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Predictive Models for Pigeonpea in Northern Hills of Chhattisgarh, India

Pradeep Kumar Ganjeer[1*], A. Sahu[1] and M. L. Lakhera[1]

[1]Department of Agricultural Statistics, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India.

Authors' contributions

This work was carried out in collaboration between all authors. Author PKG designed the study, performed the statistical analysis and first draft of the manuscript and managed the literature searches. Author AS collected the data and managed the analyses of the study. Author MLL wrote the protocol and supervised the study. All authors read and approved the final manuscript.

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Short Communication

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ABSTRACT

The study is very necessary not only for understanding the growth trends and magnitude of fluctuations in crop production but are also useful for scientific planning and effective implementation of agricultural developmental at different levels. The necessary secondary data were collected for a period of 34 years from 1979-80 to 2012-13, which divided into three groups i.e. Period-I (1979-80 to 1986-87), Period-II (1987-88 to 1997-98) and Period-III (1998-99 to 2012-13). Three models linear, quadratic and exponential have been used for the study of trend analysis of the Pigeonpea for the three districts (Sarguja, Koriya and Jashpur) of Northern Hills of Chhattisgarh in India. Compound Growth Rate (%), Coefficient of Variation (%) and Instability Index have been calculated for the respective periods and all three models. Growth rates showed a significant positive growth in area under Jashpur and Koriya while Sarguja showed non-significant negative growth. Similarly, the production of pigeonpea showed a significant positive growth for Sarguja and Jashpur whereas Koriya registered insignificant positive growth. The productivity of this crop recorded negative non-significant growth in the case of Sarguja and Jashpur while Koriya recorded positive significant growth. Study showed moderate variability in area, production and productivity. The instability indices for the area, production and productivity for pigeonpea crop were positive and less and thereby indicating medium risk for growing this crop in coming days.

**Corresponding author: E-mail: pkganjeer7@gmail.com;*

Keywords: Predictive models; Pigeonpea; Chhattisgarh; area; production and productivity.

1. INTRODUCTION

Pulses occupy an important place in Indian agricultural economy as they are rich sources of proteins and constitute 10 to 15 per cent of India's food grain diet. They are relatively the richest, cheapest and easiest source of best quality proteins and fats, have a vast multiplicity of uses as food and industrial products [1]. India is the largest producer and consumer of pulses in the world accounting for 33 per cent of the world area and 22 per cent of world production and about 30 per cent of consumption. Pulses complement cereals in both production and consumption [2]. About 90 per cent of the total global area under pigeon pea, 65 per cent under chickpea and 37 per cent under lentil is contributed by India, with a corresponding share of production of 93 per cent, 68 per cent and 32 per cent, respectively [3].

The important states engaged in growing pulses are Madhya Pradesh (22.90%), Uttar Pradesh (18.12%), Maharashtra (14.25%), Rajasthan (10.84%), Andhra Pradesh (8.64%), Karnataka (5.76%) and others (19.49%) [4].

The total area, production and productivity was 22.46 million hectares, 10.63 million ton and 473 kg/ha respectively during 1980-81, which increased to 24.66 million hectares, 14.26 million ton and 578 kg/ha during 1990-91. During 2000-01, 20.35 million hectare, 11.08 million ton and 544 kg/ha. During 2000-01 the country imported about 4.73Mt of pulses export earnings were a little less crores which increased to 23.50 million hectares, 14.60 million ton and 689 kg/ha during 2010-11. Production of pulses during 2011-12 was 14.60 million tonnes which was slightly less than the 32.48 million tonnes recorded in 2010-11 [5].

Chhattisgarh is a state in Central India. It is the 10th largest state in India, with an area of 13.5 million hectare. It is the 16th most-populated state of the nation having a total population of 25.5 million. The State has three agro-climatic zones, i.e. Chhattisgarh plains, Bastar plateau and Northern Hill Region spreading over a total geographical area of 13.60 million hectares. Forest occupies 1.85 million hectares in the State. The net area sown is 4.82 million hectares, which is 35.44 per cent of the geographical area. The cropping intensity is 117.0 per cent. Chhattisgarh is an important State as it contributed about 5.72 per cent of the total annual pulses area, production and productivity in Chhattisgarh during 2010-11 were 0.81 million hectares, 0.49 million ton and 605 kg/ha (State of Indian Agriculture, 2012-13) respectively.

