GAU Research Journal **48** (4) : 287-299 (October 2023)

Production performance of major cereals in Rajasthan

A.V. Mhaskey[1*], G. L. Meena[2], L. Sharma[3], B. Upadhyay[4], L. N. Mahawer[5] and D. Jain[6]

Rajasthan College of Agriculture, MPUAT, Udaipur, Rajasthan
*Email : akashmhaskey@gmail.com

ABSTRACT

The study conducted an in-depth analysis of the agricultural trends in Rajasthan, India, focusing on wheat and bajra (pearl millet) production from 2000-01 to 2021-22. Using secondary data from diverse sources, including Rajasthan Agricultural Statistics and the Ministry of Agriculture and Farmers Welfare, the study employed various analytical methods to assess growth, variability, trend, and decomposition analysis of these major cereal crops. For wheat, the compound annual growth rate (CAGR) analysis revealed significant growing area and output during Period-I (2000-01 to 2010-11), followed by non-significant growth in Period-II (2011-12 to 2021-22), with a note worthy surge in productivity during both periods. Similarly, bajra cultivation exhibited substantial expansion in area and output in Period-I, followed by a decline in area but maintenance of production growth in Period-II. Both crops showed greater instability in production compared to area and yield, with bajra experiencing slightly higher instability. Trend analysis indicated quadratic model for wheat area and production, exponential for bajra production, and linear for both crops' yield. Decomposition analysis revealed that while yield contributed significantly to wheat production growth across all periods, bajra production growth was primarily driven by yield during Period-I but suffered from declining yield and negative area effects overall. These findings offer beneficialinsights into the agricultural dynamics of Rajasthan, emphasizing the need for targeted interventions to sustainably enhance cereal crop production amidst changing environmental and socio-economic conditions.

Keywords : Wheat, Bajra, Compound annual growth rate, Variability analysis, Trend analysis, Decomposition analysis.

INTRODUCTION

In India, agriculture remains a crucial driver of socio-economic progress, with most of the population relying on this sector. It holds particular significance for the disadvantaged segments of Indian society, such as those with low incomes and vulnerable conditions. The development of other sectors in India is intricately connected to agricultural production, benefiting from both backward and forward linkages. During the period spanning from 2012-13 to 2018-19, there was a remarkable 59% increase in the monthly income per agricultural household in India, rising from ₹ 6426 to ₹ 10218. This significant growth can be attributed primarily to the implementation of various initiatives aimed at supporting farmers, such as the PM-KISAN Scheme introduced in 2018, the Pradhan Mantri Fasal Bima Yojana initiated

in 2016, the Pradhan Mantri Krishi Sinchai Yojana launched in 2015, and the e-NAM initiative established in 2016. These programs have played a pivotal role in boosting agricultural incomes and uplifting the farming community. The liberalization of markets throughout the country also holds immense importance in ensuring that farmers receive fair prices for their agricultural products. These noteworthy measures have made substantial contributions to the progress, empowerment, and stability of farmers (Anonymous, 2019).

Rajasthan currently holds the distinction of being the biggest state in India, encompassing an expansive area of 34.22 million hectares, which corresponds to 10.41 percent of the India's total geographic region area. The economy of Rajasthan heavily relies on the agriculture and allied sectors, which acts as a pivotal contributor to the Gross State Domestic Product (GSDP). The Gross State Value Added (GSVA) has exhibited a significant growth, with a noticeable increase from 1.569 lakh crores in 2018-19 to 2.089 lakh crores in 2022-23, showcasing a growth of 7.5 percent at constant prices of 2011-12. When considering current prices, the GSVA of the Agriculture and associated sectors experienced a substantial surge from ₹ 2.22 lakh crore in 2018-19 to ₹ 3.79 lakh crore in 2022-23, demonstrating a CAGR of 14.33 percent (Rajasthan Agriculture Department, Government of Rajasthan, 2023).

