Full Length Research Article

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Research Journal of Agricultural Sciences
Volume 16; Issue 01 (Jan–Feb 2025); pp 34–40

ISSN: 0976-1675 (P)
ISSN: 2249-4538 (E)

Growth Performance of Wheat Production in Uttar Pradesh: An Analysis of Bundelkhand Region

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Received: 25 Nov 2024; Revised accepted: 07 Jan 2025

Abstract

The present study has examined the growth and instability of the area, production, and wheat yield in the Bundelkhand region in Uttar Pradesh during 2000-2023. The study employed secondary time series data compiled from the Directorate of Economics and Statistics, Government of India. The results indicate that the growth rate of wheat cultivation maintained a positive in the area, production, and productivity and was statistically significant in Bundelkhand and Uttar Pradesh. It also estimated the relative contribution of the area and yield to change in output by decomposition analysis. The highest area effect was observed during Period II (74.04 per cent), with a yield and interaction effect of 21.45 and 4.28 per cent, respectively, in the state. During the entire study, instability indices revealed that most districts registered low and high instability. In Bundelkhand, agriculture is largely rain-dependent, and the yield of wheat crops is very sensitive to variations in rainfall. The analysis further suggests the role of irrigation, modern inputs, and fertilizer in boosting agricultural growth and productivity and reducing variability.

***Key words*:** Wheat, Instability, Growth rates, Decomposition Analysis, Bundelkhand

A tremendous increase in wheat production has been witnessed from 2.72 million in 1950-51 to 38.05 million tonnes in 2022-23 in Uttar Pradesh (DES, DoAFW, GoI) [1]. This growth was made possible by adapting high-yielding varieties of wheat crops due to expansion in irrigation, using modern inputs, and developing infrastructure and institutions, credit markets, and minimum support price policy. Agricultural credit is not an input but helps create an environment for adopting modern production technology [2]. Most inhabitants in the region depend on agriculture/livestock-based activities, and about 33% of the area is covered by degraded forest, grazing land, and wasteland [3].

Instability status is perceived vastly differently from at the disaggregate level [4]. The main reason for the variability in production is that it affects both producers and consumers, along with intermediaries involved in the movement of products through price fluctuation. Instability also adversely affects food management and macroeconomics [5]. Growth and instability in agricultural production have become a great concern for the country's long-term food security. Instability-associated growth not only hampers agricultural development but also casts an aspersion on India's economic health [6]. The correlation between growth and instability does not clearly reveal the state-level data [7].

Agriculture in the state, as well as the region, is highly vulnerable to extreme climatic shocks of drought, water crisis in the region. The study covers only wheat crops in the Bundelkhand region of Uttar Pradesh. Its specific objectives are to estimate the growth and trend patterns of area, production, and productivity (yield) of wheat in the Bundelkhand region of Uttar Pradesh and measure the instability and contribution of area and yield to change in the output of wheat crops in the Bundelkhanad region as well as Uttar Pradesh.

MATERIALS AND METHODS

The present study is based on secondary data of time-series data related to the area, production, and productivity of wheat in the Bundelkhand region of Uttar Pradesh for 23 years were collected from the Directorate of Economics and Statistics, Department of Agriculture, Cooperation and Farmers Welfare, Government of India. District-wise data on wheat area, production, and productivity in Uttar Pradesh state were also collected. Compound annual growth rates (CAGRs) and coefficient of variation of area, production and yield were worked out for each district under study. A decomposition analysis of growth in wheat production in different periods was undertaken to study the area, yield, and their interaction effects.

The study covers seven districts in the Bundelkhand Region of Uttar Pradesh. The entire study period has been divided into three periods: period I (1999-2000 to 2009-10), period II (2010-11 to 2022-23), and the overall period (1999-2000 to 2022-23). The district-wise growth rate of area, production, and productivity was computed to study the growth and patterns in area, production, and productivity in the Bundelkhand region of Uttar Pradesh over each period.

Growth analysis

The compound annual growth rate of area, production, and productivity has been estimated using the exponential growth technique, represented by the following:

$$Y = ab^t$$

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Citation: Singh P. 2025. Growth performance of wheat production in Uttar Pradesh: An analysis of Bundelkhand region. *Res. Jr. Agril. Sci.* 16(1): 34-40.

