in the country. It is providing rice, wheat, sugarcane, cotton etc to the growing population day by day. Agriculture and subsectors of Agriculture had a significant impact on economic growth (Jatoi, 2021). The significance share of Agriculture sector were examined towards growth of Pakistan from 1971-2015. In this respect, co-integrating relationships of Auto-Regressive Distributed Lags (ARDL) model indicated significant influence of agriculture sector towards economic growth. The Government may introduce latest and novel agricultural technologies and innovations such as farm mechanization, improved seeds, processing units, standardization, quality services, agriculture credits on subsidized rates, correct usage of fertilizers and farm yard manures, plant protection measures etc for bringing about structural change of revolutionary improvements in the field of agriculture industry, which will ultimately results in boosting economic growth of economy at large (Chandio et al. (2016).

Agriculture being agrarian economy of Pakistan is considered an important productive sector aimed at supporting country's rural population at large, contributing its declining share towards economic growth in Pakistan, engaging large number of labour force. By the passage of time, it was noticed that contributory sectoral share of agrarian sector towards DGP depicting declining trend mainly due to uneven wide spread rains, pest attacks, inferior quality of seed, incorrect

doses of fertilization and shortage of insecticides and pesticides, scarcity of irrigation, non provision of agriculture credits etc. Past Research findings overviews the debatable issue "Does Commodity Producing Sectors (i.e Agriculture, Manufacturing and Industry) and Service Sectors matters GDP Growth rate in assessing short and long run causality association among parameters in the model. Majority of previous literature considered commodity producing and service sectors as engine of economic development in the economy. Researcher's findings are based on contradictory conclusions regarding various impact assessment studies of Commodity Producing and Service Sectors (Baig et al., 2020). The Agriculture Sector is considered as backbone of economy for so many reasons such as huge rural population, major share of employment in Agriculture Sector, the significant sectoral contribution in terms of production capacity and national income. Though due share of Agriculture towards GDP and Foreign Trade had been declined in developing economies, but its contribution in accommodating huge employments opportunities for rural economy is well established fact. The studies in past literature advocate that the Agriculture Sector has played significant role in reduction of rural poverty Simsir (2012).

RESEARCH METHODOLOGY

Method, Structure of data, Range of data and Sources of data:

Time series data ranges from 1994-95 to 2020-21 from authenticated sources of Pakistan Economic Surveys, Federal Statistical Bureau, World Bank etc were utilized for present research study. (Dickey and Fuller, 1981) was used to employ the econometric tests such as stationarity and OLS regression model. In order to check the time series data set in terms of stationarity or non stationarity levels, most suitable test such as Augmented Dickey-Fuller test has been utilized to test the stationarity status of time series tested variables (Perron, 1990). Moreover, to estimate the long and short run relationships between variables, Auto-Regressive Distributed Lag (ARDL) Model, Bounds Test, Error Correction Mechanism were employed (Pesaram & Shin. 1998), Granger causality as an econometric test also used to verify the usefulness of one variable to forecast another, indicated a bidirectional, unidirectional or no causality moving. Impulse Response Function was also used to check the direction and magnitude of casual relationship, (Pesaran & Shin, 1998, Ahad, 2017). A normality test also applied to determine whether a sample data has been drawn from a normally distributed population. The Wald test as parametric statistical measure was also used to confirm whether a set of independent variables are individually or collectively 'significant' for a model or not. EViews, being relevant statistical package was used for time series econometric analysis throughout research study.

Econometric Model

The econometric equation to assess the impact of Total Cropped Area, Wheat Production, Rice Production, Sugarcane Production, Cotton Production, Fertilizer Offtake and Credits disbursed (as components of Agriculture Sector) on GDP Growth Rate of Pakistan is symbolically presented as follows;

$$GDP_t = \alpha_0 + \alpha_1 TCA_t + \alpha_2 W_t + \alpha_3 R_t + \alpha_4 S_t + \alpha_5 C_t + \alpha_6 FO_t + \alpha_7 CD_t + e_t \text{ ----------i}$$

Where,

GDP_t = GDP Growth Rate of Pakistan in year t.

α_0 = Constant Coefficient.

$\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5, \alpha_6$ and α_7 = Slopes Coefficient

TCA_t = Total Cropped Area in year t.

W_t= Wheat Production in year t.

R_t= Rice Production in year t.

S_t = Sugarcane Production in year t.

C_t= Cotton Production in year t.

FO_t= Fertilizer Offtake in year t.

CD_t = Credit Disbursed in year t.

e_t = Stochastic term in year t.

