

AGRO-CLIMATIC ZONE WISE ANALYSIS OF FOODGRAIN PRODUCTIVITY IN UTTAR PRADESH: AN ECONOMIC ENQUIRY

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Abstract

Agriculture plays a crucial role in foodgrain production, yet productivity varies significantly across agro-climatic zones. This study explores foodgrain productivity across the nine agro-climatic zones of Uttar Pradesh from 2004-05 to 2022-23 using secondary data. The findings reveal that the Western Plain Zone has consistently recorded the highest productivity due to better irrigation facilities and advanced agricultural practices. In contrast, the Bundelkhand region shows relatively lower productivity, though notable improvements have been observed in recent years. The study suggests targeted policy interventions and region-specific strategies to enhance productivity in lagging zones and ensure balanced agricultural growth.

Key Words: Agro-Climatic Zone, Productivity, Foodgrains etc .

INTRODUCTION

Agriculture remains the primary source of livelihood for a substantial share of the population in Uttar Pradesh (UP). Uttar Pradesh holds a dominant position in India's food grain economy—particularly as the leading contributor of wheat and a major producer of rice. Its agricultural performance is therefore fundamental to achieving food security for the country. However, despite this strong production base, India continues to face widespread nutritional deficiencies, suggesting an urgent need to enhance both productivity and the efficiency of resource utilization in the sector. Agricultural growth in UP has been moderate and slower than many other states. Therefore, indicating structural bottlenecks and productivity-related challenges in sector.

LITERATURE SURVEY

Raman and Khan (2017) found agriculture crisis in Uttar Pradesh is not uniform. Sant and Mohapatra (2019) suggests that to ensure suitability and sustainability of agriculture in Bundelkhand region the cropping pattern should align with agro-climatic conditions of the region. Kumar (2020) demonstrates that enhanced agricultural infrastructure not only correlates with but also contributes to increased farmer incomes. The study underscores that agricultural infrastructure in the state is unevenly distributed. Kumar et al., (2020) highlight the importance of diversification and enhanced market competition as essential for improving farmers' welfare. BIRTHAL et al., (2012) found that by addressing the resource constraints they face and creating a supportive environment, it is possible to unlock the economic advantages of high-value crop farming for small-scale agriculturalists. Holla and Ittyerah (2018) found the plight of farmers is exacerbated by inadequate infrastructure and mounting debt burdens.

Singh P. et al. (2021) investigated the key determinants influencing food grain productivity in Uttar Pradesh. Their study highlights considerable variations across both time and regions in terms of production and yield performance. Uneven progress of agriculture in state can be attributed to diverse agro ecological characteristics. Highlighting regional variations in vulnerability and performance (Singh & Nayak, 2020). Therefore, a comprehensive zone-wise assessment of productivity can help identify performance gaps, highlight region-specific strengths, and support policymakers in developing customized interventions etc.

OBJECTIVE OF THE STUDY

The present study has to analyse the agroclimatic zone wise productivity analysis of food grain production in Uttar Pradesh. This study shall find out zone specific policy suggestions.

RESEARCH METHODOLOGY AND DATA BASE

The present study is based on secondary data from 2004–05 to 2022–23. The analysis covers all nine agro-climatic zones of the state. The data was collected from the following published sources Statistical Diary of Uttar Pradesh, Agricultural Statistics at a Glance, District-wise Development Indicators, Department of Economics & Statistics, Government of Uttar Pradesh (desagri.up.nic.in). The major variable considered in this study is productivity of foodgrains, measured in quintals per hectare (q/ha). Productivity was calculated using the standard formula:

$$Yield \left(\frac{t}{ha} \right) = \frac{total\ production(t)}{area(ha)}$$

The Compound Annual Growth Rate (CAGR) was computed for foodgrain productivity over the study period.

$$CAGR(\%) = \left(\frac{productivity\ of\ crop\ in\ final\ year}{productivity\ of\ crop\ in\ first\ year} \right)^{\frac{1}{n}} - 1$$

Where: n = Number of years in the study period

ANALYSIS OF STUDY

Agroclimatic Zone Wise Productivity of Foodgrains

The table 1 shows that Zone-9 (Western Plain) has consistently remained the highest-performing zone, with productivity ranging from 29.59 q/ha in 2004-05 to 36.28 q/ha in 2022-23. Similarly, Zone-7 (South-West Semi-Arid) and Zone-3 (Central Plain) also maintained comparatively high productivity levels.

