International Journal of Agriculture and Food Science
www.agriculturaljournals.com
Online ISSN: 2664-8458; Print ISSN: 2664-844X; Impact Factor: RJIF 5.22
Received: 04-02-2020; Accepted: 05-03-2020; Published: 18-03-2020
Volume 2; Issue 1; 2020; Page No. 51-54

Growth and instability in the production of rice crop in Khyberpaktunkhwa, Pakistan

Sajad Ali[1], Dr. Shahab E Saqib[2] and Dr. Shah Fahad[3]
[1]Ph.D Candidate Sarhad University of Information and Technology, Peshawar, Khyber Pakhtunkhwa, Pakistan
[2]Higher education Department KPK, Pakistan
[3]Associate Professor, Jiao tong University, China

DOI: https://doi.org/10.33545/2664844X.2020.v2.i1a.77

Abstract
The current research study tried to examine fluctuation in the production of rice crop in Khyber-Pakhtunkhwa Pakistan covering the period from 1991-92 to 2020-21 for empirical analysis. To find the growth, we used various growth models such as Power, Exponential, Logarithmic, Cubic, and Compound growth model to fit the best growth model, while Cuddy Della Vella Index was employed to find instability in the production of rice crops. R^2 (coefficient of determination) criteria was used to find the suitable growth model for the production of rice crop. Cubic growth model was found best on the basis of the value of R-Square. Growth rate of rice production were calculated by using cubic model were found 1.18%. Moreover, the instability was found to be 0.79%. Based on the finding, the study recommended that government must bring additional area under rice crop, awareness about the recommended seeds and institutional credits at lower interest rate must be offered to rice growers to increase production of rice crop.

Keywords: Rice crop**,** coefficient of determination (R^2), cubic growth model, cuddy della valle index, Khyber-Pakhtunkhwa

Introduction
Agriculture is the significant sector of Pakistan's economy since it donates 19.2 percent of the gross domestic product (GDP) and employs 38.5% of the labor force. This sector in Pakistan is very critical for development of the economy as it is a market for industrial sector at one side while providing raw material to the other sectors at the other side. The performance of this sector has fallen from the last few years because of stagnant productivity of all important crop. The important crops including wheat, Maize, Rice, Sugarcane and Cotton. The crop sector showed a positive growth of 4.65% against the target of 3.6% (GoP, 2021) [6].

Rice is an important food and cash crop of Pakistan. This crop accounts about 3.5 percent in agriculture gross domestic product and 0.7 percent in the GDP. During 2020-21, cultivated area of rice crop was 3335 thousand hectares (GoP, 2021) [6]. This crop showed a record production growth of 13.6 percent during the current year. Pakistan is the fifth prime rice exporter country in the world after India, Thailand, Vietnam and USA (Tunio *et al*., 2016) [16]. The current research study was documented to investigate the growth and instability of rice crop in Khyber-Pakhtunkhwa.

Shah and Khalil (2017) [12] used the 30 years' data covering the period of 1984-85 to 2013-14 in Khyber Pakhtunkhwa, Pakistan to estimate the growth and variability of maize, rice, wheat and sugarcane production. The researchers employed compound growth model for the growth analysis and Cuddy Della Vale index were used to measure the degree of variability in the production of selected crops. The researchers found, the growth rate of 10.97 percent, 8.0 percent, 45.31 percent and 1.19 percent in wheat, maize, sugarcane and rice respectively, while the variability in the selected crops were found 1.53%, 1.23%, 0.44% and 0.79% respectively. They also concluded there is an inverse relationship between the growth and variability of the crop production.

A growth and variability of rice production, area, productivity and export quantity for the period of 1971-72 to 2010-11, was recorded by employing compound growth model and coefficient of variation conducted by Abdullah *et al*, (2015) [1]. The findings of the study reveals that, the overall increase in rice production, area and productivity were found 6.81%, 5.45% and 1.32% respectively.

The result of variability showed 30.06 percent, 15.62 percent and 14.48 percent and the compound growth for overall period in term of export quantity and value were found 15.80 percent and 30.06 percent respectively.

