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The study analyzes the growth rate of the URAD (*Vigna mungo*) crop, compares it with the state and nation, and suggests future legislation for Lucknow Division.

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ABSTRACT

Black gram, scientifically classified as *Vigna mungo*, or commonly referred to as 'Urad dal,'is a small but powerful legume with a significant role in agriculture and nutrition. This article delves into the to analyze the growth rate for area, production and productivity of black gram crop in Lucknow Division of Central Uttar Pradesh.The time series data on area, production and productivity of urad crop pertaining from "Sankhikiya Patrika" to the period 2000-01 to 2020-21 were used for the study. The per cent change was estimated on the basis of triennium and quinquennium average for area, production and productivity which is increased substantially with 20.93, 77.27 and 45.95 per cent, respectively for triennium, 3.26, 62.12 and 42.16 per cent, respectively for quinquennium. Diagrams have shown trends in Black gram area, production, and productivity. The growth rate was examined by compound annual growth rate (CAGR) which is 0.24 per cent for area, 2.63 per cent for production and for its productivity 1.90 per cent. Decomposition analysis shows the dominant effect of productivity for the growth in urad production.

KEY WORDS: Black Gram, Lucknow division, LGR, CAGR, Decomposition analysis.

INTRODUCTION

Black gram, scientifically known as *Vigna mungo*, is a prominent member of the extensive Leguminosae family. In India, it goes by the name 'Urad dal' and is highly esteemed among all pulses. Besides India, this crop is also cultivated in countries like Pakistan, Afghanistan, Bangladesh and Myanmar. The ideal climate for growing black gram is a temperature range of 27-30 ºC with ample rainfall. This annual crop thrives in loamy soil with good water retention properties. Black gram typically takes 90-120 days to reach maturity and has the added benefit of enriching the soil with nitrogen. India holds a significant position as both a major producer and consumer of black gram. This crop serves as a miniature fertilizer production unit due to its special ability to sustain and rejuvenate soil fertility by capturing atmospheric nitrogen in a mutual partnership with rhizobium bacteria located within root nodules. In the 2020-21 period, India produced around 23.4 lakh tonnes of Black gram from a cultivated area of 42.00 lakh hectares, with an average yield of 557 kg/ha. Black gram accounted for approximately 15.7% of India's total pulse acreage and contributed 9.09% to the overall pulse production. Key states for Black gram cultivation during the Kharif season include Tamil Nadu (2.74 lakh hectares), Andhra Pradesh (2.55 lakh hectares), Odisha (2.00 lakh hectares), Telangana (0.178 lakh hectares), Chhattisgarh (0.14 lakh hectares) and West Bengal (0.18 lakh hectares). "International Year of Pulses" (IYP) was declared by United States in the year 2016 to heighten public awareness of the nutritional benefits of pulses as part of sustainable food production aimed at food security and nutrition. This paper makes an attempt to analyse the nature and sources of growth in area, production and productivity of urad in Lucknow Division of Central Uttar Pradesh with specific objectives as follows:

– To study the growth in area, production and productivity of urad in Lucknow Division of Central Uttar Pradesh.

– To examine the contribution of area and productivity towards the growth in urad production.

MATERIALS AND METHODS

The present study is based on the time series data of area, production and productivity of urad for 21 years from 2000-01 to 2020-21 have been used for the present study and all the graphical representation is done by SPSS software and calculations are done by R software. The data have been collected from Sankhikiya Patrika, published by Economics and Statistics Division, Planning Department, Government of Uttar Pradesh.

ESTIMATION OF GROWTH RATE

Linear growth rate (LGR) and compound growth rate (CGR) were used for the estimation of growth rates in crop characteristics i.e., area, production and productivity of urad crop in India.

LINEAR FUNCTION

Linear function is given by the equation:

$Y_t = a + bt$

Where,

t is the time in years, independent variable

Y is the trend value of the dependent variable a and b are constants

The above equation is fitted by using the least squares method of estimation.