Year	Zone-1 B&T	Zone -2, Blkd	Zone -3 Central	Zone-4 Est-Pl	Zone 5 M-W-Pl	Zone-6_N-E-Pl	Zone-7_S-W-s-a	Zone-8_Vdh	Zone-9_W-Pl
2004-05	27.08	17.69	21.81	18.25	23.10	19.95	24.84	10.43	29.59
2005-06	27.00	16.95	21.85	21.64	24.08	20.57	25.72	13.97	29.13
2006-07	27.69	17.15	23.34	21.53	25.28	21.28	24.36	16.31	31.13
2007-08	29.91	12.88	23.42	23.02	25.71	23.39	26.69	15.44	30.44
2008-09	28.69	20.48	25.75	24.58	26.45	24.08	28.31	17.86	31.91
2009-10	28.34	19.49	24.39	24.90	27.21	22.75	26.50	17.03	31.24
2010-11	28.65	21.28	26.39	25.17	26.43	24.91	28.75	19.75	32.07
2011-12	30.50	24.23	28.05	27.08	26.59	26.40	30.45	21.89	35.28
2012-13	30.23	24.31	28.11	27.76	28.44	26.62	30.74	22.57	34.34
2013-14	30.13	20.32	28.03	25.68	28.47	27.42	30.87	22.31	34.38
2014-15	24.12	13.32	19.16	21.28	20.58	22.10	22.30	18.22	26.30
2015-16	31.12	15.60	22.82	23.75	27.23	23.01	27.86	16.86	33.19
2016-17	33.43	26.50	28.31	28.27	43.28	27.58	32.35	25.31	36.08
2017-18	34.28	25.54	31.10	30.72	32.11	30.54	32.64	26.53	37.48
2018-19	35.71	29.60	32.69	32.07	34.01	31.47	33.43	28.41	38.66
2019-20	35.38	29.53	32.37	32.08	33.66	31.48	33.02	25.55	37.70
2020-21	40.62	26.24	32.00	32.21	35.73	30.61	34.10	26.19	36.54
2021-22	34.37	27.72	29.18	30.28	33.49	28.84	31.34	28.48	35.67
2022-23	35.35	31.45	34.00	30.86	35.89	30.29	32.81	29.20	36.28

Data Source: Statistical Diary of Uttar Pradesh

The Zone-8 (Vindhyan) and Zone-2 (Bundelkhand), showed noticeable improvement after 2015. However, Bundelkhand (Zone-2) experienced sharp fluctuations during the early years due to persistent drought-prone conditions and rocky soil terrain. Overall, the long-term trend over 19 years indicates steady growth in Uttar Pradesh's foodgrain sector supported by increased adoption of improved irrigation penetration (canal + groundwater), enhanced mechanization and fertilizer use, expansion of agricultural extension services etc.

CAGR of Productivity of Rice, Wheat, Juar, Bajra, Maize & Barley

The table 2 presents the Compound Annual Growth Rate (CAGR) of six major food grains—Rice, Wheat, Juar, Bajra, Maize, and Barley—across nine agro-climatic zones of Uttar Pradesh between 2004-05 and 2022-23.

Agro-climatic Region	PVTY_Rice	PVTY_WHEAT	PVTY_JUAR	PVTY_Bajra	PVTY_Maize	PVTY_Barley
Zone-1 B&T	1.44	1.80	-0.93	-6.21	2.47	-1.15
Zone -2, Blkd	5.99	3.33	3.80	2.45	2.83	4.82
Zone -3 Central	5.17	1.90	0.92	1.56	3.85	3.23
Zone-4 Est-Pl	2.70	2.38	1.95	1.29	3.06	2.70
Zone 5 M-W-Pl	2.19	1.30	1.37	2.93	2.88	2.00
Zone-6 N-E-Pl	2.28	2.50	-1.79	-0.97	3.17	2.68
Zone-7 S-W-s-a	0.52	1.58	1.48	3.13	3.40	1.36
Zone-8 Vdh	6.24	3.92	2.00	0.99	5.31	8.27
Zone-9 W-Pl	1.53	1.27	-3.46	1.58	2.94	1.18