Log-Linear Model is specified when the logarithm (Log) of the dependent variable is modeled using a linear combination of independent variables as;

$$LogGDP_t = \alpha_0 + \alpha_1 TCA_t + \alpha_2 W_t + \alpha_3 R_t + \alpha_4 S_t + \alpha_5 C_t + \alpha_6 FO_t + \alpha_7 CD_t + e_t \text{ ----------ii}$$

RESULTS AND DISCUSION

Unit Root Tests for Tested Variables: Augmented Dickey-Fuller (ADF) Test rejected the null hypothesis of non-stationarity of all such variables, when applied 1st difference, which verified that tested variables ($LGDP_t$, W_t) are stationary at level I(0) order of integration and respective variables (A_t, TCA_t, R_t, S_t, C_t, FO_t, and CD_t) at found stationary when applied 1st difference at level I(1) as reflected in Table-1.

Table-1 Unit Root Test for Tested Variables ($LGDP_t$, A_t, TCA_t, W_t, R_t, S_t, C_t, FO_t, CD_t)

Variables	ADF (Levels)		ADF in 1st Differences		Sequence of integration through differencing I( )
	Intercept	Intercept & Trend	Intercept	Intercept & Trend	
$LGDP_t$	-3.59	-3.52	-5.11	-4.99	I(0)
A_t	-2.72	-2.59	-4.73	-4.39	I(1)
TCA_t	-1.93	-2.56	-5.18	-5.08	I(1)
W_t	-4.56	-4.99	-12.21	-13.03	I(0)
R_t	-1.28	-4.37	-6.96	-6.81	I(1)
S_t	1.03	-4.33	-5.41	-5.95	I(1)
C_t	-2.29	-1.89	-6.83	-4.82	I(1)
FO_t	-1.26	-4.69	-7.69	-7.50	I(1)
CD_t	3.05	0.59	-3.01	-5.00	I(1)

Note: All tested variables estimated in log linear form;

95% Critical values = -2.98 (No intercept and no trend)
95% Critical values = -3.63 (Presence of intercept and trend)

The present study is in line with past studies conducted by Tampubolon (2023).

Table-2 Ordinary Least Square (OLS) for variables (*$LGDP_t$, A_t, TCA_t, W_t, R_t, S_t, C_t, FO_t, CD_t)*

Response Variable: Log(GDP)				
Method: **Least Squares**				
Sample data set: 1994-95 to 2020-21				
Counted observations after adjustments: 27				
Variables	**Coefficients**	**Standard Error**	**t-Statistics**	**Probability**
Agriculture	0.284598	0.162098	1.755717	0.0961***
Total Cropped Area	0.379158	0.865523	0.438068	0.6665
Wheat Production	-0.060207	0.151940	-0.396254	0.6966
Rice Production	-1.187564	0.876716	-1.354559	0.1923
Sugarcane Production	0.133481	0.065148	2.048884	0.0553***
Cotton Production	0.053338	0.355950	0.149848	0.8826
Fertilizer Offtake	1.752284	1.483287	1.181352	0.2528
Credit Disbursed	-0.003359	0.002885	-1.164311	0.2595
Constant (C)	-10.74848	18.96627	-0.566715	0.5779
R^2	0.472230	Durbin Watson Statistics		1.831546
Adjusted R^2	0.237666			
F-Statistics	2.013220			
Probability (F-Statistics)	0.103760			

****Significance level at 10%*

The estimated econometric equation to assess the impact of Total Cropped Area, Wheat, Rice, Sugarcane, Cotton, Fertilizer Offtake and Credits disbursed (as components of Agriculture Sector) on GDP Growth Rate of Pakistan is presented as follows;

$$LGDP_t = \alpha_0 + 0.379158^{*}TCA_t - 0.060207^{*}W_t - 1.187564^{*}R_t + 0.133481^{*}S_t + 0.053338^{*}C_t + 1.752284^{*}FO_t - 0.003359^{*}CD_t \text{ ----------iii}$$

Table-2 indicated positive and significant impact of Agriculture Sector (A_t) and Sugarcane Production (S_t), whereas rest of independent variables (i.e TCA_t, W_t, R_t, C_t, FO_t, CD_t) impacted insignificant influence on GDP Growth Rate of Pakistan ($LGDP_t$) over a period of time 1994-95 to 2020-21. In case of Agriculture Sector, the significant value of its coefficient is worked out as 0.284598 means for 1 unit increase by Agriculture Sector, Dependent Variable as GDP Growth Rate increases by 28.5%. In case of Sugarcane Production, the significant value of its coefficient is worked out as 0.133481 means for 1 unit increase by Sugarcane production, Dependent Variable as GDP Growth Rate increases by 13.3%. The perusal of Table-2 provides that R^2 value is 0.47 which indicated that independents variable such as A_t, TCA_t, W_t, R_t, S_t, C_t, FO_t, CD_t are predicting 47% variation in Dependent Variable as GDP_t. F value is worked out as 2.01 (P<0.10)

revealing overall combined effects and overall Fitness of the Model. Moreover, DW (1.83) lies within acceptable range of 1.5 to 2.5 revealing no autocorrelation in the model. The present study is in agreement with past studies conducted by Abdelaal and El-Shafei (2021).

