

A TEMPORAL ANALYSIS OF RICE PRODUCTIVITY IN EASTERN UTTAR PRADESH

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ABSTRACT

Eastern Uttar Pradesh is a major economic region of Uttar Pradesh. A total of 28 districts of Uttar Pradesh are included in it. It is also known as Purvanchal. The total population of Eastern Uttar Pradesh is 803.90 lakhs. Out of which 411.73 lakhs (51.22%) are male and 392.16 lakhs (48.78%) are female. In the Eastern Uttar Pradesh about 87.79% population lives in rural area and 12.21% population resides in urban area. The population density of Eastern Uttar Pradesh is 931 persons per square kilometer. The main occupation of the residents of Eastern Uttar Pradesh is agriculture. This region is backward from the industrial point of view. The size of agricultural land holdings in this region is very small. Rice is a major cereals crop of Eastern Uttar Pradesh, which is produced in the kharif season. The production and productivity of rice in Eastern Uttar Pradesh is continuously increasing during the study period. Because of the growth in population, the demand for the main food grain crops rice and wheat is continuously increasing due to which food grain crops are produced on most of the land. On the basis of this study, it can be said that if the years from 2013-14 to 2015-16 are left aside, a continuous increase in the productivity of rice has been reflected from the year 2011-12 to the year 2022-23. It has been possible due to the using of high productivity seeds, development of irrigation facilities, arrangement of fertilizers and pesticides, training of farmers, availability of agricultural kits, favorable environment etc. In the present study, an attempt has been made to measure the trend of increase in rice productivity in Eastern Uttar Pradesh through Chow-test.

Keywords: Rice Productivity, Rice Production, Cereals, Trends, Eastern Uttar Pradesh

INTRODUCTION

The agriculture plays an important role in the economic development of a country and this role becomes more important in an agricultural country like India. At the same time, most of the population of Uttar Pradesh and Eastern Uttar Pradesh is engaged in agricultural activities. Agricultural tasks such as providing food to the people, increasing exports, preparing the basis for capital formation and industrial development, providing them markets, etc. are done through agriculture. In Eastern Uttar Pradesh, about 65% of the working

population is employed in the agriculture sector. The contribution of the agriculture sector to the GDP of Eastern Uttar Pradesh was about 17.8% in the financial year 2021-22. The agriculture sector provides the necessary labour force and raw materials for the development of the non-agriculture sector and industrial sector.

Eastern Uttar Pradesh is also known as Purvanchal. Purvanchal is a geographical region of north-central India. Made up of two Hindi words, Purva and Anchal, **Purvanchal** means eastern region of Uttar Pradesh. Basti, Sant Kabir Nagar, Siddharth

Nagar, Gorakhpur, Kushinagar, Deoria, Maharajganj, Ayodhya, Amethi, Ambedkar Nagar, Sultanpur, Gonda, Bahraich, Shravasti, Balarampur, Prayagraj, Kaushambi, Pratapgarh, Varanasi, Ghazipur, Chandauli, Jaunpur, Mirzapur, Sonbhadra, Bhadohi, Azamgarh, Mau Ballia, etc. districts are included in Purvanchal.

Eastern Uttar Pradesh is located on the Indus-Ganga plain and, consisting of the western part of Bihar, is the most densely populated region in the world. Eastern Uttar Pradesh region is bordered by Bihar and Jharkhand states in the East, Chhattisgarh, Madhya Pradesh, and Bundelkhand region of Uttar Pradesh in the South, central region of Uttar Pradesh in the West and Nepal in the North. Eastern Uttar Pradesh is divided into three climatic zones- North Eastern Plains, Eastern Plains, and Vindhya Region. The climate here is tropical and suitable for agriculture. The average minimum temperature in the winter season ranges from 15 Degrees Celsius to 25 Degrees Celsius in the northern part of the plains and in the summer season the maximum temperature ranges from 32 Degrees Celsius to 46 Degrees Celsius. The average annual rainfall here is about 1100 mm, which is quite irregular and about 85% to 90% of the rainfall occurs between July to September.

