TRENDS AND VARIABILITY OF WHEAT CROP IN PAKISTAN

Saleem Abid[a] ✝

M. Asif Masood[a]

M. Zubair Anwar[a]

Saleem Zahid[b]

Irum Raza[a]

[a] ✝ Statistics and Computing Program, Social Sciences Research Institute, PARC National Agricultural Research Centre, Islamabad, Pakistan.
[b] Institute of Business and Management Sciences, The University of Agriculture, Peshawar, Pakistan.

✝ ✉ _saleemabidpk@gmail.com_ (Corresponding author)

✝ **Corresponding Author**

ABSTRACT

The main focus of the study was to analyze trends and variability of wheat crop in Pakistan. Semi-log trend model was used to find trends and growth rate in area, yield and production of wheat crop whereas the variability was measured by Cuddy-Della Valle index of variability. The findings of the study illustrate that wheat area in Punjab, Sindh and Baluchistan was increased over the time whereas cultivated area of wheat in Khyber Pakhtunkhwa province was marginally decreased during 1981-85 to 2011-15. The results show that there was substantial increase in wheat yield and production in all four provinces of Pakistan. The increase in wheat yield may due to the adoption of new varieties of wheat in the country over the time. It was also concluded from the results that area and yield of wheat in Baluchistan recorded the highest degree of variability whereas in Punjab province area and yield of wheat crop were noticed the lowest degree of variability. Similarly, the maximum variability in wheat production was recorded for Baluchistan province followed by Sindh, Khyber Pakhtunkhwa, and Punjab. Mostly the variability in wheat production was due to the variability in wheat area and their yield.

Contribution/ Originality

The present study was conducted to examine the growth and variability in area, production and yield of wheat crop in all provinces (i.e. Khyber Pakhtunkhwa, Baluchistan, Sindh and Punjab) of Pakistan. Information on growth performance and variability in wheat production would help the policy makers of the country to implement policy measures regarding the wheat crop.

How to cite: Saleem Abid, M. Asif Masood, M. Zubair Anwar, Saleem Zahid and Irum Raza (2018). Trends and variability of wheat crop in Pakistan. Asian Journal of Agriculture and Rural Development, 8(2), 153-159.

1. INTRODUCTION

Agriculture sector plays an important role in the economy of Pakistan which contributes 18.9 percent to GDP and absorbs 42.3 percent of labour force (Government of Pakistan, 2018). Wheat is grown extensively in Pakistan on a subsistence basis for home consumption. On average, the households incur 12.55 percent of the monthly expenditures on wheat and wheat flour (Government of Pakistan, 2017). The per capita wheat production in Pakistan is 131 kgs per year, while per capita wheat consumption is 118 kgs per year which is highest in the world (Govt. Khyber Pakhtunkhwa, 2014). Wheat productivity and yield are the important determinants of wheat supply. Availability of adequate food is of major concern at household, provincial and country level for food security. Any variation in the supply and demand of wheat in world market affects the welfare of farmers, consumers, taxpayers and those directly or indirectly dependent on agriculture (Jehangir *et al.,* 2008; Hong-juan *et al.,* 2017).

Variability is an important measure of decision making in the dynamics of development and agricultural production. To analyze variations in crop production regardless of growth, it is important to understand the nature of income stability and food security. The variations in crop production affect prices and cause sharp fluctuations, but also lead to significant differences in income available to farmers. The magnitude of the variations depends on the nature of crop production technology, its sensitivity to weather, availability of inputs, economic environment, and several other factors (Wasim, 2011). Hazell (1989) found that due to the adoption of modern technology, global food grain production and the production of Indian food grains increased. Mehra (1981) argued that the variability in grain production has increased in India due to improved technological progress from the mid-1960s to large scale. Wasim (2001) evaluated that due to adoption of high yielding varieties and new farm technologies the variability in production increases. Similar opinions are also put forward by Ray (1983), Parthasarathy (1984), Mitra (1990) and Singh and Issac (2018). As wheat is a staple food of the country so it occupies a central place in Pakistan's agricultural policies. The present study was conducted to examine the growth and variability in area, production and yield of wheat crop in all provinces (i.e. Khyber Pakhtunkhwa, Baluchistan, Sindh and Punjab) of Pakistan. Information on growth performance and variability in wheat production would help the policy makers of the country to implement policy measures regarding the wheat crop.