Table-3 Auto-Regressive Distributed Lags Model for Variables (*$LGDP_t$, A_t, TCA_t, W_t, R_t, S_t, C_t, FO_t, CD_t)*

Response Variable: Log(GDP)				
Method: ARDL (1,1,1,1.0,0,1,0,1)				
Sample data set: 1994-95 to 2020-21				
Counted observations after adjustments: 26				
Variables	**Coefficients**	**Standard Error**	**t-Statistics**	**Probability***
GDP(-1)	-0.084828	0.200706	-0.422650	0.6807
Agriculture	0.369239	0.150371	2.455516	0.0319**
Agriculture(-1)	0.475731	0.162563	2.926446	0.0138**
Total Cropped Area	1.324697	0.856577	1.546502	0.1503
Total Cropped Area(-1)	-1.797386	0.788991	-2.278082	0.0437**
Wheat Production	0.291015	0.149508	1.946484	0.0776***
Wheat Production(-1)	0.310567	0.141815	2.189939	0.0510***
Rice Production	-2.183770	0.791968	-2.757399	0.0186**
Sugarcane Production	0.003204	0.061472	0.052124	0.9594
Cotton Production	-0.289497	0.358515	-0.807489	0.4365
Cotton Production(-1)	-0.587243	0.293347	-2.001872	0.0706***
Fertilizer Offtake	3.130721	1.265726	2.473459	0.0309**
Credit Disbursed	0.012083	0.007634	1.582808	0.1418
Credit Disbursed(-1)	-0.018197	0.007908	-2.301261	0.0419**
C	11.79922	17.70165	0.666561	0.5188
R^2	0.820336	Durbin Watson Statistics		1.881060
Adjusted R^2	0.591672			
F-Statistics	3.587521			
Probability (F-Statistics)	0.019716			

***Significance level at 5%*
****Significance level at 10%*

Perusal of Table-3 provides the application of Auto-Regressive Distributed Lags Model (ARDL) a standard least square regression that includes lags of dependent and independent variables as regressors. Since both order of integration at level I(0) and at 1st difference I(1) conditions presents in Table-1, after application of ARDL approach, the results findings of Table-3 revealed that lag values of Agriculture, Total Cropped Area, Wheat Production, Cotton Production, Credit Disbursed including value of Rice Production and Fertilizer Offtake impacted positive and significant influence on GDP Growth Rate of Pakistan, whereas value of Sugarcane Production revealed insignificant influence on GDP Growth rate of Pakistan. Hence, ARDL examined co-integrating relationships between tested variables (i.e TCA_t, W_t, R_t, C_t, FO_t, CD_t) in the model. The present study is on the analogy of previous studies ducted by Sayef and Malek (2022).

Table-4 Bound Test for estimating long run relationships of variables (*$LGDP_t$, A_t, TCA_t, W_t, R_t, S_t, C_t, FO_t, CD_t*)

ARDL Bounds Test		
Sample data set: 1994-95 to 2020-21		
Counted observations after adjustments: 26		
HO: Non existence of long-run relationships		
Test Statistics	Value(s)	k
F-statistics	3.894711	8
Critical Value Bounds		
Sig.	I0 Bound	I1 Bound
10%	1.95	3.06
5%	2.22	3.39
2.5%	2.48	3.7
1%	2.79	4.1

HO= No Long Run Relationships between variables
HI = Long Run Relationships between variables

Perusal of Table-4 revealed findings of Bound Test that value of F statistics is worked out 3.89, which is greater than upper bound critical value, hence by rejecting HO hypothesis and accepting HI, long run relationship established between tested variables in the model. The current study is associated with past findings of Emam (2022).

