

Impact of Agriculture Volatility on Economic Growth: A Case Study of Pakistan

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Abstract

Agriculture plays a crucial role in the economy of developing countries, and it is the main source of food, income and employment for the rural population. So developing countries like Pakistan need to sustain growth of agriculture sector. But in past few decades huge variations occurred in agriculture production. Stability is an important objective for any economy because development requires sustain growth of different sectors. So this study is an attempt to view the nature of volatility of the agriculture sector in Pakistan and trying to find out that to what extent do volatility, production and employment in agriculture sector associated with the economic growth. In first step, Auto Regressive Conditional Heteroscedasticity (ARCH) family models applied to detect volatility of agriculture sector in Pakistan. In second step, augmented dickey fuller is applied for unit root and shows that all the variables are integrated of order one. In third step, Co-integration: Trace Statistics and Eigen Values Tests are used to capture the long term effect of these variables on economic performance. The Empirical results of co-integrating equation show that agriculture productivity and employment in agriculture sector and positively and significantly associated with economic growth. While agricultural volatility is negatively contributing in economic growth in case of Pakistan. On the basis of empirical findings of this study, it is suggested for long term and sustain economic growth is that Government should take widespread transparent programs for agriculture sector and rural development, so that agriculture volatility can be controlled.

Key words: Agriculture growth, agriculture volatility, economic growth

Introduction:

At the time of independence agriculture sector was the largest contributor towards the GDP of Pakistan. But with the passage of time service sector became the largest contributor of GDP and now agriculture has the third largest share in the GDP of Pakistan. At the time of independence Pakistan was primarily agriculture based country. But as time progressed Pakistan turned into more diversified country as industrialization took hold. But industrial development could not decrease the importance of agriculture sector in Pakistan although the share of agriculture sector has decreased significantly since its birth.

According to economic survey of 2010-2011, the progress of rural areas is indispensable for the development of Pakistan's economy because nearly 62% of Pakistan's population lives in the rural sector. Agriculture has been a milestone towards the advancement of the rural sector of Pakistan. It is not only the means of subsistence for the villagers but also the biggest

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source of employment for them. Agriculture provides income to the rural people than their expenditure on education and health increased. The World Development Report (2008) recommends that the growth originating in agriculture is four times more effective in reducing poverty than the growth coming from non-agriculture sectors. Thus agriculture helps in reducing the income inequality between rural and urban areas of Pakistan.

The fluctuation in overall agriculture production has been largely dependent on the contribution of major crops. In the developmental six year program (1951-57) emphasis was on the establishment of industries, which was suspended for two years before its end, due to lack of adequate institutional credit system, absentee landlordism, uneconomic holdings, defective land tenure system etc. Agriculture remained inactive during that period, rather declined there was an increase in water logging and salinity. In the Second Five Year Plan 1960-65, the Government was determined to achieve self sufficiency in basic production. In order to achieve their objectives, it took a few effective steps like the agrarian reforms, adoption of modern technology, and provision of credit facilities to the farmers etc. During the Third Five Year Plan 1965-70, there was remarkable shift in agricultural until 1968. Since 1968 to 2002, the overall performance was badly affected due to the drought situation particularly in Baluchistan and Sindh areas. According to federal bureau of statistic (FBS) during the year 2003-04 growth was 2.4% decline in growth due to the wide spread rains, and pest attack on crop there was a fall in the production of cotton. It recorded a growth of 2.2%. However, during the year 2004-05, there was a modest recovery in agriculture due to availability of rain water, and timely provision of fertilizers and credit to the farmers. The agri. growth was remained 6.5% during 2004-05, 6.3% in 2005-06, 4.1% in 2006-07, 1.0% in 2007-08, 4.0% in the year 2008-09, 0.6% in the year 2009-2010 and 2.1% in the year 2010-2011.