2. MATERIALS AND METHOD

A time series data from 1980-81 to 2014-15 on area, yield and production of wheat for Baluchistan, Khyber Pakhtunkhwa (KP), Punjab and Sindh provinces was collected from different issues of Agricultural Statistics of Pakistan.

2.1. Linear semi-log trend function
In order to find trends and estimate growth rate in area, yield and production of wheat crop semi-log trend function was used (Abid *et al.,* 2014).

$$lnZ = \beta_0 + \beta_1 W + e$$

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

To find out the compound growth rate the following formula was used (Gujarati, 2004).
r = {antilog(β_1) -1}*100

where
r = Compound growth rate and β₁ = trend coefficient.

2.2. Measurement of variability

The variability in wheat area, yield and production was measured by Cuddy-Della Valle index of variability (1978) that is applied by different researchers in time series data. The formula for Cuddy-Della Valle Index of Variability (I) is

$$I = CV^* \sqrt{(1 - R^2}$$

where CV represent the coefficient of variation; and R^2 is coefficient of determination from a time-trend regression.

3. RESULTS AND DISCUSSION

3.1. Trends analysis of wheat crop

Trends in wheat area, yield and production were presented in Table-1. The results from the table shows that the wheat area in Pakistan during 1981-85 was 7309 thousand hectares as compared to 8783 thousand hectares sown during 2011-15, which displays that wheat area increased by 22.2 percent over the time. The production of wheat was increased from 12053 thousand tonnes to 24688 thousand tonnes during 1981-85 to 2011-15, which indicate that wheat production in Pakistan was increased by 104.8 percent. It may be due to the corresponding increase in wheat area in Pakistan and also increase in wheat yield per hectare (67.8 percent) (Table 1 & Figure 1).

Results of the study also illustrate that the wheat area in Punjab, Sindh, Khyber Pakhtunkhwa and Baluchistan was 5242,1021, 784 and 262 thousand hectares during 1981-85 whereas it was 6719, 1084,742 and 384 thousand hectares in 2011-15, respectively. So that the area under wheat crop in Punjab (28.2 percent), Sindh (6.2 percent) and Baluchistan (46.6 percent) was increased over the time. But the cultivated area of wheat crop in Khyber Pakhtunkhwa province was decreased by 5.4 percent during 1981-85 to 2011-15.

Table 1: Trend of wheat crop in Pakistan, 1981-82 to 2014-15   (5-year averages)

Year	Punjab	Sindh	Khyber Pakhtunkhwa	Balochistan	Pakistan
(Area in "000" Hectares)					
1981-85	5242	1021	784	262	7309
1986-90	5577	1041	809	273	7700
1991-95	5855	1087	850	359	8152
1996-00	6029	1061	843	334	8268
2001-05	6263	888	738	334	8223
2006-10	6655	1048	751	387	8841
2011-15*	6719	1084	742	384	8929
(Production in "000" Tonnes)					
1981-85	8653	2085	907	407	12053
1986-90	9817	2232	1023	527	13598
1991-95	11919	2313	1173	788	16193
1996-00	14258	2601	1095	707	18661
2001-05	15948	2328	1034	649	19960
2006-10	17768	3670	1149	775	23362
2011-15*	18837	3759	1253	840	24688
Yield in kgs per hectare					
1981-85	1649	2042	1158	1551	1648

1986-90	1759	2144	1261	1945	1765
1991-95	2035	2128	1379	2202	1986
1996-00	2361	2466	1291	2114	2255
2001-05	2544	2618	1402	1948	2426
2006-10	2669	3497	1531	1994	2642
2011-15*	2803	3468	1688	2185	2765