Data Source: Statistical Diary of Uttar Pradesh

Zone-1 (Bhabar & Tarai, B&T) highlights that rice and wheat recorded modest growth rates (1.44% and 1.80%, respectively). Juar and Bajra productivity declined sharply, with Bajra showing the most significant negative CAGR (-6.21%). Zone-2 (Bundelkhand, Blkd) shows the highest growth among zones for Rice (5.99%) and Juar (3.80%). The Zone-2, highlights the wheat and barley growth is also substantial (3.33% and 4.82%). Bajra (2.45%) and Maize (2.83%) maintained moderate positive trends. Zone-3 (Central Plains) highlights strong rice productivity growth at 5.17%, followed by Maize (3.85%) and Barley (3.23%). Wheat (1.90%) and Bajra (1.56%) had modest increases while Juar increased slightly (0.92%). Zone-4 (Eastern Plains) features rice and wheat growth at 2.70% and 2.38%, respectively. Maize productivity notable at 3.06%. Zone-5 (Mid-Western Plains) shows moderate growth in Rice (2.19%), Wheat (1.30%), and Maize (2.88%). Wheat, Juar, Maize, and Bajra all showed strong positive trends. Zone-9 (Western Plains) shows that rice and wheat growth is modest (1.53% and 1.27%). Zone-8 (Vindhyan) with highest CAGR consistently exhibits the highest growth across most crops, signaling a successful adaptation of agricultural technologies.

Productivity analysis of Rice, Wheat, Juar, Bajra, Maize & Barley Agro-Climatic Zone Wise

The table 3 presents the year-wise rice productivity (quintals per hectare) across nine agro-climatic zones from 2004-05 to 2022-23.

Year	Zone_1	Zone_2	Zone_3	Zone_4	Zone_5	Zone_6	Zone_7	Zone_8	Zone_9
2004-05	25.3	8.5	20.9	14.8	21.0	16.8	23.4	7.5	21.8
2005-06	23.7	9.9	20.6	19.8	19.9	19.6	23.8	13.4	20.1
2006-07	23.6	8.2	19.8	17.4	20.0	17.3	22.4	14.9	20.1
2007-08	25.6	5.6	20.9	20.2	21.3	20.1	23.1	13.8	21.1
2008-09	23.0	12.2	23.0	22.3	20.0	21.8	23.9	18.0	20.1
2009-10	24.1	10.0	22.2	20.0	21.7	20.1	21.1	15.7	21.9
2010-11	22.2	13.3	21.5	22.0	18.7	21.2	21.9	18.7	19.8
2011-12	24.6	13.8	24.2	24.4	22.8	22.8	24.2	21.9	21.7
2012-13	25.4	15.9	25.6	24.8	22.9	23.7	25.5	23.2	23.3
2013-14	24.8	15.0	25.7	24.0	23.0	24.3	24.7	23.4	23.6
2014-15	25.1	14.8	23.0	22.6	23.1	21.6	23.2	20.5	23.1
2015-16	26.2	12.1	22.1	21.1	23.4	18.7	22.4	17.7	23.2
2016-17	27.0	15.6	25.4	24.3	23.5	22.6	24.4	26.8	22.7
2017-18	27.2	16.0	27.1	26.0	24.7	25.7	24.7	28.2	24.4
2018-19	27.5	18.2	27.8	26.8	26.6	26.6	23.5	29.5	24.4
2019-20	29.7	21.7	30.7	28.5	27.2	28.0	25.0	30.1	25.3
2020-21	32.7	22.3	30.0	27.9	30.7	27.0	25.7	30.9	25.2
2021-22	29.6	19.8	209.6	25.7	27.4	25.5	24.4	31.1	28.6
2022-23	28.7	21.9	29.2	28.4	27.9	26.2	25.2	30.5	25.0

Data Source: Statistical Diary of Uttar Pradesh

Rice productivity in Zone 1 ranged from 22.2 to 29.7 q/ha during the study period. In Zone 2 (Bundelkhand), rice productivity was low, ranging between 5.6 and 12.2 q/ha. The Zone-3, Central Plains, consistently maintained high rice productivity, ranging from 19.8 to 30.7 q/ha. The Zone-4 Eastern Plains, Rice productivity increased steadily from 14.8 q/ha in 2004-05 to 28.4 q/ha in 2022-23. In Zone 5 Mid-Western Plains, rice productivity ranged from 18.7 to 30.7 q/ha, with noticeable increases after 2015-16. In the North-Eastern Plains productivity improved from 16.8 q/ha in 2004-05 to 26.2 q/ha in 2022-23. In Zone-7, South-Western Semi-Arid, Rice yields remained relatively high and stable throughout the study period. The Zone-8, Vindhyan region showed the most remarkable improvement in rice productivity. Starting from a low base of 7.5 q/ha in 2004-05, productivity increased dramatically to 30.5 q/ha by 2022-23.