The log form of the above exponential equation is expressed as:

$$\log(Y) = \log(a) + t\log(b)$$

$$Y = a + bt$$

Where;
Y= acreage/production/productivity of wheat crops
t = time/year (independent variable)
a = constant/intercept
b = regression coefficient
r% = [Antilog (B) -1} *100

The significance of the estimated compound annual growth rate was tested with the help of a student's t-test.

Trend analysis

A parametric model was used to mark out the entire analysis path of the series movement [8].

Model	Form
Linear model	$Y_t = b_0 + (b_1 t)$
Quadratic model	$Y = b_t + (b_1 t) + (b_2 t_2)$
Compound model	$Y_t = b_0 (b_t)$ or $\ln (Y_t) = \ln(b_0) + \ln (b_1)t$
Cubic model	$Y_t = b_0 + (b1_t) + (b_2 t_2) + (b_3 t_3)$
Exponential model	$Y_t = b_0 e (b1_t)$ or, $\ln(Y_t) = \ln(b_0) + (b_t)t$

Cuddy-Della Valle Index

Instability in area, production and productivity was estimated to examine the extent of risk in these variables using the Cuddy-Della Valle Index [9-10].

$$CV_t = CV * \sqrt{(1 - \bar{R})^2}$$

CV_t = Cuddy Della Valle Index (%), CV presents the coefficient of Variation, $\overline{R^2}$ indicates the coefficient of Determination from a time trend regression. Instability will be low if CV_t lies between 0 to 15, medium if 15 to 30 and high if greater than 30.

Coppock's Instability Index = $Antilog\left(\sqrt{logV} - 1\right) * 100$

$$Log\ V = \frac{\left[\left(log \frac{X_{t+1}}{X_t}\right) m\right]^2}{N - 1}$$

X_t = area/production/productivity of rice in the year 't'
N = number of years; *m* = mean of the difference between logs of X_{t+1}, X_t
Log V = Logarithmic variance of the series

Decomposition analysis

Minhas and Vaidyanath [11] worked in the line of the decomposition analysis model used to measure the relative contribution of area and productivity to the total change in wheat production. Wheat production was decomposed into three components: area, productivity and their interaction effect.

$$P = \frac{A_0 \Delta Y \times 100}{\Delta P} + \frac{Y_0 \Delta A \times 100}{\Delta P} + \frac{\Delta Y \Delta A \times 100}{\Delta P}$$

Change in production = Area effect + Yield effect + Interaction effect.

Where;

$\Delta P = (P_n - P_0)$: Change in wheat production between points of time
$\Delta A = A_n - A_0$: Change in the area under wheat between two points of time
$\Delta Y = Y_n - Y_0$: Change in yield of wheat between two points of time
A_0: Area under wheat crop in the base year
A_n: Area under wheat crop in the n^{th} year
Y_0: Yield of wheat crop in the base year
Y_n: Yield of wheat crop in the n^{th} year
P_0: Production of wheat crop in the base year
P_n: Production of wheat crop in the n^{th} year

RESULTS AND DISCUSSION

Compound annual growth rate of area, production and productivity

An examination of the wheat area, production and yield depicted the volatility of wheat in the Bundelkhand region of Uttar Pradesh. (Table 1) indicates the district-wise compound annual growth rates of area, production, and wheat yield in the Bundelkhand region of Uttar Pradesh for two periods, and the overall study period has been examined. Analysis of the across districts revealed that the annual growth rates of area, production, and productivity fluctuated throughout the two periods.

During the period I, the highest positive growth rates registered for the area (0.14), production (1.51), and yield (1.35) were recorded in Lalitpur but were statistically non-significant. The lowest growth rates for the area (-5.73), production (-8.73), and yield (-3.16) were recorded in the Mahoba district [12].

During period II, Lalitpur recorded positive growth rates for production (5.65***) and yield (4.25***) and was statistically significant at a 10 per cent level, while for the area (1.34*), significant at a 10 per cent level of significance. Almost all districts registered a positive growth rate for production, area, and yield in this period except Jhansi (-0.83), which has shown a negative area but is non-significant. The yield growth rate of Banda was positive and statistically significant at a 5 per cent significance level. In contrast, Chitrakoot's production growth rate (6.80***) and yield (5.28**) were positive and statistically significant at a 1, 5 per cent significance level, respectively [13].

