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Growth and Instability of *Rabi* Green Gram Production in Odisha

Shivani Kumari Pradhan, Abhiram Dash

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ABSTRACT

The study aims to examine the growth rate and instability patterns of green gram cultivation for *rabi* season in all districts of Odisha over a specified time period. The analysis focuses on three key aspects such as the area under cultivation, the total production and the yield per hectare of green gram, which would be helpful in visualising the progress of the state with regard to cultivation. The study is based on secondary data, that are collected from the various volumes of Odisha Agricultural Statistics, employs the compound growth rate and Cuddy Della instability index to assess the growth and instability of green gram cultivation. After estimating the data of twenty-four years, the districts of Odisha are grouped on the basis of growth rate and instability respectively. Further, the test of significance of difference has done in mean area, production and yield of green gram among the grouping districts classified on basis of growth rate and instability under two categories as compared to Odisha. The growth trends show for the study period of 1994-95 to 2017-18, where Kandhamal district exhibited the highest growth rate in both area and yield, while Nuapada led in terms of production. The district Sundargarh exhibits the highest area instability index, followed by Kandhamal on production and Puri on yield. As in whole state, the positive and significant trends in area and production contrasted with an insignificant growth rate in yield, primarily influenced by the interaction effect of area and production. The study identifies the districts with high growth rate and low instability, suggesting potential factors such as technological adaptation and favorable agricultural conditions with adequate irrigation facilities. This suggests the need to explore and recommend the practices of high-performing districts for wider implementation, potentially leading to increased production which contribution to the overall development and economic well-being of Odisha's rural population.

Keywords Growth rate, Instability, Production, Significant, *Rabi*, Green gram.

Shivani Kumari Pradhan[1], Abhiram Dash[2]*

[2]Assistant Professor and Head
Department of Agricultural Statistics, College of Agriculture, OUAT, Bhubaneswar, Odisha University of Agriculture and Technology, India

Email: abhiramdash@ouat.ac.in
*Corresponding author

INTRODUCTION

Agriculture is the chief occupation of Odisha. As

Odisha is an agrarian state as per the available reports about 61.8% of its workforce works in agriculture in every way directly or indirectly, while rest of the population resides in rural areas. Odisha contributes 31.77% in *rabi* season and accounts for roughly 9% of that total land and produces 8% of it in pulse crops compared to India. The primary pulse crop of Odisha is green gram, referred to as mung bean. It has 8.36 lakh ha area and generates 0.396 million tonnes per year at an average productivity of 434 kg per ha. Pulses are important commodity group of crops that provides high quality protein. They have been valued as important food, fodder and feed and have remained the main crop in agriculture. Thus, there is a visible variation and instability in the state's growth rate due to many barriers, which reduces crop production. Agriculture growth and instability have remained the subject of intense debate in the agricultural economics literature. The need for greater agricultural growth is evident, but the rise in fluctuation viewed adversely for a number of reasons that increases the risk related to agricultural production, affects farmer income, and influences their choices to adopt high-paying technologies and invest in farming. The government needs to give agricultural research greater funding in order to encourage agricultural growth in the state. The compound growth rate and instability of area, production and yield of green gram for *rabi* season in all districts of Odisha and the state as a whole are studied first. The growth rates of area, yield and production of *rabi* pulses in Odisha, segmenting the study based on scatter plot diagrams, confirming its appropriateness through significance testing of the coefficient of variation change by utilizing a spline regression model (Rout and Dash 2021). The study of growth rate and instability of wheat and rice revealed that production had the highest volatility, followed by area and productivity, with earlier subperiods being more unstable than later ones. Rice production increased by 0.5%, area by 2.4%, and productivity by 1.9%, while wheat production decreased by 1.6%, area by 4.1%, and productivity by 2.3% (Dey *et al.* 2020). To take various measures for increasing production in Odisha by overcoming the constraints to fulfil the need of the people, a study on compound growth rate and variability in all aspects of green gram is necessary. To assure farmer's income security, food availability, risk management, investment, and policy concerns in the agricultural sector, managing instability is essential. Keeping in view the above perspectives the study has been made regarding area, production and yield of *rabi* green gram in all the 30 districts of Odisha for the period from 1994-95 to 2017-18.

