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Analyses of growth trends and production forecast of cash crops in Pakistan

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Abstract

The objectives of present research to evaluate actual phenomena as well as to see the magnitude of future trends of cash crops in Pakistan. Thus, a time series data of last 25 years has been gathered from various official statistical reports, like Economic Survey of Pakistan, Agriculture Census Reports, where growth rate and forecast models have been applied to see their past and future magnitudes. Results show high fluctuations in the cash crop production dataset, which was due to irregular input supply as well as natural disasters in the country. Based on the growth rates, the yields of cash crops have also projected for next 20 years (upto 2034-35). Forecasted trends of the crops show that the crop production will positively grow, if inputs like land, labor and capital might be favorable. Therefore, it is suggested that introducing better farm mechanization, efficient use of irrigation, agriculture credit disbursement, better packaging services, as well as the sustainable agriculture practices may be provided to the farmers through various capacity building programs at gross root levels. Thus, it will ultimately support the farming community to improve the per acre yield of the crops.

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Introduction

Pakistan is basically an agrarian economy, in which the agriculture contributes about 21 percent in its Gross Domestic Product (GDP), employs about 44 percent of its total labor-force and is a source of foreign exchange revenue. About 68 percent of the country's population lives in rural areas and directly depends upon this sector for their livelihood. The annual growth rate of agriculture in 1990s was 4.5 percent, where it was about 11.7 percent in 1995-96 mostly due to increase in cotton, gram, meat and milk production. However, the cash crops (wheat, cotton, rice, sugarcane and maize) have accounted about 41 percent value added in country's GDP (Chandio *et al*., 2016; GOP, 2015).

Actually, cash crops are produced in foreign exchange for our realm (Barbier, 2010). For example, the cotton contributes about 1.4 percent of GDP and 6.7 percent as a main source of raw material for fabric industry. The Textile industry intended foreign swap of US$ 10.385 billion throughout July-March 2013-14. During the same period of time, the cultivated crop was in an area of 2806 thousand hectares (GOP, 2015). Globally, Pakistan is fifth largest cotton producer, the third largest exporter of raw cotton and the fourth largest consumer of cotton. Cotton products give upto 10 percent and 55 percent of the foreign markets (Pakissan, 2005). After cotton, the rice is most important source of foreign income in the country. This crop accounts about 3.1 percent in agriculture and 0.7percent in the GDP. During 2013-14, rice was exported overseas up to US$ 1.667 billion. In 2013-14, cultivated area of rice crop was 2789 thousand hectares. The Government of Pakistan is taking serious actions to lift up the yield, quality, production and export of the crop. Pakistan is the fifth prime rice exporter country in the world after India, Thailand, Vietnam and USA (Shafi *et al*., 2012). The wheat crop is a staple food of about one third of the world's population (Dani *et al*., 2016), where it is a most important cereal crop of Pakistan. It contributes about 10.3 percent in agriculture along with 2.2 percent in the GDP. During 2013-14, the wheat area has augmented upto 9039 thousand hectares, which was 4.4 percent increased of precedent year (GOP, 2015).

The sugarcane crop is an imperative cash crop of Pakistan. It is superficially vital for sugar and sugarcane related products. The sugarcane industry took part in the economy of the country. Sugarcane products grown up to the 3.4 percent in agriculture and 0.7 percent in GDP. During 2013-14 Sowing area of sugarcane was 1173 thousand hectares next to last year's 1129 thousand hectares farming broadening upto 3.9 percent. During same period, trade of sugar to others countries remain upto 236.8 US$ million (GOP, 2015).

The available literature evident that the magnitude and foreign exchange earnings of the cash crops are declining over time in Pakistan, which may create income insecurity among the growing local population in the country. Thus, to evaluate the actual phenomena as well as to see the magnitude of future trends of the cash crops in the country, and to provide policy recommendations based on the results. The objectives of this study are (i) to study the scenario of cash crops (Cotton, Rice, Sugarcane, and wheat) in Pakistan, and (ii) to calculate growth performance and their prospective trends. This study will be helpful to understand the potential of cash crops and future prospects. The forecast values for coming years can help to the policy makers to formulate policies regarding agriculture development in the country. Whereas, the present study may lead Pakistan's economy towards growth, development and also improvement in country's balance of payment.

