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Growth and Instability Analysis of Rice Production and Export of Pakistan

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Abstract

Rice is an important crop for Pakistan because it is a source of earning foreign exchange for its economy. This study was conducted with two objectives; (a) to analyze the pattern of growth and instability in production, area, yield, export quantity, and export value of Pakistani rice and (b) to determine the relationship between production, export quantity and area in Pakistan for rice crop. For the analysis, the time series data from the year of 1972 to 2011 regarding rice production, area under rice, rice export quantity and value were obtained to calculate the compound growth rate, coefficient of variation for the stated variables and to find relationship between the stated variables. The results revealed that the overall compound growth rates for rice production, area and yield were found to be positive and showed annual growth rate of 6.81%; 5.43% and 1.30% respectively. The instability analysis was applied by using the coefficient of variation calculation and the results showed that the rice production, area and yield were found to be considerably instable as the overall coefficient of variation values were found to be 30.06 %, 15.62% and 14.48% respectively. In terms of growth rate of rice exports quantity and rice export value, the compound growth rates for the overall period were found to be 15.80% and 30.06% respectively. The instability analysis was also applied by computing coefficient of variation for the rice export quantity and rice export value in dollars terms and the results revealed that in the overall period very high instability in rice export quantity and rice export value was observed as the values were found to be 58.76% and 89.32% per year respectively.

Keywords: rice; instability; growth; export; Pakistan.

Introduction

Pakistan is located in South Asia on the border of the Arabian Sea. Pakistan has border with China on the north, Afghanistan and Iran on the west and India on the east (The World Fact book. 2014). Agriculture plays a key role in the economic growth & development in Pakistan. Being a key sector in the economy of Pakistan, it contributes 21.4 % to gross domestic production (GDP), provides employment to 45 % of the labor force of the country and also plays a significant role in the growth and development of other sectors of the economy (Govt. of Pakistan, 2013). Total area of Pakistan is 79.61 million ha. Among this area, 27.10 million ha is classified as agricultural area and 1.644 million ha is classified as forest area (FAO stats country/region, 2014). Wheat, rice, cotton, maize and sugarcane are the important crops in Pakistan. The contribution of these important crops in GDP is 5.4% and these account for 25.2% of the value added in overall agriculture. Rice occupies a unique position among the important crops in Pakistan. Among the staple food grain crops in Pakistan, rice is ranked as second after wheat. Contribution of rice to value added in agriculture and GDP of Pakistan is 27% and 0.60% respectively (Govt. of Pakistan, 2013).

Rice is a cash crop in Pakistan and cultivated on 10% of the total cropped area (Shaikh et al 2011). Since rice is not a staple food in Pakistan so every year a considerable quantity of rice produced is exported to earn foreign exchange (Govt. of Pakistan, 2013). Pakistan is famous for its Basmati rice which is a type of aromatic rice. Appearance, aroma and taste are the three main factors upon which the fragrant rice is usually identified. It has superfine grain which possess pleasant aroma (Chaudhary, Tran and Duffy 2003). Rice is a staple food for almost 62.8% population of the world and a source for the 20 % of the caloric intake for the population of the world while in Asia this rate is 29.3 % (Timmer 2010). Since rice is a staple food for majority of the people in the world and a great source to ensure food security so international trading of rice produced is very low; only 7.13 % of the total rice produced in the world. Fragrant rice which includes basmati and jasmine varieties accounts for 15 to 18 percent of the rice trade in the world (Baldwin and Childs 2011; FAO 2012; Young and Wailes 2003).

Like other developing countries the economy of Pakistan is heavily dependent on exports of agricultural commodities. Exporting is very important for the development of any economy and the economic health of any country largely depends upon exporting because it creates employment opportunities, help to maintain the trade balance, contributes towards economic growth and contributes towards the improvement of the standard of living of people (Lee & Habte Giorgis, 2004). In order to enhance the exports of rice from Pakistan, several market oriented steps have been taken by government of Pakistan. Until 1987-88, Rice Export Corporation of Pakistan (RECP) had the authority to exclusively handle the rice exports of Pakistan but in 1988-1989, the government of Pakistan shifted the responsibility of exports of rice to private sector in order to create more competitive environment to support the exports. This private sector works under a platform of an organization which is called Rice Exporters Association of Pakistan (REAP) that performs its activities with the interaction and cooperation of different government departments i.e. ministry of commerce and Ministry of Food, Agriculture and Livestock (REAP, 2010).

