

Growth and Instability of Agriculture Sector in Uttar Pradesh: An Analysis of Bundelkhand Region

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ABSTRACT

The present paper has examined the trends of growth and instability (risk) in agriculture sector of Bundelkhand region in Uttar Pradesh during 2004-05 to 2015-16. The compound annual growth rate (CAGR) and Instability Index techniques have been used for the analysis of secondary data. The result indicates that the growth rate of all crops except pulses and oilseeds has been found positive in case of production and productivity of crops. It is also observed that the area, production and productivity of crops have widespread variations with mixed growth rate across all the districts of Bundelkhand throughout the entire study period. On the other hand, the trends of instability with respect to various crops has been clearly indicate that there is high level of instability index in all crops in terms of area, production and productivity in Bundelkhand region at aggregated level as well as district level. The agriculture risk has been found least in case of fruits and vegetables. It is noticed that there are significant differences in area, production and productivity risk in all the crops in the districts and Bundelkhand during the study period. The growth and instability relationship clearly indicates that there is positive relationship between growth and instability. It means that higher growth rate leads higher instability. The fluctuated growth performance of crop sector in Bundelkhand region has indicated the need for evolving specific strategies at district level for ensuring sustainable and inclusive agricultural growth in Uttar Pradesh. Moreover, there is need to mitigate agricultural risk factor and provide irrigation facilities along with modern inputs and prudent management of rainfall water for the development of sustainable agriculture sector in Bundelkhand region.

Key words: Growth, Instability, Agricultural risk, Bundelkhand

Uttar Pradesh is one of the largest agricultural states of India. Most of the population of the state depends on agriculture sector for their livelihood and employment. The agriculture sector has comparative advantage over other occupations in the state due to favourable soil and water resources. The state is basically known as an agrarian economy and has also 16.81 million ha of cultivated area, constituting 70.0 per cent of the total geographical area [1]. The irrigated area is over 73.0 per cent and the cropping intensity is 153.0 per cent which is more than the national average. The state is the highest producer of some food grains and non-food grains crops; such as vegetables, fruits, sugarcane and potato throughout the country and is commonly known as the “granary of the nation” [2]. Uttar Pradesh is divided into four economic regions, namely, Western Uttar Pradesh, Central Uttar Pradesh, Eastern Uttar Pradesh, and Bundelkhand. The first three regions fall in the fertile Gangetic plains, while Bundelkhand lies in the dry Vindhyan plateau and the economy of the State is characterized by a sharp variation at the regional and district levels. Bundelkhand region is characterized as a hot, semi-arid, eco-region and the

agriculture depends on rainfall.

In long-run, there is need to understand the regional pattern of agricultural growth and its instability. It helps to make development strategies to ensure inclusive growth in the state like Uttar Pradesh. However, most of the analysis related to the regional growth and instability of agricultural sector in India has been studied at the state level [3]. Although, there are very few studies is available at district level exist [4]. Though, states are the appropriate administrative entity to analysis the regional and climatic dimensions of agricultural sector. Moreover, the intra-state instability in performance of agriculture due to wide regional variations in resource endowments and agro-climatic conditions within the state calls for understanding the pattern of agricultural growth and development at regional as well as district level [5]. Recently, the NITI Aayog has given the importance to study agricultural sector at district level approach for agricultural development [6].

The Bundelkhand region of Uttar Pradesh is mainly agrarian economy. Majority of rural farming population depend on agriculture for employment and their livelihoods [7]. The wheat and pluses are main principal crops of this region. Agriculture sector in Bundelkhand is diverse, complex, under-invested, rainfed, risky and vulnerable [8]. These risks may be arise from climatic variability, market uncertainties, natural and man-made disasters. In Bundelkhand region, extreme droughts, short-term rain and flooding add to the

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uncertainties and seasonal migrations of farmers from rural to urban area [9]. The scarcity of water in the semi-arid region, with poor soil and low productivity further aggravates the problem of food security in this region [10]. The measures of farmers for loss management and to reduce the risk in farming in semi-arid regions are found to be very expensive [11]. Continuously suffering from natural calamities and price fluctuations further lead farmer's suicides [12]. Agricultural instability (risks) in production affect price stability and consumer welfare, and it increases vulnerability of low-income households to market [13].

