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Estimating compound growth rate, instability index and annual fluctuation of cotton in Pakistan

Saima Rani, Nusrat Habib, Irum Raza and Naheed Zahra
Social Sciences Research Institute, National Agricultural Research Centre, Islamabad, Pakistan
Saimazahid6@gmail.com (Corresponding Author email address)

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ABSTRACT

The key concern of this research is to assess the growth, instability and annual fluctuations of cotton during last three decades in Pakistan. The time series data on area, production and yield of cotton is collected for the year 1981 to 2015 from different issues of agricultural statistics of Pakistan. The results depict that positive growth rates on area, production and yield of cotton expanding over time due to involvement of private companies. The growth rate of yield is 2.65 followed by 0.88 growth of yield in cotton area in Pakistan. While analyzing the data the instability is high in production and low in area of cotton in Pakistan that mainly due to insect and pest attack on crop. Production annual fluctuation of cotton is high and not a consistent during study period especially in 1981-90. The fluctuation highly increased in 1984-85 and lowest during the year 1983-84. In the cotton area fluctuation highest in 1995-96 and lowest in 2010-11 in country. The yield of cotton is highly fluctuating during the year 1984-85 and lowest in 1983-84. There should be some control over the diseases this will reduce the fluctuation for production in cotton. Easy availability of modern factor inputs and sustained supply will reduce area instability largely.

Contribution/ Originality
This paper has attempted to assess the growth rates of cotton yield, area and production over the year and calculate the instability index over the year in the case of Pakistan.

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1. INTRODUCTION

Cotton is one of the important commercial crop of Pakistan. Cotton plays a key role in the national economy in terms of both employment generation and foreign exchange earnings and around two third of the country's export earnings are from the cotton. With economic liberalization and globalization sweeping the world there is scope for our country to play a leading role in the production and export.

Cotton commonly known as "white gold" is an important cash crop for Pakistan and normally cultivated in agriculture plains of Punjab and Sindh. It contributes 8.2 percent of the value-added share in national agricultural and about 3.2% to GDP; around two third of the country's export earnings come from the cotton made-up and textile which adds over $2.5 billion to the national economy; while hundreds of ginning factories and textile mills in the country heavily depends upon cotton (Ijaz, 2009). Primarily millions of farmers are dependent on this crop, in addition to millions of people employed along the entire cotton value chain from weaving to textile and garment exports. The area under the cultivation of cotton crop has been increased significantly in the last 30 years - around 7.85 million acres in 2005-06 as compared to 7.2 million acre in 2002-03 (GOP, 2008). Besides being the world's fourth-largest cotton producer and the third largest exporter of raw cotton and a leading exporter of yarn in the world our yield per acre ranks 13th in the world. During the year, 2015 crop production in the country declined 33% with a decrease of 44% in the largest cotton producing province Punjab alone. The reason behind decline is climate change; including heavy rains, pest attacks and harsh weather across the cotton growing areas are to blame for the slump in production, due to which the crop in most areas of southern Punjab was badly damaged (Muhammad, 2016). As a result, Pakistan imports cotton to meet growing demand from local textile mills; therefore, it has become vital for Pakistan to increase its yield potential.

The cotton industry and cotton related services play the foremost role in Pakistan's economy and contributing 63.9 percent of the total exports earnings (Pakistan Economic Survey, 2005). It provides raw material to local/domestic cotton industry comprising of 503 textile mills, 1263 ginning factories, 8.1 million Spindles and 2622 oil expelling units. It also yields 3.5 to 3.6 million tons of cotton seeds which contributes over 64 percent of the total domestic edible oil production (Pakistan Cotton Ginners Association, 2005). Cotton is cultivated on an area of 3.19 million hectares (Agricultural Statistics of Pakistan, 2005). Approximately 77 percent of all Pakistan cotton is produced in Punjab and remaining 23 percent in other provinces (GoP, 2005). On global basis, Pakistan is the fourth largest cotton producing country of the world after China, India and USA. Pakistan's share of total world cotton production in 2004-05 stood at 9.47 percent (Cotton Statistical Bulletin, 2006). Pakistan is the third largest consumer, consuming 10 percent of the world production. It is the third largest yarn producer with 9 percent second largest yarn exporter with 26 percent, third largest cloth producer with 7 percent and is also the third largest cloth exporter with 14 percent of the world cotton production (ICAC, 2005). The production process involves rationale use of inputs including seed, pesticides, fertilizers and irrigation. There is a significant increase in cotton production during the last decade but still potential yield has not yet been exploited. However, the advanced production technologies and judicious use of inputs at the subsidized rates can enhance the production of cotton. This paper has attempted to assess the growth rates of cotton yield, area and production over the year and calculate the instability index.

2. MATERIAL AND METHODS

The study is based on the secondary data. The time series data on area, yield and production of cotton is collected for the year 1981-82 to 2014-15 (34 year). The data is taken from the various issues of Agriculture Statistics of Pakistan Published by Ministry of Food and Agriculture and

later on published by the Ministry of National Food Security and Research (GoP, 1981-2011 and GoP, 2012-2015).