The measurement of instability regarding the agricultural production is important because it is helpful to understand various food issues and the issues arisen by the fluctuation in output, their impact on prices and resultantly the fluctuation of the producer's return (FAO, 1998). Due to many reasons there occur fluctuations in the production of agricultural commodities and same is in Pakistan. The performance of the agriculture sector and especially the crop (as sub sector) is effected due to unfavorable conditions i.e. weather and other natural hazards like flood and drought (Govt. of Pakistan, 2013). The fluctuations in the rice production in Pakistan can affect the domestic prices of rice as well can affect the competitiveness of Pakistan rice in the international market and resultantly the export quantities of rice from Pakistan can fluctuate . Such fluctuations also affect the returns of the farmers and exporters. The analysis of instability is useful for producers because in the light of such analysis they can better decide what to grow as well as this analysis can provide policy makers an insight to pinpoint the issues and causes of instability and variability in order to reduce the possible effects of instability.

This study was made to analyze the pattern of growth and instability in production, area, yield, export quantity, and export value of Pakistani rice as well as to determine the relationship between production, export quantity and area in Pakistan for rice crop

Materials and Methods

In this study, the secondary data regarding the rice production, area under cultivation and quantity of rice exported covering the period from 1972 to 2011 was used. This data were extracted from the official website of the food & agriculture organization of the UN; FAO. The 40 years period (1972-2011) is broken into 8 equal periods for convenience hence among the eight period, each period consists on five years data and each period represents the mean value of production and area of rice as well as export quantity and value of rice earned via rice exports.

1- For the trend analysis of production, area, yield and exports; the average production and average area were analyzed. The yield was calculated by dividing the mean production of each production by the mean area of the same period.

2- Per year growth rates for the stated variables were calculated and the geometric mean of the growth rate values was taken to find the compound growth rate for each period. In order to obtain the values of overall compound growth rate for the stated variables, the geometric mean of the compound growth rate values of all the respective periods was taken to obtained overall compound annual growth rate. Below formulas were used for this purpose

Growth rate = Current year/base year*100 to find growth rate per year within a period

$[\prod_{i=1}^n (1 + r_i)]^{1/n} - 1$ to find compound growth rate

Where n= number of years

r = compound annual growth rate value

3- Coefficient of variation has been used by different researchers for the studies regarding the instability analysis of agricultural production i.e. Hazell (1982) used coefficient of variation for the estimation of instability in Indian agriculture production. Later on Farih (1996) applied same technique in Sudan, Singh (1989) & Gangwar and Singh (1991) adopted coefficient of variation during measuring the instability and poverty in India. So for the instability analysis in this study, the measurement of coefficient of variation was made for production of rice, area under cultivation of rice as well as yield and the rice quantity exported and value earned against the export of rice from Pakistan. The measurement of coefficient of variation for the stated variables was done using the below formula.

4-

$$CV = \sigma / \bar{x} * 100$$

Where

σ = standard deviation

\bar{x} = mean

5- In order to find the relationship between the exports (as a dependent variable) and area, production as independent variables, we applied regression analysis using SPSS. Due to multi correliniarity effect and higher score of VIF value, Ridge regression was used to draw the relationship between exports of rice from Pakistan and production & area.

Results and discussion

Trend analysis

Data regarding the area under cultivation of rice in thousand hectares and production in thousand tons of Pakistan is presented in table 1 by dividing the data into 5 years average. The yield was calculated by dividing the production (sum of five years) over the area (sum of five years) of relative period. The data is given in table 1 which illustrates the trends in area, production and yield.

Table 1: Rice Production area, quantity and yield in Pakistan (based on 5 years average)

Periods	Area (000 ha)	Production(000 tones)	Yield (Tons/ha)
1972-1976	1610.9532	3735.9412	2.32
1977-1981	1973.660	4797.0912	2.43
1982-1986	1980.780	4951.500	2.50
1987-1991	2064.240	4849.540	2.35
1992-1996	2139.600	5648.580	2.64
1997-2001	2349.420	6854.2434	2.92
2002-2006	2481.560	7600.950	3.06
2007-2011	2659.520	9107.3352	3.42