In the years of 2005 and 2010 there were two most destructive natural disasters in Pakistan's history namely the earthquake and the flood respectively which damages the economy of the Pakistan very badly particularly agriculture sector that cause to create volatility in it. According to the finance minister Mr. Hafeez Sheikh "the floods, the ongoing war against terrorism and a spurt in world oil prices pulled back the economy that grew by only 2.4% against a target of 4.5% in the outgoing financial year 2010-11" (Economic Survey of Pakistan, 2010-2011). The Economic Survey of Pakistan 2010-11, Finance minister said that the floods created the domino effect that not only damaged the agriculture sector but also had a negative impact on the other sectors like manufacturing and services sectors. Floods caused losses worth Rs. 855 billion, of which Rs. 429 billion was lost only by the agriculture sector. According to the Business Recorder's report (July 28 2005) "Flood leaves positive impact on agriculture sector" there are also some positive impacts of flood on the agri. sector of the Pakistan. Agriculture experts and representatives of growers told Business Recorder that 'The recent flood and rains have helped in overcoming water shortage, which was main threat for agriculture sector in the past. According to Muhammad Idrees, Chief Organiser, Farmers Associates Pakistan, recent flood has also helped a lot in bringing up the underground water level. This situation will definitely reduce cost of farmers, as improved level of underground water will slash pumping cost of growers in various areas.

Volatility is variations or fluctuations over the time in exchange rate, interest rate, stock index, and product price or growth rate of any sector. Agriculture volatility means the relative rate at which the growth rate of agriculture sector moves up and down. Volatility is found by calculating the standard deviation of annual change in growth. Over the past six years, Agriculture has grown at an average rate of 3.7 percent per annum. However, volatility in the sector is high, with the range of growth varying between 6.5 percent and 1.0 percent (Economic Survey 2009-10). So we want to check fluctuation in the growth of agriculture

sector and find out which kind of fluctuation occurs in agriculture sector of Pakistan. Lastly we see the effect of these fluctuations on economic growth of Pakistan.

The paper is organized as follows. Section 2 provides literature review on agriculture volatility and other relevant variables, section 3 provides the theoretical framework, section 4 discusses the methodology and data collection for agriculture volatility and economic growth for Pakistan, section 5 discusses the empirical findings and section 6 provides the conclusion and policy recommendations.

Literature review:

Agriculture usually plays a vital role in the economy of every nation that exists. Not only for the reason that it tends to feed the entire population of a country but also in the respect that agriculture correlates and interacts with all the related industries of that country. A country is usually considered to be a social and politically stable nation if it possesses a very stable agricultural basis. Volatility is a hurdle in achieving sustained economic growth which is an important objective of any economy. The pattern of economic volatility in Pakistan is complex and there is no sufficient literature exists to investigate the agriculture volatility. In terms GDP the most volatile sectors are agricultural, industrial and service; while the least volatile are distribution, transport, and communications.

Ghosh, Nilabja *et al* (2009) examined whether trade liberalization has indeed worse off the unexpected volatilities of agricultural (producer) prices in India and if so, what could be sources to get rid of that situation. They used ARCH and the GARCH models and their modified versions on annual data on agricultural prices for the sample period of 31 years (1975-76 to 2005-06) to examine the effect of trade liberalization on price volatility. Their findings show that in the case of prices, the trade liberalization period has seen an increase in the volatility of production in the cases of cotton and groundnut while the other food grain crops became more stable. It shows that trade liberalization have fruitful effect on food security and food management.

Fiaschi, Davide *et al* (2005) identified the main determinants of growth volatility of a country. They proposed a model to explain the growth rate volatility through structural change and the economy size. They used nonparametric techniques for testing. Their results show that growth volatility is negatively related to total GDP, proxy for the dimension of the economy, when there is economic integration in the world markets and in isolation its impact is ambiguous. Furthermore, growth volatility is negatively related to the share of agriculture on GDP, proxy for structural change.

Iwai, Nobuyuki *et al* (2003) tried to sort out the effect of economic integration on economic growth. Their objective was to provide an alternative path for economic growth through economic integration among LDCs. They developed a simple endogenous growth model with two sources of production shocks (agriculture and manufacturing). Their study results show that economic integration is welfare improving if it reduces production volatility.

Awokuse (2009) tried to bridge the gap by re-examining the relationship between agriculture and economic growth by applying recent advances in time series analysis to national data from a different group of fifteen developing and transition economies in Africa, Asia and Latin America. His basic model was an extension of the neoclassical growth model who consider agriculture sector as a major contributor to economic growth. He used autoregressive distributed lag (ARDL) error correction modeling approach to find out the short-run and long-run relationships between both. The results of his study show that agriculture and economic growth both have strong relationship and agriculture is an engine of economic growth. Further the results show that trade openness also contributes in GDP growth.