Table-5 Error Correction Mechanism for short run relationships and long run adjustment of Variables (*$LGDP_t$, A_t, TCA_t, W_t, R_t, S_t, C_t, FO_t, CD_t*)

Response Variable: DLog(GDP)				
Method: **Error Correction Mechanism**				
Sample data set: 1994-95 to 2020-21				
Counted observations after adjustments: 26				
Variables	**Coefficientss**	**Standard Error**	**t-Statistics**	**Probability***
C	-0.645235	0.582962	-1.106821	0.2847
D(AGRICULTURE)	0.034304	0.139780	0.245413	0.8093
D(TCA)	0.525313	1.149121	0.457144	0.6537
D(WP)	-0.084481	0.124721	-0.677362	0.5079
D(RP)	-0.470769	0.749529	-0.628086	0.5388
D(SP)	0.190788	0.066514	2.868394	0.0111**
D(CP)	0.370787	0.368828	1.005312	0.3297
D(FO)	1.374493	1.413355	0.972504	0.3453
D(CD)	0.007565	0.007462	1.013775	0.3258
ECT(-1)	-3.833681	4.407562	-0.869796	0.3973
R^2	0.533441	Durbin Watson Statistics		1.776406
Adjusted R^2	0.271001			

F-Statistics	2.032622
Probability (F-Statistics)	0.103402

***Significance level at 5%*

In Table-5, the significant values of tested variable (i.e Sugarcane Production SP_t) indicated short run relationships. Since all tested variables are stationary at I(1) and error term at I(0), it means cointgration and long run relationship exists. Perusal of Table 4.15 indicated the value of Co-integrating equation is negative and insignificant provides speed of adjustment indicating that there was divergence from short run dynamics towards long run equilibrium, which can be corrected by following approach of general to specific model by using different lags of dependent and independent variables in the model. A negative value of error correction term indicated that the variables will adjust positively towards their long-run equilibrium. The perusal of Table-5 provides that R^2 value is 0.53 which indicated that independents variable such as A_t, TCA_t, W_t, R_t, S_t, C_t, FO_t, CD_t are predicting 53% variation in Dependent Variable as $LGDP_t$. F value is worked out as 2.0 ($P<0.10$) revealing overall combined effects and overall Fitness of the Model. The present study is in line with past studies conducted by Charles (2018).

Table-6 Variance Inflation Factors for checking the presence of Multicollinearity for variables ($LGDP_t$, A_t, TCA_t, W_t, R_t, S_t, C_t, FO_t, CD_t)

Part-A

Variance Inflation Factors			
Sample data set: 1994-95 to 2020-21			
Counted observations after adjustments: 27			
	Coefficient	Uncentered	Centered
Variables	Variance	VIF	VIF
AGRICULTURE	0.026276	3.619030	1.538937
TCA	0.749130	3206.867	2.888920
WP	0.023086	90.71904	3.922459
RP	0.768631	209.9731	10.33728
SP	0.004244	115.7966	4.164177
CP	0.126700	128.3693	3.254509
FO	2.200141	240.8737	11.56834
CD	8.32E-06	18.19209	10.36137
C	359.7195	2886.885	NA

Variance Inflation Factors (VIF) ≥ 10 indicate existence of severe Multicollinearity in the Model. Perusal of Table-6 (Part-A) indicated that Centered VIF values of tested variables (A_t, TCA_t, W_t, S_t, C_t) are less than 10 revealed no severe presence of multicollinearity in the model, whereas values of variables (*i.e* R_t, FO_t, CD_t) are more than 10 revealed severe presence of multicollinearity in the model, hence after removal of three highly collinear variables i.e RP_t, FO_t *and* CD_t, containing values of Variance Inflation Factors (VIF) ≥ 10, then applied VIF test again, which is reproduced as;

Part-B

Variance Inflation Factors			
Sample data set: 1994-95 to 2020-21			
Counted observations after adjustments: 27			
	Coefficient	Uncentered	Centered
Variables	Variance	VIF	VIF
AGRICULTURE	0.027790	3.471056	1.476013
TCA	0.434374	1686.268	1.519081
WP	0.020286	72.29021	3.125644
SP	0.002580	63.83193	2.295469
CP	0.055434	50.93333	1.291298
C	203.7233	1482.673	NA

After removal of three highly collinear variables i.e RP_t, FO_t *and* CD_t, in the model, thereafter Centered VIF values of all re-tested variables (A_t, TCA_t, W_t, S_t, C_t) in Table-6 (Part-B) are now found less than 10 revealed no severe presence of multicollinearity in the model.

Table-7 Heteroskedasticity Test for variables ($LGDP_t$, A_t, TCA_t, W_t, R_t, S_t, C_t, FO_t, CD_t)

Heteroskedasticity Test:			
F-Statistics	0.435826	Probability F(12,13)	0.9198
Obs*R^2	7.459044	Probability Chi-Square(12)	0.8258
Scaled explained SS	3.594761	Probability Chi-Square(12)	0.9897

H0: No Heteroskedacticity
HI: Heteroskedacticity

Perusal of Table-7 indicated that probability value of F-Statistics and Chi-square are greater than 5% level of significance, hence Null Hypothesis is accepted revealing presence of homoskedasticity (no heteroskedasticity) in the model. The study is on the analogy of previous study conducted by Alnegrish (2023).