Historical data shows that average area under rice cultivation in Pakistan was 1.61 million hectare during 1972-1976 and in the following sub period of 1977-1981 it increased to 1.973 million hectares with a positive change of 362.70 thousand hectares. In the same period the average yield increased with a minor increase and production of rice reached to 4.797 million tones with a positive increase of 1.061 million tones. Later on positive trend in the area was observed that shows that farmers considered the rice growing activity as a profitable business. During the period of increase in area, there was seen an increase in the production too except 1987-1991 when a decline was observed in production. From 1992-1996, the production increased rapidly and yield too as from this period, yield reached at 3.42 tons/ha in 2007-2011 from 2.64 tons/ha as a result of increase in production from 5.64 million tons to 9.10 million tons in 2007-2011. During the world food crisis, a sharp increase in the rice prices at international level was observed which motivated the farmers to produce more and more rice. Rice is not the staple food of Pakistan people so every year a considerable quantity of rice produced is exported and hence the farmers can get the better price of rice because of the growing demand of rice in international market. The overall picture of historical data shows a continuously increase in the area under rice cultivation in Pakistan (using 5 years average method), a continuously increase in yield except during 1987-1991 and a continuously increase in production except in the period of 1987-1991 (by considering the previous period as a base period). Results are also shown in figure 1.1 and figure 1.2

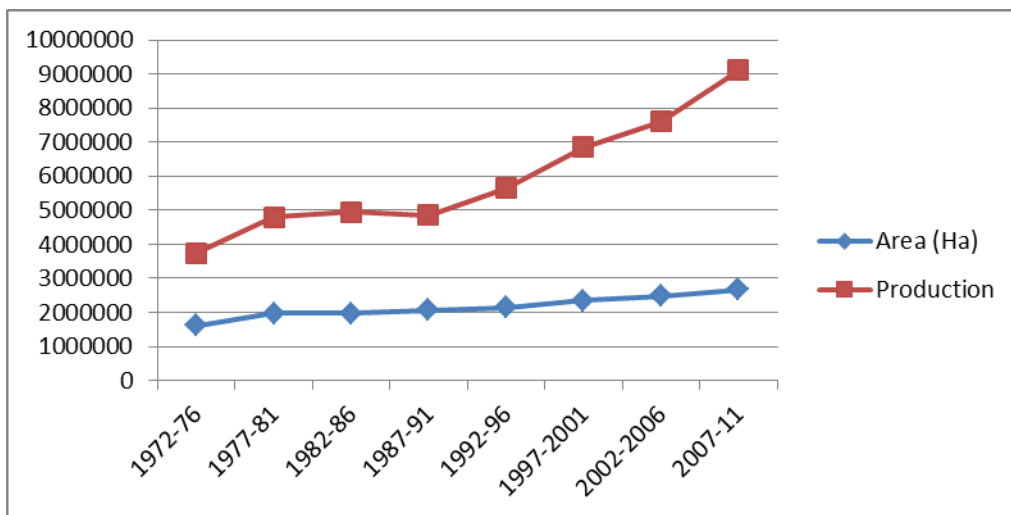


Figure (1.1) showing the trends in area and production of rice in Pakistan

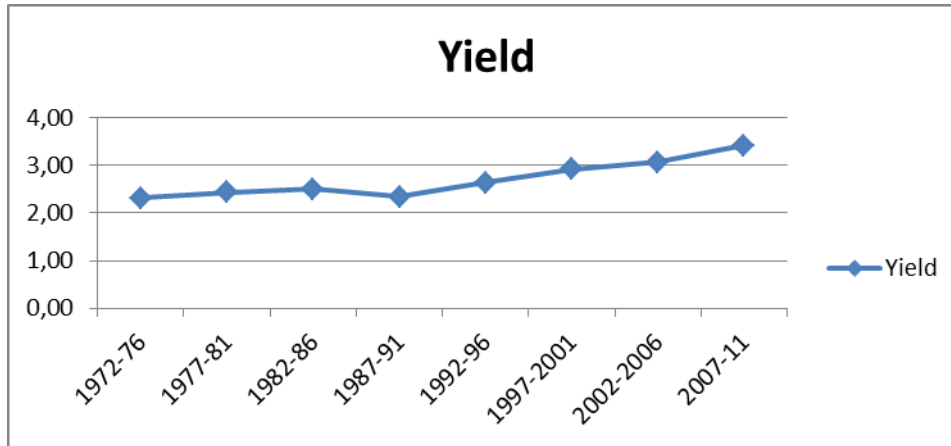


Figure (1.2) showing the trends in yield of rice in Pakistan

Growth rates in Area, Yield and Production of rice

In order to observe the changes in the production, area, yield, export quantity and export value; during the stated periods, compound annual growth rate values were calculated and given in table 2.