Huang (1995) [19] employed the production function techniques to check input levels in Chinese rice yield at the local level using secondary data for 1984-91. The results showed a great misallocation of inputs (fertilizer and labour) in rice production. Kim (1993) [18] observed that the number of agriculture households growing paddy rice goes down, but the share of total agriculture households has gone upward. He stated that the decreasing production expenditure would be vital for Korean rice to become a more profitable. Jabber *et al* (1994) [9] studied the degree of hindrance to rice production due to shrimp society, and the economic disadvantages of split use of the land resources. Estimation in increasing rice and shrimp together was recommended with the convention of better varieties of rice is helpful to constant production and growers profit in the area.

Dash *et al*. (1995) [5] studied cost benefit ratio in production for summer rice in Baharagora block of Singh bhum district in Bihar. It was found that on average per hectares outlay of grown was Rs 17113 and the per hectare yields was 56 quintals, which increases from 52 quintals to 58 quintals on the sample farms.

Sharma and Joshi (1995) [17] reported that the key factors accountable for determining the area and yield of rice during the period 1970-71 to 1988-89 examining chronological and longitudinal performance. The results revealed that the percentage of area under the rice crop in the Rabi season to total acreage of rice crop is significantly lower as paralleled to the Kharif season in all the coastline districts except in Nellore in Andhra Pradesh. During the kharif season, a positive growth of area under rice crop is recorded in majority of the districts.

Objective of the study

1. To explore the unstable growth of Rice productions in Khyber Pakhtunkhwa.
2. To analyze the instability of Rice productions in Khyber Pakhtunkhwa

Material and Method

The present study has been conceded out by employing various growth models like Power, Exponential, Logarithmic, Cubic and Compound growth model were employed to find the most appropriate model for the production of rice crop of Khyber Pakhtunkhwa. Annual time series data with effect from 1991-92 to 2020-21 to find the best suitable growth model for finding the real growth as well as their parallel variability of rice crops by taking all other factors constant in Khyber Pakhtunkhwa. Co-efficient of determination (R^2) criteria has been used to select the best fitted model among all growth models. Moreover, Cuddy Della Vella Index was employed for finding instability in production of rice.

Growth analysis

The current study used R-Square criteria to find the most suitable growth model among all the various growth model for the production of rice crop of Khyber Pakhtunkhwa. Co-efficient of determination (R^2) criteria has been used to select the best fitted model among all growth models (Shah *et al.*, 2018) [13]. The Following growth model were used.

Power Trend Model

Model whose equation is

$$Y_t = \beta_0 * t^{\beta_1} + e_t$$

Exponential Trend Model

The exponential trend model described as follows;

$$Y_t = \beta_0 * \beta_1^t + e_t$$

Logarithmic Trend Model

Model whose equation is

$$Y_t = \beta_0 + \beta_1 * ln(t) + e_t$$

Cubic Model

Model that is defined by the equation

$$Y_t = \beta_0 + \beta_1 * t + \beta_2 * t^2 + \beta_3 * t^3 + e_t$$

Compound Trend Model

Model whose equation is

$$Y_t = \beta_0 * \beta_1^t + e_t$$

Here, "Y_t" = denotes projected rice production; "t" = time index, "β_0" is the intercept, β_1, β_2, and "β_3" are change in rice production and e_t the error term.

Instability analysis

Variability is one of the most important decision factor in developing fields, specially, in the field of agriculture sector. For sustainable development of agriculture, high growth in production along with low level of instability for any desired crops (Rehman *et al.*, 2009) [11]. An adequate and substantial growth in production with a low level of variability for any crop may be required for sustainable growth of agriculture as compared to high growth in production and high level of variability.

Different variability techniques such as Standard Deviation (SD), Coefficient of variation (CV) and Cuddy-Della Valle index (CDI), have been used by different researchers (Ali & Jabbar, 2015:Abid *et al.*, 2014:Ghosh, 2010) [3, 2, 6] but CDI has been widely used techniques and is more powerful technique for time series data. Therefore, the study employed CDI to measure the instability in rice production. It is estimated by the following formula (Cuddy and Della Valle, 1978) [4];

$CD = CV * (1-R^2)^{1/2}$

Where,

CD = Cuddy-Della Valle index

CV = Coefficient of variation (%) and is equal to standard deviation / mean

R^2 = Coefficient of determination

Results and Discussion

R- Square criteria were used to find the most appropriate model among various growth models for the production of rice crop in Khyber Pakhtunkhwa. Among all the trend models, the cubic trend curve was found to be the most appropriate model as represented in the above Table-1and Figure-1 below.

