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Growth and Instability of Cluster Bean in Bhilwara District of Rajasthan

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Abstract

Cluster bean (*Cyamopsis tetragonoloba* L.) commonly known as Guar, is a drought and high temperature tolerant deep-rooted summer annual legume of high social and economic significance. It is used as animal feed, fodder, green manure and for extraction of gum for industrial uses. India, being the largest cluster bean producer, contributes 75–80% to the global cluster bean basket. Rajasthan is a major player by contributing 72% of total production. The expansion of uses of cluster bean to new areas has transformed cluster bean in recent years into an important export crop. Looking at the agricultural and industrial importance of this marginalized crop in Rajasthan, particularly realizing the potential in southern parts of the state, the present study attempted to analyze the present scenario of the area, production, productivity and instability analysis of cluster bean crop in Bhilwara district of the state. The area, production, and productivity of cluster bean in Bhilwara district registered positive growth rates of 18.68, 29.13 and 8.54% per annum, respectively. The coefficient of variation (CV) for the area, production, and productivity in Bhilwara district were 101.78, 127.74 and 144.36% respectively. The value of CV was high for production and yield, indicating high instability. The instability in the area was more in Bhilwara district compared to the state as a whole. Bhilwara district emerged as highest unstable and whole Rajasthan as lowest unstable in production of cluster bean during the study period.

Keywords: Area, Production, Productivity, Instability, Bhilwara, Rajasthan.

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Introduction

Cluster bean or guar is a drought-tolerant, multi-purpose legume crop cultivated mainly in the *Kharif* season in arid environments and is used as animal feed, fodder, green manure and for extraction of gum for various industrial uses. India contributes 75–80% to the global cluster bean basket followed by Pakistan, Sudan, and USA. Rajasthan is a major cluster bean producing a state of the country by contributing around 72% of its production. In India, Cluster bean crop is cultivated mainly during *Kharif* season, with an annual production of around 2 million metric tonnes. Cluster bean is sown in the months of July and August after the first shower of the monsoon and it is harvested in the months of October and November.

The area, production, and yield of the crop are inconsistent due to its over-dependence on weather and production confined to limited geographical area largely arid regions. During last decade in Rajasthan, the area, production, and yield under cluster bean fluctuated between3056260 ha, 481220 tonnes and 157 kg/ha to 3000780 ha, 1546470 tonnes and 515 kg/ha, respectively for the period from 2000-01 to 2010-11 (Department of Agriculture, Govt. of Rajasthan). In India, the area, production, and yield varied from 3497400 ha, 658800 tonnes and 188 kg/ha to 3402000 ha, 1971300 tonnes and 579 kg/ha, respectively during the same period, i.e., 2000-01 to 2010-11 (Directorate of Economics and Statistics, Department of Agriculture and cooperation).

The instability in the area, production, and productivity cause the excessive demand and supply gap in the economy, which leads to unstable income to the farmers. The knowledge of the extent of instability in the area, production and productivity of important crops at state/district level is important in the formulation of policies and planning strategies for increasing their production and minimizing imbalances in agricultural development in the area. In this study, an attempt has been made to analyze the present scenario of the production of cluster bean crop in Bhilwara district of the state and changes in the area, production and per hectare yield, trend and growth pattern and magnitude of instability over time.

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Objectives of the Study

The specific objectives of the study were:

- To analyze the trend in the area, production, and productivity of cluster bean in Bhilwara district of Rajasthan;

- To study the instability of cluster bean production in Bhilwara district of Rajasthan.

Materials and Methods

The primary data were collected for the year 2013–14. Bhilwara district was purposively selected for the present study. Ashind tehsil in Bhilwara district was selected on the basis of highest acreage under the cluster bean cultivation among all tehsils of the Bhilwara district. Two villages, i.e., Pratap pura and Antali in Ashind tehsil of Bhilwara district, were finally selected. A sample of 20 farmers in each village was selected randomly.