During the overall growth period, area, production, and yield rates were positive in all districts and statistically significant (except Jhansi, Jalaun in yield, Banda, Mahoba and Hamirpur in the area were positive but statistically insignificant). The highest growth rate for production was recorded in Lalitpur (7.10***), followed by Hamirpur (4.30***) and Banda (3.66***), which were positive and statistically significant at a 1 per cent level of significance. The highest growth rate for yield was gound in Lalitpur (323***), followed by Mahoba district (3.09**) and was significant at 1 and 5 per cent levels of significance.

Examining the Bundelkhand region, the period I growth rates for the area, production, and wheat yield were -0.51, -1.22, and -1.02, respectively and statistically not significant in three components. In period II, the production and yield were positive and significant at a 5% significance level. In the overall period growth rate for the area, production and productivity of wheat in Bundelkhand were positive in all three components and statistically significant at a 1 per cent significance level [14].

In Uttar Pradesh, the growth rate was positive in all periods and statistically significant except for period I. Overall, the highest growth rate was recorded for yield (2.22***) and the lowest in the area (0.46***), and it was statistically significant

at the 1 per cent significance level (Table 1). However, over the entire study period. Bundelkhand and Uttar Pradesh maintain a positive growth rate of 3.70 and 2.09 per cent in production associated with 2.05 and 2.22 per cent in productivity, respectively [15]. The compound annual growth rates of area, production, and productivity of wheat in the Bundelkhand region and Uttar Pradesh showed overall positive trends, with significant variations across districts and periods, highlighting Lalitpur's remarkable growth and statistical significance in production and yield during the study period.

Table 1 District-wise growth (in %) rate of area, production and wheat yield in Uttar Pradesh for the period 2000-10, 2011-2023 and 2000-2023

Districts	Particular	Period I	Period II	Period overall
Jhansi	Area	-1.16	-0.83	1.34***
	Production	-2.45	3.00	2.43***
	Yield	-1.30	3.82	1.07
Lalitpur	Area	0.14	1.34*	3.75***
	Production	1.51	5.65***	7.10***
	Yield	1.35	4.25***	3.23***
Jalaun	Area	1.31	0.40	1.29***
	Production	-1.0	3.03	1.88**
	Yield	-2.26	2.62	0.58
Banda	Area	-0.55	2.46	0.63
	Production	-0.35	8.61	3.66**
	Yield	0.21	6.01**	3.01***
Mahoba	Area	-5.72	2.23	0.95
	Production	-8.73	10.92**	4.06*
	Yield	-3.16	8.56***	3.09**
Hamirpur	Area	-0.24	2.90***	2.30***
	Production	0.22	4.80**	4.30***
	Yield	0.46	2.65	1.96***
Chitrakoot	Area	-0.80	1.44	0.32
	Production	-3.48	6.80***	2.77***
	Yield	-2.72	5.28**	0.86***
Bundelkhand	Area	-0.51	1.10	1.69***
	Production	-1.22	5.17**	3.70***
	Yield	-1.02	4.43**	2.05***
Uttar Pradesh	Area	0.37**	0.35***	0.46***
	Production	0.90	2.80**	2.09***
	Yield	0.72	2.73**	2.22***

***Significant at 1% level,
**Significant at 5%,
*Significant at 10% level of significance

Table 2 Trends in area, production and yield of wheat crop in Uttar Pradesh

Equation	Model Summary			Parameter estimates		
	R^2	Significance	Constant (b)	b1	b2	b3
			Area('000ha)			
Quadratic	0.849	0.00	0.00	-71.02	19.45	1.19
			Production ('000tonnes)			
Exponential	0.681	0.00	0.00	0.02		
			Yield (Kg/ha)			
Quadratic	0.668	0.00	0.00	-77.05	15.26	-.96

The non-linear patterns were visible in Uttar Pradesh (Fig 1-3). Thus, one can see from the trend analysis that quadratic and exponential trends were noticed in the area, production and yield of wheat, indicating that in the recent past, most likely, the series had reached maximum values. Then, it either remained constant or decreased, which caused concern. From (Fig 1), it is clear that the area under wheat cultivation coefficient of the determinant is (85 per cent) [16]. The area under wheat crops Increased during and after 2008. The region's expansion can be seen in wheat production, which increased by 25679 thousand tonnes to 30302 in 2013. After this, it began to decline from 2014 to 2016. In recent years, rising trends have shown farmers' interest in wheat production has increased. During the overall period, wheat production in Uttar Pradesh and the Bundelkhand region increased, possibly due to modern technology, hybrid seeds, and fertilizer adoption [17].