2. MATERIALS AND METHODS

The study was confined to the Northern Hills of Chhattisgarh state and its districts. There was only one district in Northern Hill zone is Sarguja. After the resettlement of district, there are three districts in Northern Hill zone, namely; Sarguja, Koriya and Jashpur.

The time series secondary data on area, production and productivity of Pigeonpea for three districts were collected for the period from 1979-80 to 2012-13 from various issues of publication such as 'Agricultural Statistics' published by Directorate of Agriculture, Government of Madhya Pradesh, Bhopal (1979-80 to 1997-1998) and 'Basic Agricultural Statistics' (1979-80 to 1997-1998) published by Commissioner of Land Records and Settlement Gwalior, Government of Madhya Pradesh [6] and from the website www.agridept.cg.gov.in (1998-99 to 2011-12) and 'Table of Agriculture Statistics' (2012-13) published by Commissioner, Land Records and Settlement, Raipur, Chhattisgarh.

However, the entire period has been divided into three periods to assess the trend analysis (linear, quadratic and exponential trends) as shown below:

1. Pre-establishment of IGKV, Raipur: 1979-80 to 1986-87 (Period-I).
2. Post-establishment of IGKV, Raipur and pre-period of Madhya Pradesh and Chhattisgarh partition: 1987-88 to 1997-98 (Period-II).
3. Post-period of Madhya Pradesh and Chhattisgarh partition: 1998-99 to 2012-13 (Period-III).

The main consideration underlying the choice of these sub-periods was based on the fact that 'Indira Gandhi Krishi Vishwavidyalaya' and newly formed State Chhattisgarh started functioning from the year 1987-88 and 1998-99 respectively and number of districts is different in the different study period.

To analyse the trend in area, production and productivity of pigeonpea, the following different functional forms were fitted.

1. Linear function $Y = a + bx$
2. Quadratic function $Y = a + bx + cx^2$
3. Exponential function $Y = a.b^x$

Where,

Y = Area, production and productivity of pigeonpea crop
x = Time variable

The functional form having the highest co-efficient of determination (R^2) is selected for fitting the trend [7,8]. Similarly, the growth rate of area, production and productivity of pigeonpea crop were also computed.

Compound Growth Rate was also computed for area, production and productivity of pigeonpea crop based on the exponential function for the period. The Compound Growth Rate was computed as follows:

Compound Growth percentage (CGR %) = $(b-1) \times 100$

To measure the magnitude of variability in area, production and productivity the co-efficient of variation (%) were computed. Further, the instability index was also calculated to examine the instability in area, production and productivity of pigeonpea crop in different districts of Northern Hills of Chhattisgarh over the time period by using the formula:

Instability Index (I) = $(1-R^2) \times CV^2$

3. RESULTS AND DISCUSSION

The linear, growth and quadratic trend of area, production and productivity of Pigeonpea computed for all three periods and three years forecasting are shown in Table 1.

The Sarguja had a positive linear trend in area (R^2=0.9387%), production (R^2= 0.7656%) and productivity (R^2=0.7453%) the increase were found to be highly statistically significant at 1% level of significance of pigeonpea crop during period-I. The Sarguja had positive linear trend in area (R^2=0.9381%), production (R^2=0.0131%) and negative linear trend in productivity (R^2=0.3394%) of this crop during period-II. The area and productivity were found to be statistically significant in area at 5% level of significance but production was found non-significant. The Sarguja had positive linear trend in area (R^2=0.0251%), and negative linear trend in production (R^2=0.2533%), productivity (R^2=0.2571%) of pigeonpea crop during period-III. the increase were found to be statistically significant for production and productivity at 10% level of significance and area was not found significant. The Jaspur district had linear trend in area (R^2=0.3272%) production (R^2=0.2229%) and productivity (R^2=0.2851%) of pigeonpea crop during period-III. The increases were found to be positively significant at 5% and 10% level of significance for area and productivity. Koriya district was found positively trend in area (R^2=0.6645%) at 1% level of significance, while negatively linear trend in production (R^2=0.0263%) and productivity (R^2= 0.2875%) was found to be non-significant.