MATERIALS AND METHODS

The study is based on secondary data on area, production and yield of green gram for *rabi* season in the districts of Odisha from 1994–1995 to 2017–2018. The data were collected and compiled from several volumes of Odisha Agriculture Statistics, which is issued by the Directorate of Agriculture and Food Production, Government of Odisha. The area, production and yield are expressed in '000 ha, in '000 MT and in kg/ha respectively.

Compound growth rate (CGR) analysis

The data on area, production and yield of green gram of *rabi* season in Odisha are worked out for entire period of analysis. For computing compound growth rate of area, production and yield of green gram in all districts, the exponential function of the form are used as follows:

$$X_t = ab^t$$

Where,

X_t = Area / Production / Yield of green gram in years

t = time element which takes the value 1,2,3…...n

a = intercept; b = regression coefficient

The compound growth model is established in the following manner

$\ln X_t = \ln a + t \ln b$

$X_t' = A' + B't$

Let in $X_t = X_t'$; In a = A'; In b = B'

After solving the generalized equation, we get

$$B' = \frac{\sum_{t=1}^{n} t X_t^1 - \sum_{t=1}^{n} t . \sum_{t=1}^{n} X_t^1}{\sum_{t=1}^{n} t2 - \left(\sum_{t=1}^{n} t\right)2}$$

$$A' = \frac{\sum_{t=1}^{n} t X_t^1 . B \sum_{t=1}^{n} t}{n}$$

Given,

$\ln a = A'$; $a = e^A$
$\ln b = B'$; $b = e^B$

Compound growth rate (CGR) = (b-1) × 10 ……. (Dhakre and Sharma 2010) Standard Error, SE (CGR) = SE (ln b) × (100 b / ln 10).

Cuddy-Della instability index

Cuddy-Della instability index is the broadly used procedure to analyze the instability of any given time series data and universally acceptable. The indices were originally developed by John Cuddy and Della Valle in the year 1987. This index is a better measure compared to coefficient of variation, as it is inherently adjusted for trend, which may be linear or non-linear. This measure included as a component of instability all cyclical fluctuations present in the time series data, whether regular or irregular, as well as any component which could be defined as 'white noise'. It is a better indicator of agricultural production stability.

Cuddy-Della instability index is represented as (CDII) and given as,

$CDII = CV \times \sqrt{1 - R^2}$ (Sripriya and Dash 2021)

Where, CV = Coefficient of Variation = $\frac{\sigma}{\overline{Y}} \times 100$

σ = Standard deviation of Mean area / yield / production

Y = Mean of Area / Yield / Production

R^2 = Coefficient of determination from a time trend regression adjusted for its degree of freedom

Test of significance of differences in sample variances of area/production/yield of two categories

Sample variance (S^2) of area / yield / production is given by:

$$S^2 = \frac{\sum_{i=1}^{n} (x_i - \overline{x})^2}{n - 1}$$

Sample variance provide an estimate of population variance.

F-test is used to compare the two variances

Null hypothesis; $H_0 : \frac{\sigma_1^2}{\sigma_2} = 0$

(where σ_1^2 and σ_2^2 are two sample variances)

Alternate hypothesis; $H_1 : \frac{\sigma_1^2}{\sigma_2^2} \neq 0$ (two tailed test)

Level of Significance; a = 0.05 (5%) or 0.01 (1%)
Test statistic F is given $F = s_1^2$ (if $s_1^2 > s_2^2$) or
$F = \frac{s_2^2}{s_1^2}$ (if $s_2^2 > s_1^2$)

s_1^2 is the sample variance of Group 1; s_1^2 is the sample variance of Group 2

$$s_1^2 = \frac{1}{n_2 - 1} \left\{ \sum_{i-1} n_1 x_{1i}^2 - \frac{(\sum_{i=1} n_1 x_{1i})^2}{n_2} \right\}$$

$$s_2^2 = \frac{1}{n_2 - 1} \left\{ \sum_{i-1} n_1 x_{2i}^2 - \frac{(\sum_{i=1} n_2 x_{2i})^2}{n_2} \right\}$$

Test of significance of difference in sample means of area/yield/production for two categories

Null hypothesis; $H_o : \frac{\mu_1}{\mu_2} = 0$ i.e. the two population means are identical

