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NN Pusadekar
M.Sc. Student, Department of Agricultural Economics, Dr. PDKV, Akola, Maharashtra, India

UT Dangore
Associate Professor, Agricultural Economics and Statistic Section, College of Agriculture Nagpur, Maharashtra, India

PP Baviskar
Ph.D., Scholar, Department of Agricultural Economics, VNMKV, Parbhani, Maharashtra, India

UP Gaware
Ph.D., Scholar Department of Agricultural Economics, Dr. RPCAU, Pusa, Samastipur, Bihar, India

MG Pusdekar
Assistant Professor, Horticulture Section, Anand Niketan College of Agriculture, Warora, Maharashtra, India

Corresponding Author:
NN Pusadekar
M.Sc. Student, Department of Agricultural Economics, Dr. PDKV, Akola, Maharashtra, India

Trend and Decomposition analysis of groundnut in Gujarat

NN Pusadekar, UT Dangore, PP Baviskar, UP Gaware and MG Pusdekar

Abstract
This paper has studied the growth trends and decomposition analysis of area, production and productivity of groundnut in Gujarat. The study was based on the secondary data of 20 years from 1996-97 to 2015-16 which was split into two sub-periods i.e. period I 1996-97 to 2005-06 and period II 2006-07 to 2015-16. The growth rates were calculated by exponential function and instability by Coefficient of variation and Cuddy Della Valle's instability index. The relative contribution of area and yield to change in output was estimated by using Minhas decomposition model. The result showed that, the compound growth rate for area, production and productivity during period I was positive. The instability indices i.e. CV and CDVI were lowest during all the periods in case of area. For area, production and productivity the cubic function was best fitted while the decomposition analysis showed largest area effect on groundnut production during overall period.

Keywords: Wheat, growth rate. instability, trend, decomposition

Introduction
Groundnut ranks first in India among oil seed crops. It covers 45 per cent of area and accounts for 55 per cent of production of the total oil seeds. India is rated as the third largest producer of groundnut in the world. Peanut is grown in six major states namely Andhra Pradesh, Gujarat, Tamil Nadu, Karnataka, Rajasthan, Maharashtra, and together they account for about 90 per cent of the crop's total area. Gujarat State shares about 26 per cent of the total Groundnut area respectively in the country. Groundnut contributes to nearly 25 per cent of total oil seed production in the country. Nearly 75 per cent output occurs in June-September and the rest during November-March known as kharif and rabi seasons respectively. According to APEDA source, during the financial year April 2016 to March 2017, 7.25 lakh tons of groundnut oil has been exported from the country as against the 5.42 tons of groundnut exported during last year. That is, in the year 2016-17, the export has increased by 34 per cent. Groundnut is the sixth most important oilseed crop in the world. The production of groundnut is concentrated in Asia Groundnut Seed Production Manual and Africa. The specific objectives of the study were as follows [1]: To estimate the growth rates of area, production and productivity of groundnut in Gujarat [2]; To workout instability of groundnut [3]; To assess trends in area production and productivity and [4] To estimate the relative contribution of area and yield to change in the output of groundnut in Gujarat.

Methodology
Present study was based on secondary data and confined to the period of 1996-97 to 2015-16. Data related to area, production and productivity of groundnut crop of Gujarat was collected from Ministry of Agriculture and Farmer's Welfare, Government of India.

Analytical tools and techniques
The present study was based on time series secondary data of groundnut growing state Gujarat. The analysis was done on the following aspects: Growth rate analysis, Instability analysis, trend analysis and Decomposition of output growth.

Growth rate analysis
The compound growth rates of area, production and productivity of groundnut were estimated for period I (1996-97 to 2005-06), Period II (2006-07 to 2015-16) and overall period (1996-97 to 2015-16).
The compound growth rates of area, production and productivity were estimated by using following exponential model.

$Y = a.b^t$
Log Y = log a + t log b
CGR(r) = [Antilog (log b-1)] ×100

Where
CGR = Compound growth rate
t = Time period in year
Y = Area/production/productivity
a = Intercept
b = Regression Coefficient

The significance of the regression coefficient was tested using the student's t-test.

Instability analysis
To measure the instability in area, production and productivity, an index of instability was used as a measure of variability through Coefficient of Variation (CV) and Cuddy Della Valle's Instability Index (CDVI).

Coefficient of variation (CV)

Coefficient of variation (CV) = $\frac{\sigma}{x} \times 100$

Where
σ = Standard deviation
X = Arithmetic mean

The simple Coefficient of variation (CV) often contains the trend component and thus over estimates the level of instability in time series data characterized by long term trends and Cuddy Della Valle's instability was estimated as follows,

Cuddy Della Valle's Instability Index (CDVI)
It was used to measure instability of groundnut which is close to approximation of the average year to year percent variation adjusted for trend. The algebraic form of it was,

Instability Index = $CV\sqrt{(1 - R^2)}$

Where
CV = Simple estimates of coefficient of variation in per cent and
R^2= Coefficient of determination from a time trend regression adjusted by the number of degree of freedom.

Trend analysis
The trend in area, production and productivity of groundnut was computed for the series data of last 20 years, i.e. 1996-97 to 2015-16. To trace the path of process different parametric trend functions as given in the table below were used. Among the competitive trend functions, the best functions were selected based in their goodness of fit (measured in terms of R^2 value and significance of the coefficients.

Table 1: List of different parametric models with their equations

Sr. No.	Name of Function	Equation
1.	Linear	$Y_t = a+bt$
2.	Quadratic	$Y_t = a+b_1t+b_2t^2$
3.	Cubic	$Y_t = a+b_1t+b_2t^2+b_3t^3$
4.	Exponential	$Log(y)=b_0+b_1X$
5.	Logarithmic	$Log\ Y_t = a+b\ Log(t)$

Where, a, b and t represents constant, coefficient and time respectively in the function.