The linear growth rate is calculated by the formula:

Linear growth rate (LGR %) = $100 \times \frac{bb}{\bar{y}\bar{y}}$

COMPOUND FUNCTION

Compound function is given by the equation:

$Y_t = a.b^t$

Or

Log y = log a + t log b

Where,

t is the time in years, independent variable

y is the characteristic (area, production or productivity of dependent variable)

a and b are constants

The ‘a’ and ‘b’ are calculated by applying the method of Least Squares.

The compound growth rate: CGR (%) = antilog(b-1) x 100

Measure of instability in Urad production:

High growth and low instability in production are prerequisites for sustainable agricultural performance. It has been a great concern that technological change in urad production has increased variability, which is considered to be one of the important facts. Since the magnitude of growth and instability in urad has serious implications for policy makers, the level of instability in the area, production and productivity has been estimated

by using cuddy della valle index, which corrects the coefficient of variations and it is given by:

Instability index = $CV\sqrt{1-R^2}\sqrt{1-R^2}$

where, R^2 is the co-efficient of determination from a time trend regression and CV is the co-efficient of variation.

To measure the effect of change in acreage and productivity on differential production of urad crop by decomposition analysis:

An attempt has been made to the study the effect of change in acreage and productivity of urad on its differential production between two points of time.

Let Y, A and P be the production, area and productivity of urad at a given point of time. The Y can be expressed as:

$Y = P. A$

Let ΔY, ΔA, ΔP be change in productivity, area and production, respectively, of the crop after a specific period of time.

So, we have

$$\text{Area effect} = \frac{\frac{A_0 \Delta Y}{\Delta P}}{\frac{A_0 \Delta Y}{\Delta P}} \times 100$$

$$\text{Yield effect} = \frac{\frac{Y_0 \Delta A}{\Delta P}}{\frac{Y_0 \Delta A}{\Delta P}} \times 100$$

$$\text{Interaction effect} = \frac{\frac{\Delta A \Delta Y}{\Delta P}}{\frac{\Delta A \Delta Y}{\Delta P}} \times 100$$

A_0 = Area in the base year

ΔA= Current area minus the base area

Y_0 = Yield in the base year

ΔY = Current yield minus the base yield

ΔP = Current production minus base production

RESULTS AND DATA ANALYSIS

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads:

Per cent change in area, production and productivity of urad:

The triennium average of area (in thousand hectares), production (in thousand quintals) and productivity (in q/hectare) and its per cent change for urad are depicted in the Table 1.

Table 1: Percentage change in area, production and productivity over triennium and quinquennium average

Description	% Change in 2020-21 over 2000-01	
	Quinquennium	Triennium
Area	3.26	20.93
Production	62.12	77.27
Productivity	42.16	45.95

The per cent change in area, production and productivity of actual data has increased substantially with 10.38, 91.63 and 73.62 per cent, respectively during the study period. These figures have shown positive trend for urad crop in the division.

Graphical representation for area, production and productivity of urad crop:

The graphical presentation for area, production and productivity of urad crop is shown in Fig. 1-3.

Area:

Area under urad crop shows positive trend from 2000-01 to 2007-08. The area has gone down with some ups and downs from 2007-08 to 2020-21.