Alternate hypothesis; $H_1 : \frac{\mu_1}{\mu_2} \neq 0$ (two tailed test)

Case 1 : σ_1^2, σ_2^2 unknown, but assumed to be equal

Let the populations be homoscedastic (having equal variance), i.e. $\sigma_1^2 = \sigma_2^2 = \sigma^2$

Here we estimate σ^2 by a pooled estimator,

$$s_p^2 = \frac{(n_1 - 1) s_1^2 + (n_2 - 1) s_2^2}{n_1 + n_2 - 2}$$

It is to be noted that both s_1 and s_2 are unbiased estimator of σ, the common variance Here the test statistic

(known as Fisher's t-statistic)

$$t = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{sp\ \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$ follows a t -distribution (Fisher's distribution) with df $n_1 + n_2 - 2$

Case 2: $\sigma 1^2$, $\sigma 2^2$ unknown and unequal

If there is no reason to assume that the unknown variances, σ_1^2 and σ_2^2 of the two independent normal populations are equal, then we estimate σ_1^2 and σ_2^2 separately from the sample data and get the respective unbiased estimators as

$$s_1^2 = \frac{1}{n_2 - 1}\left\{\sum_{i-1} n_1 x_{1i}^2 - \frac{(\sum_{i=1} n_1 x_{1i})^2}{n_1}\right\}$$

$$s_2^2 = \frac{1}{n_2 - 1}\left\{\sum_{i-1} n_1 x_{2i}^2 - \frac{(\sum_{i=1} n_2 x_{2i})^2}{n_2}\right\}$$

Then the test statistic, $t = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$

follows a t -distribution approximately with

degree of freedom 'v' given by $v = \frac{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)^2}{\frac{\left(\frac{s_1^2}{n_1}\right)^2}{n_1 - 1} + \frac{\left(\frac{s_2^2}{n_2}\right)^2}{n_2 - 1}} = \frac{(v_1 + v_2)^2}{\frac{(v_1)^2}{n_1 - 1} + \frac{(v_2)^2}{n_2 - 1}}$

The approximation gives good results when n_1 and n_2 both are 5 or larger. This procedure is known as Welch's approximation method.

RESULTS AND DISCUSSION

The main focuses on the results obtained from the present study and their discussion. The result of the study is obtained by analysis of the data collected for the study using the methodology mentioned earlier. The data has been processed, analyzed, tabulated, and showed graphically as per the objectives of the study.

This paper is to examine how year to year fluctuations in crop output and what is the effect on the instability in the crop output. Accordingly, instability index and growth rate of area, production and yield of *rabi* green gram has been studied with 5% level of significance at district level in Odisha.

Study of area, production and yield of *rabi* green gram in Odisha

The overall area, production and yield of *rabi* green gram in Odisha are shown in Fig. 1, that shows an uneven increase and decrease over the period of the study. The three key aspects area, production and yield are quite similar throughout the study. In year 1994-95, it reaches at peak point in one year and further decrease to some extent in the year 1996-97. The stable nature has seen in year 2013-14 to 2014-15. There is an irregular increase and decrease in all these years, with a gradual rise appearing at the end of 2017-18. The lowest area, production and yield are shown in the year 2000-01.

Analysis of growth rate under *rabi* green gram in different districts of Odisha

The study of Table 1 indicates that both the area and yield of *rabi* green gram show positive and significant values, resulting in an overall insignificant production.

The study of the compound growth rate of individual district of *rabi* green gram registered under area revealed that most districts except Balasore (-13.16%) shows a positive compound growth rate in the area of *rabi* green gram. Kandhamal recorded the highest growth rate at 11.39%, while Khurda had the lowest at 0.43%.

Most districts exhibit positive compound growth rates in production of *rabi* green gram. However, Bhadrak, Sundargarh and Malkangiri shows negatively insignificant growth rate. Rayagada has the lowest growth rate at 0.34%, while Nuapada and

Table 1. Compound growth rate of area, production and yield of *rabi* green gram in districts of Odisha.