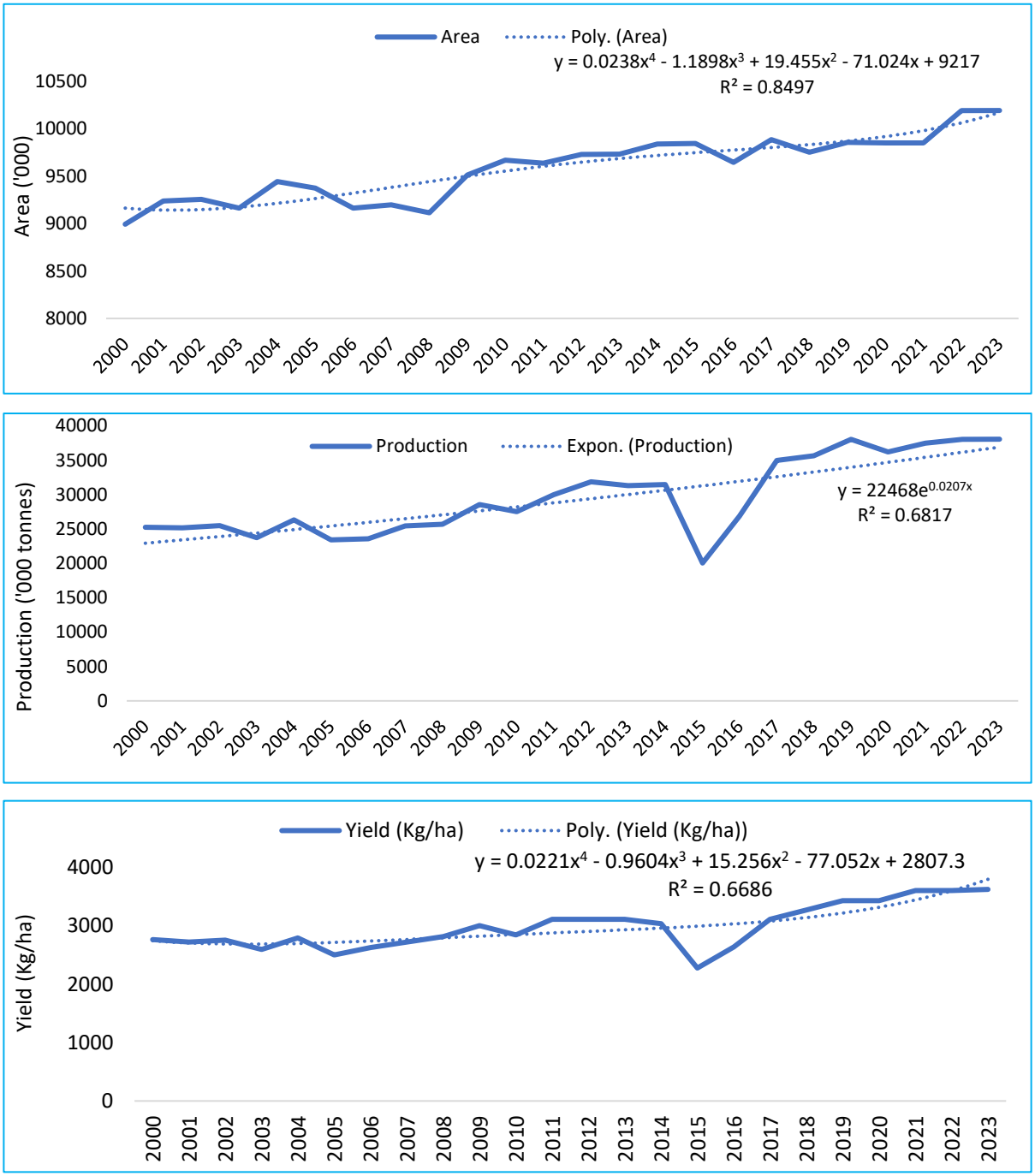

Fig 1 Observed and expected trends of the production of wheat

Instability analysis

The instability analysis of the area, production, and productivity of wheat across different districts of the Bundelkhand region is furnished in (Table 3). Again, the convenience of the study is divided into three parts: Period I (2000 to 2010), Period II (2011 to 2023) and the overall period (2000 to 2023).