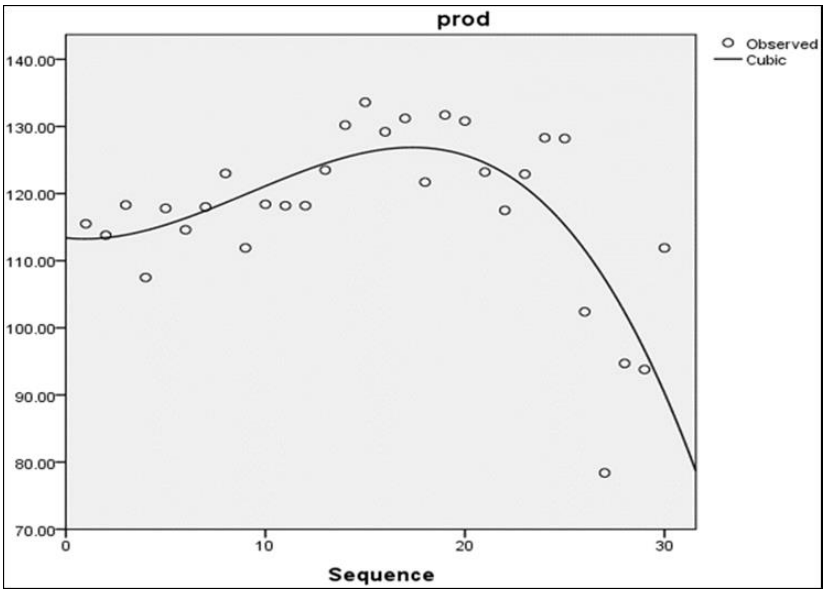

Fig 1: Cubic Curve of Rice Production

Table 1: Model Summary and Parameter Estimates of Rice Production
Dependent Variable: Production

Equation	Model Summary					Parameter Estimates			
	R Square	F	df1	df2	Sig.	Constant	b1	b2	b3
Power	.008	.213	1	28	.648	120.402	-.012		
Exponential	.070	2.107	1	28	.158	123.398	-.003		
Logarithmic	.003	.070	1	28	.793	119.442	-.735		
Cubic	.524	9.523	3	26	.000	113.397	-.302	.169	-.006
Compound	.070	2.107	1	28	.158	123.398	.997		

For the better understanding of growth and instability in rice production in Khyber Pakhtunkhwa, the growth and instability in production of rice crops is presented in Table-2 below;
The growth and variability in production of rice crop in Khyber Pakhtunkhwa are shown in the table-2. According to the findings, rice crop having growth rate of 1.19% with variability index of 0.79. The indicated results of growth as well as the trend show that production is on increasing with respect to time index.

Table 2: Growth and Variability of rice crops of Khyber Pakhtunkhwa

CV (%)	Adj-R^2	Instability Index $(I) = CV\sqrt{1 - Adj.R^2}$	Growth (%)
10.626	0.994462	0.79	1.187342 (2.80e-034)*

Represents significant p-values of the corresponding t-ratios at 5% level of significance

Conclusion and recommendations

Rice crop is the second major food crop of Khyber Pakhtunkhwa. By the analysis of the time series data of rice output. Stationary of data was found at second order difference by using augmented dickey fuller test of unit root. The best growth model among the subset models was found to be cubic growth model having coefficient of determination value "R^2" is equals to 0.524. The growth rate of production was calculated from the best fitted growth model i.e. cubic growth model which was recorded as 1.19% while the variability index was observed to be 0.79. It can be concluded from the growth rate of production and the trend of production series that the production was increased throughout the study time period and hence significant effect to growth and variability.