Anthony (2010) presented an empirical analysis of the impact of agriculture credit on economic growth or the contribution of agriculture to GDP in Nigeria. In order to examine this impact, he specified a functional and operational form, and established a causal relationship between GDP and agricultural variables. His study findings revealed that agricultural variables have significant impact on economic growth and export growth.

Matsuyama (1996) empirically tested the impact of agricultural productivity on the long-run economic growth of the contemporary developing countries. He used Ordinary Least Squares (OLS) and panel data regression Techniques. The theory predicted that the openness of economies negatively affects the gains in the economic growth with the improvement in the agricultural productivity; however, this effect is not strong enough to cause either a long-run negative relationship between economic growth and agricultural productivity.

Hye, Adnan *et al* (2010) analyzed the role of agricultural product prices and government expenditure in the determination of agricultural performance in the case of Pakistan. Dickey Fuller Generalized Least Square (DF-GLS) unit root test is used in order to determine the level of integration and autoregressive distributed lag model (ARDL) was also used. Results show that in the long run the government expenditures on agriculture and agricultural prices are positively (statistically significant) shock on agricultural performance.

Meijerink, Gerdien *et al* (2007) in their paper studied the agriculture contribution in economic development, and particular relate it to poverty. They also checked the relationship between economic or agricultural growth and pro-poor development. Agricultural development is indeed important to economic development, then why, despite all the efforts and investments, has this not led to more successes? Today most of the observers agreed on that the Agri. sector contributes in economic growth but that economic growth reduces the agriculture role in terms of GDP. Now they realized its importance and linkage with the other sectors. They stress on the need to eliminate poverty through different programs that target poor population of the rural areas. The direct role of the agri. sector is provision of food, employment, foreign exchange through exports and raw material for the industries. Along this agriculture sector plays also an important role indirectly e.g. environmental services. A review of 11 case-studies by FAO revealed that these indirect contributions of agri. sector seldom reflected in the policy formulations.

Hamid, Naved *et al* (1990) examined the role of public investment in determining the patterns of agriculture development in Pakistan. Physical and institutional infrastructure supports agriculture, and investments in these leads to the country's economic development. Agriculture development depend on the degree to which education can be improved, organized network, knowledge communicated and social relations at the village level harmonized. Due to agriculture development there would be economic development.

World Bank (2008) published a most influential report called World Development Report. According to this report growth in the agricultural sector contributes proportionally more in poverty reduction as compared to growth in any other economic sector. So there should be more concentration on agriculture sector in order to achieving MDG's first goal, poverty reduction.

Hussain, Turab *et al* (1997) examined the relationship between aggregate agricultural productivity and poverty in Pakistan through the course of time and along with estimated the determinants of agri. sector production. For the estimation they used Ordinary Least Squares (OLS) method. Their study findings shows that increase in agricultural sector production alleviate poverty in Pakistan but not at that rate at which population is increasing. In the case of the determinants of agricultural productivity, their study results shows that use of fertilizers played an important role increasing Agriculture production in Pakistan especially in late sixties with the beginning of Green Revolution.

Roumasset, James (2007) analyzed the nature and causes of economic organization.

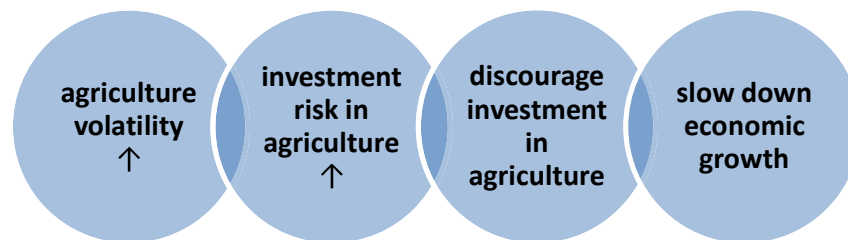
According to him there should be policy reforms; the first thing is to roll back those regulation e.g. excessive taxes that slow down the development of rural institutions and markets. Reforms should be focused on increasing market integration by improving contractual and physical infrastructure and appropriate rules of property and contracting should be allowed.