The Sarguja districts had a positive growth trend in area (R^2=0.9286%), production (R^2=0.7042%) and productivity (R^2=0.7285%) were found to be statistically highly significant at 1% level of significance for pigeonpea crop during study period-I. The Sarguja districts had a positive growth trend in area (R^2=0.9467%) and productivity (R^2=0.3167%) for pigeonpea crop during study period-II, the increase were found to be significant at 1% and 10% level of significance respectively for area and productivity while production (R^2=0.0149%) was found to be statistically non-significance. The Sarguja district had a positive growth trend in production (R^2=0.2365%) and productivity (R^2=0.2228%) was found to be statistically negative significant at 10% level of significance while area was found to be statistically non-significance for pigeonpea crop during study period-III. The Jaspur district had a positive growth trend in area (R^2=0.4680%) was found to be statistically significant at 1% level of significance, while production (R^2=0.2336%) and productivity (R^2=0.2590%) was found to be positively and negatively significant at 10% level of significance of pigeonpea during study period-III. The Koriya district had a positive growth trend in area (R^2=0.6589%), and productivity (R^2=0.2486%) though the increase was found to be statistically positively and negatively significant at 1% and 10% level of significance while production (R^2=0.0730%) was found non-significant for pigeonpea crop during study period-III.

Table 1. R^2 value of linear, quadratic and exponential and Forecast for Pigeonpea

District	Aspects	R^2 (in %)			Forecasted area and production		
		Linear	Quadratic	Exponential	Years		
		Y= a+bx	Y= a+bx+cx^2	Y= a.b^x	2013-14	2014-15	2015-16
Sarguja	Area	0.0251	0.3956	0.0008	8.71	13.07	17.88
	Production	0.2533	0.4558	0.2365	2.25	2.28	2.30
Jashpur	Area	0.3272	0.2352	0.4680	6.42	6.82	7.27
	Production	0.2229	0.5118	0.2336	3.09	3.29	3.33
Koriya	Area	0.6645	0.3807	0.6589	4.12	4.26	4.39
	Production	0.0263	0.4708	0.0730	1.66	1.65	1.64

The Sarguja district quadratic trend were found to be non-significant for area, production and productivity under study period-I.

The quadratic trend were found positive significant for production (R^2=0.5242%) under study period-II for pigeonpea crop. It was found significant at 5% level of significance. The quadratic trend were found respectively positive and negative significant for area (R^2=0.3956%), production (R^2=0.4558%), and productivity (R^2=0.8937%), but productivity was found to be significant at 5% level of significance of pigeonpea crop during study period-III. The Jaspur district quadratic regression coefficient were found to be significant at 5% level of significance for production (R^2=0.5118%), and productivity (R^2=0.5194%) while area (R^2=0.2352%) was non-significant for pigeonpea crop during study period III. The Koriya district quadratic regression coefficient were found positive significant in area (R^2=0.3807%), production (R^2=0.4708%), under study period-III for pigeonpea crop. It was found significant at 5% level of significance.

The Compound growth rate (%), co-efficient of variation (%) and instability index of area, production and productivity of pigeonpea had computed for all the periods and presented in Table 2.