Table 2: Compound annual growth rates values (%) for area, production and yield of rice

Periods	Area	Production	Yield
1972-1976	8.65	6.66	-1.83
1977-1981	3.89	8.29	4.23
1982-1986	0.08	-4.36	-4.43
1987-1991	5.12	-0.25	-5.10
1992-1996	8.32	20.05	10.83
1997-2001	1.22	4.97	3.71
2002-2006	11.35	12.81	1.31
2007-2011	5.35	8.13	2.64
Overall			
1972-2011	5.43	6.81	1.30

The results shown in table 2 reveal that during the period of 1972-1976, rice area under rice cultivation in Pakistan showed a positive growth rate of 8.65% per year. There was observed a positive growth rate in the production of rice and it was recorded 6.66% per year. Since the increase in area was greater than the increase in production so as a result the growth rate in yield was recorded negatively and it was -1.83% per year. Overall in the period of 1972-1976, an increase in terms of percentage in the area and production was observed while a decline in the area was observed. In the following period of 1977-1981, the annual growth rate in area was increased by 3.89% per year and an increase of 8.29% per year in the production was recorded. The greater increase in production as compare to increase in area resulted a positive impact on the growth of yield which caused a 4.23% per year average increase in the yield in this period. In the next period of 1982-86, the average per year increase in the area was slightly; by 0.08% but the decline in the production was recorded as 4.36% and as a result the yield also declined by 4.43% per year. For the period of 1987-91, there was seen a significant increase in area; by 5.12% per year but instead of increase in the production there was onward a decline in the production by 0.25% per year and as a result, during this period the yield declined by 5.10% per year. For the following period of 1992-1996, the area under rice cultivation increased by 8.32% per year and a huge increase in production; 20.05% per year was observed which caused an increased in yield which grew by 10.83% per year in this period. During the period of 1997-2001, the compound growth rate in area was recorded as 1.22% per year and compound growth rate in production was recorded as 4.97% per year which caused an increased in yield of 3.71% per year. For the period of 2002-2006, area and production both increased by 11.35% and 12.81% per year respectively and yield could increase

by just 1.31% per year because the increase in production was mostly due to increase in the area. For the last period of 2007-2011, area under cultivation of rice increased by 5.35% per year and production increased by 8.13% per year. Since the increase in production was greater than that of increase in area so the rate of growth in yield increased and it reached 2.64% per year. The overall compound annual growth rate values for area, production and yield were found to be 5.43%, 6.81% and 1.30% per year respectively.

Instability analysis for area, yield and production

In order to analyze the instability in the rice production in Pakistan in terms of area, production and yield, the instability analysis was conducted. This analysis was conducted using the sub periods defined earlier in this paper. For this purpose the values of coefficient of variation were calculated for the respective fields as given in table 3. The greater values of coefficient of variation represent a higher degree of instability or variation while the smaller values of coefficient of variation show stability in the respective field i.e. a stable growth was observed during the periods when the less coefficient of variation was found. The results shown in table 3 reveal that in terms of production, the first 4 sub period starting from 1972 and ending at 1991, showed relatively less instability (stable growth) as compared to last 4 sub periods where a greater instability was observed in terms of production. The greater instability found in last four periods was due to the sharp increase in production. The instability analysis in terms of area showed that the 1st period (1972-1976) and the last three sub periods showed greater instability as compare to other periods which were recorded as 7.35%, 6.39%, 6.28% and 9.53% per year respectively. This higher instability was due to the relatively greater increase in the area. The periods where less coefficient of variation was observed, it was due to the fact that area increased in those periods but at a slower pace than with the periods with higher coefficient of variation value.

Table 3: Coefficient of variation for production, area and yield of rice (%)

Periods	Production	Area	Yield
1972-1976	7.39	7.35	4.36
1977-1981	5.57	2.96	4.30
1982-1986	6.82	3.71	3.81
1987-1991	0.72	3.06	3.11
1992-1996	12.65	4.85	8.30
1997-2001	10.59	6.39	4.78
2002-2006	8.63	6.28	3.29
2007-2011	14.88	9.53	6.58
Overall (1972-2011)	30.06%	15.62%	14.48%

The instability analysis in terms of yield showed that relatively little deviation was observed in the yield. Only in the period of 1992-96 and 2007-2011, there existed greater instability i.e. 8.30 % per year and 6.58 % per year and for the other periods there was not observed much instability. This showed that except the two stated periods, there were not greater shocks in the yield and a consistency in the growth of yield was observed. In terms of overall instability analysis from 1972-2011, the coefficient of variation values for production, area and yield were found to be 30.06 %, 15.62 % and 14.48 % respectively which state that in Pakistan the rice yield was found to be stable (static) as compare to area and area was found to be more stable than the production.

