https://doi.org/10.48047/AFJBS.6.14.2024.4362-4369

African Journal of Biological Sciences

Journal homepage: http://www.afjbs.com

Research Paper Open Access

"A Time Series Analysis of Oilseed Crops Area, Production & Yield in Uttar Pradesh and India: Growth and Instability analysis"

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Volume 6, Issue 14, Aug 2024

Received: 09 June 2024

Accepted: 19 July 2024

Published: 08 Aug 2024

doi: 10.48047/AFJBS.6.14.2024.4362-4369

Abstract:

The instability was highest during period III, but it decreased after 2003, suggesting expansion. In Uttar Pradesh, there was a significant change from period I to period IV, suggesting expansion in period III. The variation in coefficient around trend decreased slightly from 9.847 to 9.186, indicating period 3 (1986-2003) had the highest degree of instability. In winter (1950-2022), area, production, and productivity all increased significantly, increasing by 1.30% (t=17.19), 6.59% (t=19.04), and 5.23% (t=18.25). Oilseed production technology has been developed over a period of time. The first period (1950-1967) had the highest area growth (2.31, t=14.64) and the highest productivity growth (2.53, t=5.28), but the lowest productivity growth (0.22, t= 0.61). Area (1.31, t=25.77), production (2.90, t=25.88) and output (1.57, t=22.39) have increased significantly in the fifth period (1950-2022), indicating that India continues to grow.

Keywords: growth rate, instability, Oilseed, yellow revolution

INTRODUCTION:

Oilseed crops are the second most significant factor influencing the agricultural economy, after cereals. The "Yellow Revolution" in the early 1990s helped maintain oilseed self-sufficiency. This study investigates trends, oilseed production, area, and yield from 2000 to 2020 in Uttar Pradesh, India. The state's oilseed production has varied significantly over the last 20 years, reaching a record high of 5.5 million metric tonnes in 2018-2019 and a significant fall of 4.2 million metric tonnes in 2015-2016. Variables such as pests and diseases, market dynamics, and climate change are primarily responsible for variations in oilseed yield. The study aims to determine the fundamental causes and determinants of oilseed productivity and production in Uttar Pradesh, India. Over 70% of vegetable oil production globally comes from oilseed crops, with India being the leading producer. Oilseed cakes provide animal feed protein and biodiesel as a sustainable alternative. The oilseed market is expected to grow at a 5% CAGR between 2022 and 2027.

MATERIAL AND METHODS:

The primary source of data used in this analysis is secondary data on oilseed yield, production, and area that was gathered from several published sources over a 72-year span from 1950 to 2022. To gain an insight of decadal performance, the period was split into five sub-periods: 1950–1967 to 1968–1985, 1986–2003 to 2004–22, and 1950–2022. The study employed several methodologies, such as growth rate estimation with significance testing, growth slowing or standstill, and instability analysis.

Growth Rate

The growth rate was measured following the procedure adopted by various authors, Edwin K. et al. (2014) and many others and the steps foo lowed are presented below. By taking time as independent variable and area, production and yield of the crops as dependent variables, the compound growth rates were estimated.

$$Y = A\ (1 + r)t$$

Where,

Y denotes dependent variables like area, production and yield in the year ‘t’ for which growth rate is estimated.

A is a constant

r is the rate of annual increment.

Estimation of instability index

For assessing the instability in the production, the index certain by Cuddy- Della Valle index (Cuddy and Valle 1978) and used by Verma *et al.*,(2024): $CV_t = (CV) \times \sqrt{\mathbf{1} - \boldsymbol{R^2}}$

$$C.V. = \frac{\sigma}{\underline{X}} \times 100$$

Where, σ = Standard Deviation

$$\underline{X} = Mean$$

R^2 = coefficient of determination of the variable's linear trend model.

CVt = CV around trend

RESULT AND DISCUSSION:

To analysis the growth and instability analysis of oilseeds in Uttar Pradesh and India;

1.1: Instability analysis

The Cuddy and Della (1978) approach was used in India and Uttar Pradesh to assess instability in oilseed areas, production, and yield. However, finding a linear trend in long-term time series data is challenging. The study integrated nonlinearity into the trend model, using the modified Cuddy and Della measure. The R2 in the Cuddy and Della model and the modified model can differ.