Cuddy Della Valle index

Instability in selected dimensions was estimated for seven districts of the Bundelkhand region. The Cuddy Della Valle Index for area, production and yield of wheat in Uttar Pradesh has been analyzed in (Table 3). During the period I, the data presented in the table depicts that the highest instability for production and productivity was found in the Mahoba district, and production decreased in period I. Low instability for the area (7.19 per cent) was recorded in the Banda district. Medium instability in the production and yield has been found in most districts. The area has been found low and medium unstable in all districts, whereas in the case of the area [18]. In the case of production, medium instability was found in all districts except the Mahoba district.

During period II, high instability for production was recorded in the Mahoba and Banda districts (37.77 and 34.15 per cent, respectively). The instability varies from 20.96 to 37.77 per cent, 14.78 to 27.52 per cent for production and productivity, respectively, which are in low, Medium and highly unstable ranges, and 5.96 to 27.53 per cent for the area in low to medium unstable during period II.

During the overall period, production and productivity were highly unstable in Mahoba, followed by Banda and Chitrakoot districts only in Production.

A perusal of (Table 3) revealed that there was no wide variation in instability across districts in the region. A similar pattern was observed for area, production and productivity at the state level. In three components, instability shown overall was lower than in the range of instability across the district of the Bundelkhand region [19].

Coppock's instability index

The table also represented the instability of the area under three components of wheat production. The objective is mainly to find out the source of high instability in the wheat area. of Coppock's instability examination of the area, production, and wheat yield are presented in (Table 3), which is discussed in periods I, II, and overall. The instability analysis revealed that during the period I, higher instability for the area, production, and yield (51.6, 77.81, and 58.71, respectively) were observed in the Mahoba district. The lowest instability was shown in the Banda district for area (39.52). Whereas for yield, low instability was found in Jalaun (41.31) followed by Banda (41.32) and for production, the district observed was (43.70) in Banda district [20].

In period II, the Banda district showed the highest instability in area, production, and yield, 63.91, 83.29, and 53.64, respectively. Low instability for the area was recorded in the Jalaun district (39.40). Similarly, the Lalitpur district registered low instability in production (49.46) and yield (46.29), respectively.

In the overall period, Banda has registered the highest instability for area components (55.03), followed by Mahoba (54.85) and Lalitpur (50.41), respectively. In the case of production, the highest instability was found in all districts except Jalaun and Banda; Mahoba and Chitrakoot registered high instability in the yield component. The low level of instability was registered in all districts except Mahoba, Banda and Lalitpur for the area, production Jalaun registered (49.71), and yield all districts except Banda, Mahoba and Chitrakoot [21].

The over entire study period Bunderkhand, low instability in area (43.19), productivity (47.82), and high (53.27) in the production. In Uttar Pradesh, the area, production, and productivity under the wheat crop corresponding to Coppock's instability index value were estimated to be 38.12, 44.37, and 43. 28 per cent, respectively, during the overall period [22].

The instability analysis of wheat production in the Bundelkhand region revealed significant variations across districts and periods, with Mahoba and Banda exhibiting the highest instability in area, production, and yield during Period I and II, respectively, while districts like Jalaun and Lalitpur showed relatively lower instability; overall, Bundelkhand and Uttar Pradesh demonstrated moderate instability in wheat production, with the Coppock's instability index highlighting production as the most unstable component.