These phenomena can also be stated in terms of quantitative measures i.e. the overall increase in production of rice in Pakistan was recorded as higher than that of the increase in area and the increase in the area was found to be greater than that of the increase in the yield.

Trends in rice export from Pakistan:

The quantity of rice exported and the value of the exported rice is shown in table 4 in a five years average figure from 1972 to 2011. The data shows that the quantity of exported rice increased with the passage of time consistently and as a result the value of exported rice also increased consistently because the demand and prices of rice in the international market also increased.

Table 4: Trends in export of rice from Pakistan (based on 5 years average)

Periods	Export quantity (tons)	Value (ooo \$)
1972-1976	571,259	171,069
1977-1981	1,016,416	367,262
1982-1986	1,031,106	333,419
1987-1991	1,056,676	312,076
1992-1996	1,396,218	390,244
1997-2001	1,994,026	538,544
2002-2006	2,381,436	746,058
2007-2011	3,256,120	1,782,992

In 1988-1989, Pakistan decentralized the rice marketing and export system as a result the private sector took over the control of rice export and this step facilitated the competition in the rice production and export in Pakistan (REAP, 2010) resultantly the market forces started determining the price in local market and this healthy competition facilitated the exports. The greater demand of Basmati rice (a type of fragrant rice) which is a premium variety of rice in Pakistan also played a vital role in the earning of foreign exchange as this variety is sold at a higher price than the other varieties of Pakistan rice. Another reason for growing exports quantity of rice is that rice is not a staple food for Pakistani people so much surplus rice is available for export. The results are also shown in figure 3 and 4

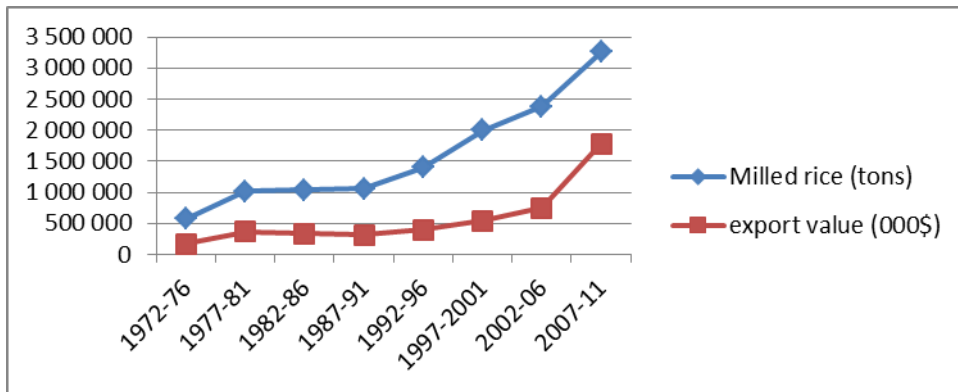


Figure 3. Graphic presentation of milled rice export quantity and export value

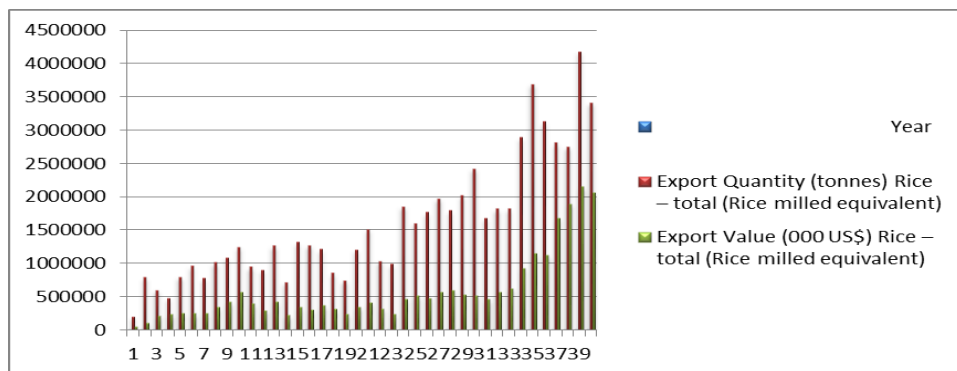


Figure 4. Export quantity and export value (1972-2011)

Analysis of growth rate of rice export from Pakistan

Table 5 presents the analysis of growth in export quantity of rice and exported value of rice from Pakistan. The data of rice exported and value of exported rice was divided in a 5 years average from 1972 to 2011. The average increase in export quantity within the 1st period of 1972-1976 was observed to be 158.93% while the average increase in the same period in exported value in

monetary terms was observed to be 181.48%. The positive growth in this period shows an increase in exported quantity and exported value for the economy of Pakistan. During 1970 and 1971 there was political unrest in the country which ended in 1971 on the division of country so after the political situation came on normal routine, exports from country came on normal routine and a sharp increase in exports of rice was observed during the preceding years.