Sl. No.	Districts	Area	Production	Yield	Sl. No.	Districts	Area	Production	Yield
1	Angul	1.31*	3.94*	2.59*	16	Kandhamal	11.39*	7.27	3.18*
2	Balasore	-13.16*	1.38	2.09*	17	Kendrapada	3.8*	4.69*	0.86
3	Balangir	5.8	8.01	2.08*	18	Keonjhar	3.35*	4.1*	0.73
4	Bargarh	4.17*	3.05*	-1.08*	19	Khurda	0.43	2.3	1.86
5	Bhadrak	-0.73	-0.07	0.66	20	Koraput	4.32*	4.6*	0.26
6	Boudh	2.35	4.03*	1.64*	21	Malkangiri	-3.14	-1.04	2.17
7	Cuttack	1.31	1.69	0.37	22	Mayurbhanj	4.91*	6.15*	1.18*
8	Deogarh	4.25*	2.7*	-1.49*	23	Nabrangpur	10.04*	11.95*	1.74*
9	Dhenkanal	-0.67	0.48	1.16	24	Nayagarh	2.21*	2.16	-0.06
10	Gajapati	6.97*	6.57*	-0.37	25	Nuapada	8.21*	12.2*	3.69*
11	Ganjam	0.63	1.8*	1.16*	26	Puri	4.14*	6.98*	2.73*
12	Jagatsinghpur	4.4*	4.07*	-0.31	27	Rayagada	-0.13	0.34	0.47
13	Jajpur	1.65	3.03*	1.35	28	Sambalpur	3.64	2.16	-1.43
14	Jharsuguda	2.87	1.21	-1.62*	29	Sonepur	5.48*	6.97*	1.41
15	Kalahandi	3.34*	3.85	0.49	30	Sundargarh	-0.34	-0.76	-0.42
	Odisha	**2.08***	**0.78**	**2.87***					

*significant at 5% level.

Nabarangpur boast the highest compound growth rates at 12.2% and 11.95%, respectively.

In terms of yield, Nuapada also led with a growth rate of 3.69%, while Bargarh, Deogarh and Jharsuguda showed negative growth rates. The district Nuapada has the highest compound growth rate of yield (3.69%) while Koraput has the lowest (0.26%) growth rate. Figure 2 shows a graphical representation of the compound growth rate of area, production and yield of *rabi* green gram for different districts in Odisha.

The graph shows that the compound growth rate is positive for the districts in terms of area, production and yield. Only the district, Balasore has a negative area growth rate. The compound growth rate of yield in the districts of Bargarh, Deogarh, and Jharsuguda are negative. Sundargarh is the only district with a

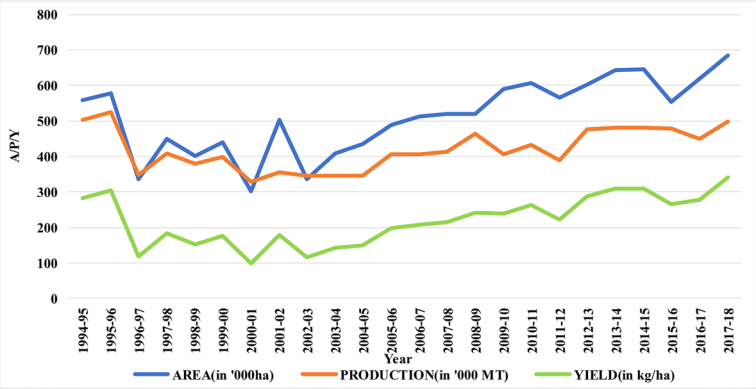

Fig. 1. Area, production, and yield of *rabi* green gram in Odisha.

Table 2. Cuddy-Della instability index (in%) of *rabi* green gram in districts of Odisha.