To examine changes in the area, production, and productivity of cluster bean in Bhilwara district of Rajasthan for 20 years (i.e. from 1993–94 to 2012–13), compound growth rates were worked out for Bhilwara district and state as a whole. The compound growth rates were computed by fitting the exponential function of the following form.

$Y_t = ab^t . e^{Ut}$ (i)

Where,

Y_t is area/production/productivity of cluster bean crop in time period t,

t is time element that takes the values 1, 2, 3, ……. n,

a and b are parameters to be estimated, and

e^{Ut} is the error term.

Where, $b = (1 + r)$; and 'r' is compound growth rate

Thus, equation (i) can be rewritten as

$Y_t = a\ (1 + r)^t . U_t$ (ii)

On logarithmic transformation of equation (ii) we get:

$Log\ Y_t = log\ a + t\ log\ (1 + r) + log\ U_t$ (iii)

The compound growth rate (r) was obtained as

$r = [(\text{Antilog of } b) - 1] \times 100$

Instability analysis

The instability in the area, production and productivity of cluster bean in Bhilwara district of Rajasthan for the period of 20 years i.e. from 1993- 94 to 2012- 13 was worked out through following measures (Purbia 2002):

- Instability Index 1 (I_1) = $\frac{SD}{AM} \times 100$

  or

  $\frac{\sigma}{\overline{X}} \times 100$

  Where,

  σ = Standard deviation of area, production and productivity of the crop for a specified period

  $\overline{X}$ = Arithmetic mean of area, production and productivity of the crop for a specified period

- Instability Index 2 (I_2) = $\frac{SD^*}{AM^*} \times 100$

  or

  $\frac{\sigma'}{\overline{X'}} \times 100$

  Where, σ' = Standard deviation of detrended area, production and productivity of the crop for a specified period

  X' = Arithmetic mean of detrended area, production and productivity of the crop for a specified period

  Detrended values were worked out by assuming the multiplicative model as described below:

  $Y_{dt} = TSCR/T$

  Where,

  Y_{dt} = detrended value of the area, production, and productivity of guar

  T = trend Value,

  S = seasonal variation,

  C = cyclical variation

  R = random variation

- Instability Index 3 (I_3) = $CV\sqrt{(1-r^2}$

  Where, CV = Coefficient of variance of area, production and productivity of cluster bean

  r^2 = coefficient of multiple determination of the trend equation for original time series data on area, production and productivity of cluster bean

Based on these indices, the extent of instability in area, production and productivity of cluster bean in Bhilwara district was assessed.

Results and Discussion

Area and production of cluster bean

The area under cluster bean in Bhilwara district was 28955 hectares in the year 2012–2013. Bhilwara district had the highest area (51616 hectares) in the year 1999–2000. The area under cluster bean started declining at a steady pace, mainly because of instability in prices. The production data revealed that Bhilwara district accounted for 15832 tonnes out of total cluster bean production of 20.23 lakh tonnes in the state during the year 2012–2013. The productivity of guar fluctuated to a great extent in the selected district as well as in the state in general and Bhilwara district in particular where it ranged from 3243 kg/ha in the year 1994–95 to 2 kg/ha in the year 1998–99. The fluctuation in productivity (as shown in table 1) was probably due to unfavorable climatic conditions.

Trend in area, production and productivity

The knowledge of relative growth of area, production and productivity in different areas in the past is immensely useful for the people engaged in policy formulation to promote balanced regional development strategy. To estimate trends of growth, in the area, production, and productivity of cluster bean in Bhilwara district of the state, the exponential function was used.