Rice is a major crop of Eastern Uttar Pradesh which is planted in the Kharif season in June-July and is harvested in October-November. Rice is cultivated in about 2 million hectares in Eastern Uttar Pradesh. Rice is one of the three most important food grains in the world and is the staple diet of 2.7 billion people in the world. It is essential for ensuring food security in Asia. Farming is extremely important, with more than 90% of the global rice produced and consumed in this continent. Clay soil is considered most useful for rice cultivation and rice can be cultivated in other types of soil where there is a suitable irrigation facility. It is a tropical plant, which requires a hot and humid climate. Rice is mainly grown in areas with high rainfall; it requires a temperature above about 25 Degrees Celsius and rainfall of more than 1000 mm. In terms of rice production Uttar Pradesh holds an

important place in the country in which Eastern Uttar Pradesh has the major share. In this region, 63.80% of the net sown area is used for rice cultivation, out of which 76.2% is irrigated. Ayodhya, Basti, Shiddharth Nagar, Maharajganj, Deoria, Kushinagar, Gonda, Bahraich, Mau, Ballia are major area where intensive production of rice can be seen.

REVIEW OF LITERATURE

The review of related literature highlights the previous study on the related topic, that helps to make objectives and create hypotheses for the present study. The review of related literature, outcome of research inquires, accomplished through systematic thinking, factual observations and past experiences becomes a sound base of knowledge for the future research because such study is always undertaken based on past acquired and accumulated knowledge in the concerned area. Before initiating a research work, an insight into the related studies is utmost important because the primary objective of the review of literature is to reveal the nature of study and ascertain the level of a theoretical and empirical framework already applied in related studies for setting the guidelines in developing scientific methodology and new dimensions for future research.

Niaz and other (2013) have studied the prospects of Boro Rice Production in Bangladesh. Secondary data for the period of 1972-73 to 2011-12 have been used for this study. The growth rates of total period have been computed between four sub-periods. Area and production of Boro rice showed significant and positive growth during the study period. The area and production of Boro Rice during the period 1972-1973 to 2011-2012 shows the highest degree of instability which is significant at 1% level of significance. For forecasting, linear, logarithmic, quadratic, cubic, compound and inverse models have been made on the basis of the best fitted regression model. The cubic model has been selected as the best fitted model using the model selection criteria.

Sawanth and Achutan (1995) analyzed the India's agricultural growth across crops and regions for the 1967-68 to 1992-93. They found that the food grain output in the 1990s expanded at the low rate of 1.32% in Andhra Pradesh and remained stagnant with non-significant growth in Karnataka. Shift in area from food grains to non-food grain production was better in 1990s which was mainly attributed by area expansion.

OBJECTIVES OF THE STUDY

- To study the current trend of Rice Productivity in Eastern Uttar Pradesh.
- To study the various factors affecting Rice Productivity in Eastern Uttar Pradesh.

HYPOTHESES OF THE STUDY

- **H₀:** *There has been no significant increase in the trend of rice productivity in Eastern Uttar Pradesh. ($\mu_1 - \mu_2 = 0$)*
H₁: *There has been a significant increase in the trend of rice productivity in Eastern Uttar Pradesh. ($\mu_1 - \mu_2 \neq 0$)*
- **H₀:** *The effect of any one factor is not significant in affecting the productivity of rice in Eastern Uttar Pradesh. ($\mu_1 - \mu_2 = 0$)*
H₁: *A factor also significantly affects the productivity of rice in Eastern Uttar Pradesh. ($\mu_1 - \mu_2 \neq 0$)*

RESEARCH METHODOLOGY

The selection of a research methodology for a research work is very important step. Only through a proper research methodology, proper results can be obtained. In the present research, Analytical research methodology has been used. Through this methodology, an attempt has been made to analyze the current problem in detail. Secondary data has been used in this study, which has been obtained from the Economics and Statistics Division of the

Government of Uttar Pradesh, the updes.up.nic.in website of the Government of Uttar Pradesh, and the website of the Department of Agriculture and Farmers Welfare, Government of India. On the basis of the secondary data, the current trend of rice productivity in Eastern Uttar Pradesh has been studied. In the present study, the current trend of rice productivity has been tested through **Chow-test** of Stata software.