In this context, the present research paper focuses on the regional analysis of growth and instability (risk) of agriculture sector in Uttar Pradesh with special reference to Bundelkhand region. The main objective of the paper was to examine the trends of growth and instability of major crops in terms of area, production and productivity (yield) in Uttar Pradesh at regional level and also identify the regional and district level disparities. Moreover, the research paper also gives policy insights for removing regional inequality in agriculture sector in the state.

MATERIALS AND METHODS

The data for the present research paper was retrieved from various secondary data sources such as Land Use Statistics prepared by Department of Agriculture and Co-operation Network (DACNET), Agricultural Statistics at a Glance, Ministry of Agriculture, Government of India, District Wise Development Indicators Uttar Pradesh, Government of Uttar Pradesh, Directorate of Economics and Statistics, Government of Uttar Pradesh (UPDES) and

Sankhyakiya Patrika, Department of Economics and Statistics, State Planning Commission, Government of Uttar Pradesh. The performance of agricultural economy in Uttar Pradesh varies greatly at the regional as well as district levels. Agriculture sector in Bundelkhand is diverse, complex, under-invested, rain-fed, risky and vulnerable. These risks may be arising from climatic variability, market uncertainties, natural and man-made disasters. The Bundelkhand region falls in the dry plateau region of Vidhya and divided into warm, semi-arid and eco-zones, and agriculture is primarily dependent on rainfall. Bundelkhand has been declared a physical region and its boundaries are based on this - it is surrounded by the Yamuna in the region, the ranges of Vidhi Plato in the south, Chambal in the northwest and Panna in the south east, Ajaygarh ranges. It consists of seven districts of Uttar Pradesh, Jalaun, Jhansi, Lalitpur, Chitrakoot, Hamirpur, Banda, and Mahoba. This region is a large part of the districts, which is mainly one of the most backward districts of India. Agriculture and allied activities are the main sources of livelihood in Bundelkhand. The national average of per hectare value of output by agriculture and its allied sector is higher than the per hectare value of output by agriculture sector in Uttar Pradesh. Moreover, the per hectare value of output by agriculture sector in Bundelkhand region is much lower as compared to state average. The same story is repeated in case of food grain productivity. In sum, it is concluded that there are wide disparities in agriculture sector at regional levels in the state of Uttar Pradesh and the performance of Bundelkhand region with respect to these parameters is worse as compared to state average. The basic features of agriculture sector in Bundelkhand region and Uttar Pradesh are given in (Table 1).

Table 1 Basic features of agriculture sector in Bundelkhand region

Variables	Bundelkhand		Uttar Pradesh	
	2004-05	2015-16	2004-05	2015-16
Crop intensity (%)	123.84	132.67	147.89	156.20
Per capita production of food grain in (kg)	181.70	166.00	215.93	195.00
Gross irrigation area sown (%)	41.34	48.39	68.17	74.71
Normal rainfall (Millimetres)	898.29	1001.76	931.00	809.88
Food grain productivity (Kg/ha)	1243	1326	1965	2271
Per hectare value of output by agriculture	58877	61141	88641	122254

Source: Author's Calculation based on UPDES data

Growth estimation

A widely accepted exponential model, $y = ab^t e^u$ has been fitted to the time series data for estimating the compound annual growth rates (CAGR) of area, production and productivity of various crops in Bundelkhand region of Uttar Pradesh during 2004-05 to 2015-16. The compound annual growth rate (CAGR) is usually estimated by using the following semi log functional form:

$$\ln(y) = \ln(a) + t \ln(b) + u$$

Where, y is the dependent variable whose growth rate is to be estimated; t is the independent variable (time); u is the disturbance or error term and, 'a' and 'b' are the parameters to be estimated from sample observations. The regression coefficient b is estimated by ordinary least squares (OLS) technique. The compound annual growth rate (CAGR) in per cent term is estimated as:

$$\text{Growth rate (CAGR)} = \{\text{antilog}(b) - 1\} * 100$$

Estimation of instability

The study estimates instability (risk) associated with respect to various crops and crop groups in agriculture sector

through instability index and also identifies degree of risk in Bundelkhand region of UP. The present paper has been measures the three types of agricultural risks viz. area, production and yield (crop productivity). The instability index as an indicator of risk as below:

$$\text{Instability index (Risk)} = \text{Standard deviation of natural logarithm } (Y_{t+1}/Y_t)$$