Zone-3 (Central Plains), Zone-8 (Vindhyan Region), and Zone-9 (Western Plains) show strong productivity growth over the period. Zone-2 (Bundelkhand) and Zone-8 started with low productivity but improved significantly over the study period.

The table 4 provides year wise wheat productivity (quintals per hectare) across nine agro-climatic zones of Uttar Pradesh from 2004-05 to 2022-23. In Zone-1, Wheat productivity displayed a steady and consistent increase from 29.1 q/ha in 2004-05 to 40.5 q/ha in 2022-23.

Table: 4 Productivity of Wheat in Uttar Pradesh-Agro Climatic Zone Wise									
Year	Zone_1	Zone_2	Zone_3	Zone_4	Zone_5	Zone_6	Zone_7	Zone_8	Zone_9
2004-05	29.1	20.1	25.3	21.4	26.2	23.7	29.0	13.5	29.0
2005-06	30.3	18.9	25.7	24.0	29.0	22.4	31.2	15.5	28.6
2006-07	31.7	18.7	28.6	26.0	31.0	26.1	28.6	19.4	30.7
2007-08	33.3	15.0	27.5	26.8	30.5	27.8	31.9	18.9	29.5
2008-09	33.7	22.9	30.8	28.0	32.4	27.8	33.5	20.0	31.4
2009-10	31.7	21.9	28.4	26.5	31.4	26.7	31.4	20.4	30.7
2010-11	34.2	22.5	32.1	29.0	32.4	29.5	34.9	23.1	33.0
2011-12	35.3	26.4	33.4	30.5	34.0	30.9	36.7	25.2	35.5
2012-13	34.3	25.9	32.5	31.7	32.8	30.3	36.2	24.8	35.1
2013-14	34.2	21.6	31.7	27.9	33.0	31.0	35.7	23.8	34.9
2014-15	23.8	12.9	18.5	20.4	19.6	22.9	22.0	17.8	24.7
2015-16	34.7	15.2	26.3	26.3	30.7	27.1	32.9	18.6	33.0
2016-17	38.6	29.8	35.5	33.2	34.7	33.3	38.9	28.4	35.8
2017-18	39.6	27.0	36.4	35.4	34.8	36.1	38.1	30.4	35.6
2018-19	41.6	31.7	38.5	36.9	36.6	36.9	40.6	32.0	36.8
2019-20	39.7	31.4	36.3	35.7	35.1	36.2	37.9	25.2	36.2
2020-21	41.6	31.2	37.0	36.0	36.4	36.8	39.6	31.8	36.3
2021-22	40.6	32.3	35.5	35.6	36.1	36.6	37.7	32.5	35.5
2022-23	40.5	34.6	36.5	33.4	37.0	36.1	39.2	29.9	35.8

Data Source: Statistical Diary of Uttar Pradesh

The Zone-2, Wheat productivity was initially low and somewhat erratic, with yields fluctuating between 15.0 and 26.4 q/ha in early years. In Zone-3, Central Plains demonstrated consistently high wheat productivity, ranging from 25.3 q/ha to 36.5 q/ha. The Zone-4, Eastern Plains, Wheat productivity increased from 21.4 q/ha in 2004-05 to 33.4 q/ha in 2022-23. In Zone-5, Mid-Western Plain, wheat productivity rose from 26.2 q/ha to 37.0 q/ha over the study period. Wheat yields in the North-Eastern Plains increased from 23.7 q/ha in 2004-05 to 36.1 q/ha in 2022-23. Wheat productivity in the South-Western Semi-Arid zone-7 exhibited a strong and consistent upward trajectory, increasing from 29.0 q/ha to 39.2 q/ha. Zone-8 (Vindhyan Region) The Vindhyan region showed remarkable improvement in wheat productivity, starting from a low base of 13.5 q/ha in 2004-05 to 29.9 q/ha in 2022-23. In the Western Plains, wheat productivity remained high and relatively stable, ranging from 29.0 q/ha to 36.8 q/ha.