DATA ANALYSIS

Eastern Uttar Pradesh has different agro-climatic conditions and variations in soil fertility, due to the region is known as a **Basket of a Variety of Crops**. Most of the parts of Eastern Uttar Pradesh are situated in the alluvial Indus-Ganga plain and in the southern part of Eastern Uttar Pradesh, plateau and rocky soil is found where there is less rainfall. Cereals and coarse grains (millet) are produced in most parts of Eastern Uttar Pradesh. At present, most of the farmers in the Indus-Ganga plain region adopt rice and wheat as agricultural rotation. The share of pulses in the total crop production area is low and a large part of the area under pulse farming is cultivated with gram, peas, and pigeon peas. Sugarcane is an important cash crop in Eastern Uttar Pradesh. This is planted on about 40% of the total sown area. Sugarcane cultivation has increased because of the expansion of irrigation facilities, the development of improved varieties of seeds and the lack of any other option for the farmer. The area under cultivation of fruits and vegetables in Eastern Uttar Pradesh is about 5%. Potato is mainly produced among vegetables. Along with Eastern Uttar Pradesh, Uttar Pradesh is also a big potato-producing state. Rapeseed, mustard, groundnut, sunflower etc. are produced as oilseeds in Eastern Uttar Pradesh. This region is located in the fertile Indus-Ganga plain and is mainly known as a food grain-producing area. Foodgrains are cultivated on about 83% of the land area in this region.

Table: 1- Share of Major Crops in Gross Cropped Area in Eastern Uttar Pradesh

S No.	Crops	% Share in Gross Cropped Area in Eastern Uttar Pradesh		
		2001-02	2011-12	2021-22
1	Rice	36.1	36.6	37.22
2	Wheat	38.4	41.4	42.76
3	Other Cereals and Millets	6.7	5.2	4.03
4	Pulses	8.5	6.4	5.02
5	Oilseeds	1.6	0.9	1.20
6	Sugarcane	4.4	4.8	5.94
7	Fruits and Vegetables	2.9	2.8	2.81
8	Other Crops	1.2	1.9	1.12

Source: *Land Use Statistics at a Glance (July, 2022) Directorate of Economics and Statistics, Department of Agriculture and Farmer Welfare, GOI*

According to the agricultural production estimates of Uttar Pradesh 2021-22, 37.22 percent area in this region was for rice production, 42.76 percent for wheat production, 5.02 percent for pulses production, 40 percent for sugarcane production, 2.81 percent for fruit and vegetable production, and 1.2 percent for oilseeds. 1.12 percent of the land was used for other crops. Mustard is mainly produced under oilseed crops in Eastern Uttar Pradesh.

The Crop patterns in Eastern Uttar Pradesh have also been affected due to central-sponsored schemes and state-sponsored schemes for agricultural development. There has been an increase in the area under rice cultivation in most of the districts in Eastern Uttar Pradesh like Ayodhya, Sidharth Nagar, Basti etc. and some districts of the eastern region such as Sant Kabir Nagar, Prayagraj, Jaunpur, Azamgarh, Deoria, Mau etc. the area used under wheat cultivation has also increased. An increase in the area under vegetable cultivation has been recorded in areas like Ayodhya, Ambedkar Nagar etc. whereas in the southern part, there has been an increase in the area of pulses and coarse grains and there has also been an increase in the

area of sugarcane. At present, farmers are focusing on the '**Intensity of Crops**' instead of the '**Diversity of Crops**'. In other words, it can be said that there is a tendency among farmers to produce some profitable crops by not imposing too many decisions on their cultivable land, which is an important step for increasing farm production and productivity.