Materials and method

In Pakistan, it is commonly accepted that the magnitude and foreign exchange earnings of the cash crops are declining over time, which may create insecurity among the growing local population in the country. Therefore, there is a need to utilize the mathematical tools to calculate the extents of the crop dynamics. Thus, in the research growth rate and forecast models have been selected. The aim of the models selection was to prospect the production trends of the cash crops from the available dataset, while applying mathematical tools (model).

Simple growth rate model

Growth rate is normally defined as the value added by which a quantity increases (or decreases) over time. To many researchers, "Calculating a growth rate" may sound like an intimidating mathematical process. Actually, growth rate calculation can be remarkably simple. Basic growth rates are simply expressed as the difference between two values in time in terms of the first value. Growth rates are frequently used as a summary of trend in time series data, where efficiency indices, price indices and output indices are typically discussed in terms of the varying the growth rates more than diverse periods of era. Wiktor and Travis (1985) have described with the purpose of growth rates are measures in the past performances of economic variables which are not urbanized to predict the trend in a variable over time. Normally the economic growth is expressed in percentage terms, implying the exponential growth. It is basically the application mathematical models in allied sciences, e.g. social sciences (Rao *et al.*, 1980). In business and management point of view the annual percentage growth rates are useful when considering investment opportunities or to know the current trends of the outcomes in order to solve the basic economic question that how much to produce etc. Moreover, the policy decisions are often based on such a growth rate estimates.

In order to apply the mathematical model likewise growth rate model in the data on cash crop productivity in Pakistan. After reviewing the different growth rate models, for this study simple growth rate model has been selected, because the model is mathematical in nature and it is simple to be apprehended, while the other models are more econometric rather mathematical.

$$(1)\ g = \left(\frac{x_t - x_T}{x_T}\right) \ldots \ldots \ldots \text{Per year growth rate}$$

$$(2)\ ga = \left(\frac{x_T}{x_t}\right)^{\frac{1}{T}} - 1. \text{ Average growth rate per time period}$$

Where:

g = per year growth rate

ga = average growth rate (time series)

Xt = Initial value of variable X

XT = Final value of variable X

t = Base year/current year

T = Final year/next year

Simple forecast model

Mathematicians have derived and accomplished substantial work on forecasting models, where the models have been applied by the economists on various research grounds in order to acquire the desired results. Forecasting is the process of making predictions of the future as a function of past and present data and analysis of trends. However, risk and uncertainty are central to forecasting and prediction, where the most important criterion in forecasting agricultural production is the theoretical consistency of the model (Gujrati, 1978; Granger, 1980).

$$(3)\ fy = (ga + 1)^T \times x_t \ldots . \text{Forecasted year value}$$

Where:

fy = forecasted/prospected year

g = per year growth rate

ga = average growth rate (time series)

Xt = Initial value of variable X

XT = Final value of variable X

t = Base year/current year

T = Final year/next year

Data collection procedure

For this study, the secondary data on the cash crops (cotton, rice, wheat, and sugarcane) were used for last 25 years, which have been collected from various sources, such as Pakistan Economic Survey reports, Agriculture census reports as well as from Food and Agriculture Organization (FAO) reports.

Those mentioned datasets are published either by the public or private organizations, which are considered as the reliable sources towards the information.

Results and discussion

In this section of the article the results on the cash crops' growth performances for last 25 years (1990-91 to 2014-15) have been documented, as well as the projected estimations of the crop production for next 20 year have also been provided.

Growth performance of cash crops' in Pakistan (1990 to 2015)

In this subsection, the growth rates of the total production of cash crops have been calculated by employing a growth rate model, where the results are given in Table 1. The data analysis result exposes that during 1991-92 cotton shows positive annual growth rate of 0.33. Subsequently, from 1992-93 to 2013-14 the cotton' syearly production growth rates remained in high fluctuations, e.g. either positive or negative. Contrary, in 2004-05 cotton production displays highest annual growth rate of 0.42.

It was the result of timely rains and high support price announced by the government (Go P, 2015; Magsi, 2012). Later, data analysis reveals that the cotton growth rate started declining and remained 0.04 to -0.02 in2012-13 and 2013-14 respectively. This negative growth is might be increased temperature in the crop growing areas of the country (GOP, 2015).

Table 1. Pakistan's yearly production of cash crops' from 1990-91 to 2014-15.