The table 5 presents year-wise Juar productivity (quintals per hectare) across nine agro-climatic zones of Uttar Pradesh from 2004-05 to 2022-23. Juar productivity in Zone-1 shows considerable fluctuations, ranging from a low of 1.8 q/ha in 2011-12 to a peak of 13.3 q/ha in 2015-16.

Table:5 Productivity of Juar in Uttar Pradesh-Agro Climatic Zone Wise									
Year	Zone_1	Zone_2	Zone_3	Zone_4	Zone_5	Zone_6	Zone_7	Zone_8	Zone_9
2004-05	5.9	9.7	10.8	10.3	8.6	8.4	7.5	5.7	5.0
2005-06	7.0	8.2	12.6	11.2	10.5	7.8	10.1	11.7	6.3
2006-07	7.0	10.0	11.2	11.4	10.4	8.1	10.5	10.7	6.1
2007-08	2.1	3.6	11.0	10.7	5.0	6.6	6.8	10.3	4.5
2008-09	11.7	9.2	12.4	9.4	9.8	8.3	10.4	11.4	5.4

2009-10	10.5	7.8	11.3	10.2	8.4	7.0	9.0	9.9	4.4
2010-11	2.0	10.1	11.4	10.9	6.4	6.0	6.9	8.4	4.9
2011-12	1.8	10.3	11.9	11.3	5.9	5.6	9.1	12.9	3.4
2012-13	3.5	14.1	13.5	12.9	7.5	7.2	11.2	11.7	3.9
2013-14	3.6	8.9	11.7	8.7	6.3	5.4	7.6	12.2	3.3
2014-15	6.9	9.0	9.2	11.3	7.4	5.2	16.0	9.8	4.7
2015-16	13.3	3.7	8.6	9.0	9.2	4.3	6.5	9.8	3.4
2016-17	3.3	9.3	10.7	10.5	9.6	4.8	10.2	12.6	4.4
2017-18	3.4	11.5	12.7	11.3	9.3	4.3	10.4	13.1	3.1
2018-19	3.5	12.7	12.6	12.5	8.4	4.8	11.0	11.3	5.3
2019-20	3.7	12.3	11.3	13.9	7.6	3.7	11.7	13.3	2.8
2020-21	9.1	16.5	13.5	16.7	10.7	8.1	11.4	10.7	3.0
2021-22	3.6	16.4	14.1	20.6	10.1	6.7	8.8	13.0	4.2
2022-23	5.3	15.9	16.1	14.9	12.8	9.1	11.7	12.9	2.1

Data Source: Statistical Diary of Uttar Pradesh

In Zone-3, the Central Plains consistently achieved high Juar productivity, between 8.6 and 16.1 q/ha, with minor fluctuations. Zone-4, productivity in the Eastern Plains fluctuated between 8.7 and 20.6 q/ha, peaking in 2021-22 at 20.6 q/ha. The Zone-5, Juar productivity remained moderate, ranging from 5.0 to 12.8 q/ha. The Zone-6, showed low productivity, ranging from 3.7 to 9.1 q/ha, with minor fluctuations. In Zone-7 the productivity varied between 6.5 and 16.0 q/ha, with occasional peaks such as 16.0 q/ha in 2014-15. Zone-8, the Vindhyan region recorded moderate to high productivity. Zone-9, Juar productivity in the Western Plains remained the lowest among all zones, ranging from 2.1 to 6.3 q/ha.

The table 6 presents year-wise Bajra productivity (quintals per hectare) across nine agro-climatic zones of Uttar Pradesh from 2004-05 to 2022-23. In Zone-1, Bajra productivity shows high variability, ranging from a peak of 14.3 q/ha in 2007-08 to a low of 2.0 q/ha in 2013-14. In Zone-2 (Bundelkhand), productivity ranged from 4.2 to 16.4 q/ha.