TRENDS OF RICE PRODUCTION IN EASTERN UTTAR PRADESH

The production of crops requires a special combination of factors of production. The important factors required for agricultural production are land, labour, capital, entrepreneurship and organization etc. The land is an essential and stable factor of agricultural production. Agricultural production is not possible without any land area. Production is a process by which certain goods and services, called factors of production, are transformed into another good or service by an appropriate combination is changed. The technical relationship between total production and factors of production is called production function. which can be displayed in the following way:

$$P = f(\text{Land, Labour, Capital and Technology})$$

There are two main parts of agricultural production, food grains and non-food grains. Total Agriculture of Eastern Uttar Pradesh the share of food grains in production is about two-thirds. In other words, it can be said that agricultural work is done for the production of food grains on most of the land of the

Eastern Uttar Pradesh. The main reason is that the population pressure is high on agriculture, hence production of food grain crops is necessary for people's livelihood and the second reason is average size of agricultural land holdings is very small (0.39 hectares).

Table: 2- Trends of Major Crops Production in Eastern Uttar Pradesh

(in Thousand MT)

Crops/ Year	Rice	Wheat	Barley	Jowar	Millet (Bajra)	Maize	Other Crops	Total Cereals
2015-16	7635.5	11322.7	73.6	38.6	89.4	397.6	46.8	19604.2
2016-17	7863.8	10568.6	78.4	41.7	91.4	424.3	42.3	19110.5
2017-18	8263.4	11672.2	81.9	42.5	95.6	451.2	53.4	20660.2
2018-19	8587.5	11982.8	103.3	44.6	138.9	427.3	58.1	21342.5
2019-20	8768.9	12307.5	114.2	63.2	128.2	457.0	64.9	21903.9
2020-21	8735.7	12956.7	121.9	69.4	132.7	388.7	73.2	22478.3
2021-22	8992.2	13364.3	129.9	73.8	133.5	382.5	68.4	23144.6
2022-23	9154.3	13785.6	136.5	78.4	139.2	445.6	86.2	23825.8

Source: District Statistical Magazine, all Districts of Uttar Pradesh 2023, Economic and Statistics Division, Planning Department, Uttar Pradesh

AGRICULTURAL PRODUCTIVITY IN EASTERN UTTAR PRADESH

The Agricultural productivity is a relative concept. Agricultural productivity has been defined by ILO as the ratio of production of factors and factors used in agricultural production, that is, agricultural productivity is a ratio of output and input of agriculture and every increase in it, reflects the proper use of factors of production, land, labour and capital.

According to Saxon (1965), "agricultural productivity is mainly the physical relationship between the factor of production and output by which the production work is carried out".

According to Devett (1966), "agricultural productivity expresses the different relationships between agricultural production and any one of the major factors used in production such as land, labour, capital etc. and other supplementary factors remain the same period."

Every increase in agricultural production cannot be considered as agricultural productivity

growth. If an increase in total production is achieved by using the factors of production in a certain quantity, only it is called an increase in productivity and an increase in agricultural production can also be possible through more use of factors of production. In such a situation, agricultural productivity is equal and can remain. But if increased production is achieved by using a fixed quantity of factors or by using fewer factors, then it can be said that productivity has improved.

The land productivity is an important factor in agriculture because it is one of the three main factors (land, labour, and capital) of agricultural production. Among the factors, land are the most permanent and fixed factors. The agricultural productivity of land is understood in terms of production or yield per unit of land.

$$\text{Agricultural Productivity} = \frac{\text{Total Agricultural Crop Production}}{\text{Total Land Used for Agricultural Work}}$$