Where, Y_t is the area / production / yield (crop productivity) of crop/ crop group in the current year and, Y_{t+1} represent the same in the next year. This index is unit free and very robust and it measures deviations from the underlying logarithmic trend. When there are no deviations from trend value, the ratio Y_{t+1}/Y_t is constant, and thus standard deviation (SD) in it is zero. As the series fluctuates more than the ratio of Y_{t+1}/Y_t is also fluctuate at high rate, and standard deviation (SD) increases [14].

RESULTS AND DISCUSSION

Growth trends of APY in major crops at district level in Bundelkhand region

District wise compound annual growth rate (CAGR) of area, production, productivity in major crops during 2004-5 to 2015-16 has been shown in (Table 2). It is found that area under rice grew at positive rate of 20.37 per cent in Jhansi, 5.05 per cent of Jalaun and 0.10 per cent for Banda, whereas area of rice showed negative growth rate in Chitrakoot, Hamirpur, Lalitpur and Mahoba. In case of rice production, it grew at rate positive as 25.76 per cent in Jhansi, followed by 15.55 per cent of Jalaun, 7.70 per cent for Banda and 6.25 per cent of Chitrakoot while rice production accounted negative growth rate of -14.66 per cent for Mahoba, -8.85 per cent of Lalitpur, and -11.47 per cent in Hamirpur. Productivity of rice grew at positive rate in all the districts but it accounted highest growth rate of 10.0 per cent in Jalaun and lowest 2.99 per cent being witnessed in Mahoba over the study period. On the

other hand, the area and production of wheat accelerate positively but in case of wheat productivity it showed mixed growth rate across all the districts. Regarding coarse cereals, the area and production grew at mixed rate but productivity of coarse cereals showed positive growth rate in all the districts. Considering area under cereals, it revealed highest growth rate of 4.55 per cent in Jhansi and least is witnessed in Chitrakoot whereas in case of cereals production it grew highest of 10.02 per cent in Lalitpur and lowest as 1.74 per cent in Jhansi. Similarly, productivity of cereals grew at positive rate in all the districts except for Jhansi, which showed a negative of -2.68 per cent. The growth in area, production and productivity under pulses showed very wide fluctuations with mixed trends at districts level [15].

Table 2 District wise growth trends in APY of major crops in Bundelkhand region

APY	Regions	Rice	Wheat	Coarse cereals	Total cereals	Pulses	Food grain	Oilseeds	Sugarcane	Vegetables and fruits
Area	Banda	0.10	2.07	-0.84	1.21	-1.40	0.12	14.54	-5.45	8.13
	Chitrakoot	-1.53	2.74	-0.75	1.13	-0.76	0.32	9.39	-5.39	19.71
	Hamirpur	-17.65	4.06	-2.30	2.71	-1.75	0.07	16.03	5.49	-3.62
	Jalaun	5.05	2.15	-0.64	1.67	-1.73	-0.12	5.30	-3.36	8.78
	Jhansi	20.37	4.19	1.39	4.55	2.21	3.03	5.10	12.84	3.92
	Lalitpur	-13.14	8.66	-4.37	5.31	-3.67	1.69	1.49	-12.41	8.64
	Mahoba	-17.14	2.51	1.20	2.26	-0.39	0.53	9.11	6.48	0.89
	Bundelkhand	0.83	3.85	-1.40	2.69	-1.10	0.79	7.23	2.84	6.02
Production	Banda	7.70	4.25	4.90	4.99	2.91	4.37	10.60	-3.57	9.21
	Chitrakoot	6.25	2.95	2.09	3.06	2.14	2.73	13.98	-3.51	16.58
	Hamirpur	-11.47	3.89	7.86	4.12	0.61	2.76	15.15	7.59	-0.62
	Jalaun	15.55	2.29	-0.41	2.11	-2.56	0.69	1.97	-1.34	9.06
	Jhansi	25.76	0.72	4.44	1.74	2.49	1.62	5.58	15.19	6.55
	Lalitpur	-8.85	11.96	-1.01	10.02	-4.06	5.83	2.21	-10.59	14.01
	Mahoba	-14.66	1.98	11.18	2.88	-3.35	-0.01	6.91	8.60	5.31
	Bundelkhand	8.64	4.25	2.41	4.30	-0.40	2.69	6.25	4.80	8.70
Productivity (yield)	Banda	7.60	2.14	5.78	3.73	4.37	4.24	-3.44	2.00	0.99
	Chitrakoot	7.91	0.20	2.86	1.90	2.93	2.41	4.19	2.00	-2.62
	Hamirpur	7.51	-0.16	10.41	1.38	2.41	2.68	-0.75	2.00	3.11
	Jalaun	10.00	0.14	0.24	0.43	-0.85	0.81	-3.16	2.09	0.26
	Jhansi	4.48	-3.33	3.01	-2.68	0.28	-1.37	0.45	2.09	2.53
	Lalitpur	4.94	3.04	3.52	4.48	-0.41	4.07	0.71	2.09	4.94
	Mahoba	2.99	-0.52	9.85	0.61	-2.97	-0.53	-2.02	2.00	4.38
	Bundelkhand	7.74	0.38	3.86	1.56	0.71	1.88	-0.91	1.90	2.53