The significant compound growth rate in area under pigeonpea was about 2.55%, production is growing at around 13.76% and productivity increment of 14.90% was found also the coefficient of variation for area is very low while production and productivity is crosses over 10% with very low value of instability index for this crop in period-I for Sarguja district. The significant compound growth rate in area under pigeonpea was about 3.41%, production is growing non-significantly at around 0.044% and productivity was found decreases significantly of about 2.25% also the coefficient of variation for area, production and productivity is not more than 12% with very low value of instability index for this crop in period-II for Sarguja district. The negative non-significant compound growth rate in area under pigeonpea was about 0.23%, production is growing significantly at around 3.56% and productivity was found decreases significantly of about 3.38% also the coefficient of variation for area, production and productivity is crosses over 20% with low to moderate value of instability index for this crop in period-III for Sarguja district. The highly significant compound growth rate in area under pigeonpea was about 6.49%, production is growing significantly at around 3.70% and productivity was found decreases significantly of about 4.00% also the coefficient of variation for area, production and productivity is crosses over 40% with moderate value of instability index for this crop in period-III for Jashpur district. The significant compound growth rate in area under pigeonpea was about 3.28%, production is growing non-significantly at around 0.43% and productivity was found significant increment of about 3.79% also the coefficient of variation for area, production and productivity is crosses over 20% with low value of instability index for this crop in period-III for Koriya district.

The growth rate of area under pigeonpea was significantly positive and it has increased at the rate of 0.87 per cent and production has increased significantly at the rate of 8.49 per cent but productivity was found non-significant at the rate of 4.69 per cent during overall period. The coefficient of variation of area, production and productivity was 2.46, 24.67 and 23.61 per cent respectively. The instability index of the area, production and productivity were 0.061, 6.042 and 5.562 per cent respectively during the overall period for pigeonpea crop.

Table 2. Compound growth rate (%), co-efficient of variation (%) and instability index of area, production and productivity of Pigeonpea

Aspects	Particulars	Periods					Northern Hills
		I	II	III			
		Sarguja	Sarguja	Sarguja	Jashpur	Koriya	
A	CGR (%)	2.55***	3.41***	-0.23 ^{NS}	6.49***	3.28***	0.87***
	CV (%)	5.90	10.95	24.72	58.19	15.61	2.46
	Instability Index	0.025	0.063	9.992	18.01	0.841	0.061
P	CGR (%)	13.76***	0.044 ^{NS}	3.56 *	3.70*	0.43 ^{NS}	8.49**
	CV (%)	29.64	10.68	26.13	46.72	22.99	24.67
	Instability Index	2.59	1.12	5.213	16.72	5.246	6.042
Y	CGR (%)	14.90***	-2.25*	-3.38 *	-4.00**	3.79*	4.69^{NS}
	CV (%)	31.69	12.78	38.80	42.25	42.45	23.61
	Instability Index	2.72	1.11	11.70	13.22	1.354	5.562

*Note: ***, **,* & NS: Significant at 1 per cent, 5 per cent, 10 per cent probability level and Non Significant respectively*
A=Area, P=Production, Y=Yield/Productivity

4. CONCLUSION

From the above findings, the area under pigeonpea crop in all three districts is increasing but production has low increasing rate. However, the productivity of this crop is almost stagnant. Thus there is a need to take up productivity enhancing measures like a varietal improvement, improved cultural practices, distribution of planting materials, disease control measures, and selection of appropriate crop according to agro-climatic conditions and irrigation facilities.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Kumar V, Patle GT, Singh DR, Chand R. Trend of area, production and productivity of major cereal crops in context of food security: Sikkim, India. International Journal of Engineering Technology Science and Research. 2017;4(9):523-529.
2. Joshi PK, Saxena R. A profile of pulses production in India: Facts, trends and opportunities. Indian Journal of Agricultural Economics. 2002;57(3):326-339.
3. Reddy A. Consumption patter, trade and production potential of pulses. Economic and Political Weekly. 2004;34(44):4854-4860.
4. Shailendra. Marketing of pulses in India. *Research Report.* CCS National Institute of Agricultural Marketing. Jaipur, Rajasthan; 2011.
5. GoI. Data base on Indian agriculture, Department of Agriculture and Cooperation. Ministry of Agriculture; 2012.
6. Anonymous. Basic agricultural statistics, commissioner of land records and settlement, Gwalior, Madhya Pradesh. 1979-1998.
7. Rajan MS, Palanivel M. Application of regression models for Area, production and productivity growth trends of cotton crop in India. International Journal of Statistical Distributions and Applications. 2018;4(1):1-5.
8. Sharma A. Current trends in oilseed crops production: An Overview. International Journal of Agriculture Sciences. 2018; 10(3):5104-5114.

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