In the year 2022-23, the state achieved a total food grain production of 253.99 lakh tonnes. Among these, *kharif* production contributed 97.98 lakh tonnes, while *rabi* food grain production accounted for 156.02 lakh tonnes. In terms of cereals, *kharif* cereals production reached 77.84 lakh tonnes, while *rabi* cereals production amounted to 128.73 lakh tonnes. (Rajasthan Agriculture Department, Government of Rajasthan, 2023). Among the cereal group, bajra covers 47.02% of the total area and contributes to 28.85% of the production. On the other hand, wheat occupies 30.52% of the area and accounts for 50.21% of the production.

The examination of the growth, variability, trend and decomposition of major agricultural commodities holds significant importance in formulating effective agricultural policies. Rajasthan, being the largest state in India renowned for its rich food and cultural heritage, stresses the importance of examining the growth rate, variation, trend and decomposition of its major crops.

Ensuring sustainable agricultural performance requires both high growth and low instability in production. There has been growing concern that technological advancements in cereal production have led to increased variability, which is seen as a significant factor impacting agricultural stability.In the state of Rajasthan, wheat and bajra are the major cereal crops with the highest area and production. Given the significant implications for policymakers, it is crucial to assess the extent of growth, instability, trend and decomposition analysis in cereals production.

MATERIALS AND METHODS

The investigation utilized secondary data from multiple sources such as Rajasthan Agricultural Statistics at a Glance, Directorate of Economics and Statistics, Ministry of Agriculture and Farmers Welfare, Government of India, and Indiastat.com. The data covered a period of 22 years, from 2000-01 to 2021-22, and included figures on the area, production, and yield of wheat and bajra. This data was then analyzed to assess the growth, variability, trend, and decomposition analysis.

1. Analysis of compound annual growth rate

The Compound Annual Growth Rate (CAGR) was computed for the area, production, and yield of major cereals within Rajasthan. This calculation spanned a 22year period from 2000-01 to 2021-22. The data was then segmented in two distinct sub-periods: Period-I (2000-01 to 2010-11) and Period-II (2011-12 to 2021-22). An exponential function of the form described below was utilized for this analytical process.

$Y = a\, b^t e^{Ut}$ (1)

Where,

Y = Area / Production /Yield

a = Intercept

b = Regression coefficient (*'a'* and *'b'* are the parameters to be estimated)

U_t = Disturbance term in year *'t'*

Equation (1) was converted into a log-linear format and expressed as follows:

$\log Y = \log a + t \log b + U_t + \log e$ (2)

Equation (2) was estimated using the Ordinary Least Squares (OLS) technique.

The compound growth rate (g) was subsequently computed as follows:

$g = (b-1)100$ (3)

Where,

g : Compound growth rate in (%) per annum

b : Antilog of log b

The standard error of the growth rate was estimated and tested for significance using the 't' statistic. The formula used for the 't' statistic is as follows:

$$t = \frac{\bar{x} - \mu}{s/\sqrt{n}}$$

n = sample size

x = mean

s = standard deviation

μ = population with mean and unknown standard deviation

2. Instability analysis

Instability was assessed employing the Cuddy-Della-Valle Index. While the Coefficient of Variation (CV) is a straightforward measure of instability, it does not fully capture the instability existing in time series data due to the presence of trend components. To address this limitation, a formula proposed by Cuddy and Della (1978) was employed to overcome the issue of trend component interference. The instability index, as proposed by Cuddy and Della Valle in 1978, is calculated using the following expression:

$$CDVI = CV\,(1 - R^2)^{0.5}$$

CV= Coefficient of variation (in per cent)

R^2= The coefficient of determination

3. Trend analysis

To analyze the trends in the area, production, and yield of major cereals, various models were utilized, encompassing linear, quadratic, cubic, exponential, and other relevant models. The following models were subsequently used to evaluate the trends in area, production, and yield:

A) For Linear trend

$$X_t = a + b_t$$

Where,

X_t = Area/production/yield in year 't'.