Source: Authors Calculation based on data from UPDES, Government of Uttar Pradesh

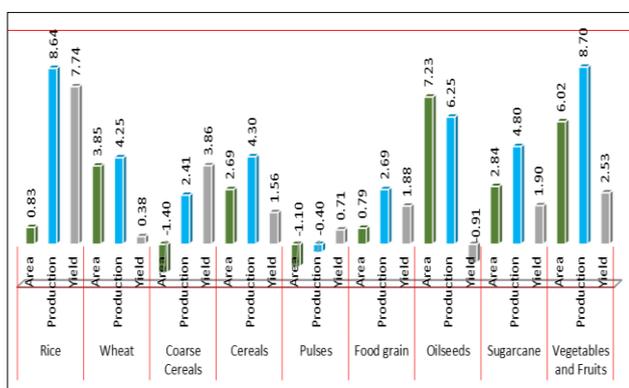


Fig 1 Growth trends in APY of major crops in Bundelkhand region

Food grains are the most important source of food in Bundelkhand. The growth in area under food grain grew at positive rate in all the districts except for Jalaun, which revealed a negative of -0.12 percent. Likewise, the production food grain rose positive rate in most of the districts except for

Mahoba, which accounted negative of -0.01 per cent. In case of food grain productivity, it grew with extensive variations with mixed bag trends in all the districts. Area under oilseeds grew at the positive rate in all the districts and the highest being seen as 16.03 per cent in Hamirpur. But production of oilseeds shows positive growth rate and maximum has been noticed in Hamirpur as 15.15 per cent. In case of productivity of oilseeds has been observed mixed growth rate across the districts over the period of time. With regards to the area, production and productivity of sugarcane, vegetables and fruits has been seen mixed growth rate i.e., positive and negative in all the districts during the study period [16].

Considering Bundelkhand region, the growth in area under rice, wheat, cereals, food grain, oilseeds, sugarcane, vegetables and fruits is positive as 0.83 percent, 3.85 per cent, 2.69 per cent, 0.79 per cent, 7.23 per cent, 2.84 per cent and 6.02 per cent whereas coarse cereals and pulses grew at negative rate of -1.40 and -1.10 per cent respectively over the study period. On the other hand, production of all crops shows positive growth rate except for pulses, which showed a

negative of -0.40 per cent in Bundelkhand. In case of productivity under all crops grew at positive except for oilseeds as -0.91 per cent during the study period of time [17]. Overall, from the above analysis, it is noticed that the area, production and productivity of crops have widespread variations with mixed growth rate across all the districts of Bundelkhand throughout the entire study period. The growth trends in area, production and productivity of major crops in Bundelkhand region is also presented in (Fig 1).