Table 3 Instability in area, production and yield of wheat in Uttar Pradesh (in %)

Districts	Periods	Area			Production			Yield		
		CV%	CV_t	CII	CV%	CV_t	CII	CV%	CV_t	CII
Jhansi	I	8.57	8.11	40.21	17.93	17.07	44.64	12.22	12.13	41.73
	II	9.28	9.13	40.32	28.07	27.7	51.64	26.33	23.78	51.19
	Overall	15.53	12.71	43.01	31.72	26.63	51.1	22.52	21.1	47.59
Lalitpur	I	15.88	16.67	43.81	27.77	28.16	49.21	13.53	13.29	42.02
	II	9.98	9.15	40.93	27.3	18.12	49.46	21.7	14.78	46.29
	Overall	29.06	15.33	50.41	52.01	23.88	64.29	27.97	15.59	48.26
Jalaun	I	11.91	11.43	41.25	21.18	22.31	47.81	15.13	14.38	41.31
	II	5.93	5.96	39.04	23.57	21.87	49.51	23.5	22.72	50.21
	Overall	12.12	12.22	41.68	25.64	21.71	49.71	20.51	20.67	47.61
Banda	I	7.02	7.19	39.62	16.43	17.31	43.7	11.71	12.32	41.32
	II	27.44	27.52	63.91	44.23	34.15	83.29	31.4	22.93	53.64
	Overall	22.47	21.55	55.03	48.4	35.63	69.1	32.96	23.38	51.05
Mahoba	I	28.92	27.16	58.1	38.91	35.27	78.21	30.16	30.59	52.9
	II	24.16	23.72	51.6	53.71	37.77	77.81	41.45	27.52	58.71
	Overall	26.81	26.45	54.85	58.23	47.86	80.3	42.55	35.03	57.51
Hamirpur	I	11.27	11.87	41.3	20.94	21.96	45.74	11.61	12.09	41.47
	II	12.72	10.28	41.67	26.94	20.96	50.01	20.08	18.37	46.96
	Overall	19.95	11.86	44.91	38.16	23.13	54.15	21.7	16.48	46.23
Chitrakoot	I	7.51	7.47	39.78	25.63	24.48	48.34	20.69	19.77	45.67
	II	15.65	14.8	42.11	37	26.56	53.65	29.9	23.91	52.66
	Overall	12.58	12.52	40.11	38.25	31.64	53.70	31.83	26.03	51.31
Bundelkhand	I	9.34	9.76	40.78	18.75	19.56	45.76	12.72	13.04	42.22
	II	9.18	8.57	40.55	28.68	22.10	51.30	25.37	20.08	49.60
	Overall	15.47	10.11	43.19	36.40	24.27	53.27	25.35	20.03	47.82
Uttar Pradesh	I	2.11	1.80	37.57	6.26	5.74	39.14	5.21	5.13	38.77
	II	1.76	1.16	37.44	16.05	12.65	44.15	15.19	12.72	43.81
	Overall	3.53	1.46	38.12	18.76	11.20	44.37	15.99	10.87	43.29

Decomposition analysis

Decomposition analysis is used to analyze the area, yield, and their interaction effects on the production variability. The (Table 4) results revealed that in period I, the yield effect positively and significantly contributed to wheat production in all districts except for Banda, Hamirpur, and Chitrakoot. In period I, the area effect was the change in production in most districts of the Bundelkhand region. As for wheat production during periods I and II, the yield effect was responsible for the most significant change in wheat production. The highest yield effect was observed during Period I (378.52) with an area (-222.97) and interaction effect (-53.41) in the Jalaun district [23].

During period II, the area effect was positive in all districts. In contrast, interestingly, the yield effect was found to be positive and a major contributor to wheat production in the Hamirpur district (62.16). The contribution of area (110.40) to wheat production was high in the Jhansi district, whereas the yield effect was negative (-8.81). The interaction and yield effect were also positive in most districts. (Table 4) shows that,

overall, the area, yield, and interaction effect were positive in all districts. The area affected was more responsible for production in the overall period. The highest area effect (74.80) is in the Jhansi District. In contrast, the yield effect was (19.11) [24].

Examining the results of area, productivity, and their relative contribution to production in Bundelkhand, it was found that, in the overall period, Bundelkhand's area effect was highly responsible for production variability. The study shows the yield effect (1279.53 and 218.05, respectively) in the Bundelkhand during Periods I and II [25].

In the overall period, the area effect is higher than the yield effect in the Bundelkhand region of Uttar Pradesh; the yield effect is less compared to period I. The interaction effect is almost higher than in Periods I and II.