Compound growth rates of area, production, and productivity of cluster bean crop in the Bhilwara district of Rajasthan were worked out for the period 1993-94 to 2012-13. The compound growth rates in the area, production, and productivity of cluster bean in Bhilwara district, during the study period were worked out and are presented in Table 2 and growth trends are shown in Fig.1 to 3. The perusal of

Table: 1: Area, production, and productivity of cluster bean (1993–94 to 2012 – 13)

Area (Ha), production (Tonnes) and productivity (Kg/Ha)

	Bhilwara			*Rajasthan*		
Particulars	*Area*	*Production*	*Productivity*	*Area*	*Production*	*Productivity*
1993-94	563	1	2	1897085	287212	151
1994-95	423	1372	3243	1959356	708299	361
1995-96	721	74	103	1774724	274195	155
1996-97	501	655	1307	1818771	739917	407
1997-98	1500	1363	909	1985257	733553	370
1998-99	10812	18	2	1611907	319629	198
1999-00	51616	11338	220	2648486	231572	87
2000-01	47300	493	10	3056272	481219	157
2001-02	11674	1168	100	2409948	823366	342
2002-03	5644	44	8	556476	27869	50
2003-04	10985	5988	545	2278339	1163170	511
2004-05	6956	3225	464	1944348	338351	174
2005-06	16312	2030	124	2444648	593223	243
2006-07	21379	12801	599	2807918	658426	234
2007-08	36921	18820	510	2909793	1243732	427
2008-09	24183	5846	242	3315732	1261215	380
2009-10	13331	181	14	2586857	202738	78
2010-11	7574	4898	647	2980946	1540544	517
2011-12	6218	3449	555	3094163	1846609	597
2012-13	28955	15832	547	4526368	2023096	447

Source: Vital Agricultural Statistics (Directorate of Agriculture, Pant Krishi Bhawan, Jaipur, Rajasthan)

Table 2: Compound growth rates of area, production, and productivity of cluster bean in Bhilwara district (percent per annum)

Particulars	Area (Ha)	Production (Tonnes)	Productivity (Kg/ Ha)
Compound Growth Rate	18.68 (648.86)	29.13* (218.55)	8.54 (30.03)
r^2 (Coefficient of determination)	0.05 [-0.002]	0.22 [0.18]	0.11 [0.06]

Figures in parentheses are standard errors
Figures in brackets are values of adjusted r^2
*Significant at 5% level of significance
**Significant at 1% level of significance

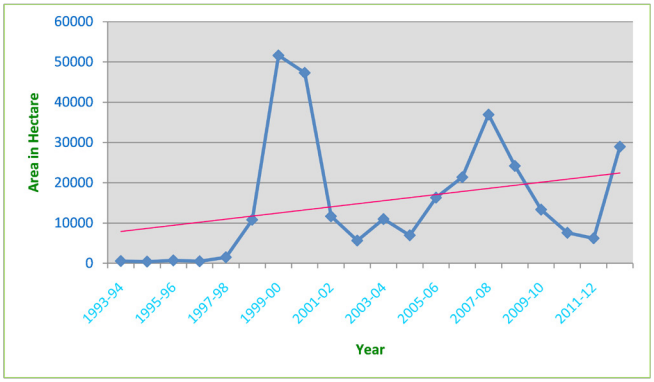

Fig. 1: Trend in area of cluster bean over time in Bhilwara district

Table 3: Instability in area, production, and productivity of cluster bean in Bhilwara district of Rajasthan

Particulars		*Area (Ha)*				*Production (Tonnes)*				*Productivity (Kg/ Ha)*			
		I_1	I_2	I_3		I_1	I_2	I_3		I_1	I_2	I_3	
Bhilwara	CV (%)	101.8	-1.2	115.41	99	127.7	-1	125.6	-218.55	112.09*	144.4	-1.18	106.4	-30	135.5
	r^2		[-0.05]	0.001	0.05		[-0.03]	0.01	[0.18]	0.2		[-0.04]	0.01	[0.06]	0.11
Rajasthan	CV (%)	33.65	-5.4	24.83	25.21**	73.18	-2	60.93	-19245.5	57.27**	55.11	-0.01	51.4	-6.58	51.65
	r^2		[-0.05]	6E-05	0.43		-0.1	0.06	[0.35]	0.4		[-0.04]	0.01	[0.06]	0.12

Figures in parentheses are standard errors
Figures in brackets are values of adjusted r^2

*Significant at 5% level of significance
**Significant at 1 % level of significance

r^2 refers to the coefficient of Determination
CV refers to Coefficient of Variation