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

a = intercept

b_t = regression coefficient

B) For Exponential trend

$X_t = ab^t$

$\text{Log } X_t = \text{Log } a + t\text{Log } b$

Where,

X_t = Area/production/yield of commodity in year 't'.

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

log a = intercept

log b = regression coefficient

C) For Quadratic trend

$X_t = ax^2 + bx + c$

Where,

X_t = Area/production/yield of commodity in year 't'.

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

a = coefficient of determination

b = x-intercept

c = y-intercept

D) For cubic trend

$X_t = ax^3 + bx^2 + cx + d$

Where,

X_t = Area/production/yield of commodity in year 't'.

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

a, b, c, and d represent the parameters to be estimated.

The optimal trend model was chosen based on the highest R-squared value and the significance of its variables.

4. Decomposition analysis:

To investigate the decomposition of sources ofoutput growth for selected crops spanning a 22-year period from 2000-01 to 2021-22, an analysis was conducted. The data was additionally divided into two sub-periods: Period-I (2000-01 to 2010-11) and Period-II (2011-12 to 2021-22).

The sources of production growth were examined using the decomposition model proposed by Minhas & Vaidyanathan (1965).

The relative contributions of area, yield, and their interaction effect to the total output change in Wheat and Bajra was calculated. In this methodology, A_0, P_0, and Y_0 represent the area, production, and yield in the base year, while A_n, P_n, and Y_n denote the corresponding values in the n^{th} year.

$P_o = A_o \times Y_o$

$P_n = A_n \times Y_n$

Where,

A_0 and A_n represent the area, and Y_0 and Y_n represent the yield in the base year and n^{th} year, respectively.

$P_n - P_o = \Delta P$

$A_n - A_o = \Delta A$

$Y_n - Y_o = \Delta Y$ (2)

From equation (1) and (2) we can write

$P_o + \Delta P = (A_o + \Delta A)(Y_o + \Delta Y)$

Hence,

$$P = \frac{Ao\,\Delta Y \times 100}{\Delta P} + \frac{Yo\,\Delta A \times 100}{\Delta P} + \frac{Yo\,\Delta A \times 100}{\Delta P}$$

Production = Yield effect + Area effect + Interaction effect

Where,

P = Change in production

ΔA = Change in area $(A_n - A_0)$

ΔY = Change in yield $(Y_n - Y_0)$

Therefore, the total change in production was decomposed into three

components: the yield effect, the area effect, and the interaction effect resulting from changes in both yield and area.

RESULTS AND DISCUSSION

Estimation of growth rate in area, production and yield of major cereals in rajasthan

In the current research, the Compound Annual Growth Rate (CAGR) of area, production, and yield of major cereals in Rajasthan was calculated for the period spanning from 2000-1 to 2021-22. This 22year period was further subdivided into three sub-periods: Period-I (2000-01 to 2010-11), Period-II (2011-12 to 2021-22), and Overall Period (2000-01 to 2021-22). The growth rate in each period, in terms of area, production, and yield of major cereals, is presented in the tables. The significance of the growth rate was assessed using the student's t-test.

1. **Compound Growth rate in Area, Production and Yield of Wheat**

Table1 presents the Compound Annual Growth Rate (CAGR) of wheat in Rajasthan during Period-I, Period-II, and the Overall Period. In Period-I (2000-01-2010-11), wheat exhibited significant growth in both area and production, anda non-significant growth in yield. Specifically, the area of wheat in Rajasthan experienced a significant growth of 3.88%, while production showed a growth of 6.35%.However, the yield recorded a non-significant growth of 2.38%. This finding is consistent with the research carried outby Udhayan *et al.* (2023), who also stated positive and significant growth in wheat during the period 2001-02 to 2010-11.

In Period-II (2011-12 to 2021-22), wheat exhibited negatively non-significant growth rates in area (-1.09%), while production (0.72%) recorded positive and non-significant growth rates. Notably, a positive and significant growth in yield (1.83%) was recorded during this period.During the Overall Period (2000-01 to 2021-22), wheat in Rajasthan showed a significant growth in area (2.27%), while production (4.20%) and yield (1.89%) exhibited non-significant growth rates.