Table:6 Productivity of Bajra in Uttar Pradesh-Agro Climatic Zone Wise									
Year	Zone_1	Zone_2	Zone_3	Zone_4	Zone_5	Zone_6	Zone_7	Zone_8	Zone_9
2004-05	8.0	8.8	12.1	14.2	10.7	16.2	17.5	9.9	13.1
2005-06	8.0	10.2	11.3	14.5	9.8	13.4	16.3	11.9	12.2
2006-07	9.7	9.3	13.2	14.8	11.1	13.6	16.1	9.8	11.9
2007-08	14.3	7.7	12.6	14.4	12.2	12.7	16.8	9.6	11.2
2008-09	9.7	8.1	14.5	15.0	12.4	11.0	17.6	9.3	12.9
2009-10	14.1	6.2	12.8	13.9	13.6	9.4	17.3	12.3	13.7
2010-11	5.6	6.2	13.3	10.0	10.2	9.5	17.9	12.7	12.8
2011-12	3.6	7.6	13.3	15.9	13.3	10.8	20.6	14.8	13.1
2012-13	4.8	14.7	13.6	12.9	12.1	11.0	22.0	10.9	12.3
2013-14	2.0	10.9	12.7	8.8	12.6	11.0	23.7	14.4	16.4
2014-15	7.2	6.2	12.3	14.5	13.4	10.3	21.9	13.6	12.7
2015-16	3.6	4.2	13.1	11.3	16.0	9.8	20.9	10.3	12.5
2016-17	4.2	7.3	14.5	11.8	14.4	10.3	23.0	12.7	14.2
2017-18	3.3	10.0	13.4	15.4	14.4	10.6	24.3	8.4	13.8
2018-19	3.9	8.6	16.5	18.5	14.6	9.7	24.5	12.9	14.0
2019-20	5.6	15.9	17.7	17.3	14.9	12.3	26.2	12.7	14.6
2020-21	3.3	16.4	15.7	18.8	19.3	13.1	27.8	12.5	17.3
2021-22	3.8	12.5	14.4	18.0	17.7	10.1	25.9	11.8	16.6
2022-23	3.9	12.7	16.3	16.8	16.9	11.9	26.1	13.3	15.6

Data Source: Statistical Diary of Uttar Pradesh

The Zone-3 consistently show high productivity, ranging from 11.3 to 17.7 q/ha. In Zone-4, Bajra productivity fluctuated between 8.8 and 18.8 q/ha. The Zone-5, Productivity ranged from 9.8 to 19.3 q/ha. In Zone-6, it consistently record moderate productivity, ranging from 9.4 to 16.2 q/ha. The Zone-7, consistently demonstrates the highest Bajra productivity across Uttar Pradesh, ranging from 16.1 to 27.8 q/ha. Peaks in 2020-21 at 27.8 q/ha.

The table presents year-wise maize productivity (quintals per hectare) across nine agro-climatic zones of Uttar Pradesh from 2004-05 to 2022-23. In Zone-1, Maize productivity shows moderate yields ranging from 7.9 to 29.6 q/ha.

Table:7 Productivity of Maize in Uttar Pradesh-Agro Climatic Zone Wise

Year	Zone_1	Zone_2	Zone_3	Zone_4	Zone_5	Zone_6	Zone_7	Zone_8	Zone_9
2004-05	13.6	12.2	14.5	17.8	14.5	13.7	20.3	6.1	12.9
2005-06	14.8	10.4	12.6	13.3	13.5	13.3	16.8	8.7	13.1
2006-07	15.1	11.0	13.1	12.4	14.3	12.0	18.8	6.3	15.1
2007-08	17.0	9.0	15.0	12.6	15.4	11.0	20.0	8.0	15.2
2008-09	15.2	9.8	15.0	9.9	16.7	10.5	22.3	6.0	17.5
2009-10	15.5	13.9	14.2	14.2	16.8	11.9	19.1	6.9	14.2
2010-11	9.3	11.0	12.6	13.7	12.1	11.6	20.5	7.8	16.2
2011-12	11.8	13.0	14.1	14.2	16.8	14.5	23.3	7.9	16.8
2012-13	10.1	13.0	16.7	16.1	15.8	16.2	25.0	9.9	18.0
2013-14	17.4	11.4	17.2	15.9	16.4	16.7	26.1	10.6	17.6
2014-15	13.3	15.2	16.3	15.4	17.1	16.0	24.0	10.9	17.1
2015-16	19.5	14.5	16.3	12.3	17.8	15.7	24.4	10.8	19.2
2016-17	20.9	13.7	20.4	13.6	19.1	15.1	25.3	7.4	16.6
2017-18	26.5	20.0	23.6	17.1	20.3	15.4	27.2	12.9	19.0
2018-19	21.0	16.7	20.5	18.9	18.8	14.5	27.5	13.4	20.4
2019-20	19.6	16.6	23.9	16.7	21.6	15.6	30.1	11.7	21.0
2020-21	29.6	19.6	24.9	17.1	24.7	16.2	32.0	12.6	21.1
2021-22	7.9	11.0	22.9	30.3	20.2	22.9	38.0	11.9	28.4
2022-23	26.5	16.2	23.0	25.0	23.1	25.8	28.9	25.5	19.8