Akram, Waqar *et al* (2006) estimated the long term impact of agriculture credit on growth and poverty in Pakistan through Cointegration and Error Correction Models (ECM) covering the period from 1973 to 2005. They used Gross Domestic Product (GDP), Agricultural GDP, Water Availability, Agricultural Credit, and Number of Tube wells, Number of Tractors, Fertilizer, Seed, Poverty and Rural Poverty variables in their study. Their study results show that the water availability agricultural credit, fertilizer, seed, and tractors have a significant impact in reducing poverty.

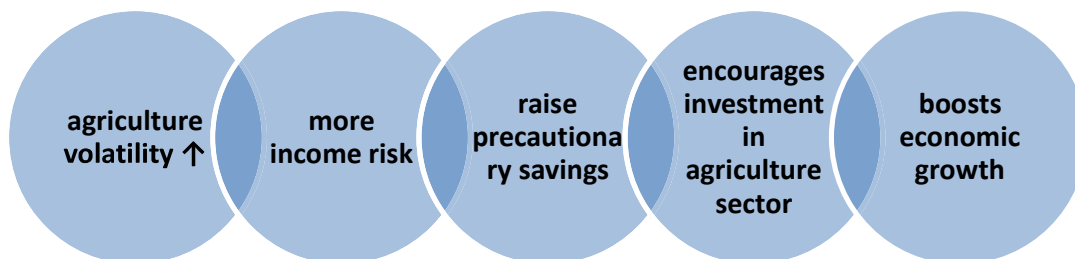
Theoretical Framework:

The theoretical framework is supposed to help the reader make logical sense of the relationships of the variables and factors that have been relevant to the problem. It provides relationships between all the variables so the reader can understand the theoretical relationships between them. A theoretical framework guides your research study, determining what things researcher is going to measure, and what statistical relationships you have to look for.

Agriculture volatility affects economic growth through two channels. First, high volatility means more investment risk in agriculture sector, which tends to discourage investment in agriculture sector and there by there is slowdown in economic growth.



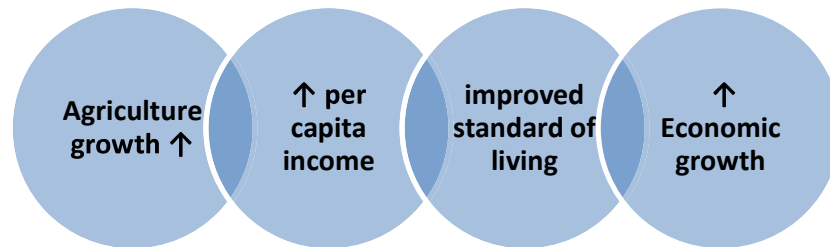
Secondly, high volatility also means more income risk, which tends to raise precautionary savings, which in turn encourages investment in agriculture sector and it boosts economic growth.



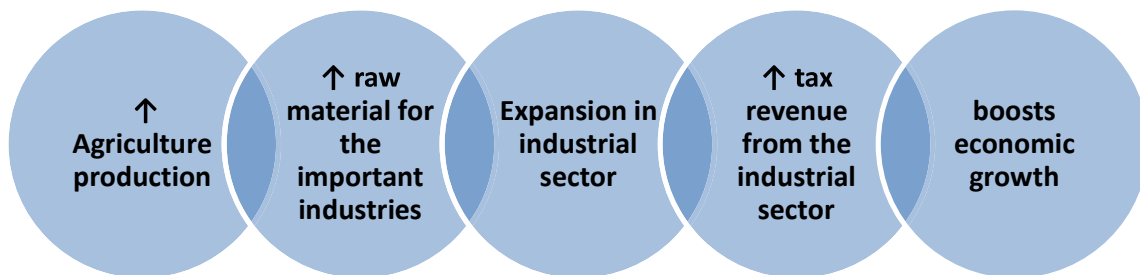
Agriculture is the major foundation of boosting economic growth in Pakistan. Agriculture's traditional roles are: to provide food, create jobs, earn export income, generate savings and funds for investment, and produce primary commodities for expanding industries. So through different ways agriculture sector is contributing in economic growth.