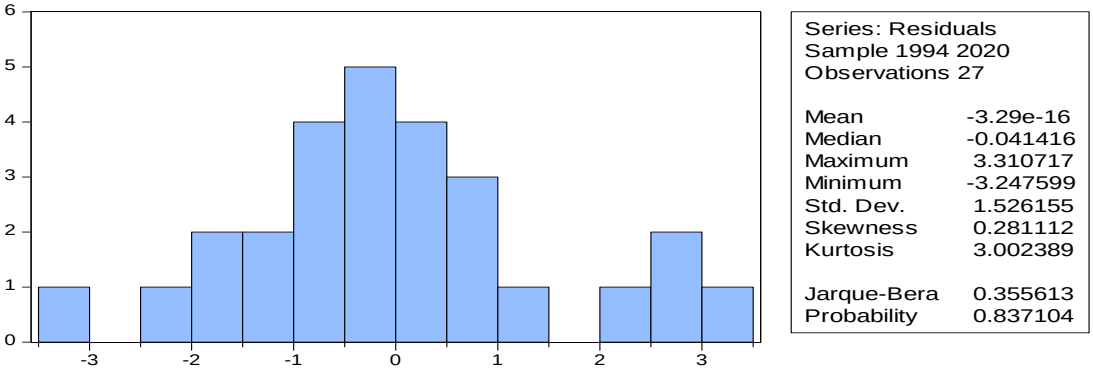
Table-8 Lagrange Multiplier (LM) Test for checking Serial Correlation/ Autocorrelation of variables ($LGDP_t$, A_t, TCA_t, W_t, R_t, S_t, C_t, FO_t, CD_t)

Serial Correlation LM Test:			
F-Statistics	0.094023	Probability F(2,11)	0.9110
Obs*R^2	0.437003	Probability Chi-Square(2)	0.8037

HO: Absence of serial correlation between variables
H1: Presence of serial correlation between variables

Since the probability values of all tested variables (i.e A_t, TCA_t, W_t, R_t, S_t, C_t, FO_t, CD_t) are greater than 5% level of significance (P>0.05) as shown in Table-8, hence null hypothesis is accepted, which revealed there is no serial correlation/ no autocorrelation in the model.

Figure-1 Normality Test for variables ($LGDP_t$, A_t, TCA_t, W_t, R_t, S_t, C_t, FO_t, CD_t)



HO: Sample data has been drawn from normally distributed
HI: Sample data has not been drawn from normally distributed

Since the probability value of Normality Test (0.84) is greater than 5% level of significance (P>0.05) depicted in Figure-1, hence null hypothesis is accepted, confirming that sample data has been drawn from normal distributed. Hence relationships among tested variables are normal in the model.

Table-9 Granger Causality Test for variables ($LGDP_t$, A_t, TCA_t, W_t, R_t, S_t, C_t, FO_t, CD_t)

Pairwise Granger Causality Tests			
Sample data set: 1994-95 to 2020-21			
Lags: 1			
HO:	Obs	F-Statistics	Probability*
AGRICULTURE not Granger Causing LGDP	26	0.02016	0.8883
LGDP not Granger Causing AGRICULTURE		1.71087	0.2038
TCA not Granger Causing LGDP	26	2.44920	0.1312
LGDP not Granger Causing TCA		0.98363	0.3316
WP not Granger Causing LGDP	26	0.47609	0.4971
LGDP not Granger Causing WP		0.11600	0.7365
RP not Granger Causing LGDP	26	0.64213	0.4311
LGDP not Granger Causing RP		0.01514	0.9031
SP not Granger Causing LGDP	26	0.33545	0.5681
LGDP not Granger Causing SP		4.57429	0.0433***
CP not Granger Causing LGDP	26	0.47711	0.4966
LGDP not Granger Causing CP		2.11658	0.1592
FO not Granger Causing LGDP	26	0.08485	0.7734
LGDP not Granger Causing FO		0.89905	0.3529
CD not Granger Causing LGDP	26	0.50388	0.4849
LGDP not Granger Causing CD		1.69833	0.2054
TCA not Granger Causing AGRICULTURE	26	0.99810	0.3282
AGRICULTURE not Granger Causing TCA		1.21352	0.2820
WP not Granger Causing AGRICULTURE	26	0.24031	0.6286
AGRICULTURE not Granger Causing WP		0.12195	0.7301
RP not Granger Causing AGRICULTURE	26	3.96711	0.0584***
AGRICULTURE not Granger Causing RP		0.37129	0.5483
SP not Granger Causing AGRICULTURE	26	0.19936	0.6594
AGRICULTURE not Granger Causing SP		1.48490	0.2354
CP not Granger Causing AGRICULTURE	26	3.00914	0.0962
AGRICULTURE not Granger Causing CP		0.21600	0.6465
FO not Granger Causing AGRICULTURE	26	0.99820	0.3281
AGRICULTURE not Granger Causing FO		1.18995	0.2866
CD not Granger Causing AGRICULTURE	26	0.19236	0.6650
AGRICULTURE not Granger Causing CD		0.00590	0.9394
WP not Granger Causing TCA	26	0.51867	0.4787
TCA not Granger Causing WP		5.78414	0.0246**