The study measured the trend coefficient of variation in five periods. 1.1.1 Instability of oilseed Examination of oilseed areas in Uttar Pradesh are displayed in Table 1.1.1. As can be seen from the table, period III saw the highest level of instability; however, after period III, instability started to decline, indicating that the area had expanded in India. The coefficient variant around trend (CV_t) in the oilseed area increased from 3.287 (period 1) to 4.521 (period 4). In contrast, there is a marked shift in Uttar Pradesh from Time I (4.644) to Period IV (5.090), suggesting that the region has expanded during Period III and that the time had the greatest degree of instability. Analysis of oilseed production in Uttar Pradesh and India are shown in Table 1.1.1. The data unequivocally demonstrates that the coefficient variant around trend (CV_t) fell slightly from 9.847 (period 1) to 9.186 (period 2), suggesting that period 3 (India, 1986–2003) had the highest level of instability. In Uttar Pradesh, however, there has been a significant shift from period 1 (10.807) to period 4 (18.312), with period 2 (1968–1985) exhibiting the highest level of instability.

The situation in India and Uttar Pradesh is shown in Table 1.1.1 for oilseed yield analysis. It is evident from this table that the highest level of instability was sown in period 3 (1986–2003) but that instability started to decline after 2003. In Uttar Pradesh, on the other hand, there is a significant change between period 1 (12.759) and period 4 (15.775), and the highest level of instability was sown in period 2 (1968–1985). The analysis of oilseed area, production, and yield instability thus suggests that the introduction of new technology has increased oilseed production insecurity. It raises the production risk on farms, affects farmer income, and influences the choice to invest in high-paying farming technology. It affects price stability as well as the susceptibility of low-income households.

Table 1.1.1:- Instability Analysis of Area, Production and yield of oilseeds crops during

INDIA
Area ('000' ha)

Yield	**PERIOD I (1950-1967)**	**PERIOD II (1968-1985)**	**PERIOD III (1986-2003)**	**PERIOD IV (2004-2022)**	**PERIOD V (1950-2022)**
R Square	0.9305726	0.765411035	0.08240306	0.000448813	0.903436708
CV	12.4784353	7.52298403	5.40547326	4.522662778	27.46875522
CV_t	3.28795283	3.64371105	5.17797206	4.521647749	8.535815328
Production ('000' ton)					
R Square	0.635757782	0.589500245	0.323261673	0.468900984	0.904216445
CV	16.31703798	17.61162854	19.73862206	12.60496078	58.53423648
CV_t	9.847737539	11.28381528	16.23780113	9.186059352	18.11571307
Yield (kg/h.)					
R Square	0.023283633	0.305129189	0.074530532	0.402142374	0.5171871
CV	8.696450207	12.03155397	15.74687324	12.19585919	38.175667
CV_t	8.594611442	10.02937241	15.1487005	9.429991212	26.526262
UTTAR PRADESH					
Area ('000' ha)					
R Square	0.941319	0.337599	0.000377	0.760187	0.806364
CV	19.17262	13.59655	17.23338	10.39479	28.45011
CV_t	4.644388	11.06596	17.23014	5.090401	12.5192
Production ('000' ton)					
R Square	0.584219	0.632073	0.041795	0.449741	0.836308
CV	16.76081	115.825	23.69174	24.68736	88.55928
CV_t	10.80755	70.25597	23.19137	18.31295	35.83004
Yield (kg/h.)					
R Square	0.02328	0.30513	0.07453	0.4021424	0.5171871
CV	12.9107	108.688	13.1575	20.402156	78.538032
CV_t	12.7595	90.6012	12.6577	15.775203	54.571946

1.2: Growth analysis

Uttar Pradesh

There are several variations in location, yield, and yield when oilseed agriculture in Uttar Pradesh is analyzed over time. During the first era (1950–1967), yields and earnings climbed by 2.62% and 1.01%, respectively, while the amount of land increased significantly to reach 3.67 (t=16.02). Production and output rose dramatically in the second era (1968–1985), with 18.08 (t=5.24) and 16.29 (t=5.24), respectively, whereas the area only expanded by 1.53 (t= 2.85). By contrast, there was notable expansion in the sector (1.66, t=7.34) and output (3.04, t=3.72) during the fourth period (2004–2022), with an increase in output of 1.50 (t=1.92). Area, production, and productivity all had notable increases during the fifth era (1950–2022), rising by 1.30 percent (t=17.19), 6.59% (t=19.04), and 5.23 percent (t= 18.25). Techniques for growing oilseeds have continued to advance over a long time.