Years	Growth rate			
	Cotton	Rice	Sugarcane	Wheat
1990-91	Base period			
1991-92	0.33	-0.01	0.08	0.08
1992-93	-0.29	-0.04	-0.02	0.03
1993-94	-0.11	0.28	0.17	-0.06
1994-95	0.08	-0.14	0.06	0.12
1995-96	0.22	0.15	-0.04	-0.01
1996-97	-0.12	0.09	-0.07	-0.02
1997-98	-0.02	0.01	0.26	0.12
1998-99	-0.04	0.08	0.04	-0.04
1999-00	0.28	0.10	-0.16	0.18
2000-01	-0.04	-0.07	-0.06	-0.10
2001-02	-0.01	-0.19	0.10	-0.04
2002-03	-0.04	0.15	0.08	0.05
2003-04	-0.02	0.08	0.03	0.02
2004-05	0.42	0.04	-0.12	0.11
2005-06	-0.09	0.10	-0.05	-0.02
2006-07	-0.01	-0.02	0.23	0.09
2007-08	-0.09	0.02	0.17	-0.10
2008-09	0.01	0.25	-0.22	0.15
2009-10	0.09	-0.01	-0.01	-0.03
2010-11	-0.11	-0.30	0.12	0.08
2011-12	0.19	0.28	0.06	-0.07
2012-13	-0.04	-0.10	0.07	0.03
2013-14	-0.02	0.23	0.06	0.04
2014-15	0.06	0.03	-0.06	0.01

Source: Author's calculation, data obtained from Economic survey of Pakistan 2016.

Similarly, year-wise production data of rice were analyzed, where the results shown both positive and negative. During first half of 1990's, rice production performances show negative growth rate of -0.14, in 1994-95. Later during 1995-96, results confirmed positive growth rate of 0.15, annually. Whereas, following period from year 1997 to 2000 rice production growth rates remained 0.09 to 0.10, annually. Again, for the second time, results revealed positive rice growth annual growth rate of 0.10. During 2009-2011 and 2010-11 subsequently data analysis shows low Rice growth rates of -0.01, to -0.30 respectively. During 2010-11, the overall performance of agriculture sector exhibited a weaker growth mainly due to negative growth of major Crops. This has washed up the rice belt in the country (GOP, 2015).

Results of this study show that the production declined over time, in fact for nourishment of the growing population in the country, it is the main source of food (Farooq, 2009) further he added that in Pakistan net annual requirement for a population including seed requirement is more than 21mmt besides unavoidable post production losses. In order to increase the production in the country, it is imperative to introduce latest seed varieties (Masoood and Javed, 2004).

Likewise, Sugarcane crop is an imperative cash crop of Pakistan and is full-grown on area of more than one million hectares. It provides raw material to 77 sugar factories besides indigenous "brown Sugar" cottage industry. According to the results the crop production having no high fluctuations because the crop cultivation is mainly ignored by the farmers because of lower product prices (Go P, 2015). The sugarcane crop is beset with many plights: one an awfully low yield leading to yearly vacillation in production, and secondly monopolistic utilization of sugarcane growers by the powerful sugar syndicate. The sugarcane highly water consumptive crop, thus losing comparative advantages in water scarce scenario. Therefore, it is important to look at the economics of sugarcane production in the WTO regimes. The results of sugarcane crop production revealed negative growth rate of -0.07 in year 1996-97 per annum.

After that, in 2002-03 sugarcane product growth analysis shows the massive Growth rate of 0.08. Similarly, the positive growth rate of higher sugarcane production result of increase due to timely rains, judicious application of fertilizer, improvement in cultural practice, batter management and attractive prices offered by the millers last five years (GoP,2015). Results added that sugarcane production growth rate declined from 0.06, to -0.06 in 2015.

Likewise, by applying mathematical models in agriculture sector of Pakistan, the analyzed of performance of production wheat of last 25 years from (1990-91 to 2014-15) reveals that wheat crop production revealed positive growth rate of 0.08, in Year 1991-92 per annum. Likewise, during (1996-2000) and (2001-2005) production results shows positive growth rate of 4.30 and 3.81 respectively by Muhammad (2001) and Abid *et al.* (2014). After that in 2002-03, wheat production growth analysis shows the massive Growth rate of 0.05. While performance of wheat production signifies during the year (2011-15) improved high growth rate of2.05, this was also evaluated by Hussain *et al.* (2016). Similarly, results added that s production of wheat growth rate remained 0.04, to 0.01till 2014-15.

Besides yearly growth performance of the production of cash crops, we have also calculated growth rate on five yearly spilt periods, are shown in Table2.