RP not Granger Causing TCA	26	1.48134	0.2359
TCA not Granger Causing RP		0.78014	0.3862
SP not Granger Causing TCA	26	5.63479	0.0263**
TCA not Granger Causing SP		0.42059	0.5231
CP not Granger Causing TCA	26	0.93507	0.3436
TCA not Granger Causing CP		0.70700	0.4091
FO not Granger Causing TCA	26	3.27115	0.0836***
TCA not Granger Causing FO		3.22935	0.0855
CD not Granger Causing TCA	26	3.05153	0.0940***
TCA not Granger Causing CD		0.67359	0.4202
RP not Granger Causing WP	26	13.0436	0.0015
WP not Granger Causing RP		1.82831	0.1895
SP not Granger Causing WP	26	2.47297	0.1295
WP not Granger Causing SP		5.06820	0.0342**
CP not Granger Causing WP	26	1.61540	0.2164
WP not Granger Causing CP		0.23571	0.6319
FO not Granger Causing WP	26	10.9563	0.0031***
WP not Granger Causing FO		3.68357	0.0674
CD not Granger Causing WP	26	3.00824	0.0962
WP not Granger Causing CD		1.24739	0.2756
SP not Granger Causing RP	26	13.8012	0.0011***
RP not Granger Causing SP		2.81320	0.1070
CP not Granger Causing RP	26	0.74284	0.3976
RP not Granger Causing CP		1.36521	0.2546
FO not Granger Causing RP	26	2.96742	0.0984***
RP not Granger Causing FO		3.42407	0.0771***
CD not Granger Causing RP	26	8.19279	0.0088***
RP not Granger Causing CD		1.10058	0.3050
CP not Granger Causing SP	26	0.00899	0.9253
SP not Granger Causing CP		0.23344	0.6335
FO not Granger Causing SP	26	4.63936	0.0420**
SP not Granger Causing FO		1.68894	0.2066
CD not Granger Causing SP	26	6.35753	0.0191**
SP not Granger Causing CD		8.05612	0.0093*
FO not Granger Causing CP	26	0.51518	0.4801
CP not Granger Causing FO		3.28058	0.0832***
CD not Granger Causing CP	26	3.37954	0.0790***
CP not Granger Causing CD		1.09186	0.3069
CD not Granger Causing FO	26	3.87568	0.0612***
FO not Granger Causing CD		4.22229	0.0514***