In Uttar Pradesh, the highest area effect was observed during Period II (74.04 per cent) with a yield and interaction effect of 21.45 and 4.28 per cent, respectively. While during the overall period, yield effect, area effect and interaction effect were recorded at 26.29, 64.56 and, 8.61 per cent, respectively [26].

The decomposition analysis revealed that the area and yield effects significantly influenced wheat production variability in the Bundelkhand region, with the yield effect being the primary contributor during Period I and the area effect dominating during Period II and the overall period; Uttar Pradesh showed a similar trend, with the area effect playing a major role in production variability, while the yield and interaction effects had relatively smaller but positive contributions.

Table 4 Decomposition analysis for area, yield and Interaction effect

Districts	Period	Decomposition analysis		
		Area effect	Yield effect	Interaction effect
Jhansi	I	93.56	3.66	-0.20
	II	110.40	-8.81	-2.38
	Overall	74.80	19.11	5.91
Lalitpur	I	64.09	29.30	5.20
	II	49.45	32.60	17.82
	Overall	43.15	31.57	25.19
Jalaun	I	-222.97	378.52	-53.41
	II	33.86	58.98	7.00
	Overall	17.94	74.80	7.34
Banda	I	149.76	-40.04	-3.36
	II	57.76	23.47	19.06
	Overall	60.88	18.56	20.71
Mahoba	I	93.21	8.38	-2.41
	II	72.43	8.66	18.85
	Overall	74.18	14.44	11.54
Hamirpur	I	162.42	-64.00	-3.48
	II	25.34	62.16	12.80
	Overall	31.01	51.31	17.82
Chitrakoot	I	597.81	-525.84	18.88
	II	39.94	34.11	26.06
	Overall	39.22	27.76	23.04
Bundelkhand	I	-1246	1279.53	-54.41
	II	413.55	218.05	117.33
	Overall	339.19	244.0	125.90
Uttar Pradesh	I	15.89	83.64	1.19
	II	74.04	21.45	4.28
	Overall	64.56	26.29	8.61

Sum of all three effects = 100

CONCLUSION

The study showed that the growth rate for Uttar Pradesh in the overall period was registered to be positive and statistically significant for the area, production and yield (0.46, 2.09 and 2.22 per cent, respectively). In the Bundelkhand region, the annual growth rate area, production and productivity were positive and statistically significant for the entire study period. Coppock's indices revealed the degree of instability for the area, and production was estimated to be 38.12, 44.37, and 43. 28 per cent, respectively. The area under wheat crops Increased during and after 2008. The region's expansion can be seen in wheat production, which increased by 25679 thousand tonnes to 30302 in 2013. After this, it began to decline from 2014 to 2016. There was no wide variation in instability across districts in the region. A similar pattern was observed for area, production and productivity at the state level. In three components, instability was shown to be lower overall than in the range of instability across the district of the Bundelkhand region. In the case of decomposition analysis. The primary reason for variability during the study period was the area and yield effect. The results revealed that the yield, area, and interaction effects were recorded at 26.29, 64.56 and 8.61 per cent, respectively.

LITERATURE CITED

1. Anonymous. 2023. Directorate of Economics and Statistics, Ministry of Agriculture, Government of India. https://data.desagri.gov.in/website/crops-report-major-contributing-State-web
2. Sidhu RS, Gill SS. 2006. Agricultural credit and indebtedness in India: Some issues. *Ind. Jour. of Agri. Economics* 61: 12-35.