Decomposition analysis
To measure the relative contribution of area, yield to the total output of the groundnut crop, Minhas (1964) Decomposition analysis model was used, which is given below.

$P_o = A_o \times Y_o$ and
$P_n = A_n \times Y_n$ ---------- (1)

A_o, P_o and Y_o are area, production and productivity in base year and A_n, P_n and Y_n are values of the respective variable in n^{th} year item respectively.

Where,
A_o and A_n = Area
Y_o and Y_n = 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)

For equation (1) and (2) we can write
$P_o + \Delta P = (A_o + \Delta A)(Y_o + \Delta Y)$

Hence

$$P = \frac{Ao\ \Delta Y}{\Delta P} x100 + \frac{Yo\ \Delta A}{\Delta P} x100 + \frac{\Delta Y\ \Delta A}{\Delta P} x\ 100$$

Production = yield effect + area effect + interaction effect

Thus, the total change in production can be decomposed into area effect and the interaction effect due to change in yield and area.

Result and Discussion
Growth rates of area, production and productivity of groundnut in Gujarat
The period wise compound growth rates of area, production and productivity were worked out and presented in table 2.
The data presented in the table 1 revealed that, during period I area, production and productivity showed positive growth rate (0.84 per cent, 3.70 per cent and 2.83 per cent respectively.) while during period II and overall period, growth rates of area were negatively significant at 5 percent and 1 percent respectively (-3.24 per cent and -1.45 per cent) with production (2.41 per cent and 2.18 per cent) and productivity (2.46 per cent and 4.17 per cent) being positive for both the periods.

Table 2: Compound growth rates of area, production and productivity

Sr. NO.	Particulars	Period I	Period II	Overall
1	Area	0.84	-3.24*	-1.45**
2	Production	3.70	2.41	2.18
3	Productivity	2.83	2.46	4.17

Note: **Significant at 1% level, * Significant at 5% level.
(CGR: per cent per annum)

Instability of area, production and productivity of groundnut in Gujarat

Period wise coefficient of variation and Cuddy Della Valle Instability Index of area, production and productivity of groundnut in India was estimated and presented in table 3

It is seen from table 3 that, the coefficient of variation as well as CDVI of area were lowest (4.75 and 4.01 per cent; 14.29 and 10.55 per cent; 12.28 and 9.36 per cent respectively) than production (53.21 and 51.60 per cent; 45.19 and 44.18 per cent; 48.13 and 46.76 per cent respectively) and productivity (51.51 and 50.43 per cent; 41.24 and 40.93 per cent; 48.80 and 43.95 per cent respectively) during period I, period II and overall period respectively.

Table 3: Instability Indices of Area, Production and Productivity

Sr. No.	Particulars	Instability Indices	Period I	Period II	Overall
1	Area	CV	4.75	14.29	12.28
		CDVI	4.01	10.55	9.36
2	Production	CV	53.21	45.19	48.13
		CDVI	51.60	44.18	46.76
3	Productivity	CV	51.51	41.24	48.80
		CDVI	50.43	40.93	43.95

Trends in area, production and productivity of groundnut in Gujarat

The trend have been fitted on the time series data. The slope of the curve is given by the value associated with year (x). Trend analysis provides the rate of change of particular variables during the period of reference and the direction of change but it fails to provide the rate of change per annum. The trend in area, production and productivity of groundnut in Gujarat was estimated and presented in table 4. It is seen from the table 4 that, the cubic function was best fitted to area, production as well as productivity. The cubic functions were best fitted by considering the highest value of R^2.

Table 4: Trends in area, production and productivity

Sr. No.	Particulars	Functions	Constant	Coefficients			R Square
			a	b_1	b_2	b_3	
1	Area	Cubic	1774.88	50.96	-4.06	0.03	0.620
2	Production	Cubic	2453.67	-201.83	27.34	-0.83	0.069
3	Productivity	Cubic	1429.23	-204.78	29.15	-0.91	0.228

Decomposition analysis in groundnut production in Gujarat

The per cent contribution of area, yield and their interaction for changing production of groundnut in Gujarat for two periods and overall period was estimated and presented in table 5. It is evident from the table 5 that during period I yield effect was the most responsible factor for changing production in Gujarat i.e. 78.00 per cent whereas area effect was 16.94 per cent and interaction effect was 5.06 per cent. Similar results were seen during period II with yield effect 165.65 per cent as the most responsible factor but area effect and interaction effect were found to be negative i.e. -32.11 and -33.54 per cent respectively. While in case of overall period area effect was seen as the most responsible factor for changing the production in Gujarat i.e. 503.97 per cent with yield effect being negative i.e. -528.11 per cent and interaction effect 121.14 per cent.

Table 5: Per cent contribution of area, yield and their interaction for increasing production of groundnut in Gujarat

Sr. No.	Particulars	Period I	Period II	Overall
1	Area Effect	16.94	-32.11	503.97
2	Yield Effect	78.00	165.65	-528.11
3	Interaction Effect	5.06	-33.54	121.14

Conclusion

The compound growth rate of area under crop was negative. Hence, there is a need to concentrate on this crop for policy makers. Yield effect was seen to be responsible for change in production of groundnut in Gujarat therefore, it is necessary to provide high yielding varieties to the farmers. In order to maintain stability in production of groundnut, efforts like evaluation of high yielding and drought resistant variety of groundnut should be made available in the state.

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