District level trends of instability (Risk) in APY of major crops in Bundelkhand

Data depicted in (Table 3) the districts wise trends of Instability (risk) in agriculture of major crops grown in Bundelkhand region based on Area, Production and Productivity. From the table we find that in terms of area under rice the risk is highest as 64.87 per cent in Jalaun district and lowest 15.90 percent in Banda district while in case of production the risk is highest of 76.65 per cent in Jhansi and lowest being witnessed by Banda as 36.90 per cent.

Likewise risk in productivity of rice is highest of 50.69 per cent in Lalitpur and least 23.59 per cent is seen in Banda district during the study period. Area, production and productivity under wheat and total cereals showed highest instability (risk) in Mahoba and lowest risk being witnessed by Banda district over the study period [18].

In case of coarse cereals, risk in area, production and productivity also revealed highest in Mahoba and least instability (risk) in area of coarse cereals is seen in Chitrakoot as 14.88 per cent but risk in production and productivity of coarse cereals is lowest in Banda. Similarly, the risk in area under pulses showed maximum of 32.88 per cent in Jhansi and minimum 3.72 per cent in Chitrakoot whereas the risk in production and productivity of pulses showed highest in Mahoba. Considering food grain, the risk in area, production and productivity revealed highest of 24.01 per cent, 63.26 per cent, and 44.92 per cent respectively in Mahoba, whereas lowest risk in area, production, and productivity of food grain being witnessed by Banda i.e., 3.04 per cent, 19.46 per cent and 17.73 per cent respectively over the study period [19].

Table 3 District wise instability (Risk) in agriculture of major crops in Bundelkhand region

APY	Regions	Rice	Wheat	Coarse cereals	Total cereals	Pulses	Food grain	Oilseeds	Sugarcane	Vegetables and fruits
Area	Banda	15.90	4.89	16.25	5.06	5.41	3.04	31.44	19.08	11.09
	Chitrakoot	31.19	10.66	14.88	10.11	3.72	5.49	35.96	34.61	46.05
	Hamirpur	42.36	7.54	38.09	16.15	13.29	9.45	43.95	42.36	12.87
	Jalaun	64.87	8.07	31.39	12.67	21.73	7.61	47.90	33.48	9.67
	Jhansi	54.44	11.65	47.78	11.72	32.88	13.39	39.49	46.34	13.12
	Lalitpur	14.25	20.32	33.80	13.71	17.30	13.68	25.43	22.22	23.12
	Mahoba	29.16	24.26	52.09	24.78	25.83	24.01	16.61	21.04	6.09
	Bundelkhand	16.21	7.99	20.92	8.46	15.11	8.93	30.84	24.99	7.50
Production	Banda	36.90	17.78	26.21	18.33	28.24	19.46	26.05	26.96	11.18
	Chitrakoot	47.99	24.91	28.15	24.75	30.78	24.51	49.85	46.17	29.95
	Hamirpur	50.42	27.03	59.96	30.23	30.16	25.28	24.55	41.64	12.16
	Jalaun	74.01	24.79	43.02	25.05	48.11	26.35	44.71	53.62	12.53
	Jhansi	76.65	31.28	41.92	31.02	55.35	29.02	36.92	76.88	12.37
	Lalitpur	54.02	33.63	37.41	30.97	29.41	27.49	25.79	49.25	28.93
	Mahoba	50.62	65.02	80.70	63.63	67.35	63.26	32.02	29.87	8.83
	Bundelkhand	33.34	23.42	30.75	23.60	34.68	24.36	22.24	32.42	9.38
Productivity (yield)	Banda	23.59	16.14	19.57	15.76	27.74	17.73	42.63	25.00	6.53
	Chitrakoot	33.96	25.55	30.85	24.60	30.18	23.63	30.88	25.02	18.70
	Hamirpur	35.01	24.53	48.44	24.16	20.83	20.75	48.52	25.00	3.95
	Jalaun	53.63	23.44	40.72	26.10	32.99	21.67	57.45	43.62	5.13
	Jhansi	43.31	22.25	39.46	23.98	39.26	23.28	54.70	43.83	2.87
	Lalitpur	50.69	16.33	27.04	19.74	30.33	17.76	32.13	43.48	7.15
	Mahoba	31.96	43.35	52.89	43.53	49.79	44.92	36.00	25.00	5.24
	Bundelkhand	21.83	17.03	27.11	18.99	25.63	18.19	39.48	27.94	3.41