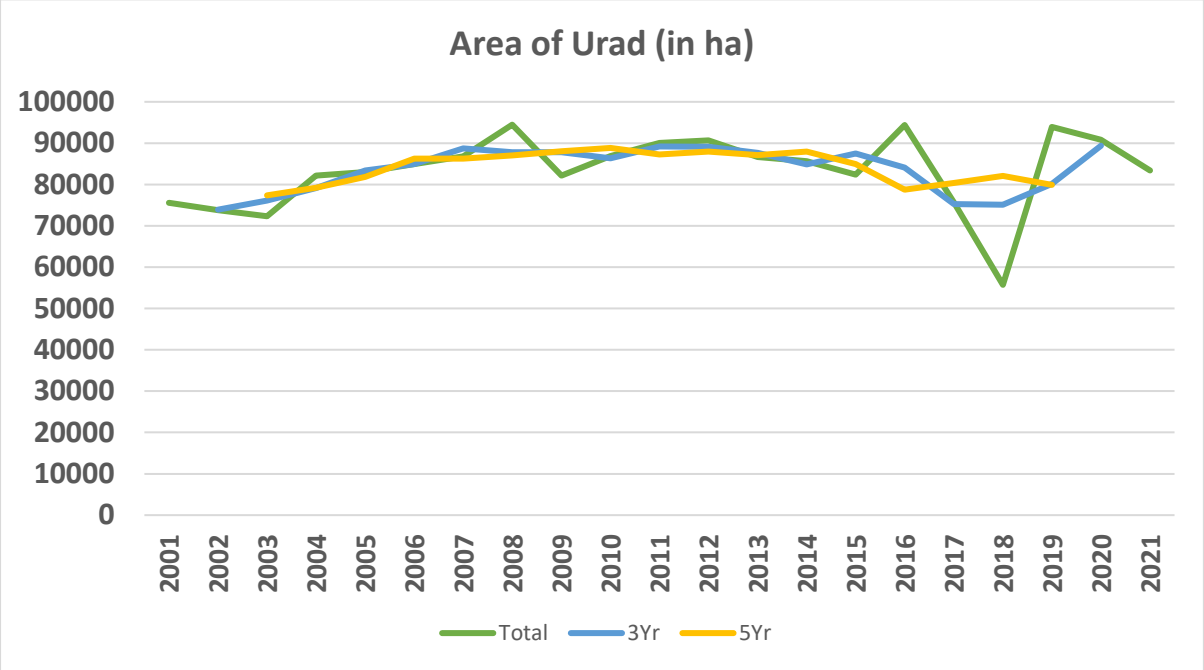

Fig. 1: Area (in Hect.) of Urad in Lucknow Division of Central Uttar Pradesh over

Production:

Lucknow division achieved highest production in year 2020-21 during the study period and positive growth trend of production is visible in Fig. 2.

