



Growth and Trend in Area, Production and Yield of Major Crops of Khyber Pakhtunkhwa, Pakistan

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Abstract

The present study was conducted with a view to analyzed growth and trend in area, production and yield of major crops of Khyber Pakhtunkhwa. A time series data from 1980-81 to 2011-12 (32 years) of major crops (wheat, maize, rice and sugarcane) were collected. The compound growth rate as well as trend analysis indicated that the area under wheat crop has decreased over the time due to shifting of area to other rabi crops. The production of wheat during 1981-85 to 2010-12 was increased due the corresponding increase in per hectare yield of wheat crop in Khyber Pakhtunkhwa. The results show that area, production and yield of maize was increased over the time the reason is that more area was brought under hybrid and improved open pollinated maize varieties. The area under rice crop has decreased whereas their production increased due the corresponding increase in per hectare yield of rice crop. It was revealed from the results that area, production and yield of sugarcane crop was increasing at a rate of 0.24 percent, 0.85 percent and 0.60 percent per annum, respectively.

Keywords: Growth, trend, semi-log model, wheat, maize, rice and sugarcane

Introduction

Agricultural production is the foundation of food availability, especially for calories and proteins. Adequate food supply at affordable prices is the cornerstone of food security policy of all nations of the world including generally Pakistan and particularly Khyber Pakhtunkhwa (Ahmad and Farooq, 2010). Agriculture is the most important sector of

Pakistan due to its primary commitment of providing healthy food to her fast growing population. Although the rate of population increase has considerably slowed down from over 3 percent in 1980s to 2.0 percent in 2012-13, but it is still considered high. With the current rate of population growth, it is expected that Pakistan will attain fifth position from current status of sixth most populous country in the world by 2050 (Government of Pakistan, 2013).

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The Khyber Pakhtunkhwa (KP) is essentially a rural province. Only 17 percent of the

population lives in urban conurbations. Economic structure of the province reflects that 30 percent of provincial GDP is derived from agriculture. Agriculture is not only an important source of employment and income generation for the rural population but also critical from nutritional perspective. Wheat is the main staple food for most of the population and largest grain source of Pakistan as well as of Khyber Pakhtunkhwa. It occupies the central position in formulating agricultural policies. The wheat area in Khyber Pakhtunkhwa is 729271 hectares with production of 1130263 tonnes, respectively during 2011-12. Maize is the second most important crop after wheat in the Khyber Pakhtunkhwa, and for much of the province, it is the dominant crop in the farming system. The maize area in Khyber Pakhtunkhwa is 475342 hectares with production of 887787 tonnes during 2011-12. The area under rice in Khyber Pakhtunkhwa is estimated around 50081 hectares with a production of about 94695 tonnes during 2011-12 (Government of Khyber Pakhtunkhwa, 2013).

Growth rates are commonly used as summaries of trends in time series data. Productivity indices, price indices and output indices are usually discussed in terms of the changing growth rates over various periods of time. Policy decisions are often based on such growth rate estimates. Computation of trend rate estimates with and without the extreme fluctuations can provide meaningful insights into the process of crop forecasting and planning purposes. Rao *et al.* (1980) assert that measurement of trends and fluctuations should be of great interest for both the researchers and planners. Sagar (1980) discussed a general decomposition model of crop output growth that takes care of basic three components (area, productivity and prices). Wiktor and Travis (1985) have described that growth rates are measures of past performance of economic variables which are not developed to predict the trend in a variable over time.

The present study was undertaken with a view to analyzed growth and trend in area, production and yield of major crops of Khyber Pakhtunkhwa. The information about the growth performance of selected food commodities would help the policy makers of the country to implement policy measures.

Materials and methods

A time series data from 1980-81 to 2011-12 (32 years) regarding the area, production and yield of major crops (wheat, maize, rice and sugarcane) were collected from the various issues of Crops Statistics of Khyber Pakhtunkhwa (Crops Reporting Services) and Agricultural Statistics of Pakistan (Ministry of National Food Security and Research).

The following semi-log trend function was used to find out the trend and estimate the growth rate of area, production and yield of major crops of Khyber Pakhtunkhwa.

$$\ln Z = \beta_0 + \beta_1 X + e$$

Where

Z = dependent variable (area, yield and production); X = trend over specific period
 β_1 = coefficient of trend; \ln = natural logarithm; and e = error term

Here, the coefficient of trend (β_1) measures the constant proportional or relative change in Z for a given absolute change in the value of the regressor X .

$$\beta_1 = \frac{\text{relative change in regressand}}{\text{absolute change in regressor}}$$

If 100 multiply the relative change in Z , give the percentage change, or the growth rate, in Z for an absolute change in X , the regressor. That is, 100 times β_1 gives the growth rate in Z ; 100 times β_1 is known in the literature as the semi-elasticity of Z with respect to X and gives the instantaneous (at a point in time) rate of growth, to find out the compound (over a period of time) rate of growth, the following formula was applied.

$$\beta_1 = \ln(1 + r)$$

Where

β_1 = Instantaneous rate of growth; \ln = Natural logarithm; r = Compound rate of growth. Hence taking antilog of β_1 , subtract 1 from it and multiply the difference by 100, would give compound rate of growth.