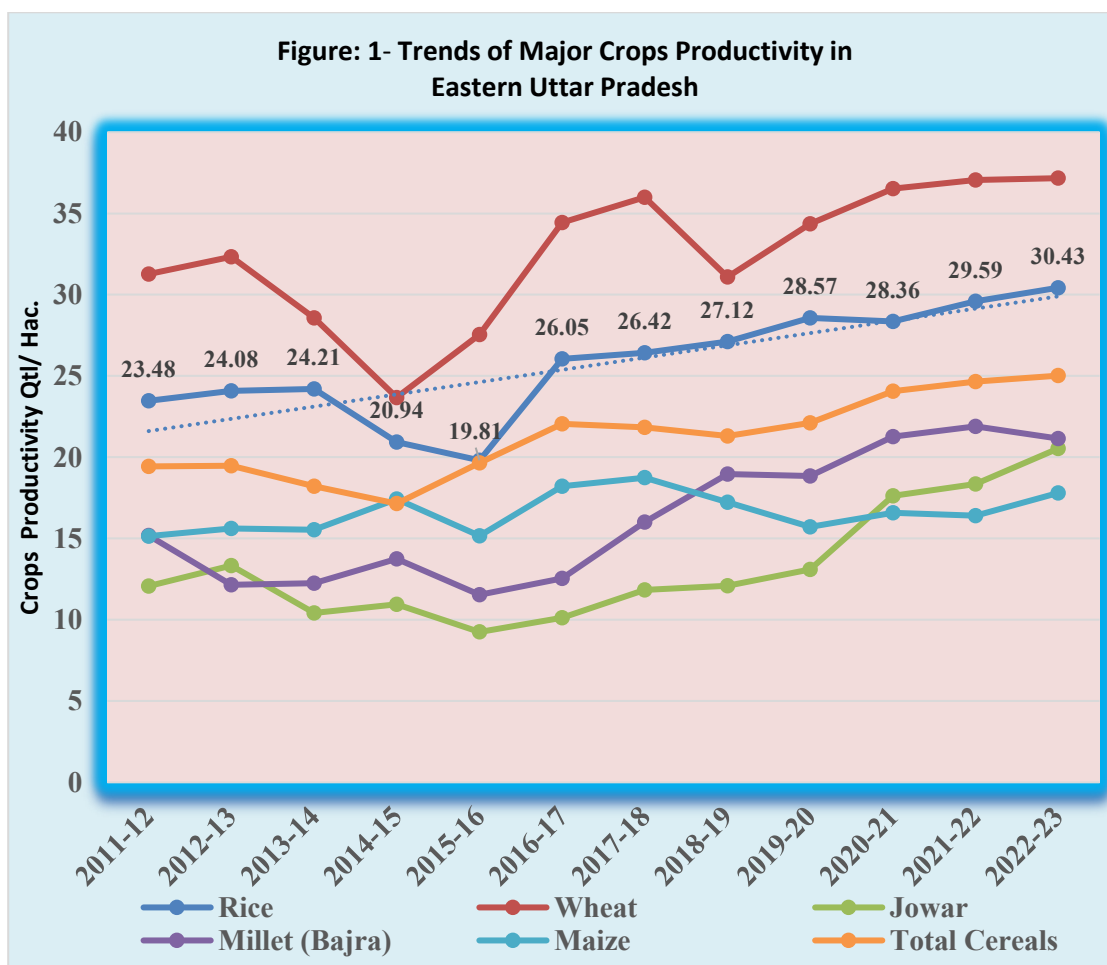
Table: 3- Trends of Major Crops Productivity in Eastern Uttar Pradesh

(in Quintals per Hectare)

Crops / Year	Rice	Wheat	Jowar	Millet (Bajra)	Maize	Total Cereals
2011-12	23.48	31.26	12.08	15.18	15.15	19.43
2012-13	24.08	32.34	13.33	12.15	15.62	19.47
2013-14	24.21	28.58	10.42	12.26	15.54	18.21
2014-15	20.94	23.68	10.96	13.75	18.43	17.15
2015-16	19.81	27.55	9.25	11.54	15.17	19.66
2016-17	26.05	34.43	10.12	12.55	18.22	22.06
2017-18	26.42	35.99	11.84	16.01	18.74	21.83
2018-19	27.12	31.09	12.10	18.97	17.24	21.31
2019-20	28.57	34.37	13.10	18.85	15.72	22.12
2020-21	28.36	36.53	17.62	21.26	16.58	24.06
2021-22	29.59	37.05	18.35	21.90	16.41	24.66
2022-23	30.43	37.17	20.54	21.15	17.80	25.02