Sl. No.	Districts	Area	Production	Yield	Sl. No.	Districts	Area	Production	Yield
1	Angul	10.76	40.92*	36.28*	16	Kandhamal	83.66*	138.71*	29.53*
2	Balasore	28.61*	76.76*	25.81*	17	Kendrapada	26.74*	35.18*	19.69*
3	Balangir	28.37*	40.56*	20.57*	18	Keonjhar	18.89*	35.96*	31.28*
4	Bargarh	25.26*	29.09*	14.82*	19	Khurda	19.44*	36.11*	28.41*
5	Bhadrak	24.69*	34.93*	18.65*	20	Koraput	44.97*	69.96*	30.36*
6	Boudh	21.99*	26.23*	12.88*	21	Malkangiri	53.28*	76.56*	30.47*
7	Cuttack	19.4*	27.7*	19.9*	22	Mayurbhanj	45.94*	53.33*	14.94*
8	Deogarh	27.94*	34.05*	20.82*	23	Nabrangpur	77.19*	89.9*	26.27*
9	Dhenkanal	30.42*	58.21*	32.4*	24	Nayagarh	21.62*	40.19*	36.17*
10	Gajapati	29.55*	26.61*	9.85*	25	Nuapada	32.96*	60.68*	39.29*
11	Ganjam	21.6*	27.87*	10.15*	26	Puri	24.65*	66.12*	39.32*
12	Jagatsinghpur	14.35*	25.86*	17.92*	27	Rayagada	23.86*	46.18*	31.23*
13	Jajpur	28.12*	43.67*	22.97*	28	Sambalpur	29.08*	36.09*	18.03*
14	Jharsuguda	49.95*	51.44*	12.45*	29	Sonepur	24.18*	40.97*	25.68*
15	Kalahandi	29.51*	30.07*	22.51*	30	Sundargarh	95.95*	100.44*	28.07*
	Odisha	**15.98***	**13.18***	**26.52***					

*significant at 5% level.

negative growth rate in all aspects.

Analysis of instability under *rabi* green gram in different districts of Odisha

The study of Table 2, reveals that the instability of area, production and yield of *rabi* green gram in Odisha is found to be highest in case of production than area and yield.

The study of Cuddy-Della instability index of individual district under area, it is recorded as the districts have less than 50% instability among all districts except Kandhamal (83.66%), Sundargarh (95.95%), Nabrangpur (77.19%), Malkangiri (53.28%), which shows the instability above 50%. The lowest instability index is shown by the district Angul (10.9%).

According to the Cuddy-Della instability index for production, obtained the highest instability in district Kandhamal (138.71%) followed by Puri (100.44%) and the lowest instability is found in district Jagatsinghpur (25.86%).

Similarly, the study of the instability index of *rabi* green gram registered under yield shown in district Puri (39.32%) has the highest instability, followed by Nuapada (39.29%) and lowest instability in Gajapati (9.85%). The majority of districts have an instability index that is greater than 30%.

Figure 3, shows the graphical representation of instability index of area, production and yield of *rabi* green gram of different districts of Odisha.

The study of the figure reveals that in Kandhamal district has the highest degree of instability index under production goes above 120% as compared to other districts, followed by Sundargarh and Nabrangpur. Most of the districts have the instability index greater than 30% under all aspects except few districts Angul which is unstable with less than 15% instability under area.

Table 3 shows the grouping of districts of Odisha on basis of growth rate and instability index of area, production and yield of *rabi* green gram.

The grouping of districts has been presented in all three aspects which has been done on the basis of

Table 3. Grouping of districts of Odisha on basis of growth rate and instability of area, production and yield of *rabi* green gram.

Grouping	Area	Production	Yield
1A	Balasore	-NA-	Bargarh, Deogarh, Jharsuguda
1B	-NA-	-NA-	-NA-
2A	Bargarh, Deogarh, Nuapada, Gajapati, Keonjhar, Koraput Nayagarh, Jagatsinghpur, Puri, Kalahandi, Kandhamal Kendrapada,Mayurbhanj Nabrangpur, Sonepur	Angul, Bargarh, Boudh, Deogarh, Gajapati, Koraput, Sonepur, Kendrapada, Puri, Keonjhar, Nuapada, Jagatsinghpur, Jajpur, Mayurbhanj,Nabrangpur, Ganjam	Angul, Balasore, Balangir, Boudh, Mayurbhanj, Puri, Ganjam, Nuapada, Kandhamal, Nabrangpur
2B	Angul	-NA-	-NA-
3A	Balangir, Bhadrak, Boudh, Cuttack, Ganjam, Jharsuguda, Jajpur, Khurda, Malkangiri, Sambalpur, Rayagada, Sundargarh, Dhenkanal	Balasore, Balangir, Bhadrak, Cuttack, Dhenkanal, Jharsuguda, Kalahandi, Kandhamal, Khurda, Sundargarh, Sambalpur, Rayagada, Nayagarh, Malkangiri	Bhadrak, Cuttack, Dhenkanal, Gajapati, Jagatsinghpur, Jajpur, Kalahandi, Keonjhar, Kendrapada, Khurda, Koraput, Sundargarh, Sonepur, Sambalpur, Rayagada, Nayagarh, Malkangiri
3B	-NA-	-NA-	-NA-