Table 1: Compound Growth Rates in Area, Production and Yield of Wheat

(In Per cent)

Particulars	Period-I (2001-2011)	Period-II (2012-2022)	Overall Period (2001-2022)
Area	3.88***	-1.09 NS	2.27***
Production	6.35**	0.72 NS	4.20 NS
Yield	2.38NS	1.83**	1.89 NS

Note:*** Significant at 1 per cent level of significance, ** Significant at 5 per cent level of significance, * at 10 per cent level of significance and NSNon-significant

2. Compound Growth rate in Area, Production and Yield of Bajra

Table 4.2 outlines the CAGR for bajra cultivation in Rajasthan, encompassing area, production and yield during distinct periods. During Period-I, Bajra cultivation demonstrated significant growth in area and production, with a CAGR of 1.91% and 5.61% respectively, both significant at the 5% level. These findings indicated a substantial expansion in both the cultivated area for Bajra and the overall production output. Moreover, the yield also exhibited significant growth, with a CAGR of 3.69%, highlighting efforts to improve yield per unit of land during this period.

In contrast to Period-I, Period-II (2011-12 to 2021-22) witnessed a contrasting trend in Bajra cultivation. The CAGR for area showed a negative growth rate of -1.03%, significant at the 5% level, suggesting a slight decline in the cultivated area for Bajra during this period. Production maintained a growth rate of 0.02%, albeit non-significant, indicating a marginal increase in Bajra output. Notably, the yield experienced a significant and growth rate of 1.05%, emphasizing continued efforts to enhance yield per unit of land despite challenges in maintaining the cultivated area.

Across the overall period (2000-01 to 2021-22), Bajra cultivation witnessed mixed trends in growth rates. The CAGR for area showed a significant negative growth rate of -0.88%, indicating a slight overall decline in the cultivated area for Bajra. However, production maintained a growth rate of 2.74%, significant at the 1% level, suggesting an overall increase in Bajra output. The yield also exhibited significant growth, with a CAGR of 3.62%, emphasizing sustained efforts to improve yield per unit of land throughout the period.

These findings emphasize the complex dynamics influencing Bajra cultivation, including efforts to balance expansion in cultivated area with improvements in yield to ensure sustainable production growth. Further research focusing on factors influencing acragegrowth and yield enhancement in Bajra cultivation could provide valuable insights for enhancing productivity and sustainability in Bajra production systems.

Table 2 : Compound Growth Rates in Area, Production and Yield of Bajra

(In Per cent)

Particulars	Period-I (2001-2011)	Period-II (2012-2022)	Overall Period (2001-2022)
Area	1.91**	-1.03**	-0.88**
Production	5.61**	0.02**	2.74**
Yield	3.69**	1.05**	3.62**

Note: *** Significant at 1 per cent level of significance, ** Significant at 5 per cent level of significance, * at 10 per cent level of significance and ^{NS}Non-significant

Estimation of Instability in the Area, Production and Yield of Major Agricultural Commodities in Rajasthan

This section examined the variations observed in the area, production, and yield of wheat and bajra crops specifically in Rajasthan. To reapunderstanding of the extent of instability, it's important to consider measures of instability rather than just focusing on the direction of increase or decrease in the cereal crops' area, production, and yield.

The time frame of the study, spanning from 2000-01 to 2021-22, was partitioned into three sub-periods: Period-I (2000-01 to 2010-11), Period-II (2011-12 to 2021-2022), and Overall-Period (2000-01 to 2021-22). In terms of the instability index, values exceeding 30 are classified as high instability, while values below 30 are regarded as low instability.

1. Instability in area, production and yield of wheat crop in Rajasthan

(i) Area:

Table 3 provides insights into the instability of wheat crop area. During Period-I, the state exhibited lower variation based on the Cuddy-Della-Valle index (CDVI), the instability in Period-I was 9.62%. Similar observations were noted for Period-II and the Overall Period in the state. In Period-II, the instability was 6.89% while for the Overall Period, CDVI showed 13.70% instability.