Table 5: Growth rate analysis of rice export from Pakistan (%)

Periods	Exported rice quantity (%)	Value (%)
1972-1976	158.93	181.48
1977-1981	4.62	39.78
1982-1986	5.76	-17.12
1987-1991	-18.68	3.67
1992-1996	-10.43	-8.61
1997-2001	12.09	11.96
2002-2006	34.47	53.03
2007-2011	2.82	54.69
Overall (1972-2011)	15.80%	30.06%

For the next period of 1977-1981, the growth rate in exported quantity was observed positive with an average increase of 4.62 % and an average increase in exported value of rice was observed 39.78 %. This indicates that although the growth rate in exported quantity was not higher but the average growth rate in exported quantity was relatively much higher and it was due to increase in the price of rice at international market. In the third period of 1982-1986, although there was observed a growth in the milled rice exported but a decline in the value was observed and it was due to decline in the prices of rice. In the coming period of 1987-1991, a decline in the growth of export of rice was seen but the increasing prices provided support to Pakistan economy. During the last period of 2007-2011, the growth rate in export of rice was just 2.82% but the average growth in value of rice was observed to be 54.69% and it was due to the global food crisis when the prices of rice increased tremendously in international markets. The overall CGR of export quantity and export value of rice were found to be 15.80% and 30.06% which states that overall there was an increase in the prices of rice in the international market.

Analysis of Coefficient of variation in rice export:

The analysis of coefficient of variation for rice export quantity and dollar value earned was made. The results are shown in table 6.

Table 6: Coefficient of variation for milled rice exported and value earned (%)

Periods	Exported rice quantity (%)	Value earned (%)
1972-1976	43.41	50.48
1977-1981	16.84	35.75
1982-1986	24.53	24.07
1987-1991	22.69	15.24
1992-1996	26.93	28.11
1997-2001	13.23	7.99
2002-2006	36.86	38.33
2007-2011	17.82	22.98
Overall (1972-2011)	58.76%	89.32%

The lower values of coefficient of variation shows stability and the greater value of coefficient of variation shows instability in the milled rice exported quantities and dollar values earned in each

period. The table 6 shows that the most instable period for the milled rice exported quantity were 1972-1976, 2002-06 and 1992-96 with coefficient of variation values of 43.41%, 36.86% and 26.93% respectively. Among the three stated periods with higher instability, the reason for the instability for first two is the increase in export quantity and for the third period of 1992-96, the reason for instability is decline in export quantity and a decline in the prices received by the exporters. In terms of dollar value earned for export of rice, the periods of 1972-76, 1977-81 and 2002-06 were found most instable with the CV values of 50.48%, 35.75% and 38.33% respectively. The instability in value earned is due to fluctuations in prices received by the exporters due to increase in export quantity and increase/decrease in the export price.

Regression analysis

At first, we applied the OLG regression by taking export quantity of rice as a dependent variable while production and area of rice as the independent variables but the variables were found to be highly correlated and in such cases the OLS does not reflect better relationship between the stated variables. The results of correlation and OLS are given in table 7 and table 8.

Table 7: Correlation calculation
Correlations

		exp_qty	area	production
exp_qty	Pearson Correlation	1	.748**	.828**
	Sig. (2-tailed)		.000	.000
	N	40	40	40
Area	Pearson Correlation	.748**	1	.965**
	Sig. (2-tailed)	.000		.000
	N	40	40	40
Production	Pearson Correlation	.828**	.965**	1
	Sig. (2-tailed)	.000	.000	
	N	40	40	40

** . Significant at 0.01 level (2-tailed).

Table 8: OLS regression
Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Co linearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	395368.029	568424.648		.696	.491		
Area	-1.156	.508	-.751	-2.273	.029	.068	14.656
Production	.451	.096	1.553	4.699	.000	.068	14.656

a. Dependent Variable: export quantity

Higher VIF value in our data indicates the multi colinearity in our data as well as the correlation table shows a strong correlation (0.965) between area and production which are our independent variables so to overcome this problem, we applied Ridge regression as the Ridge regression is applied in such cases where the independent variables have strong correlation and under such circumstances ridge regression provides better estimates of the regression coefficients.