(1) Agriculture directly and indirectly is the biggest source of employment for the people of Pakistan. Employment leads towards higher per capita income of people and increase the

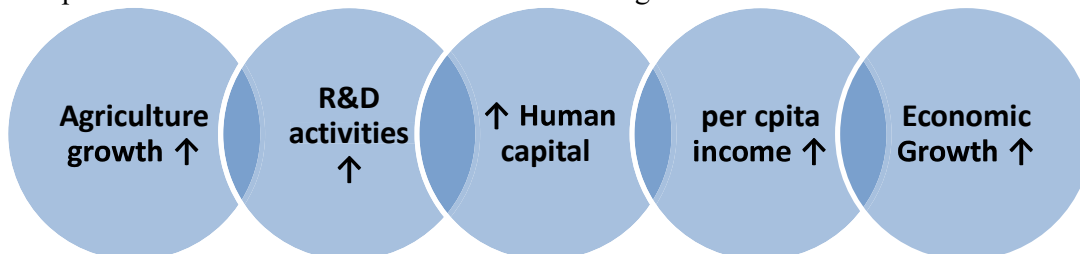
GDP of Pakistan. High per capita income results in improved standard of living of the people which mean more access to basic needs, better health facilities, quality education etc, which are all the signs of economic development. In this way employment as a result of agricultural activity is adding momentum to the economic growth of Pakistan.



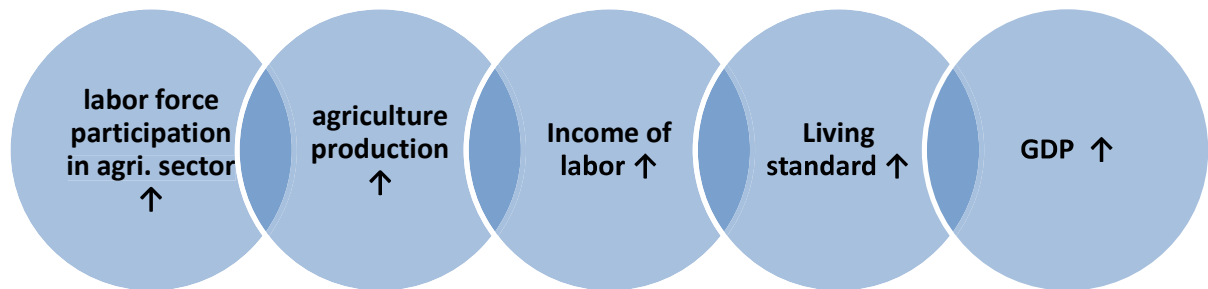
(2) Agriculture helps the government by increasing its tax revenue. Agriculture also provides raw material to many important industries of Pakistan, therefore, as agriculture expanded in the country, industrial activities also expand. Expansion in industrial sector leads towards the increase in tax revenue for the government from the industrial sector. In this way the agriculture is playing a significant role in increasing the tax revenue of the government. The Government of Pakistan used this tax revenue to bring structural changes into the country by investing in its institutions in order to make them more efficient, and expanding education with in the country and many more.



(3) Agriculture growth also give a opportunity to increase research and development activities in agriculture sector, like exploring new ways of cultivation, technical courses for labor, inventing new machinery, fertilizers and seeds etc. These innovations improve the efficiency of labor that increases human capital. Due to the increase in labors efficiency their per capita income increases which leads to economic growth.



Labor force participation in agri. sector also an important variable to determine agriculture performance, it causes to increase agriculture production and thus their income. It will cause to improve the living standard of labors and the GDP of Pakistan.



Methodology and Data:

The variables we used in this paper are real gross domestic product (GDP), Agriculture Volatility (VOLT), real agricultural production (AGRI), Agricultural employment (EMPL). The main objective of this study is to use time series data from 1972-2011 to analyze the actual cause of the agricultural volatility and its impact on the economic growth of the Pakistan.

Until a decade ago the focus of most macro econometric and financial time series modeling was on the worldly higher order moments in different sectors. Risk and uncertainty elements increased the importance of measuring volatility in modern economic theory. The development of new econometric time series techniques allow for the modeling of time varying variances and covariance. Econometricians are being asked to forecast and analyze the size of the errors of the model. In this case of volatility, the standard tools are: Auto Regressive Conditional Heteroscedasticity (ARCH) model introduced by Professor Engle (1982) that explained time varying volatility using ARCH and GARCH Models for which he won the Nobel Prize in 2003 and Generalized Auto Regressive Conditional Heteroscedasticity (GARCH) introduced by Bollerslev (1986).