(ii) Production:

Like the area, the production of wheat displayed a comparable pattern. During Period-I, wheat production exhibited less variation according to the Cuddy-Della-Valle index (CDVI) at 12.73%. This trend persisted in Period-II and the Overall Period in the state. In Period-II, the instability was 9.98% while for the Overall Period, CDVI indicated 24.62% instability.

(iii) Yield:

During Period-I, the yield of the wheat crop exhibited less variation with instability of 4.66%. A similar pattern was noticed in Period-II and the Overall Period. In Period-II, the instability was 6.13% while in the Overall Period, CDVI indicated 12.08% instability.

The instability in the area, production, and yield of wheat was observed to be higher during the Overall Period compared to Period-I and Period-II. These findings support the investigation carried out by Tewari *et al.* (2017), who analyzed the growth and instability of wheat in terms of area, production, and yield in Uttar Pradesh.

Table 3: Measure of instability in Area, Production and Yield of Wheat

(In Percent)

Crops Instability index	Period-I (2001-2011)			Period-II (2012-2022)			Overall-Period (2001-2022)		
	Area	Production	Yield	Area	Production	Yield	Area	Production	Yield
CDVI	9.62	12.73	4.66	6.89	9.98	6.13	13.70	24.62	12.08

2. Instability in Area, Production and Yield of Bajra Crop in Rajasthan

(i) Area:

Table 4 provides insights into the instability in the bajra crop. During Period-I, the state exhibited less variation in bajra crop according to the Cuddy-Della-Valle index (CDVI) at 12.47%. Similar observations were reported in Period-II and the Overall Period in the state. In Period-II, the instability was 6.78%. In the Overall Period, the area for bajra crop showed lower instability at 6.10%.

(ii) Production:

During Period-I, higher variations were observed in the state for bajra production, according to the Cuddy-Della-Valle index (CDVI) at 45.23%. In Period-II, the instability was 11.49% for CDVI. In the Overall Period, CDVI values of 9.96% indicated that bajra production exhibited lower instability.

(iii) Yield:

During Period-I, higher variations were observed in the state for bajra yield at 37.08%. In Period-II, the instability was 8.35% and in the Overall Period, instability of 18.55% was spotted.

The variability in the area, production, and yield of bajra was higher in Period-I compared to Period-II and the Overall Period during the study period. These conclusions are coherent with the analysis carried out by Byaligoudra *et al.* (2019), who examined instability in terms of area, production, and yield of bajra in Andhra Pradesh.

Table 4 : Measure of Instability in Area, Production and Yield of Bajra

(In Percent)

Crops Instability index	Period-I (2001-2011)			Period-II (2012-2022)			Overall-Period (2001-2022)		
	Area	Production	Yield	Area	Production	Yield	Area	Production	Yield
CDVI	12.47	45.23	37.08	6.78	11.49	8.35	6.10	9.96	18.55

Analysis of Trend in Area, Production and Yield of Major Cereals in Rajasthan:

The analysis investigated the trends in the area, production, and yield of major cereals in Rajasthan from 2000-01 to 2021-22. For each commodity, the trend analysis encompassed the examination of trends across different time periods in area, production, and yield. The significance of the trend equation was evaluated using the 'P value' method. This portion presented trends observed for the selected major cereals.

1. Trend in Area, Production and Yield of Wheat:

(i) Area: Examination of Table 5 revealed that the coefficient of determination (R-squared) for the wheat area was 0.75, indicating that the quadratic equation accounted for 75% of the instability in the data. While this suggested a moderate fit, it falls short of the desired level of accuracy. The p-value of 0.002 indicated statistical significance, albeit not as high as desired, implying that the

quadratic model explained a significant portion of the variation in wheat cultivation area but may not capture all underlying complexities. The negative coefficient (x^2) suggested a significant decrease in the area under wheat cultivation over the study period.