Source: Authors Calculation based on data from UPDES, Government of Uttar Pradesh

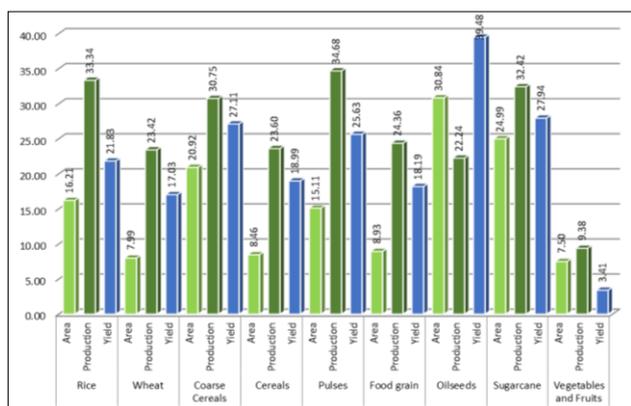


Fig 2 Trends of instability (Risk) in agriculture of major crops in Bundelkhand

Regarding area under oilseeds showed highest instability (risk) of 47.90 per cent in Jalaun district and lowest 16.61 per cent has been seen in Mahoba district although in case of production under oilseeds revealed highest as 44.71 per cent in Jalaun and least 24.55 per cent in Hamirpur. In contrast, risk in oilseeds productivity reached highest of 43.83 per cent in Jhansi. In the same way, risk in area, production and productivity under sugarcane revealed highest of 46.34 per cent, 76.88 per cent and 43.83 per cent respectively in Jhansi whereas lowest risk is 19.04 per cent, followed by 26.96 per cent and 25.00 per cent in area, production and productivity of sugarcane being seen by Banda district respectively. But risk in area and production under vegetables and fruits showed maximum in Chitrakoot and lowest being witnessed in Mahoba. In case vegetables and fruits

productivity, the trends of instability (risk) revealed highest of 18.70 per cent in Chitrakoot district and least has been noticed by Jhansi district i.e., 2.87 per cent during the study period [20].

The instability (risk) in area under cereals, pulses and food grain was 8.46 per cent, 15.11 per cent and 8.93 per cent respectively in Bundelkhand. Similarly, instability (risk) in area under oilseeds, sugarcane, vegetables and fruits showed as 30.84 per cent, 24.99 per cent and 7.50 percent respectively. In case of risk in production of cereals, pulses and food grain revealed 23.60 per cent, 34.68 per cent, and 24.36 per cent while the risk in production of oilseeds, sugarcane, vegetables and fruits showed highest 30.84 percent, followed by 24.99 percent and 7.50 percent respectively. In contrast, risk in cereals, pulses and food grain productivity was 18.99 per cent, 25.63 per cent, and 18.19 per cent but risk in productivity of oilseeds, sugarcane, vegetables and fruits

showed highest 39.48 per cent, followed by 27.94 per cent and 3.41 per cent respectively in Bundelkhand during the study period. Overall, from the analysis, it is observed that there are significant differences in area, production and productivity risk in all the crops in the districts and Bundelkhand during the study period. It is also seen that the risk in production is found to be much higher than risk in area of crops in Bundelkhand [21]. The trends of instability (risk) in agriculture of major crops in Bundelkhand region is also presented in above (Fig 2).

Relationship between growth and instability (Risk) of major crops in Bundelkhand

The trends of growth and instability of agriculture in Bundelkhand districts during 2004-05 to 2015-16 are presented in (Table 4). The growth and instability values have been divided into two groups i.e., Low and High.