Results and discussion

Trend and rate of growth in wheat crop of Khyber Pakhtunkhwa

Wheat is grown extensively in Pakistan as well as in Khyber Pakhtunkhwa on subsis-

tence basis for home consumption (Farooq *et al.*, 2007). Table-1 indicates that during 1981-85 the area under wheat crop in Khyber Pakhtunkhwa was 801.5 thousand hectares as compared to 726.9 thousand hectares sown during 2010-12, which shows that area of wheat crop decreased over the time due to shifting of area to other rabi crops. The production of wheat during 1981-85 to 2010-12 was increased from 926.7 thousand tonnes to 1155.8 due the corresponding increase in per hectare yield of wheat crop in Khyber Pakhtunkhwa (Table 1).

Table 1: Trend in area, production and yield of wheat crop in KP, 1981-2012

(5-Years Average)

Years	Area (^{'000'} hectares)	Production (^{'000'} tonnes)	Yield (kgs per hectare)
1981-85	801.5	926.7	1156
1986-90	797.6	974.2	1220
1991-95	845.1	1161.9	1375
1996-00	858.2	1182.5	1375
2001-05	751.9	967.0	1291
2006-10	750.2	1138.0	1517
2010-12*	726.9	1155.8	1595

Source: Various issues of crops statistics of KP and agri. statistics of Pakistan *2-Years Avg.

The results of semi-log model for area, production and yield of wheat crop during 1980-81 to 2011-12 were presented in Table-2. The results of F-statistic show that the models were significant for area, production and yield of wheat crop in Khyber Pakhtunkhwa. It was revealed from the results that trend co-efficient for wheat production and yield was positive except area

which was negative. The positive sign of compound growth rate shows that production and yield of wheat crop was increasing at a rate of 0.60 percent and 0.90 percent per annum. The compound growth rate during this period in area was -0.30 per cent, production grew at the rate of 0.60 per cent and yield growth is 0.90 per cent.

Table 2: Trend and rate of growth in area, production and yield of wheat crop in Khyber Pakhtunkhwa, 1981-2012

Particulars	Area	Production	Yield
F-statistic	9.89**	7.15*	30.3**
Trend coefficient	-0.003	0.006	0.009
t-statistic	-3.15**	2.67*	5.51**
Instantaneous growth rate (%)	-0.30	0.60	0.90
Compound growth rate (%)	-0.30	0.60	0.90

**Significant at 1 percent level of significance; *Significant at 5 percent level of significance

Trend and rate of growth in maize crop of Khyber Pakhtunkhwa

Maize (*Zea mays* L.) is an exhaustive cereal crop. It is a multipurpose crop that provides food for human, feed for animals especially poultry and livestock and raw material for the industries (Khaliq *et al.*, 2004). Maize is the second most important crop after wheat in the Khyber Pakhtunkhwa, and for much of the province, it is the dominant crop in the

farming system (Byerlee and Sajidin, 1986). Table-3 indicates that maize was planted in Khyber Pakhtunkhwa in 1981-85 on an area of 420.4 thousand hectares with production of 534.2 thousand tonnes and yield 1272 kgs per hectare. In the year 2010-12 the maize area, production and yield was increased to 449.1 thousand hectares with an annual production of 814.2 thousand tonnes and yield 1809 kgs per hectare.

Table 3: Trend in area, production and yield of maize crop in KP, 1981-2012

(5-Yrs Avg)

Years	Area '000' hectares	Production '000' tonnes	Yield (kgs per hectare)
1981-85	420.4	534.2	1272
1986-90	473.8	675.8	1424
1991-95	519.8	781.2	1503
1996-00	534.0	820.0	1536
2001-05	517.6	875.0	1691
2006-10	489.7	863.0	1762
2010-12*	449.1	814.2	1809

Source: Various issues of crops statistics of KP and agri. statistics of Pakistan *2-Years Avg.

The semi-log model was run for maize area, production and yield of Khyber Pakhtunkhwa and the results shows that the models were significant for area, production and yield of maize crop. The trend coefficient of area, production and yield was positive. The positive sign of compound growth rate shows that area, production and yield of maize crop was increased over the time. Annual percentage growth during 1980-81 to 2011-12 was increased at the rate

of 0.4 percent in area, while production and yield increased per year at the rate of 1.6 percent and 1.20 percent, respectively. Whereas, the compound growth rate in area 0.40 percent, production 1.60 percent and yield 1.21 percent were calculated respectively. The data shows that area, production and yield of maize was increased over the time the reason is that more area was brought under hybrid and improved open pollinated maize varieties

Table 4: Trend and rate of growth in area, production and yield of maize crop in KP, 1981-2012

Particulars	Area	Production	Yield
F-statistic	5.4**	64.1**	292.1**
Trend Coefficient	0.004	0.016	0.012
t-statistic	2.32*	8.01**	17.1**
Instantaneous growth rate (%)	0.40	1.60	1.20
Compound growth rate (%)	0.40	1.61	1.21

**Significant at 1 percent *Significant at 5 percent level of significance

Trend and rate of growth in Rice Crop of Khyber Pakhtunkhwa

The area under rice crop in Khyber Pakhtunkhwa was decreased from 70.1 thousand hectares to 48.1 thousand hectares

during 1981 to 2012. The production of rice during the same period was also decreased from 112 thousand tonnes to 86.5 thousand tonnes due to the corresponding decrease in area (Table 5).