Recommendations

1. The government must create hard work to bring additional area under rice crop for rising production of rice crop.
2. Awareness must be given to the rice growers to produce better varieties rather usual varieties. The growers must grow the most beneficial varieties of rice crop with respect to the climatic situations of the province.
3. The rice grower's use only recommended seeds, which is vigorous, desired resistant and standard.
4. Institutional credit services must be offered to the rice growers at a minimum rate of interest.

References

1. Abdullah M, Ghazanfar S, Ahmed J, Khan I. Growth and instability analysis of rice production and export of Pakistan. European Journal of Economic Studies. 2015; (1):4-15.
2. Abid S, Shah NA, Hassan A, Farooq A, Masood MA. Growth and trend in area, production and yield of major crops of Khyber Pakhtunkhwa, Pakistan. Asian Journal of Agriculture and Rural Development. 2014;4(393-2016-23787):149-155.
3. Ali S, Jabbar A. Growth and variability in area production and yield of selected fruit crops in Khyber Pakhtunkhwa. Pakistan J. Agric. Res. 2015, 28(1).
4. Cuddy JD, Valle PD. Measuring the instability of time series data. Oxford bulletin of economics and statistics1978;40(1):79-85.
5. Dash JK, Singh RP, Pandey RK. Economic Analysis of Summer Rice Production in Baharagora Block of Singhbhum District, Bihar. Journal of research-birsa agricultural university. 1995;7:131-136.
6. Ghosh BK. Growth and variability in the production of crops in West Bengal Agriculture. Trends in Agricultural Economics. 2010;3(3):135-146.GoP. (2021).
7. Economic Survey of Pakistan. Economic Advisors Wing, Ministry of Finance, Islamabad. 2020-21.
8. Jikun H, Qiaojun W, Qinggen C. Agricultural production resources allocation: Rice input and output analysis. Chinese Journal of Rice Science. 1995;9(1): 39.
9. Jabber A, Alam MS, Islam R. Economics of rice cultivation and shrimp culture in the Khulna district, Bangladesh. Bulletin de la Commission Internationale du Riz (FAO); Noticiario de la Commission International del Arroz (FAO); c1994.
10. Myung-Hwan K. Structure of the rice market and proposals for rice policy changes in Korea. Journal of Rural Development/Nongchon-Gyeongje. 1993;16 (1071-2019-1266):101-131.
11. Rehman A, Chandio AA, Hussain I, Jingdong L. Fertilizer consumption, water availability and credit distribution: Major factors affecting agricultural productivity in Pakistan. Journal of the Saudi Society of Agricultural Sciences. 2019;18(3):269-274.
12. Shah SAA, Khalil AK. Growth and Variability of Major Food Crops Production in Khyber Pakhtunkhwa, Pakistan. Journal of Applied and Advanced Research. 2017;2(1):6-12.
13. Shah SAA, Ali S, Jadoon A. Growth, Variability and Forecasting of Wheat and Sugarcane Production in Khyber Pakhtunkhwa, Pakistan. Agri. Res & Tech. 2018;18(2);556056.
14. Sharma RK, Bala B. Dynamics of Production and Consumption of Food grains in India. The Asian economic review. 1994;36(2):443-464.
15. Sidibe A, Sere Y. The demand for fertilizer on upland rice in the south-west of Burkina Faso: determinants and cost and returns analysis. In The Economics of Agro-Chemicals. Routledge; c2018. p. 227-234.
16. Tunio A, Magsi H, Solangi MA. Analyses of growth trends and production forecast of cash crops in Pakistan. International Journal of Agronomy and Agricultural Research. 2016;9(1):158-164.
17. Sharma VP, Joshi PK. Performance of rice production and factors affecting acreage under rice in coastal regions of India. Indian Journal of Agricultural Economics. 1995;50(902-2018-3359):153-67.

18. Kim KJ, Li B, Winer J, Armanini M, Gillett N, Phillips HS, Ferrara N. Inhibition of vascular endothelial growth factor-induced angiogenesis suppresses tumour growth in vivo. Nature. 1993 Apr;362(6423):841-4.
19. Huang PG, Coleman GN, Bradshaw P. Compressible turbulent channel flows: DNS results and modelling. Journal of Fluid Mechanics. 1995 Dec;305:185-218.