Ridge Regression Analysis:

The variable of export quantity was considered as dependent variable and the independent variables were taken as area under rice cultivation and production of rice. Data of 40 years (1972-2011) were used in this analysis. The results are below.

Results for the Ridge Parameter = 0.35

Parameter	Estimate	VIF
CONSTANT	-970298.	
Area	0.363579	0.300596
Production	0.128904	0.300596

	Estimation
N	40
MSE	1.03789E11
MAE	194447.
MAPE	36.0288
ME	-6.40284E-11
MPE	-12.2506

R-Squared = 54.4752 percent, R-Squared (adjusted for d.f.) = 52.0144 percent, Standard Error of Est. = 322162, Mean absolute error = 194447, Durbin-Watson statistic = 0.394339, Lag 1 residual autocorrelation = 0.694303

Below is the fitted regression model:

Export Quantity = -970298. + 0.363579*area + 0.128904*production

In this study the ridge parameter value was set to be 0.35 and this value is usually set between zero and one. To determine a better value of ridge parameter, we examine the standardized regression coefficients and the variance inflation factors. The R-Squared statistic indicates that the model as fitted explains 54.4752% of the variability in export quantity. The adjusted R-Squared statistic is 52.0144%. The standard error of the estimate shows the standard deviation of the residuals to be 322162. The mean absolute error (MAE) of 194447 is the average value of the residuals. The Durbin-Watson (DW) statistic tests the residuals to determine if there is any significant correlation based on the order in which they occur in your data file and the result shows that there is no autocorrelation in our data.

Estimates table shows the estimated regression coefficients for values of the ridge parameter between 0.0 and 0.5. As the ridge parameter is increased from 0, the coefficients often change dramatically at first but then become relatively stable. A good value for the ridge parameter is the smallest value after which the estimates change slowly. This table shows the variance inflation factors for each of the coefficients in the regression model. As the ridge parameter is increased from 0, the VIFs often decrease dramatically at first but then become relatively stable. We selected the smallest value for the ridge parameter at the point where the VIF's change slowly. Both explanatory variables (coefficient of area=0.3635 and Production=0.1289) impact positively on our explained variable significantly. The regression equation derived using Ridge regression shows that -970298 is the intercept value for our regression equation. Both the explanatory variables (area and production) impact positively on the explained variable (export quantity). From the equation it can be concluded that an increase of one unit in area would have a positive impact on export and export quantity would increase 0.364 times and vice versa while an increase of one unit in production would result a positive impact on export quantity and export quantity would increase 0.13 times and vice versa.

Conclusion

On the basis of five year average, there has been observed a continuously increase in the area of rice in Pakistan since 1972, a continuously increase in yield except during 1987-1991 and a continuously increase in production except in the period of 1987-1991 (by considering the previous period as a base period). This increase has been result of green revolution, introduction of new rice varieties with higher promising yields, better supply of agricultural inputs, sharp increase in the international rice prices and many other factors. The privatization of the export sector of rice has also helped a lot to promote rice exports from Pakistan which motivated farmers to grow rice as the better prices were expected.

The growth rate analysis suggests that if the increase in area is greater than the increase in production, it would have a negative impact on the growth of yield. For area under rice, the compound growth rates have been positive for all periods but variations occurred at production level and as a result the compound growth rates for yield were affected. The overall compound growth rate values for area, production and yield were found to be 5.43%, 6.81% and 1.30% respectively which state that the growth in production was greater than the area and this was the main reason of growth in yield but since the gap between the growth in production and area was narrow so a short increase in the yield was observed. So in order to increase the yield, efforts should be made to get maximum production by utilization of minimum area. Except the two periods of 1987-1991 and 1992-1996, a positive growth rate was observed for the export quantity of rice from Pakistan while 1982-1986 and 1992-1996 were the two periods when there was observed a decline in the growth of export value. The overall compound growth rates of export quantity and export value of rice were found to be 15.80% and 30.06% which states that overall there was an increase in the prices of rice in the international market.