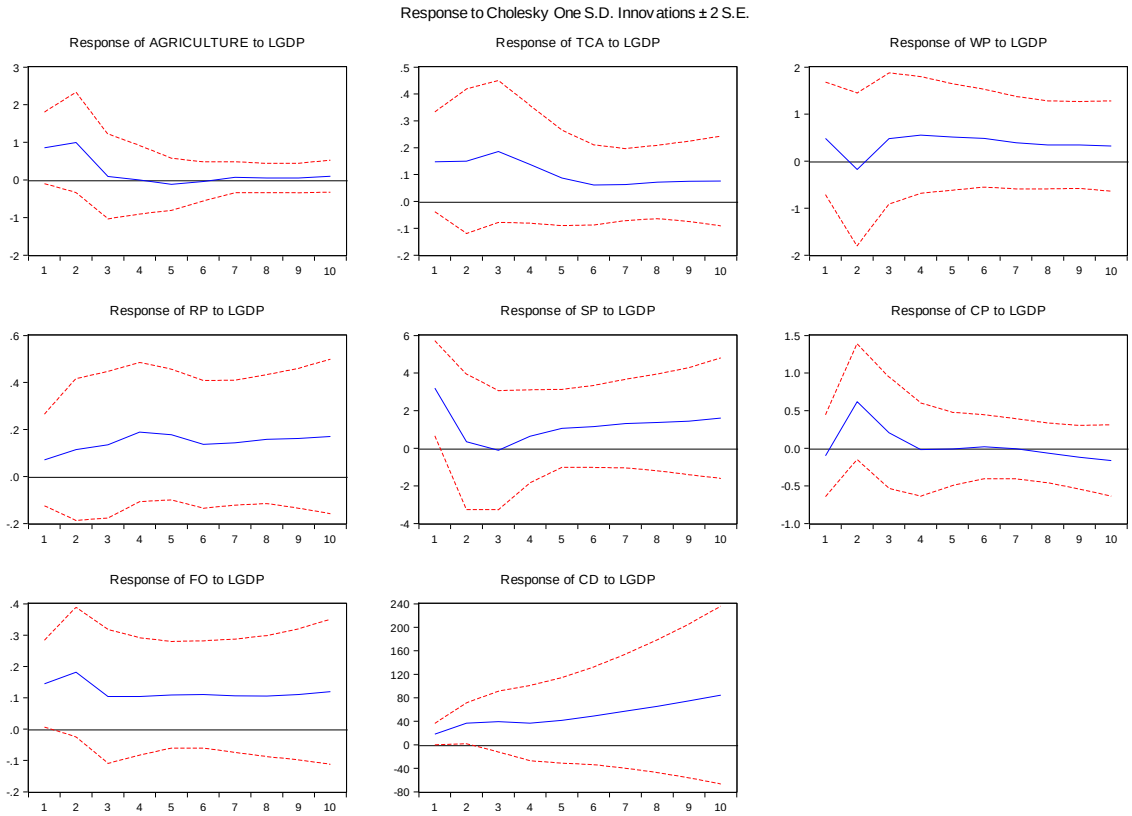
**Significance level at 1%*

***Significance level at 5%*

****Significance level at 10%*

Perusal of Table-9 revealed uni-directional causal relationship between LGDP and Sugarcane Production (P<0.05), between Cotton Production and Agriculture (P<0.10), between Total Cropped Production and Wheat Production (P<0.05), between Sugarcane Production and Total Cropped Area (P<0.05), between Cotton Production and Total Cropped Area (P<0.10), between Rice Production and Wheat Production (P<0.01), between Sugarcane Production and Rice Production (P<0.01), between Cotton Production and Rice Production (P<0.01), between Fertilizer Offtake and Sugarcane Production (P<0.05), between Credit Disbursed and Fertilizer Offtake (P<0.10), between Cotton Production and Fertilizer Offtake (P<0.10), between Credit Disbursed and Cotton Production (P<0.10). The results also revealed bi-directional causality between Fertilizer Offtake and Total Cropped Area, between Fertilizer Offtake and Wheat Production, between Fertilizer Offtake and Rice Production, between Cotton Production and Fertilizer Offtake. The present results are in agreement with past study conducted by Singariya and Sinha (2015) revealed uni-directional relationship between GDP and industrial sector in India, contrary to present study, Gabriel et al. (2022) revealed uni-directional association from agriculture to economic growth in Nigera. The findings of present study in comparison with previous studies showed that the importance of agriculture and manufacturing sector have been shifted to the service sector and significantly contributed to GDP growth of Pakistan's economy.

Figure-2 Impulse Response Analysis for variables ($LGDP_t$, A_t, TCA_t, W_t, R_t, S_t, C_t, FO_t, CD_t)



Perusal of Figure-2 depicted red lines and blue line in all eight responses of Agriculture, Total Cropped Production, Wheat Production, Rice Production, Sugarcane Production, Cotton Production, Fertilizer Offtake and Credit Disbursed to LGDP. Red lines referred to 95% confidence interval and blue line referred to Impulse Response Function. The blue line should always exist within red lines.

In order to explain Response of Agriculture to LGDP, one standard deviation shock or impulse or innovation given to LGDP resulted in gradual increase of production in Agriculture from period 1st to 2nd, then sharp increases from 2nd to 3rd period and thereafter in stable state from 3rd to 10th period.

In case of Response of Total Cropped Production to LGDP, one standard deviation shock or impulse or innovation given to LGDP resulted in gradual increases of Total Cropped Production from 1st to 3rd Period, then gradual decreases from 3rd to 5th period and thereafter in stable state from 5th to 10th period.

In case of Response of Wheat Production to LGDP, one standard deviation shock or impulse or innovation given to LGDP resulted in sharp decline from 1st to 2nd period becomes negative, then sharp increases from 2nd to 3rd period becomes positive, then gradual declines from 3rd to 7th period.

In case of Response of Rice Production to LGDP, one standard deviation shock or impulse or innovation given to LGDP resulted in gradual increase from 1st to 2nd period, then gradual increases from 2nd to 4th period, gradual decline from 4th to 6th period and thereafter gradual increases from 6th to 10th period.