Table 2. Production of cash crops in five-yearly spilt periods from (1990-91 to 2014-15).

Five-yearly spilt periods	Growth rate			
	Cotton	Rice	Sugarcane	Wheat
1990-1995	-3.75	1.84	5.45	3.76
1996-2000	1.56	3.12	3.06	4.30
2001-2005	2.59	1.95	4.15	3.81
2006-2010	-2.80	3.22	4.43	3.59
2011-2015	2.21	3.65	4.93	2.05

Source: author's calculations.

Thus, table 2. shows that cotton productivity in the country was -3.75 in 1990-1995 than grew by 1.56 in next five years, where again its production has been negatively in 2006-2010, due to heavy flood in Pakistan said by Quads' and Mustafa (2011).

Contrary, the production of rice, sugarcane and wheat crops were positive through last 25 years, but, during 2001-2005 the rice crop grew lower as compared to the last five years (1996-2000), due to high temperature and shortage of rain fall (GO P, 2007),

where at the same time periods the growth rates for sugarcane and wheat crops were 5.15 and 3.81 respectively. During the last five years' period all cash crops had positive growth rates.

Projected cash crop production in Pakistan from 2015-16 to 2034-35

Projections for production of cash crops in Pakistan for 20 upcoming years are calculated; however, these projections are based on past data. Thus the forecast values up to 2034-35 are given in Table 3.

Table 3. Pakistan's projected cash crops production for 2015-16 to 2034-35.

Projected Years	Forecasted Production			
	Cotton	Rice	Sugarcane	Wheat
2015-16	2,321	7,223	64,057	26,054
2014-17	2,352	7,447	65,493	26,644
2014-18	2,384	7,678	66,962	27,246
2014-19	2,416	7,917	68,463	27,863
2014-20	2,449	8,162	69,998	28,493
2014-21	2,482	8,416	71,568	29,137
2014-22	2,516	8,677	73,173	29,796
2014-23	2,550	8,947	74,813	30,470
2014-24	2,584	9,225	76,491	31,160
2014-25	2,619	9,511	78,206	31,865
2014-26	2,654	9,806	79,960	32,585
2014-27	2,690	10,111	81,753	33,322
2014-28	2,727	10,425	83,586	34,076
2014-29	2,764	10,749	85,460	34,847
2014-30	2,801	11,083	87,376	35,635
2014-31	2,839	11,427	89,336	36,441
2014-32	2,877	11,782	91,339	37,265
2014-33	2,916	12,148	93,387	38,108
2014-34	2,956	12,525	95,481	38,970
2034-35	2,995	12,914	97,622	39,852

Source: author's calculations

Cash crops production growth is mainly determined by increase in economic activity that uplifts per capita income related with population growth which results increase in number of consumers. Pakistan's total production forecast analysis reveals regular increase in total meat production. Based on average annual crops growth rate of Pakistan during last 25 years from (1990-91 to 2014-15), which is 0.026, cash crops production of Pakistan is expected to be approximately 5.4 million tons in the end of 2034-35.

Although the forecast results show the positive growth yields, which is based on the average GR of the previous 25 years' dataset, where it was assumed that other factors are held fixed, but in case of inadequate facilities, inexperienced and uneducated employment in this sector might affect the results (Raza *et al*., 2012).

Conclusions and suggestions

The estimation of status, growth and forecast of cash crops in Pakistan study was conducted using historical time series data of past 25 years from 1990-91 to 2014-15 by employing a growth rate model to evaluate country's major crops production and growth performance, to see the projected values for their production upto 2034-2035. Therefore, mainly model has resulted that there were high fluctuations in the cash crop dataset of last 25 years (1990-91 to 2014-2015), where the results of the growth rate shall help economists and other social scientist to realize the actualities on the cash crop production in the country. We have also forecasted the cash crop yields for next 20 years (2015-16 to 20134-35), and saw that if the other thing will be fixed, the projected yield is increasing (see Table 3).

Those results can help the policymakers in the country to formulate policies for better improvement of agricultural sector in the country. Since the mathematical models on growth rates and forecasts have been applied on the dataset of the cash crops of Pakistan, where it is suggested that the models could also be applied on the various datasets from different sectors of the economy including services sector, industrial sector, etc, which might help the policymakers to formulate the policies for sustainable development in the country. It is also suggested that a research might be conducted to evaluate different forecast models either mathematical, econometric or statistical, in order to check the reliability of forecasted outcomes.

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