(ii) **Production :** From Table 5, it became apparent that the coefficient of determination (R-squared) for wheat production was 0.832, signifying that the quadratic equation provided a superior fit for explaining the instability in wheat production. This suggested that approximately 83.2% of the variation in production was accounted for by the quadratic model. The p-value of 0.026 indicated statistical significance, although marginally lower than that observed in the yield model.

(iii) **Yield :** It was observed that the coefficient of determination (R-squared) for wheat yield was 0.828, indicating that the linear model explained approximately 82.8% of the instability in yield which was significant. This suggested that the linear equation provided a robust fit for predicting variations in yield. Additionally, the positive coefficient (x) suggested a significant enhancement in wheat yield over specified period. Similar findings were reported by Kumari *et al.* (2020), who detected a substantial rise in wheat yield with a relatively high R-squared value during the study period.

Table 5 : Estimated Trend Equations of Area, Production and Yield of Wheat

Particulars	Functional forms	Equations	R^2	P value
Area	Quadratic	$Y= -5.368x^2 +181.3 x+1585.9$	0.750	0.002
Production	Quadratic	$Y = -15.943x^2 + 717.61x + 3751.8$	0.832	0.026
Yield	Linear	$Y= 0.0617x + 2.6065$	0.828	0.001

2. Trend in Area, Production and Yield of Bajra:

Table 6 illustrates the trend in the area, production, and yield of bajra in Rajasthan from 2001 to 2022.

(i) **Area:**Among the models employed for analysis, the cubic equation provided the best fit for bajra's area under cultivation. With an R-squared value of 0.342, it explained approximately 34.2% of the instability in bajra's cultivation area. The negative coefficient (x^2) indicates a decrease in bajra crop during the specified time, particularly in the year 2022.

(ii) **Production :** Among the models analyzed, the exponential equation emerged as the best-fit model for bajra's production. However, it demonstrated a relatively weaker fit with an R^2 value of 0.158, describing around 15.8% of the instability in bajra's production. The positive coefficient indicated an improvement in bajra's production level over the specified time.

(iii) **Yield :** The linear equation emerged as the best-fit model for analyzing bajra's yield among the other models utilized for analysis. It exhibited an R-squared value of 0.412, explaining

approximately 41.2% of the instability in bajra's yield. The negative coefficient (x^2) suggested a slight decrease in the yield of bajra crop specifically in the year 2022.

The trend analysis indicated an overall increase in production for the bajra crop, except for the year 2022 where a decline was observed. Analogous conclusions were reported by Kumari *et al.* (2020), who noted a significant decline in bajra.

Table 6 : Estimated Trend Equations of Area, Production and Yield of Bajra

Particulars	Functional forms	Equations	R^2	P Value
Area	Cubic	$Y = 0.7256x^3 - 30.068x^2 + 308.25x + 4105.9$	0.342	0.153
Production	Exponential	$Y= 2548.7e^{0.0271x}$	0.158	0.067
Yield	Quadratic	$Y = -0.0003x^2 + 0.0315x + 0.5094$	0.412	0.261

Evaluation of the Relative Impact of Cultivated Area and Yield on the Expansion of Agricultural Production

Decomposition analysis offers several advantages over growth analysis, including its ability to identify the fundamental elements crucial for estimating output, restructuring development strategies for governmental implementation, and setting targets for specific agricultural commodities to achieve higher output growth rates while recognizing trade-distorting factors.

Minhas & Vaidyanathan Decomposition Model (1965) was utilized to identify the factors contributing to output growth. This analysis was conducted for two distinct sub-periods (Period-I: 2000-01 to 2010-11, Period-II: 2011-12 to 2021-22) as well as for the Overall-Period from 2000-01 to 2021-22. The sources of growth are classified into three effects: Yield Effect, Area Effect, and Interaction Effect. A higher percentage of a parameter indicated a greater contribution to output growth.

1. **Sources of Output Growth in Wheat Crop**

Table 7 presents a decomposition analysis of the factors driving wheat production growth.