In case of Response of Sugarcane Rice Production to LGDP, one standard deviation shock or impulse or innovation given to LGDP resulted in sharp decline from 1st to 2nd period, then in stable state from 2nd to 3rd period, then gradual increases from 3rd to 5th period and thereafter gradual increases from 5th to 10th period.

In case of Response of Cotton Production to LGDP, one standard deviation shock or impulse or innovation given to LGDP resulted in shock or impulse or innovation given to GDP resulted in gradual increase of Cotton Production from 1st to 2nd period, then sharp declines from 2nd to 4th period, then in stable state from 4th to 7th period and thereafter gradual declines from 7th to 10th period becomes negative.

In case of Response of Fertilizer Offtake to LGDP, one standard deviation shock or impulse or innovation given to LGDP resulted in sharp increase of Fertilizer Offtake from 1st to 2nd period, then sharp declines from 2nd to 3rd period and thereafter in stable state from 3rd to 10th period.

In case of Response of Credit Disbursed to LGDP, one standard deviation shock or impulse or innovation given to LGDP resulted in gradual increase of Credit Disbursed from 1st to 2nd period, then in stable state from 2nd to 4th period and thereafter gradual increases from 4th to 10th period.

Hence in all eight responses, negative as well as positive responses exist, so shock to LGDP will have symmetric impact of Agriculture, Total Cropped Production, Wheat Production, Rice Production, Sugarcane Production, Cotton Production, Fertilizer Offtake and Credit Disbursed of Pakistan in short as well as in long run. The present study is in agreement with past studies conducted by Pesaran and Shin (1998) and Kashif et al. (2023).

Table-10 Wald Test for tested variables ($LGDP_t$, A_t, TCA_t, W_t, R_t, S_t, C_t, FO_t, CD_t)

Wald Test:

Test Statistics	Value(s)	df	Prob.
F-Statistics	16.68896	(8, 19)	0.0000*
Chi-square	133.5117	8	0.0000*

HO: C(1)=0,C(2)=0,C(3)=0,C(4)=0,C(5)=0,C(6)=0,C(7)=0,C(8)=0

**Significance level at 1%*

HO: The value of independent variable is zero (0)
H1= The value of independent variable is not equal to zero (0)

Since the results of Wald Test indicated the probability values at F-test and Chi-Square values are less than 1% (P<0.01) as shown in Table-10, it means Null Hypothesis of assuming the values of independent variable is zero (0) is rejected, confirming set of independent variables (i.e A_t, TCA_t, W_t, R_t, S_t, C_t, FO_t, CD_t) are significant for a model. Present study recommended that priority must be given to the development of Agriculture Sector in order to ensure consistent production of agriculture produce i.e wheat, rice, sugarcane, cotton etc. Agricultural Policy must be framed in a manner to ensure provision of regular and timely supply of inputs i.e quality seed, recommended doses of fertilizer, insect and pest management practices, timely and adequate irrigation. The study recommends rationalization of wheat, rice, sugarcane, cotton, fertilizer offtake and credits disbursed so as to raise the working of domestic production in Pakistan. The present study is on the analogy of past studies conducted by Abdelaal and El-Shafei (2021).

CONCLUSION AND RECOMMENDATIONS

The study arrived at conclusion that Agriculture Sector Components significantly influenced economic growth of Pakistan from 1994-95 to 2020-21. This is quite essential to look into consideration the significance contribution of Agriculture sector towards GDP growth rate of Pakistan. Hence, it is mandatory on the part of Government to introduce latest and novel agricultural technologies and innovations making sure practically applicable to help solve growing concerns of farming community such as modest farm mechanization practices, improved seeds, advanced processing units, standardization of agriculture, quality delivery services right from seed bed preparation till the disposal of final product, provision of agriculture credits in kind depending upon the dire need of farmers on subsidized rates, correct usage of fertilizers and farm yard manures for improved soil fertility status, plant protection measures through integrated pest management thresholds etc for bringing about structural change of revolutionary improvements in the field of agriculture industry. The study recommends to Governmental and Private Organization of Pakistan to ensure rationalization of wheat, rice, sugarcane, cotton, fertilizer offtake and credits disbursed so as to raise the working of domestic production in Pakistan. Present study recommended that priority must be given to the development of Agriculture Sector in order to ensure consistent production of agriculture produce i.e wheat, rice, sugarcane, cotton etc. Agricultural Policy must be framed in a manner to ensure provision of regular and timely supply of inputs i.e quality seed, recommended doses of

fertilizer, insect and pest management practices, timely and adequate irrigation, which will ultimately results in boosting economic growth of economy at large.

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