Source: District Statistical Magazine, all District of Eastern Uttar Pradesh , Economic and Statistical Division, Planning Department, Uttar Pradesh 2023

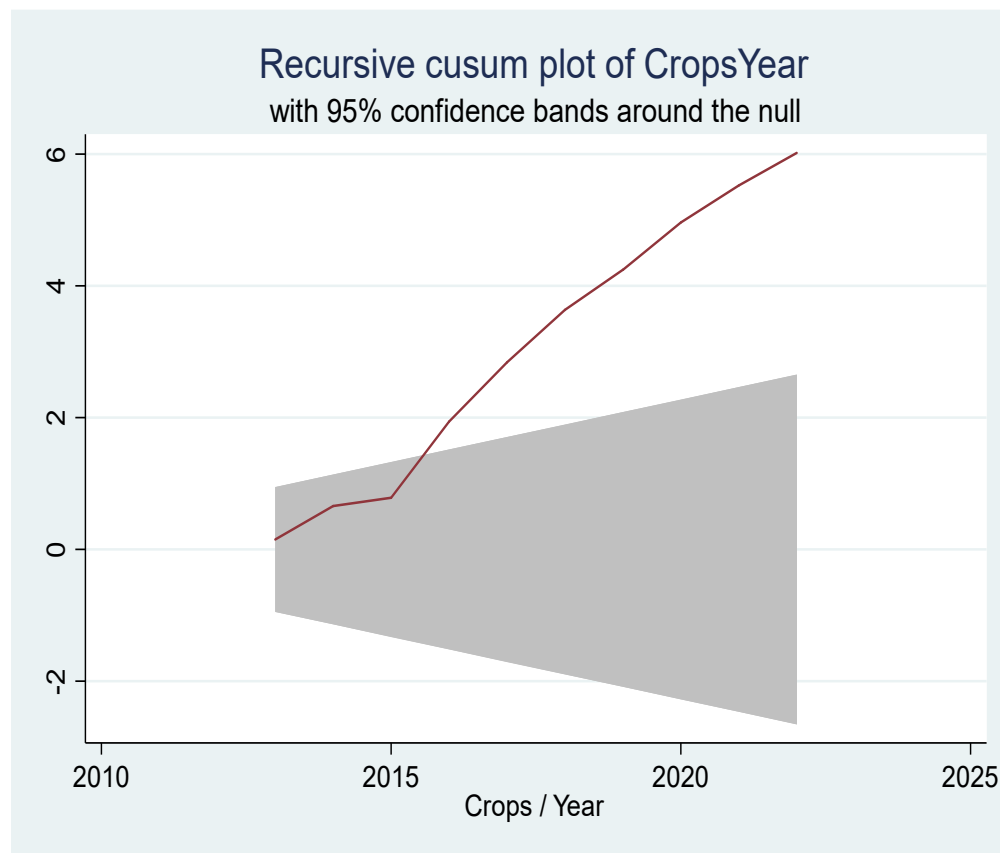
According to the Agricultural Productivity Estimate 2022-23 of the Agriculture Department, Uttar Pradesh, Ayodhya division ranks first in terms of productivity of rice.



Source: Prepared by Researcher

Figure-1 shows the current trend of productivity of various food grain crops like rice, wheat, jowar, bajra, maize etc. in Eastern Uttar Pradesh through a line graph. The dark blue line shows the productivity of rice and the dotted blue line shows the path of continuous increase in the productivity of rice without any fluctuations. It is clear from the line graph that the productivity of rice is increasing from

the year 2011-12 to 2013-14, but from 2013-14 to 2015-16, a sharp declining trend has been observed and from the year 2016-17 to the year 2022-23, a continuous increase is being shown with some fluctuations. Thus, a significant change is being reflected in the productivity of rice after the year 2015-16.