During Period-I, the yield effect exhibited a positive value of 40.55%, indicating a significant contribution of increased wheat yield per unit of land to the growth in wheat production. Similarly, the area effect was positive at 47.97%, suggesting that the expansion of cultivated land area for wheat also performed a substantial function in improving wheat production. The interaction effect was positive with a value of 11.48%, indicating that the combined impact of changes in yield and area contributed positively to wheat output growth in this period.

During Period-II, the yield effect was negative at -181.76%, indicating a decline in wheat yield per unit of land, which significantly impacted wheat production negatively. Conversely, the area effect was highly positive at 253.08%, indicating a substantial improvement in the land area dedicated to wheat cultivation. This expansion performed a major function in driving

the growth of wheat production. The interaction effect was also positive with a value of 28.67%, suggesting that despite the negative yield effect, the overall impact of interactions between yield and area remained positive.

Over the Overall-Period, the yield effect remained positive at 69.12%, indicating that, on an average, increased yield per unit of land contributed to the overall growth in wheat production. The area effect was positive at 22.04%, highlighting the ongoing contribution of expanded cultivated land areas to the overall wheat production growth. The interaction effect was positive at 8.84%, demonstrating a positive synergy between changes in yield and area that promoted the overall growth in wheat production. Kumar and Shekhar (2017) also found positive results in wheat crop in terms of area, yield, and interaction effect during the period 2001 to 2016 in India.

Table 7 : Sources of Output Growth in Wheat Production

(In Per cent)

Periods	Yield Effect	Area effect	Interaction Effect
Period-I (2000-01 to 2010-11)	40.55	47.97	11.48
Period-II (2011-12 to 2021-22)	-181.75	253.08	28.67
Overall-Period (2000-01 to 2021-22)	69.12	22.04	8.84

2. Sources of Output Growth in Bajra Crop

Table 8 presents a decomposition analysis of the sources of output growth in bajra production. During Period-I (2000-01 to 2010-11), the yield effect was notably positive at 71.88%, indicating a substantial increase in bajra yield per unit of land, which significantly contributed to production growth. The area effect was also positive, though to a lesser extent, at 14.92%, suggesting some expansion in cultivated land area for bajra production during this period. The interaction effect, with a positive value of 13.20%, further highlighted the combined positive impact of changes in yield and area on bajra production growth.

In Period-II (2011-12 to 2021-22), the yield effect turned negative at -50.59%, indicating a decline in bajra yield per unit of land, which negatively impacted production. However, the area effect was highly positive at 137.65%, signifying a substantial increase in cultivated land area contributing to production growth. The interaction effect, with a positive value of 12.94%, suggested that despite the negative yield effect, the overall impact of interactions between yield and area remained positive, albeit to a lesser extent compared to Period-I.

Throughout the time span from 2000-01 to 2021-22, there was notably a positive yield effect of 153.26% in Bajra production, indicating a substantial rise in Bajra yield per unit of land, thus contributing significantly to overall production growth. Conversely, the area effect showed a negative value of -

23.48%, signifying a decrease in the cultivated land area for Bajra production over the entire period, which had an adverse impact on production growth. The interaction effect, at -29.78%, demonstrated a negative synergy between changes in yield and area, further contributing to the overall decline in production growth.

Table 8 : Sources of Output Growth in Bajra Production

(In Per cent)

Periods	Yield Effect	Area effect	Interaction Effect
Period-I (2000-01 to 2010-11)	71.88	14.92	13.20
Period-II (2011-12 to 2021-22)	-50.59	137.65	12.94
Overall-Period (2000-01 to 2021-22)	153.26	-23.48	-29.78

CONCLUSION

This research paper examined the production performance of two major cereals, wheat and bajra (pearl millet), in the state of Rajasthan, India, spanning the period from 2000-01 to 2021-22. Utilizing secondary data from reputable sources such as Rajasthan Agricultural Statistics and the Ministry of Agriculture and Farmers Welfare, the study employed various analytical techniques to assess the growth, instability, trends, and decomposition in wheat and bajra cultivation. The findings revealed significant growth in both wheat and bajra production during the initial period (2000-01 to 2010-11), followed by changing trends in subsequent years. While wheat cultivation exhibited non-significant growth in the latter period (2011-12 to 2021-22), bajra production-maintained growth despite a decline in cultivation area. Decomposition analysis highlighted the dominant role of yield in driving production growth for both crops, emphasizing the importance of yield-enhancing interventions. Overall, this study presented production dynamics of major cereals in Rajasthan, offering a foundation for informed policy interventions aimed at sustainable agricultural development in the region.