Source: Government of Pakistan. 1990-2017   *4-year averages*

The average production of wheat crop in Punjab, Sindh, Khyber Pakhtunkhwa and Baluchistan provinces were 8653,2085,907 and 407 thousand tonnes during 1981-85 whereas it was 18837,3759,1253 and 840 thousand tons during 2011-15, respectively. The results shows that there was a substantial increase in production of wheat crop in all provinces of Pakistan. Similarly, it was exposed from the results that the yield of wheat crop was significantly increased in Punjab (70 percent), Sindh (69.8 percent), Khyber Pakhtunkhwa (45.8 percent) and Baluchistan (40.9 percent); it may be due to the introduction of new wheat varieties in the country over the time.
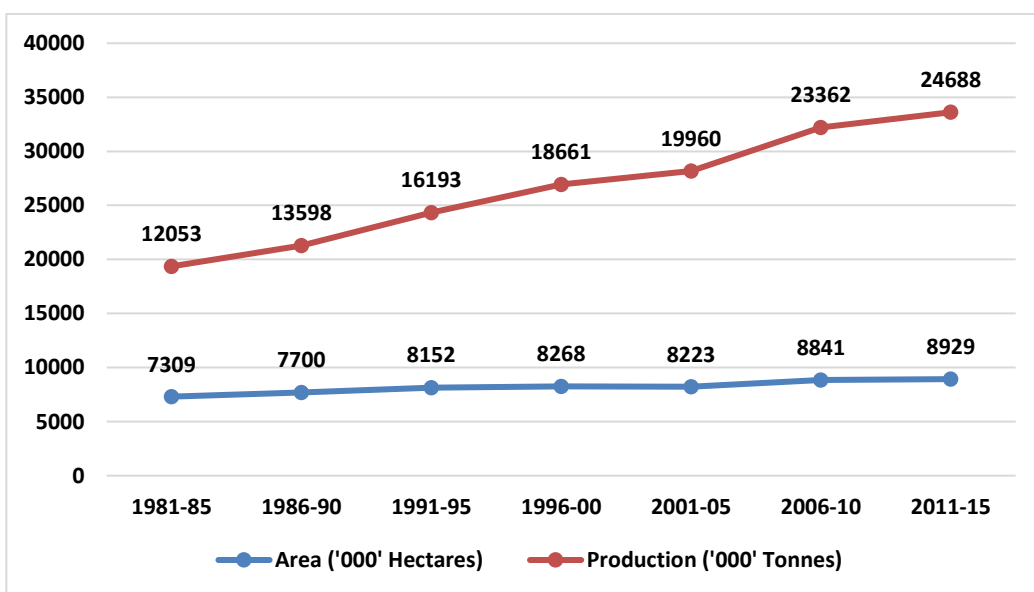

Figure 1: Trend in area and production of wheat crop in Pakistan, 1981-82 to 2011-15

3.2. Growth analysis of wheat crop
Estimated growth rates of wheat Crop during 1981-82 to 2014-15 were accessible in Table-2. It was revealed from the outputs that the semi log models were statistically significant for wheat area, yield and production in all provinces of Pakistan but wheat area model for Sindh province was statistically non-significant. The sign of trend co-efficient for yield and production of wheat was positive for all models of four provinces of Pakistan except wheat area for Khyber Pakhtunkhwa and Sindh provinces where the sign of trend co-efficient were negative. The positive sign of growth rate explain that wheat area, yield and production in Pakistan was increased at a rate of 0.65 percent, 1.90 percent and 2.56 percent per year, respectively.