ARCH models are employed commonly in modeling financial time series that exhibit time-varying volatility clustering, i.e. periods of swings followed by periods of relative calm. Although the GARCH methodology has been used extensively in modeling financial time series and in particular for stock returns, a detailed study of the application of the GARCH methodology on intraday returns of individual stocks have only been published very recently by Rahman, et al (2002). So we measured the agriculture volatility by using Auto Regressive Conditional Heteroscedasticity (ARCH) and Generalized Auto Regressive Conditional Heteroscedasticity (GARCH) econometrics techniques. Volatility forecasts obtained from a variety of mean and variance specifications in ARCH /GARCH models and they are compared to a proxy of actual volatility calculated using agricultural growth.

The functional form of our variables is:

$$GDP_t = \beta_0 + \beta_1 VOLT + \beta_2 AGRI + \beta_3 EMPL + \mu_t$$

The sample period covers the annual data from 1972-2011 and will be obtained from World Bank (WB) and Economic Survey of Pakistan. After collection of data on above stated variables, different time series econometrics techniques have been used for the analysis of study objectives. In the first step we applied the Augmented Dickey Fuller (ADF) to verify the presence of unit root in the series which is an extended version of the Dickey Fuller (DF) test because DF is only valid for AR (1) process not for others, so due to this drawback Dickey and Fuller (1979) introduced ADF test which includes lagged terms of the dependent variable in order to remove autocorrelation. After unit root analysis, it was found that all

variables are non-stationary at their levels but found to be stationary at their first differences. Table 1 gives a detail of all variables status.

Table 1: Unit Root Test

Variables	Level			First Difference		
	Test Statistic	Critical Value	Probability	Test Statistic	Critical Value	Probability
Log(GDP)	-1.467439	-2.943427	0.5387	-8.377316	-2.945842	0.0000
Log(VOLT)	-1.469638	-2.948404	0.5369	-5.556098	-2.951125	0.0001
Log(AGRI)	-1.057593	-2.950394	0.1395	-5.752940	-1.951332	0.0000
Log(EMPL)	-0.093396	-2.957110	0.9419	-2.338173	-1.951687	0.0001

Note: All the variables are stationary at their first differences and 5% level of significance is used.

Table 2: Cointegrating Trace Statistics and Eigen Values

Null Alternati ve	Trace test				Maximum Eigen value test			
	Trace Statist ics	Eigen Value	Critical Value	Prob	Max-Eigen Statistics	Eigen Value	Critical Value	Prob
r=0 r≥1	65.61	0.68	47.85	0.0005	34.82	0.68	27.58	0.0049
r≤1 r≥2	30.78	0.52	29.79	0.0383	22.64	0.52	21.13	0.0304
r≤2 r≥3	8.14	0.23	15.49	0.4502	8.03	0.23	14.26	0.3752
r≤4 r=4	0.10	0.003	3.84	0.7422	0.10	0.0031	3.84	0.7422

As Table 1 shows that all variables are integrated of order one then the next step is to check long run association between variables of this study. Long run relationship is checked by using Johansen Cointegration technique. Here we use criterion, Trace statistics and maximum Eigen value at 5% level of significance which is presented in Table 2, which shows that there is long run association within all variables. Cointegration is confirmed here on the basis of probability value and critical value also greater than Trace and Max-eigen value at 5% level of significance. The equation given below shows the direction of relationship between independent and dependent variables with level of significance.

$$\text{GDP} = 4.01 - 0.071 (\text{VOLT}) + 1.83 (\text{AGRI}) + 0.65 (\text{EMPL})$$

(-0.025)	(-0.275)	(-0.891)
[-2.842]	[6.746]	[0.724]

Note: Standard errors are in parenthesis and t-statistics are in brackets.