Figure: 2- Graphical Representation of Rice Productivity in Eastern Uttar Pradesh from 2011-12 to 2022-23

Source- Drawn by Researcher through STATA software

The present figure mainly shows the productivity of Rice from the year 2011-12 to the year 2022-23 in total 28 districts of Eastern Uttar Pradesh. As a thumb rule, this graph shows the volatility in the productivity of Rice over the last 13 years because the productivity line crosses the shaded area. In the

given graph, a significant change can be seen in the productivity of Rice around the year 2016. There has been a significant increase in the average productivity of Rice in Eastern Uttar Pradesh in the last 13 years.

Table: 4 Regression Result Description of Productivity of Rice in Eastern Uttar Pradesh Relative to Time Series

. regress CropsYear Rice						
Source	SS	df	MS	Number of obs	=	12
Model	94.7639414	1	94.7639414	F(1, 10)	=	19.65
Residual	48.2360586	10	4.82360586	Prob > F	=	0.0013
				R-squared	=	0.6627
				Adj R-squared	=	0.6290
Total	143	11	13	Root MSE	=	2.1963
CropsYear	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
Rice	.8793165	.1983853	4.43	0.001	.4372864	1.321347
_cons	1993.853	5.1486	387.26	0.000	1982.381	2005.325

Source: Calculated by Researcher through STATA Software

In the present table, the regression relationship of Rice with respect to the time series is given in the above regression table. The details are as follows:

F- Value = 0.0013

R-square = 0.6627

Adjusted R-Square = 0.6290

Root Mean Square Error = 2.1963

P-Value: - = 0.001

The significance of the regression model in the above table is 0.0013. The value of R-Square is 0.6627, Adjusted R-Square value 0.6627 and the P value is 0.001. This makes it clear that the present regression model shows a significant chronological growth of Productivity of Rice.

Table: 5 Statistical Testing for the Increase in Productivity of Rice in Eastern Uttar Pradesh through Structural Breaks

. estat sbcusum				
Cumulative sum test for parameter stability				
Sample: 2011 - 2022			Number of obs =	12
Ho: No structural break				
Statistic	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
recursive	2.0061	1.1430	0.9479	0.850

Source: Calculated by Researcher through STATA Software

In the above table, the productivity of Rice in Eastern Uttar Pradesh has been statistically tested chronologically from the year 2011-12 to the year 2022-23. This test is known as Structural Break in statistics. This test has been done with STATA software. This test is known as **Chow-test** in STATA software. STATA software has the **estat sbcusum** command for the Chow-test. It gives statistical explanation of stability, growth, decline etc. of time series. The present table includes discussion of a total of 12 years.

RESULT AND DISCUSSION

The value of test statistic is **2.0061**. Correspondingly, the table value at 1% significance level is 1.1430, the table value at 5% significance level is 0.9479 and the table value at 10% significance level is 0.850.

As a thumb rule, when the calculated value is greater than the value in the test statistics table (at the 1% significance level) then the null hypothesis is rejected. On the contrary, if the calculated value is less than the value of 1% significance level of the table then the null hypothesis is not rejected.

The calculated Test Statistics value in this table is **2.0061**. The table value of **Chow-test** is 1.1430 at the 1% level of significance. Hence, it is clear that the calculated value of **Chow-test** is greater than the table value so the null hypothesis is rejected. This is why the alternative hypothesis defines the outcome. The average productivity of Rice of Eastern Uttar Pradesh from the year 2011-12 to the year 2022-23 shows a significant increase on the statistical scale in chronological order.

CONCLUSION

On the basis of the above study, it can be concluded that there is a significant increase in the productivity of rice in Eastern Uttar Pradesh between the years 2011-12 to 2022-23. Only between 2013-14 to 2015-16, the productivity of rice growth rate was negative and due to the adverse monsoon, a decline in the productivity of rice was recorded. Apart from this, a

continuous increase has been observed in the productivity of rice after the year 2015-16, as positive growth in rice production has been observed every year in Eastern Uttar Pradesh. In this research paper, the productivity of rice has been tested through the Chow-test, which at 5% significance level, the null hypothesis is being rejected and the alternative hypothesis explains the result on the basis of which it can be said that there is no structural break in the productivity of rice in Eastern Uttar Pradesh.

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