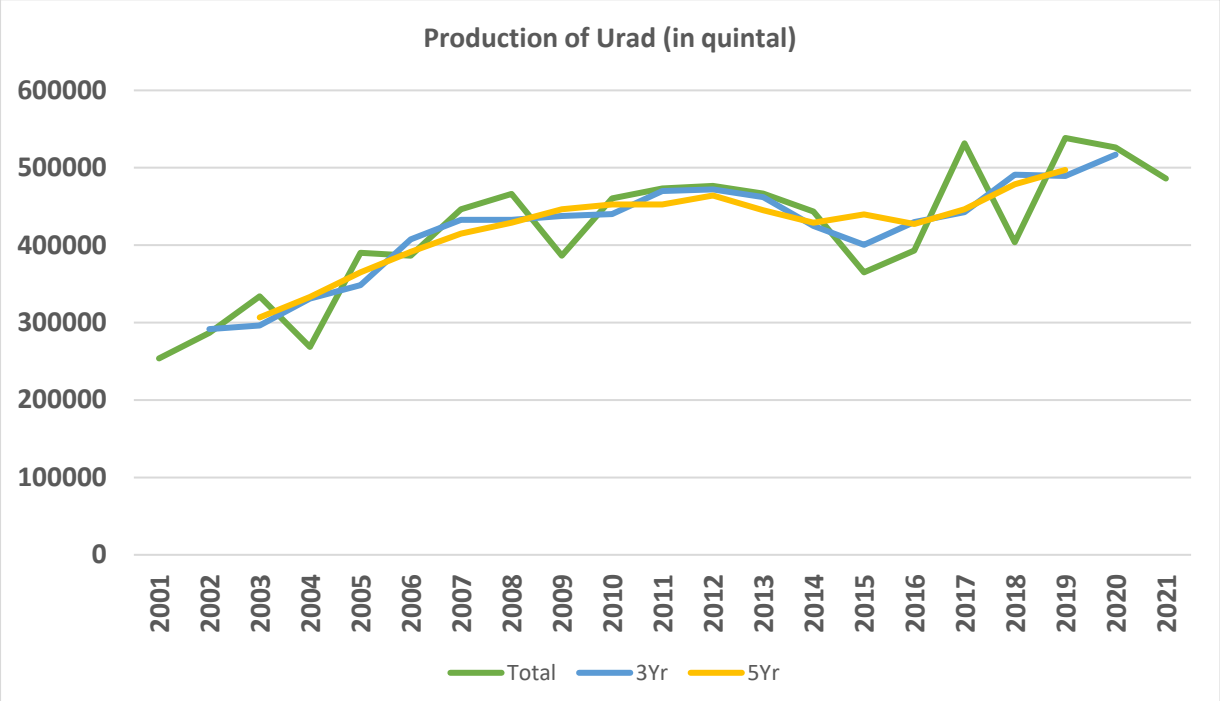

Fig. 2: Production (in quintal) of Urad in Lucknow Division of Central Uttar Pradesh

Productivity:

The division achieved highest productivity in 2020-21. Fig. 3 shows that the productivity of urad has increasing trend till 2020-21.

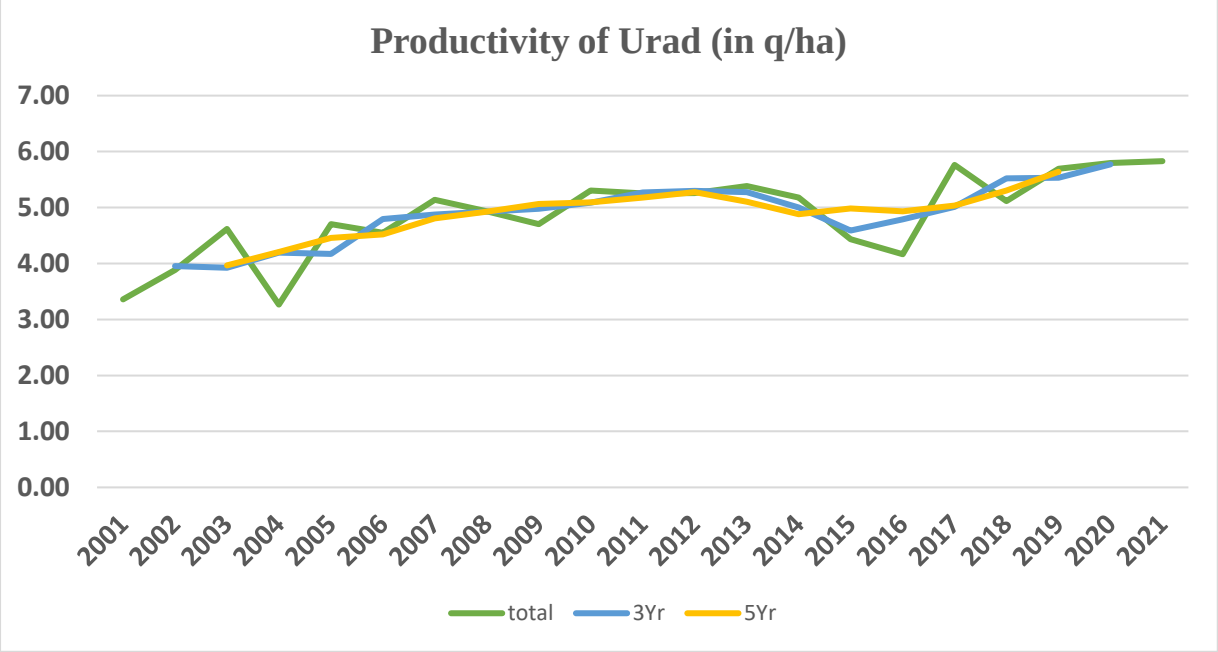

Fig. 3: Productivity (in q/ha) of Urad in Lucknow Division of CentralUttar Pradesh

Table 2: Linear Growth Rate and Annual average compound growth rate of area, production and productivity of urad crop in Lucknow Division of Central Uttar Pradesh

Growth Rate(%)	Lucknow Division					
	Area (ha)		Production (q)		Productivity(q/ha)	
	Triennium	Quinquennium	Triennium	Quinquennium	Triennium	Quinquennium
LGR(%)	0.16	-0.03	2.20	1.95	1.56	1.37
CGR(%)	0.17	0.09	2.39	2.04	1.61	1.35

Table 3: Measures of instability index (in %) of area, production and productivity of urad

Description	CV (%)	R^2	Instability (%)
Area	10.90	0.03	10.75
Production	19.87	0.56	13.16
Productivity	15.81	0.75	7.83

Coefficient of variation (CV) and instability is significant in the context of production, followed by productivity and area. R^2 is more crucial for productivity, afterwards area and production. (α= 0.05).