The significant growth in wheat and bajra production during the initial period highlighted the potential for increasing cereal yields in the region. However, the non-significant growth in wheat production and the decline in bajra cultivation area in the latter period signal challenges that need to be addressed to ensure continued productivity growth. Analysis also revealed moderate instability in wheat production with relatively stable yields but higher instability in bajra production. Trend analysis indicated a decrease in wheat cultivation area but overall increase in production and yield, while bajra cultivation area declined with fluctuating production levels. Decomposition analysis highlighted the positive contributions of yield and area effects to wheat production growth, contrasting with positive yield effects but negative area effects leading to an overall decline in bajra production growth. Policy measures including enhanced research, infrastructure development, crop diversification, capacity building, market linkages, policy support, and risk management are suggested to improve cereal production and ensure food security in Rajasthan.

REFERENCES

Annual Report, 2023. Rajasthan Agriculture Department, Government of Rajasthan.

Anonymous, 2019. National Statistical Office (NSO), Situation Assessment Survey (SAS) of Agricultural Households during NSS 77th round. Ministry of Statistics and Programme Implementation, Government of India.

Anonymous, 2022. Ministry of Agriculture and Farmers Welfare, Government of India.

Anonymous, 2023. Ministry of Statistics & Programme Implementation, Ministry of Commerce and Industry, Government of India.

Bairwa, K. C., Meena G. L., Singh H., Meena, M. L., Yadav, A., Balai H. K. and Meena, P. C. 2022. Growth and variability analysis of seed spices in Rajasthan. Economic Affairs, 67(3): 201-209.

Byaligoudra, A. I., Aparna, B. N., Vani and Naidu, G. M. 2019. Growth and Instability of Major Millets in Andhra Pradesh, India. *International Journal of Current Microbiology and Applied Sciences*,8(7): 985-993.

Coppock, J. D. 1962. International economic instability. McGraw-Hill Book Company, 523-525.

Cuddy, J. D. A. and Della, V. P. A. 1978. Measuring the instability of time series data. *Oxford Bulletin of Economics and Statistics*,40 (10):79-84.

Kumar, P. and Shekhar, H. 2017. Estimation of growth rates and decomposition analysis of rice and wheat production in India. *International Journal of Multidisciplinary Research and Development*, 4 (6):127-130.

Kumari, N., Mehta, V. P. and Bhatia, J. K. 2020. Foodgrains production in India: Trend and decompositions analysis. *Economic Affairs*, 65(3):333-342.

Minhas, B. S. and Vaidyanathan, A. 1965. Growth of crop output in India 1951-54 to 1958-61: An analysis by component elements. *Journal of The Indian Society of Agricultural Statistics*, 17(2): 230-252.

Senapati, A. K. and Goyari, P. 2020. Effect of Climate Variability on Yields of Major Crops Grown in Odisha, India. *Indian Journal of Agricultural Economics*, 75(2):186-216.

Tewari, H., Singh, H. P. and Tripathi, U. 2017. Growth and Instability in Wheat Production: A Region-wise Analysis of Uttar Pradesh, India. *International Journal of Current Microbiology and Applied Sciences*, 6(9): 2537-2544.

Udhayan, N., Naik, A. D., Naik, B. K., Kerur, N. M. and Dolli, S. S. 2023. Trends in area, production and productivity of wheat in India with special reference to Karnataka. *The Pharma Innovation Journal*, 12(6): 3608-3611.