Table 2: Estimated growth rate of wheat crop in Pakistan, 1981-82 to 2014-15

Wheat/Region	Coefficient of Determination (R^2)	Trend Coefficient (b)	t-Statistic	Growth Rate (%)
Area				
Pakistan	86.4	0.00651	14.26**	0.65
Khyber Pakhtunkhwa	23.8	-0.00316	-3.16**	-0.32
Punjab	94.3	0.00858	22.92**	0.86
Sindh	0.10	-0.00033	-0.21[NS]	-0.03
Baluchistan	52.0	0.0133	5.89**	1.34
Production				
Pakistan	95.2	0.0253	25.19**	2.56
Khyber Pakhtunkhwa	30.2	0.00755	3.72**	0.76
Punjab	94.0	0.0283	22.40**	2.87
Sindh	69.6	0.0196	8.56 **	1.98
Baluchistan	50.2	0.0198	5.68**	2.00
Yield				
Pakistan	93.4	0.0188	21.24**	1.90
Khyber Pakhtunkhwa	59.6	0.0107	6.87**	1.08
Punjab	89.6	0.0197	16.6**	1.99
Sindh	83.4	0.0199	12.6**	2.01
Baluchistan	19.8	0.00654	2.81**	0.66

**Significant at 1% level of significance; NS=Non significant

Table 2 illustrate that the compound growth rate for wheat area in Punjab and Baluchistan provinces were 0.86 percent and 1.34 percent, respectively. It means that the area under wheat crop in these two provinces were increasing at a rate of 0.86 percent and 1.34 percent per annum. In contrast, compound growth rate for wheat area of Khyber Pakhtunkhwa and Sindh were -0.32 and -0.03 percent, which indicate that area under wheat crop was decreased at the rate of 0.32 percent and 0.03 percent per annum in these two provinces, respectively. It was also exposed from the results that the compound growth rate of wheat production for Khyber Pakhtunkhwa, Punjab, Sindh and Baluchistan were 0.76, 2.87, 1.98 and 2.00 percent respectively, which explain that the production of wheat crop in the four provinces were increased at the rate of 0.76, 2.87, 1.98 and 2.00 percent per annum. The data also indicate that the yield of wheat crop in Pakistan as well as in all the four provinces were increased.

3.3. Variability in wheat crop
The estimated relative variability index in wheat crop during 1981-82 to 2014-15 was presented in Table 3. It may be observed from the results that area and yield of wheat crop in Baluchistan recorded the highest degree of variability whereas in Punjab province area and yield of wheat crop were noticed the lowest degree of variability. Similarly, the maximum variability in wheat production was recorded for the Baluchistan province followed by Sindh, Khyber Pakhtunkhwa, and Punjab. Mostly the fluctuation in wheat production was due to the fluctuations in area under wheat crop and their yield. According to Goswami and Challa (2006), if variability in both area and yield components decline, then the variability in production is bound to decline. This is true with respect to wheat crop in Pakistan (Table-3). The results shows that the variability in wheat production had increased with the increased variability in area and yield, it may be due to the adoption of new technology.

Table 3: Variability in wheat crop of Pakistan during 1981-82 to 2014-15

Provinces	Instability Index		
	For Area	For Production	For yield
Punjab	2.1	6.0	5.8
Sindh	8.4	14.6	10.1
Khyber Pakhtunkhwa	5.8	11.0	8.2
Balochistan	11.7	18.8	12.7
Pakistan	2.5	5.2	4.5

Source: Author's own calculation

4. CONCLUSION

The results illustrate that the area under wheat in Punjab, Sindh and Baluchistan were increased over the time whereas cultivated area of wheat in Khyber Pakhtunkhwa province was marginally decreased during 1981-85 to 2011-15. The results show that there was significant increase in wheat yield and their production in the four provinces of Pakistan. The increase in yield of wheat was possibly due to the introduction of new varieties in the country over the time. The semi log models were statistically significant for wheat area, yield and production in all provinces of Pakistan except wheat area model for Sindh province which was statistically non-significant. It may be observed that area and yield of wheat in Baluchistan recorded highest degree of variability whereas in Punjab province area and yield of wheat were noticed lowest degree of variability. Similarly maximum variability in wheat production was recorded for the Baluchistan province followed by Sindh, Khyber Pakhtunkhwa, and Punjab. Mostly the variation in wheat production was due to the fluctuations in wheat area and their yield. The variability in wheat had increased, it may be due to the adoption of new varieties and better methods of cultivation, increase in variability of rainfall and prices and so on.