growth rate and instability. From the study of table, it is found that, the districts as Balasore, in case of area and Bargarh, Deogarh, Jharsuguda, in case of yield shows negative growth rate but significant instability. So, they are placed under group 1A. Angul is the only district that observed to have positive growth rate with insignificant instability under area of *rabi* green gram, that perform better among all other districts which is placed under group 2B. There is negligible district placed under negative growth rate and insignificant instability 1B and insignificant growth rate and instability 2B.

Growth rate is represented by 1- Negative, 2- Positive, 3-Non-Significant;

Instability index is represented by A- Significant, B- Non -Significant

1A: Negative growth rate with Significant instability
1B: Negative growth rate with insignificant instability
2A: Positive growth rate with significant instability

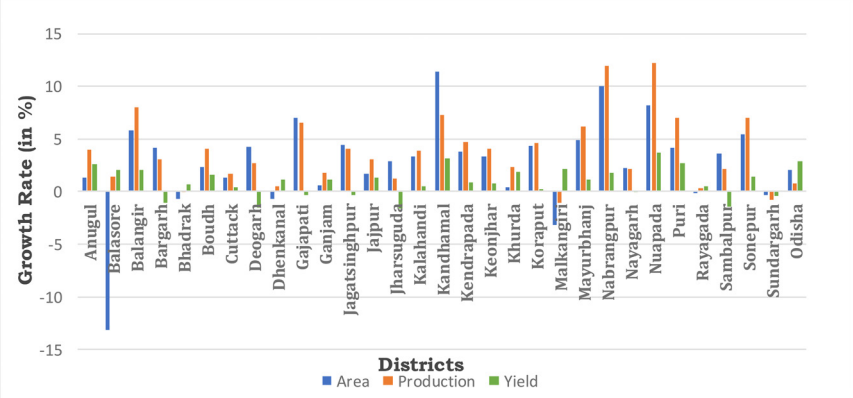

Fig. 2. Multiple Bar Diagram showing the growth rates (in%) of area, production and yield.

Table 4. Classification of districts on basis of growth rate and instability in all aspects under two categories as compared to Odisha.

		On basis of compound growth rate			
Area	Districts I	Gajapati	Boudh	Jajpur	Puri
	-19	Deogarh	Sonepur	Nuapada	Sonepur
		Bargarh	Koraput	Keonjhar	Sambalpur
		Balangir	Jharsuguda	Kalahandi	Mayurbhanj
		Nayagarh	Jagatsinghpur	Kandhamal	Nabrangpur
		Kendrapada			
	Districts II	Angul	Jajpur	Khurda	Malkangiri
	-11	Balasore	Ganjam	Rayagada	Dhenkanal
		Bhadrak	Cuttack	Sundargarh	
Production	Districts I	Angul	Boudh	Puri	Nuapada
	-25	Bargarh	Ganjam	Jajpur	Jharsuguda
		Balangir	Koraput	Keonjhar	Nabrangpur
		Balasore	Kandhamal	Kalahandi	Mayurbhanj
		Deogarh	Sonepur	Sambalpur	Cuttack
		Nayagarh	Gajapati	Kendrapada	Khurda
		Jagatsinghpur			
	Districts II	Bhadrak	Malkangiri	Rayagada	Sundargarh
	-5	Dhenkanal			
		On basis of Cuddy-Della instability index			
Yield	Districts I	Angul	Dhenkanal	Kandhamal	Koraput
	-12	Puri	Rayagada	Malkangiri	Nuapada
		Khurda	Nayagarh	Keonjhar	Sundargarh
	Districts II	Deogarh	Ganjam	Boudh	Balangir
	-18	Cuttack	Balasore	Sonepur	Mayurbhanj
		Gajapati	Jharsuguda	Kendrapada	Bargarh
		Nabrangpur	Jagatsinghpur	Jajpur	Bhadrak
		Kalahandi	Sambalpur		