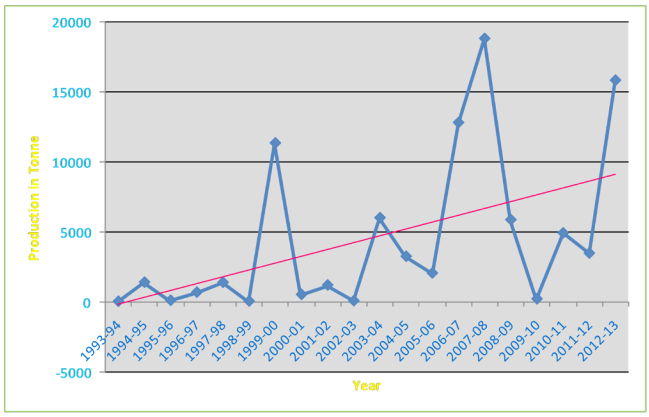

Fig. 2: Trend in Production of cluster bean over time in Bhilwara district

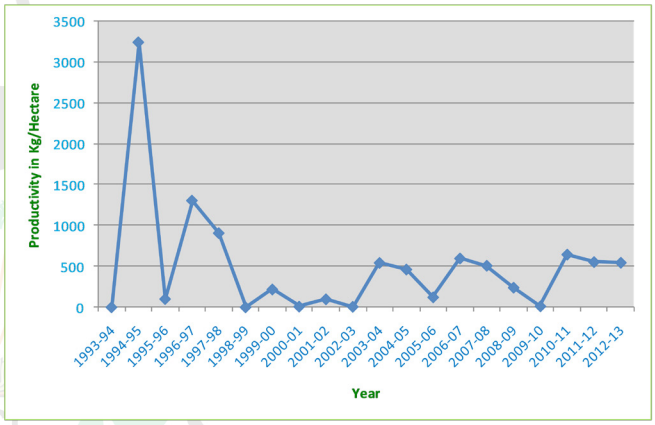

Fig. 3: Trend in productivity of cluster bean over time in Bhilwara district

this table shows that the production increased significantly by 29.13% per annum during the study period which was largely attributed by non–significant growth in area of 18.68 per cent per annum and supplemented with productivity growth by 8.54 per cent per annum. The coefficient of determination was also quite low in case of all parameters, i.e., area, production, and productivity. It is evident from the foregoing discussion that there was significant growth in production of cluster bean crop in Bhilwara district during the study period 1993-94 to 2012-13.

Instability in area, production, and productivity

The instability in the area, production, and productivity causes the excessive demand and supply gap in the economy, which leads to unstable income to the farmers. The coefficient of variation for the area, production, and productivity in Bhilwara district were 101.78, 127.74 & 144.36% respectively. Coefficient of variation for the area, production, and productivity were 33.65, 73.18, and 55.11%, respectively, for the state as a whole. Similar results were also observed for agriculture in Andhra Pradesh by Chand and Raju (2008). The value of CV was high for production and yield, indicating high instability. Variation in yield may be due to weather

conditions, technological changes, agronomic practices followed, etc. However, lower CV for the area shows stability in the acreage allocation. It was mainly because under rainfed conditions, farmers have limited alternatives in terms of crop selection, implying thereby that production of cluster bean can be stabilized with the stable yield of the crop over the years.

The estimated measures of instability in production of cluster bean in Bhilwara district and for Rajasthan state as a whole are given in Table 3.

Policy Implications:

- The yield stabilizing strategies, coupled with yield growth strategies, must get priority as crop production is taken up under very high risk in the state, especially of output price risk.
- Growth with stability, limiting the wide fluctuations in price, must be the guiding principle for research and extension strategies in the southern parts of the state.
- Agriculture should be diversified with the inclusion of cluster bean in non-traditional regions and seasons due to multi-utility and very less and low-cost input requirement.
- Variation in yield may be minimized by technological changes, follow up of improved agronomic practices, etc.
- There is an urgent need of intensification of efforts and exploitation of untapped potential area for increasing cluster bean production and export scenario.

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