2.1. Compound growth rate estimation

Average annual growth rates have been computed for area, production and yield for cotton. Hence for measuring the growth rates of area, production and yield it is using as follows (Prajneshu and Chandran, 2005, Rani *et al.*, 2012 and Rehman *et al.*, 2010). The following equation is used for calculating the growth rate separately for each variable.

$$Y_t = Y_0 (1 + r)^t \quad \text{---------- (1)}$$

Where:
Yt = price/area/production/yield of cotton in year t
Y_0=initial (i.e. 1981/82) price/area/production/yield of cotton
r = the compound (i.e. over time) rate of growth of Y_t.where stands for the year t.

2.2. Instability estimation

Instability index capture both explained and unexplained variations of the concerned variable and should better reflect the true instability situation. The index is used to measure instability for area, production and yield it is defined as follows by (Karim and Ismail, 2007 and Rani *et al.*, 2012).

$$I = C.V. \times \sqrt{1 - R^2} \quad \text{---------- (2)}$$

Where: I = Instability index C.V. = Coefficient of variation
R^2= Adjusted coefficient of determination

2.3. Annual fluctuation estimation

The inter year fluctuation in area, production and yield was estimated by the simplest method year by year. The method is followed by (Javed *et al.*, 2004 and Rani *et al.*, 2012).

$$\Delta X_t = [(X_t - X_{t-1}) / X_{t-1}] \times 100 \quad \text{---------- (3)}$$

Where
X = area/production/yield in year t
ΔX_t= Percentage changes of area/production/yield in year t over the last period (Year)
X_t= Current year's area/production/yield in year t
X_{t-1} = Previous year's area/production/yield in year t -1

3. RESULTS AND DISCUSSION

Compound growth rates on area production and yield of cotton for 34 years (1981-2014) in Pakistan shows in Table 1. The results shown that growth rates of area, yield and production of cotton found positive it means that the area, production and yield is expanding over time. But the rate of growth of production is high in cotton in Pakistan one of the reason behind this is introduction of new cotton varieties with high yield in Pakistan. The growth rate of yield is 2.65 followed by 0.88 growth of yield in cotton area of Pakistan.

Table 1: Compound growth rates and instability index of area, yield and production of cotton in Pakistan

Estimates	Compound Growth Rate	Instability Index (I)*
Area	0.88	7.13
Production	3.56	14.39
Yield	2.65	13.12

Instability index capture both explained and unexplained variations of the concerned variable and should better reflect the true instability situation of the selected cotton shown in Table 1. While analyzing the data the instability is high in production and low in area of cotton in Pakistan.

Table 2: Annual fluctuations of lagged area, yield and production of cotton in Pakistan

Annual fluctuation	Lowest Value	Highest Value
Area	-13.41	12.99
Prod	-39.97	103.96
Yield	-38.74	101.79

When a farmer cultivated a crop on his farm keeping in mind its price of previous year profitability then a farmer will allocate his limited resources for that crop which is stable and less risky. Annual fluctuation of cotton area; yield and production is shown in Table 2. It was noticed that production fluctuation of cotton is high and not a consistent during study period especially in 1981-90. The fluctuation highly increased in 1984-85 and lowest during the year 1983-84. In the cotton area fluctuation highest in 1995-96 and lowest in 2010-11 in country. The yield of cotton is highly fluctuating during the year 1984-85 and lowest in 1983-84. The detail of annual fluctuation shown in annexure 1.

4. CONCLUSION

This study shows the growth rates of cotton are positive in case of yield, production and area. The instability index is high in case of yield and production. Annual fluctuation is higher for production and yield. The reason of these fluctuations is that production is not in the control of farmers due to insect and disease attack. Therefore, there should be some control over the diseases this will reduce the fluctuation in production of cotton. Easy availability of modern factor inputs and sustained supply will reduce area instability largely. Further Government should insure stable annual price that will also helpful in reducing area instability for cotton in the country.

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Annexure 1: Annual fluctuation in area. Production and yield of cotton in Pakistan

Year	Annual fluctuation (Area)	Annual fluctuation (Production)	Annual fluctuation (yield)
1981-82	5.01	4.70	-0.29
1982-83	2.20	10.13	7.69
1983-84	-1.86	-39.97	-38.74
1984-85	0.94	103.96	101.79
1985-86	5.46	20.64	14.44
1986-87	5.97	8.46	2.33
1987-88	2.50	11.25	8.54
1988-89	2.01	-2.87	-4.90
1989-90	-0.80	2.08	2.94
1990-91	2.45	12.48	9.82
1991-92	6.51	33.18	25.04
1992-93	0.01	-29.39	-29.39
1993-94	-1.10	-11.19	-10.13
1994-95	-5.41	8.16	14.14
1995-96	12.99	21.82	7.90
1996-97	5.05	-11.52	-15.81
1997-98	-6.00	-2.03	4.30
1998-99	-1.25	-4.29	-3.08
1999-00	2.06	27.87	25.28
2000-01	-1.86	-4.52	-2.71
2001-02	6.43	-1.11	-7.09
2002-03	-10.34	-3.79	7.31
2003-04	7.01	-1.60	-8.04
2004-05	6.80	41.97	32.93
2005-06	-2.81	-8.74	-6.10
2006-07	-0.91	-1.25	-0.34
2007-08	-0.67	-9.34	-8.73
2008-09	-7.67	1.41	9.83
2009-10	10.13	9.26	-0.79
2010-11	-13.41	-11.25	2.49
2011-12	5.41	18.63	12.54
2012-13	1.56	-4.15	-5.63
2013-14	-2.54	-2.01	0.54
2014-15	5.55	9.33	3.58