References

Abid, S., Shah, N. A., Hassan, A., Farooq, A., & Masood, A. (2014). Growth and trend in area, production and yield of major crops of Khyber Pakhtunkhwa, Pakistan. *Asian Journal of Agriculture and Rural Development, 4*(2), 149-155. *view at Google scholar*

Cuddy, J. D. A., & Della, V. P. A. (1978). Measuring of instability of time series data. *Oxford Bulletin of Economics and Statistics, 40*(1), 79-85. *view at Google scholar*

Government of Pakistan. (2017). *Household integrated economic survey 2015-16*. Statistics Division, Pakistan Bureau of Statistics, Islamabad.

Government of Pakistan. (1990-2017). *Agricultural statistics of Pakistan.* Ministry of National Food Security and Research (Economic Wing), Government of Pakistan, Islamabad. *view at Google scholar*

Government of Pakistan. (2018). *Economic survey of Pakistan.* Economic Adviser's Wing, Finance Division, Islamabad. *view at Google scholar / view at publisher*

Goswami, S. N., & Challa, O. (2006). Socio-economic factors affecting land use in India. *Agri. Situ. India, 60*(10), 615-623. *view at Google scholar / view at publisher*

Govt. Khyber Pakhtunkhwa. (2014). *Khyber Pakhtunkhwa development statistics.* Planning and Development Department, Bureau of Statistics, Peshawar.

Gujarati, N. D. (2004). *Basic econometrics.* The McGraw−Hill Companies, United States. *view at Google scholar*

Hazell, P. B. R. (1989). *Changing patterns of variability in world cereal production*. In: J.R. Anderson and P.B.R. *view at Google scholar*

Hong-juan, J., Yan-jie, Y., & Guo-qiang, Z. (2017). Hydrogen Peroxide Involved in Tip Growth of Wheat (TriticumAestivum) Root Hairs by High Concentration Chlorogenic Acid. *Canadian Journal of Agriculture and Crops*, *2*(1), 22-33.

Jehangir, M. K., Ahmad, S., & Saddozai, K. N. (2008). Economic analysis of wheat profitability in Peshawar Valley. *NWFP. Pak. j. life Soc. Sci., 6*(2), 112-117. *view at Google scholar*

Mehra, S. (1981). Instability in Indian agriculture in the context of the new technology. International Food Policy Research Institute. Research Report. 25. Washington, USA. *view at Google scholar*

Mitra, A. K. (1990). Agricultural production in Maharashtra: growth and instability in the context of new technology. *Economic and Political Weekly, 25*(52), 146-164. *view at Google scholar*

Parthasarathy, G. (1984). Growth rates and fluctuations of agricultural production: a district-wise analysis in Andhra Pradesh. *Economic and Political Weekly, 19*(26), 74-84. *view at Google scholar*

Ray, S. K. (1983). An empirical investigation of the nature and causes for growth and instability in Indian agriculture: 1950-80. *Indian Journal of Agricultural Economics, 38*(4), 459-474. *view at Google scholar*

Singh, A. K., & Issac, J. (2018). Impact of climatic and non-climatic factors on sustainable livelihood security in Gujarat state of India: A statistical exploration. *Agriculture and Food Sciences Research*, *5*(1), 30-46.

Wasim, M. P. (2001). Agricultural growth and instability in major crops production: a province wise analysis in Pakistan. *The Asian Economic Review, 43*(2), 294-314. *view at Google scholar*

Wasim, M. P. (2011). Trends, growth and variability of major fruit crops in Baluchistan. *Journal of Agricultural and Biological Science, 6*(12), 27-36. *view at Google scholar*