Data Source: Statistical Diary of Uttar Pradesh

Zones like Vindhyan and Bhabar & Tarai show moderate and fluctuating yields, indicating susceptibility to climatic variability and soil limitations.

The table 8 show that Zone-1, Barley productivity ranges from 10.8 to 28.5 q/ha, showing high variability over the years. Zone-2 (Bundelkhand), Productivity ranges from 8.0 to 29.8 q/ha.

Table:8 Productivity of Barley in Uttar Pradesh-Agro Climatic Zone Wise

Year	Zone_1	Zone_2	Zone_3	Zone_4	Zone_5	Zone_6	Zone_7	Zone_8	Zone_9
2004-05	21.1	16.0	16.1	16.3	21.1	19.5	27.0	6.9	22.7
2005-06	22.2	13.9	17.5	17.4	22.2	17.1	29.5	5.8	23.0
2006-07	21.8	11.8	18.5	19.2	21.8	20.4	25.6	10.1	28.3
2007-08	21.1	8.0	17.4	19.3	21.1	21.4	27.5	7.4	24.7
2008-09	24.6	13.7	19.6	21.9	24.9	23.6	30.8	10.9	28.6
2009-10	22.8	14.6	15.8	21.2	22.8	21.9	29.5	9.0	27.4
2010-11	26.2	24.3	21.6	23.0	26.2	22.1	31.6	12.2	27.8
2011-12	18.9	26.0	24.3	23.5	28.4	27.4	33.5	15.5	30.9
2012-13	26.5	24.4	25.6	23.2	26.5	25.2	32.4	15.8	23.2
2013-14	19.3	27.3	29.0	25.1	29.0	29.1	33.8	20.8	29.3
2014-15	10.9	14.3	13.7	15.8	16.3	13.4	21.5	15.7	22.8
2015-16	15.5	13.8	17.7	20.9	23.3	17.2	27.4	9.5	27.3
2016-17	27.0	25.7	25.7	23.3	25.7	30.1	33.7	16.6	27.9
2017-18	28.5	25.7	28.2	25.1	27.2	26.9	34.7	11.6	30.4
2018-19	20.4	29.8	29.0	27.5	30.2	30.8	34.0	20.0	31.9
2019-20	10.8	25.7	28.5	29.7	32.1	30.0	36.0	29.5	32.2
2020-21	20.8	23.8	29.9	28.9	30.6	31.2	35.7	28.8	30.5
2021-22	20.2	26.6	26.8	26.2	30.4	30.2	34.1	26.8	30.8
2022-23	20.5	28.5	27.4	29.2	29.9	30.7	34.0	30.7	27.0

Data Source: Statistical Diary of Uttar Pradesh

In Zone-2, Productivity ranges from 8.0 to 29.8 q/ha. The Zone-3 shows consistently high barley productivity, ranging from 13.7 to 29.9 q/ha. In Zone-8 (Vindhyan Region), Barley productivity ranges from 5.8 to 30.7 q/ha.

CONCLUSION

Wheat and rice exhibited the strongest and most consistent improvements, reflecting the continued dominance of the rice–wheat cropping system in Uttar Pradesh. The better irrigation coverage, diffusion of seed varieties, mechanization, and assured procurement policies support productivity. In contrast, Bundelkhand (Zone-2), though traditionally lower-performing, recorded exceptional growth rates in recent years for cereals like rice and wheat, indicating the impact of targeted water resource development and government interventions. Jowar and Bajra showed highly fluctuating and often declining productivity in several zones, requires special attention. The study suggesting diversification, strengthening infrastructure, technology dissemination are important intervention required.

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