Table 4 Relationship between growth and instability (Risk) of major crops in Bundelkhand

2 x 2 Table		Instability (Risk)		Risk (Variability)	
		Food grain		Oilseeds	
		Low	High	Low	High
Growth rate	Low	Jalaun, Jhansi and Mahoba		Lalitpur and Mahoba	
	High	Banda and Chitrakoot		Banda and Hamirpur	
		Vegetables and fruits		Pulses	
Growth rate	Low	Hamirpur, Mahoba and Jhansi		Hamirpur and Lalitpur	
	High	Banda and Jalaun		Banda and Chitrakoot	
		Rice		Wheat	
Growth rate	Low	Banda, Chitrakoot and Mahoba		Chitrakoot, Hamirpur and Jalaun	
	High	Hamirpur and Lalitpur		Banda	
		Jalaun and Jhansi		Jhansi and Mahoba	
				Lalitpur	

From the (Table 4), it is found that Banda, Chitrakoot, and Mahoba districts have low growth with low variability while Hamirpur and Lalitpur districts have low but high variability in rice. Likewise, Bundelkhand has high growth but low variability whereas Jalaun and Jhansi districts have high growth and high variability in rice crop over the study period. On the other hand, Chitrakoot, Hamirpur, and Jalaun districts shows low growth and low variability while Jhansi and Mahoba has low growth but high variability in wheat. Similarly, Bundelkhand and Banda reveal high growth but low variability while Lalitpur shows high growth and high variability in wheat crop. In case of pulses, Hamirpur, Lalitpur and Bundelkhand have low growth and low variability while Jalaun and Mahoba shows low growth but high variability. Banda and Chitrakoot show high growth but low variability whereas Jhansi district has high growth and high variability in pulses during the study period. With regards to food grain, Jalaun, Jhansi, and Mahoba districts have low growth but high variability whereas Bundelkhand region and the districts as Banda and Chitrakoot districts shows high growth but low variability [22]. Hamirpur and Lalitpur districts have high growth and high variability in food grain over the study period. Considering oilseeds, the districts like Lalitpur and Mahoba has low growth and low variability whereas Jalaun and Jhansi reveals low growth but high variability. Likewise, Banda and Hamirpur districts have high growth but low variability while only Chitrakoot district has high growth and high variability in food grain during the study period. In case of vegetables and fruits, Bundelkhand region and districts like Hamirpur, Mahoba, and Jhansi reveal low growth and low variability whereas Lalitpur shows low growth but high variability. Likewise, Banda and Jalaun districts have high

growth but low variability while Chitrakoot district has high growth and high variability in vegetables and fruits throughout the entire study period [23].

CONCLUSIONS

This paper has examined the pattern of growth and instability of the principal crops in Bundelkhand region of Uttar Pradesh. The result indicates that there were several fluctuations in the growth pattern of APY of the major crops at district level in Bundelkhand. While the growth rate of area showed a continuous decline for pulses and coarse cereals it increased throughout the period for fine cereals, oilseeds, fruits and vegetables. In case of production and productivity, the growth rate of all crops except pulses and oilseeds has been found positive. It is also observed that the area, production and productivity of crops have widespread variations with mixed growth rate across all the districts of Bundelkhand throughout the entire study period. On the other hand, the trends of instability with respect to various crops has been clearly indicate that there is high level of instability index in all crops in terms of area, production and productivity in Bundelkhand region at aggregated level as well as district level. The agriculture risk has been found least in case of fruits and vegetables. It is noticed that there are significant differences in area, production and productivity risk in all the crops in the districts and Bundelkhand during the study period. It is also seen that the risk in production is found to be much higher than risk in area of crops in Bundelkhand with high fluctuation at district level. The growth and instability relationship clearly indicates that there is positive relationship between growth and instability. It means that higher growth

rate leads higher instability. The present study has been carried at the district level of Bundelkhand region and the study will facilitate pragmatic agricultural development planning and policy formulation at regional as well as district units. The fluctuated growth performance of crop sector in Bundelkhand region has indicated the need for evolving specific strategies at district level for ensuring sustainable and inclusive agricultural growth in Uttar Pradesh consequently in the India. The districts have depicted low production and productivity having diverse, complex, under-invested, rain-fed, risky and vulnerable area. Therefore, there is need to mitigate agricultural risk factor and provide irrigation facilities along with modern inputs and prudent management of rainfall water for the development of agriculture sector in Bundelkhand region. The instability in production as well as

productivity of crop sector continues to persist and there are wide and high variations in instability across different districts in Bundelkhand region. Moreover, there is a require to focus on specific cropping pattern, improved irrigation services, provide better rural infrastructure, an effective institutionalized mechanism and crop insurance to enhance the farmer's income and reducing agricultural instability (risk) in Bundelkhand region.

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