In terms of instability, there were three periods; 1992-96, 1997-2001 and 2007-2011 which were found to be much instable regarding area, production and yield. The overall coefficient of variations for production, area and yield were found to be 30.06%, 15.62% and 14.48% respectively which states that instability in production was greater than area and yield and this implied that the positive variation in production was found to be greater than the positive variation in area and yield. The difference between the CV of production and area was greater and as a result the value of CV of yield was lower. For the instability analysis of rice export and value of rice exported the periods of 1972-1976, 2002-06 and 1992-96 were found to be the most instable period for the milled rice exported quantity while the periods of 1972-76, 1977-81 and 2002-06 were found to be the most instable with the CV values of 50.48%, 35.75% and 38.33% respectively.

While the overall coefficient of variation values for export quantity and export values were found to be 58.76% and 89.32% respectively. The higher coefficient of variation value for export value earned showed a higher positive instability in the rice value earned which was a positive sign for the exports. The positive sign in the coefficient of variation in export quantity showed that the instability was there in export quantity which states that increase in export quantity was observed.

Application of Ridge regression using the historical data, the regression intercept was found to be 970298 and production and area both were found to be the factors which affect the export quantity of rice of Pakistan. Area was found relatively more influencing factor as compare to production which means more export is possible by increasing the area under rice cultivation but it is not easily possible so focus should be on the increase in production and in this way the yield gaps of rice with other rice growing countries can be reduced and export of rice can be increased.

The yield in Pakistan is lower as compare to many other rice producing and exporting countries. These yield gaps are due to differences in management practices and such gaps can be narrowed by applying efforts in research and development and facilitating the extension services. In order to bridge the yield gaps several steps can be taken. For this purpose stable performing varieties can be introduced and as well as the hybrid rice varieties are very useful and this experience has been very successful in china, Vietnam, Indian and Philippine. The effective measures to prevent the weeds can be taken to increase the production and reduction of the losses. Better irrigation facilities can also be very useful to increase the production and yield.

References:

1. Baldwin, K. and N. Childs. 2011. 2009/10 Rice Yearbook. ERS USDA RCS-2010 January 24
2. Chaudhary, D., D.V. Tran and R. Duffy. 2003. Specialty Rices of the World: Breeding

Production and Marketing. FAO books, Roma, 358.

3. FAO (2014) Last retrieved on 30, November 2014 from <http://faostat3.fao.org/browse/area/165/E>
4. FAO, 1998. "On the measurement of instability of agricultural production and the associated risk of insecurity". : A Paper Presented on Sixth IWG. Agri. Seminar on Agri. Statistics, Russia, June 29–July 3, 1998.
5. FAO. 2012. *Rice Market Monitor*. XV (4): November 37.
6. Farih, A.A., 1996. Instability in agricultural production and its effects on farmers income. M.Sc. Thesis, University of Khartoum, Sudan.
7. Gangwar, A.C., Singh, S.P., 1991. Instability in cereal production in Haryana: a decomposition analysis. *The Recent Advances in Agricultural Statistics Research*. Wiley Eastern, New Delhi, p. 130.
8. Government of Pakistan. (2013). *Economic survey of Pakistan*. Islamabad: Ministry of Finance, Pakistan
9. Hazell, Peter B.R., 1982. Instability in Indian food grain production. Research Report No. 30, International Food Policy Research Institute, Washington, DC.
10. Lee, J., and Habte-Giorgis, B., 2004, "Empirical approach to the sequential relationships between firm strategy, export activity and performance in U.S. manufacturing firms", *International Business Review*, 13, 101-129.
11. Rice Exporters Association of Pakistan (REAP). "Introduction." Rice Exporters Association of Pakistan's web page <http://reap.com.pk/links/introduction.asp> (Last accessed on 23-11-2014)
12. Shaikh FM, Jamali MB, Shaikh K, Abdi AR. 2011. WTO reforms and rice market in Pakistan. *Int. J. Asian Soc. Sci.* 1(3):45-51.
13. Singh, I.J., 1989. Agricultural instability and farm poverty in India. *Indian J. Agric. Econ.* 44 (1), 1.
14. The World Factbook. 2014. Washington, D.C.: Central Intelligence Agency Retrieved 24 November, 2014 from <https://www.cia.gov/library/publications/the-worldfactbook/geos/pk.html>
15. Timmer, C.P. 2010. *The Changing Role of Rice in Asia's Food Security*. Asian Development Bank, Working paper series, 15, September, 19.
16. Young, K.B. and E.J. Wailes. 2003. Rice Marketing. In Smith C.W. and R.H. Dilday eds., *Rice: Origin, History, Technology, and Production*. J. Wiley press: 473-488.