India

A study of oilseed crop growth in India throughout time reveals some interesting patterns in terms of acreage, yield, and production. Area (2.31, t=14.64) and production (2.53, t=5.28) showed notable growth rates during Period I (1950–1967), but yield growth was minimal (0.22, t=0.61). There were notable gains in area (1.25, t=7.25), yield (1.30, t=3.14), and production (2.57, t=4.79) during Period II (1968–1985). The third period (1986-2003) saw a notable increase in yield (1.74, t=3.53), but less so in area (0.59, t=1.19) and output (2.34, t=2.76). Production and yield increased significantly during Period IV (2004–2022) (1.54, t=3.87) and 1.68, t=5.40), although area growth was minimal (0.02, t=0.87). Over Period V's whole duration (1950–2022), notable increases were noted in area (1.31, t=25.77), production (2.90, t=25.88), and yield (1.57, t=22.39), reflecting sustained long-term improvements in oilseed cultivation across India.

Table 1.2.2 Growth analysis of Area, Production and yield of oilseeds crops Uttar Pradesh & India during

PERIOD	UTTAR PRADESH			INDIA		
	Area	**Production**	**Yield**	**Area**	**Production**	**Yield**
PERIOD I (1950-1967)	3.67 (16.02)**	2.62 (4.74)	1.01 (2.16)	2.31 (14.64)**	2.53 (5.28)*	0.22 (0.61)
PERIOD II (1968-1985)	1.53 (2.85)	18.08 (5.24)*	16.29 (5.24)*	1.25 (7.25)*	2.57 (4.79)	1.30 (3.14)*
PERIOD III (1986-2003)	0.48 (0.77)	1.24 (0.83)	1.29 (2.26)	0.59 (1.19)	2.34 (2.76)	1.74 (3.53)*
PERIOD IV (2004-2022)	1.66 (7.34)**	3.04 (3.72)**	1.50 (1.92)	0.02 (0.87)	1.54 (3.87)**	1.68 (5.40)**
PERIOD V (1950-2022)	1.30 (17.19)*	6.59 (19.04)**	5.23 (18.25)**	1.31 (25.77)**	2.90 (25.88)**	1.57 (22.39)*

*Significant at 1 per cent level **Significant at 5 per cent level.

CONCLUSIONS:

The analysis of oilseed areas in Uttar Pradesh, India. The highest level of instability was observed in period III, but it declined after 2003, indicating expansion. The coefficient variant around the trend increased from 3.287 to 4.521 in the oilseed area. Uttar Pradesh experienced a significant shift from Time I to Period IV, indicating expansion during Period III. The coefficient variant around the trend decreased slightly from 9.847 to 9.186, indicating period 3 (1986-2003) had the highest level of instability. In Uttar Pradesh, the highest level of instability was observed between periods 1 and 4, with period 2 (1968-1985) exhibiting the highest level. Extensive country, crop, and product analysis of oil production in Uttar Pradesh is conducted. In the second period (1968-1985), yield and output increased significantly, 18.08 (t=5.24) and 16.29 (t=5.24) respectively, while the area only increased by 1.53 (t=2.85). In winter (1950-2022), area, output, and productivity all increased significantly, growing by 1.30% (t=17.19), 6.59% (t=19.04), and 5.23% (t=18.25) respectively. The technology for producing oilseeds has been developed over a long period. The first period (1950-1967) showed the highest growth in area (2.31, t=14.64) and productivity (2.53, t=5.28), but the lowest productivity growth (0.22, t=0 .61). The fourth period (2004-2022) shows a significant increase in productivity and production (1.54, t=3.87) and 1.68, t=5.40), although there is a small growth in the area (0.02, t =0, 87). Area (1.31, t=25.77), output (2.90, t=25.88), and output (1.57, t=22.39) increased significantly during the fifth period (1950-2022), showing that India continues to grow.

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