Table 4 : Effect of change in acreage and productivity on differential production (in quintals) of Urad crop in Lucknow Division of Central Uttar Pradesh based on total, triennium and quinquennium average

Description	Total	Triennium	Quinquennium
Differential production (ΔY)	232480.00 (100%)	225333.30(100%)	190510.00(100%)
Area effect (A ΔY)	186774.40 (80.34%)	135875.64(60.30%)	174825.70(91.77%)
Yield effect (Y ΔA)	26325.49 (11.32%)	61022.82(27.08%)	9989.72(5.24%)
Interaction effect (ΔYΔA)	19380.11 (8.34%)	28434.88(12.62%)	5694.58(2.99%)

Table 5: Comparative study of productivity of urad crop 2020-21 with different scenario

Particulars	Average productivity (q/ha)
Lucknow	5.83
Central UP	6.03
UP	5.73
Andhra Pradesh	9.29
India	5.38

Linear growth rate and Annual average compound growth rate (%) of area, production and productivity of urad:

In respect of this the area, production and productivity of urad in the division exhibit positive growth rate during the study period from 2000-01 to 2020-21 with 0.16 per cent, 2.20 per cent and 1.55 per cent, respectively on the basis of triennium and with 0.03 per cent, 1.95 per cent and 1.37 per cent on the basis of quinquennium for LGR. CGR for area, production and productivity are 0.17 per cent, 2.38 per cent and 1.61 per cent respectively on the basis of triennium and 0.09 per cent, 2.04 per cent and 1.35 per cent respectively on the basis of quinquennium.

Measure of instability in area, production and productivity of Urad crop:

High growth and low instability in agricultural production are essential components for sustainable agricultural development. It is desirable that production increases with improved technological and infrastructural changes in agriculture.

Instability index for area, production and productivity is given below in Table 3.

Table 3 indicates that instability in production and productivity needs to be reduced by intervention of technology and strengthening of infrastructure- like irrigation system.

Decomposition analysis:

Decomposition analysis shows the effect of changes in acreage and productivity and their interaction on differential production of urad crop. Table 4 shows the contribution of area, productivity and their interaction to the change in production over the years.

In the study period the differential production is positive which shows that the production was increases from 2000-01 to 2020-21 by 225.33 thousand quintals in which the contribution of area effect, yield effect and interaction effect is 60.30, 27.08 and 12.62 per cent, respectively on the basis of triennium and by 190.51 thousand quintals in which the contribution of area effect, yield effect and interaction effect is 91.77, 5.24 and 2.99 per cent, respectively on the basis of quinquennium.

CONCLUSION

To summarize, the current study was conducted to assess the increase in area, production, and productivity of the urad crop in Uttar Pradesh's Lucknow division. The linear and compound growth rates for the study period 2000-2021 have been determined by fitting the linear and compound functions to the area, production, and productivity of the urad crop, respectively. During the study period, the average area, production, and productivity of urad in Uttar Pradesh's Lucknow division were 83411.06 hectares, 486190 quintals, and 6.18 q/ha, respectively, and exhibited a significantly increasing trend with linear and compound growth rates of 0.30 and 0.24 percent, respectively, for area and 2.40 and 2.64 percent, respectively for production. However, the productivity of urad indicated an upward trend, with linear and compound growth rates of 1.79 and 1.90 percent, respectively. In Uttar Pradesh, production displayed greater growth rates with an enhancing a propensity as area and productivity grew at a faster pace. Based on the R^2 values, CV, and Instability, it was determined to be the best for predicting urad area, production, and productivity in Uttar Pradesh.

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