So the above equation shows that agriculture volatility is negatively and significantly impacting economic growth. Coefficient shows that due to 1% change in agriculture volatility cause to lower 0.071% in the economic growth of Pakistan. There is no specific study available on agriculture volatility but Azid Toseef, Naeem Khaliq, and M. Jamil measured the volatility of different sectors and found negative link between volatility and economic growth. In the case of Pakistan agriculture volatility also negatively affects GDP because agriculture sector is back bone for Pak economy and last few years huge variation occur in agriculture growth that badly affect GDP. High volatility means more investment risk in agriculture sector, which tends to discourage investment in agriculture sector and there by there is slowdown in economic growth in the case of Pakistan.

The coefficient of agriculture productivity is positively and significantly associated with economic growth, due to 1% change in agriculture productivity there will be 1.83% change in the economic growth. Richard Bolt (2004), Awokuse Titus O. (2009), Matsuyama (1996) and Meijerink Gerdien & Roze Pim (2007) also found that agriculture and economic growth both have strong relationship and agriculture growth and rural development play an important role not only in overall economic growth but also in poverty reduction. Agriculture helps the government by increasing its tax revenue. Agriculture expanded in the country, industrial activities also expand because in Pakistan agriculture provides raw material to many important industries. So expansion in industrial sector leads towards increased tax revenue for the government from the industrial sector. In this way the agriculture plays a significant role in increasing the tax revenue of the government. The Government of Pakistan used this tax revenue to bring structural changes so agriculture growth indirectly increases GDP. Agriculture sector directly and indirectly also a biggest source of employment for the people of Pakistan. Employment leads towards higher per capita income of people and increased GDP of Pakistan because high per capita income results in improved standard of living of the people which mean more access to basic needs, better health facilities, quality education etc, which are all the signs of economic development. In this way employment as a result of agricultural activity is adding momentum to the economic growth of Pakistan.

Similarly our last variables agricultural employment also positively impact on economic growth because our most of population attach with agriculture sector for their livelihood in Pakistan. Above equation also indicate 1% change in agriculture employment 0.65% change in the economic growth. Labor force participation in agri. sector is an important variable to determine agriculture performance; it causes to increase agriculture production and their income. It will cause to improve the living standard of labors that will boost up economic growth.

Conclusion and Recommendations:

Improvements in agriculture and land use are fundamental to achieving food security, poverty alleviation and overall sustainable development. Agriculture usually plays a vital role in the economy of every nation that exists. Not only for the reason that it tends to feed the entire population of a country but also in the respect that agriculture correlates and interacts with all the related industries of that country. A country is usually considered to be a social and politically stable nation if it possesses a very stable agricultural basis.

Developing countries like Pakistan needs sustain and long term growth in agriculture sector for the economic growth. High rates of economic growth may rapidly reduce the poverty; in fact, it is agricultural growth that accounts for virtually the entire poverty decline because economic growth is positively correlated with agriculture growth rate. Our study is important in this point of view because we focused on the volatility in agriculture sector and there are very few studies available on this topic. So it provides an area to policy makers to give their concentration on this major issue. If Government of Pakistan wants to increase the GDP than their focus should be on agriculture sector and for the agriculture growth, agricultural volatility should be controlled. In Pakistan agriculture sector is highly volatile during past decades and negative relationship exists between agricultural volatility and economic growth. So the government and other private institutions should take joint steps to sustain agriculture growth.

Basically our farmers are illiterate and they don't have sufficient information regarding modern technology. There should be human capital formation through improvements in education and health sectors. Our small and medium scale farmers should have access to adequate capital for innovative production and marketing techniques. To enhance sustainability, government should train smallholder farmers in the efficient use of irrigation, crop production, proper maintenance and use of agricultural tools and machinery and post-harvest management.

Thus, training the farmers and educating them appropriately to change their mindset and reorienting them to take up new activities or adopt foreign technology is utmost important. In this context, it is necessary to involve non-governmental organizations in training and mobilizing the rural poor to face the challenge of liberalization. In addition, the Government should embark on widespread programmers on the need to meet the standards required in the export markets and equally important is the need to expose information about possible export markets to farmers, so that market access is achieved at minimum cost. Lastly, there should be infrastructure development, technical assistance and Agriculture disasters management cells in order to deal the natural and other climates that are the main cause of volatility of agriculture sector last few decades in Pakistan.

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