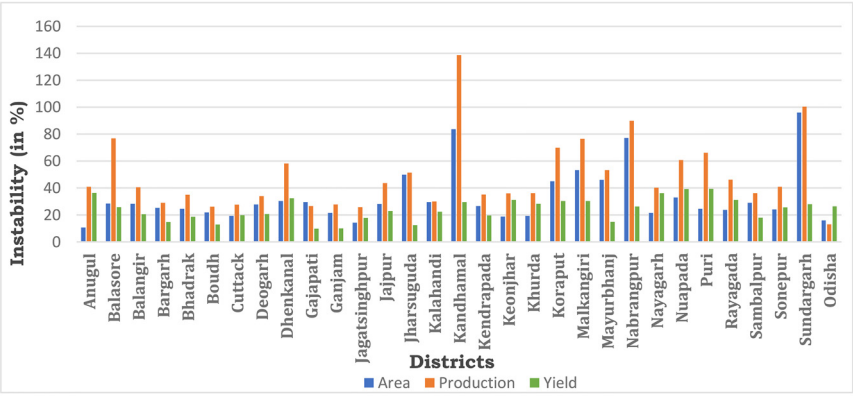

Fig. 3. Multiple Bar Diagram showing the instability index (in%) of area, production and yield.

Table 5. Test of significance of difference in mean area, production and yield of *rabi* green gram for the two categories.

	Growth rate			Instability
	Area	Production		Yield
Variance (I)	164.77	123.69	Variance (I)	1057.32
Variance (II)	1146.9	7.26	Variance (II)	2891.45
F-value	6.96	17.028	F-value	2.735
p-value	0.0002*	0.006*	p-value	0.047*
Mean (I)	13.09	8.25	Mean (I)	356.29
Mean (II)	24.09	2.79	Mean (II)	447.12
|t|-value	1.035	2.158	|t|-value	5.759
p-value	0.321	0.04*	p-value	1057.32

*significant at 5% level.

2B: Positive growth rate with insignificant instability
3A: Insignificant growth rate and insignificant instability
3B: Insignificant growth rate and insignificant instability

Table 4 shows the classification of districts on basis of growth rate and instability index of area, production and yield under two categories as compared to Odisha i.e.

Category I – Districts having growth rate and instability more than Odisha.

Category II – Districts having growth rate and instability less than Odisha.

On basis of compound growth rate, the districts have been classified under area, where number of 19 districts are placed under category I and 11 districts are placed under category II and whereas in production, number of 25 districts are placed under category I and 5 districts are placed under category II.

On basis of Cuddy-Della instability index, the districts have been classified where number of 12 districts are placed under category I and 18 districts are placed under category II.

The Table 5, demonstrates the significance of differences in the mean value of area, mean production and mean yield of *rabi* green gram for the two categories of districts classified on basis of growth rate and instability in contrast to Odisha as mentioned earlier in Table 4.

In accordance with the analysis, there is no significant difference in mean area between the two categories of districts indicated in the table as p value is 0.321, but there is a significant difference in mean production as the p value is less than 0.05. In terms of instability, there is no statistically significant difference in mean yield between the two groups of districts defined as it shows that the p – value is much higher.

CONCLUSION

The study highlighted the fact that the growth of area, production and productivity for green gram in Odisha mostly registered as positive and statistically significant at 5% level of significance. Over the years the compound growth rate of all three aspects continues to be positive in most of the districts but has been declining in some districts. The *rabi* green gram, with its relative stability, can act as a reliable income source, especially when balanced with other crops in a diversified agricultural state. The instability index of green gram shows positive and high in nature usually in production aspect the instability goes above 40% in most districts while Odisha has lowest instability index compared to all districts. The study of growth rate in *rabi* season gives us an idea regarding the change in performance of green gram crop in Odisha during different time periods. The district Angul has highest growth rate and low instability. This may be due to better adaption of new technology and favorable soil conditions, irrigation facilities. The reason for this better performance for the districts, may be further probed and can be suggested for further districts. As, there are several fluctuations in the growth pattern of green gram, the policies need to be focused to increase the yields of the crop. Scientific methods of cultivation of crop and sustainable agriculture need to be carried out to increase the productivity. Ultimately, this research has the potential to enhance the overall production in Odisha, contributing to the food security, agricultural development and economic well-being of the rural population in the state.

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