Table 5: Trend in area, production and yield of rice crop in KP, 1981-2012

Years	(5-Years Average)		
	Area (‘000’ hectares)	Production (‘000’ tones)	Yield (kgs per hectare)
1981-85	70.1	112.0	1597
1986-90	65.2	114.4	1759
1991-95	62.7	117.9	1880
1996-00	66.1	127.0	1919
2001-05	61.9	121.4	1960
2006-10	59.4	119.8	2015
2010-12*	48.1	86.5	1795

Source: Various issues of crops statistics of KP and agri. statistics of Pakistan *2-Years Avg

The results of semi-log model for area, production and yield of rice crop were presented in Table 6. It was revealed from the table that trend co-efficient for rice production and yield was positive whereas the co-efficient for rice area was negative. The value of t-statistic of trend co-efficient for area, production and yield was also significant at 1%, 5% and 1% level of

significance, respectively. The positive sign of compound growth rate shows that production and yield of rice crop was increasing at a rate of 0.08 percent and 0.70 percent per annum. The compound growth rate during this period in area was -0.80 per cent, which shows that area under rice crop in Khyber Pakhtunkhwa was decreased by 0.80 per cent per annum.

Table 6: Trend and rate of growth in area, production and yield of rice crop in KP, 1981-2012

Particulars	Area	Production	Yield
F-statistic	34.31**	0.51 ^{NS}	28.28**
Trend coefficient	-0.008	0.0008	0.007
t-statistic	-5.86**	-0.39 ^{NS}	5.32**
Instantaneous growth rate (%)	-0.80	0.08	0.70
Compound growth rate (%)	-0.80	0.08	0.70

**Significant at 1 percent level of significance NS= Non significant

Trend and rate of growth in sugarcane crop of Khyber Pakhtunkhwa

Sugarcane is an important cash crop of Khyber Pakhtunkhwa. Sugarcane production in Khyber Pakhtunkhwa has increased over time up to the year 2001-2005. In 1981-85, the area under sugarcane was 98.5 thousand hectares which increased to 105.8 thousand hectares in 1996-00 and sugarcane production increased from 3892.1 thousand

tonnes in 1981-85 to 4803.5 thousand tonnes in 1996-2000, while the yield of sugarcane increased from 39.5 tones per hectare to 45.4 tones per hectare during the same period. Area of sugarcane crop for the year 2010-12 shows a decreased as compared to 2006-10 whereas their production also decreased due to the corresponding decrease in area and average yield of sugarcane (Table 7).

Table 7: Trend in area, production and yield of sugarcane crop in KP, 1981-2012

Years	(5-Years Average)		
	Area (‘000’ in hectares)	Production (‘000’ in tonnes)	Yield (Tones per hectare)
1981-85	98.5	3892.1	39.5
1986-90	96.5	3973.7	41.1
1991-95	102.1	4509.1	44.2

1996-00	105.8	4803.5	45.4
2001-05	104.7	4836.5	46.2
2006-10	100.8	4558.5	45.2
2010-12*	97.2	4357.3	44.9

Source: Various issues of crops statistics of KP and agri. statistics of Pakistan *2-Years Avg

The results of semi-log model for area, production and yield of sugarcane crop were presented in Table-8. The results of F-statistic show that the models were significant for production and yield of sugarcane crop whereas model for sugarcane area was statistically non-significant. It was

revealed from the table that trend co-efficient for sugarcane area, production and yield is positive. The positive sign of compound growth rate shows that area, production and yield of sugarcane crop was increasing at a rate of 0.20 percent, 0.70 percent and 0.50 percent per annum, respectively.

Table 8: Trend and rate of growth in area, production and yield of sugarcane crop in KP, 1981-2012

Particulars	Area	Production	Yield
F-statistic	2.52 ^{NS}	21.31**	50.63**
Trend coefficient	0.002	0.007	0.005
t-statistic	1.59 ^{NS}	4.62**	7.12**
Instantaneous growth rate (%)	0.20	0.70	0.50
Compound growth rate (%)	0.20	0.70	0.50

**Significant at 1 percent level of significance

NS= Non Significant

Conclusion

The compound growth rate as well as trend analysis indicated that the area under wheat crop has decreased over the time due to shifting of area to other rabi crops. The production of wheat during 1981-85 to 2010-12 was increased due the corresponding increase in per hectare yield of wheat crop in Khyber Pakhtunkhwa. The results show that area, production and yield of maize was increased over the time the reason is that more area was brought under hybrid and improved open pollinated maize varieties. The area under rice crop has decreased whereas their production increased due the corresponding increase in per hectare yield of rice crop.

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