3. Gupta AK, Nair SS, Ghosh O, Singh A, Dey S. 2014. Bundelkhand drought: retrospective analysis and way ahead. *Nation. Inst. of Disaster Manage New Delhi*. pp 1-133.
4. Chand R, Raju SS. 2008. Instability in Andhra Pradesh agriculture—A disaggregate analysis. *Agri. Econ. Research Review* 21: 283-288.
5. Chand R, Raju SS. 2009. Instability in Indian Agriculture during different phases of technology and policy. *Ind. Jr. Agri. Economics* 64: 187-207.
6. Sharma HR, Singh K, Kumari S. 2006. Extent and source of instability in food grains production in India. *Indian Journal of Agricultural Economics* 61(4): 648-666.
7. Raju SS, Chand R, Chauhan S. 2014. Instability in Indian agriculture: An inter-state analysis. *Econ. Affair* 59: 735-744.
8. Srivastava AB, Kushwaha RR, Yadav S, Verma SK, Mishra P. 2022. Source of growth for wheat in Uttar Pradesh: Decomposition analysis. *Ind. of Econ and Develop* 18: 976-980.
9. Cuddy JDA, Della PA. 1978. Measuring the instability of time series data. *Oxford Bulletin of Econ. Stat.* 40: 79-85.
10. Bera BK, Chakraborty AJ, Nandi AK, Sarkar A. 2011. Growth and instability of food grains production of India and West Bengal. *Jr. of Crop and Weed* 7: 94-100.
11. Minhas BS, Vaidyanath A. 1964. Growth of crop output in India 1951-54 to 1956-61: An analysis by component elements. *Jr. of Ind. Soci. of Agri. Stat.* 17: 230-252.
12. Tewari H, Singh HP, Tripathi U. 2017. Growth and instability in wheat production: A region wise analysis of Uttar Pradesh. *Int. Jr. Curr. Microbiol. Applied Science* 6(9): 2537-2544.
13. Bhalla GS, Singh G. 2009. Economic liberalization and Indian agriculture: A state wise analysis. *Economic and Political Weekly* 34-44.
14. Srivastava SC, Singh BK, Yadava HS. 2013. Growth and instability of chickpea production in India: State wise Analysis. *International Journal of Agricultural and Statistical Sciences* 9(1): 203-212.
15. Srivastava SC, Singh, Rajeev Kumar, Tomar, Sudeep S, Jain S. 2015. Costs, margins and price spread of cotton in Nimar Valley agro- climatic zone of Madhya Pradesh. *Journal of Cotton Research and Development* 29(1): 159-162.
16. Singh B, Arya CK, Singh A, Mourya KK, Snehdeep. 2021. Identification of mutation point and trend analysis of wheat crop in Western Uttar Pradesh. *Environment and Ecology* 39(4A): 1193-1198.
17. Singh A, Kumar S, Tiwari KG, Devi L, Babulal. 2020. A statistical study of trends of wheat production in districts of eastern Uttar Pradesh. *Int. Jr. Curr. Microbiol. Appl. Sciences* 9(4): 158-166.
18. Goyal AK, Kumar S. 2013. Agricultural production trends and cropping pattern in Uttar Pradesh: An overview. *International Journal of Agriculture Innovations and Research* 2(2): 229-235.
19. Oladele TA, Kenamara DM. 2015. Trends in production and export of wheat in India. *International Research Journal of Agricultural Economics and Statistics* 6(1): 189-192.
20. Faldu SM, Upasana D Bhopala, Ardeshna NJ. 2024. An analysis of growth and instability in area, production, yield and price behaviour of rice in India. *International Journal of Statistics and Applied Mathematics* 9(1): 06-14.
21. Byaligoudra AI, Aparna B, Vani N, Naidu GM. 2019. Growth and instability of major millets in Andhra Pradesh, India. *International Journal of Current Microbiology and Applied Science* 8(7): 985-993.
22. Choudhury N, Saurav S, Kumar R, Budhlakoti N. 2017. Modelling and forecasting of total area, irrigated area, production and productivity of important cereal crops in India towards food security. *International Journal of Current Microbiology and Applied Sciences* 6(10): 2591-2600.
23. Parmar P, Devi G. 2021. Growth and decomposition analysis of area, production and yield of soybean. *Gujarat Journal of Extension Education* 32(1): 116-119.
24. Asha R, Umadevi K, Suseela K. 2020. Decomposition analysis for impact of backward integration on input use pattern and profitability of chilli farmers in Andhra Pradesh. *Economic Affairs* 65(2): 173-178.
25. Kumar P, Handral AR, Mondal B, Yadav RK, Anbukkani P. 2022. Economics of pulse production in Bundelkhand region of Uttar Pradesh, India: An empirical analysis. *Research on World Agricultural Economy* 3(3): 560.
26. Suman J, Singh H, Verma DK, Ahmad S. 2019. Effects of area, yield and their interactions on change in production of major crops in Rajasthan. *International Res. Jr. Agric. Eco. and Statistics* 10(2): 246-251.