

# **Growth Analysis and Instability in Groundnut Area, Production, Productivity in India**

## **Abstract**

Measuring the trends of growth and variability in agricultural production is important to understand how outputs changes over time. The present study analyzed the growth and instability index of groundnuts. The study depends on secondary data, which was collected from the Ministry of Agriculture and Farmers Welfare (GOI 2021) for the period 1950-2022. The entire study period is divided into three sub-periods: 1950-51 to 1969-1970, 1971-1972 to 1999-2000 and 2000-2001 to 2021-2022. The compound annual growth rate, instability Index and decomposition analysis were used for the analysis. The compound annual growth rates for production, area, and yield are -0.14 percent, 1.05 percent, and 1.2 percent, respectively, groundnut production and yield are increasing and the area in India has changed throughout time. The decomposition of groundnut production in area, yield, and interaction effect showed that the yield effect was responsible for increasing the production of groundnut in India followed by the interaction effect and area effect. The results revealed that the level of instability was high in yield while it was lowest in area. The findings showed that the annual growth rate of productivity of groundnuts also shows an increasing trend during the recent period due to the availability of high-yielding cultivars and the deployment of innovative cultivation technologies. From the result, it is concluded that including the non-traditional areas increases the area under cultivation to sustain and improve groundnut production.

## **1. Introduction**

Oilseed production occupies an important position in the Indian agriculture economy, next to cereals. Recently, oilseeds have attracted more attention due to the increasing demand for healthy vegetable oils, livestock feeds, medicines and biofuels. India is the fourth largest oilseed producer in the world, next to the USA, China, and Brazil, contributing 10% of the world's oilseed production, 6-7% of the global production of vegetable oil, and nearly 7% of protein meal. India is fortunate to have a variety of oilseeds grown in its distinctive rich agro-climatic zones. It has ideal conditions to grow a variety of oilseeds throughout the year. This sector has an important place in the Indian agricultural sector covering an area of about 27.1 million hectares, with a total production of over 33 million tonnes in the year 2019-20 (Indiastat, 2020). Among the nine oilseed crops grown in the country, seven are edible oils

(groundnut, rapeseed-mustard, soybean, sunflower, sesame, safflower and niger seed) and two are non-edible oils (castor seed and linseed). The data on area, production and productivity of oilseed crops in India shows that of the nine oilseed crops, three crops viz.; groundnut, rapeseed-mustard and soybean contribute 86.42 percent in area and 90.95 percent in the production of total oilseed. The non-edible oilseeds constitute only 4.67 percent of the total area and 5.53 percent of the total production of all oilseeds, implying the role played by the edible oilseed cultivation of India. (Indiastat, 2020).

Among the oilseed crops, Groundnut is one of the most important food and cash crops of India. Groundnut is called as king of oilseed crops as well as poor man's cashew nut. It plays an important role in reducing India's oil deficit. Groundnut is particularly valued for its protein content of 26 percent protein. China is the largest producer as well as consumer of groundnut in the world with 166.24 lakh tonnes followed by India 68.57 lakh tonnes. India is the second largest producer of groundnut in the world after China (GOI, 2017). In India, the production of groundnut was 8434 tonnes in an area of 4913 thousand hectares during 2020-21 (GOI, 2021). Groundnut is mainly grown in the states of Gujarat, Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra and Rajasthan. The crop can be grown successfully in areas with a minimum of 500 mm of rainfall and a maximum of 1250 mm of rainfall. Groundnut is primarily grown as a rain-fed Kharif crop, nearly 80% of production comes from Kharif crop.

Hence, the present study is attempted with the following specific objectives;

1. To analyse the growth of area, production and productivity of Groundnut in India.
2. To estimate the contribution of area and yield towards change in the production of groundnut in India.
3. To study the instability of area, production, and productivity of Groundnut in India

## **2. Methodology**

The area, production and productivity of groundnut (*Arachis hypogea*) for the period of 1951-2022 have been collected from Annual report 2021-22 by the Ministry of Agriculture and Farmers Welfare, Government of India(2021).

### **2.1 Compound Annual Growth Rate**

The growth rate was calculated for the area, production, and productivity of groundnuts in India in the present study. The compound Growth Rate was used (Exponential model).

$$Y = a^{bt}$$

Where,

Y - Dependent variable for which growth rate is estimated,

a - Intercept, b - Regression coefficient, t - Time variable

The logarithmic form of the above equation estimated the compound growth rate

$$\log Y = \log a + t \log b$$

The compound growth rate (g) was estimated by using

$$g = [\text{Anti log of } (b) - 1] * 100$$

## 2.2 Decomposition analysis

Decomposition is a technique to discern the effect of technology environmental damage or any other impact on production. The following decomposition model was used for the estimation of the contribution of area and yield towards change in production (positive/negative) and is expressed as:

$$\Delta P = A_0 \Delta Y + Y_0 \Delta A + \Delta A \Delta Y$$

Change in production = Area Effects + Yield Effects + Interaction Effects

Area Effect: Average percentage of total production in terms of area.

$$AE = \frac{(A_n - A_0) Y_0}{P_n - P_0} \times 100$$

Yield Effect: Average yield as a percentage of total production.

$$YE = \frac{(Y_n - Y_0) A_0}{P_n - P_0} \times 100$$

Interaction Effect:

$$IE = \frac{(A_n - A_0)(Y_n - Y_0)}{P_n - P_0} \times 100$$

Where,

$A_0$  = Triennium average of area in base year

$A_n$  = Triennium average of area in current year

$P_0$  = Triennium average of production in base year

$P_n$  = Triennium average of production in current year

$Y_0 = P_0/A_0$

$Y_n = P_n/A_n$

### 2.3. Measure of Instability

The instability in area, production and productivity of groundnuts is measured in relative terms by the Cuddy-Della Valle index and Coppock index .

#### a) Cuddy-Della Valle index

The instability index IX is given by the expression:  $IX = C.V \times \sqrt{(1 - \bar{R}^2)}$

Where, CV = coefficient of variation (in percent),

$R^2$  = coefficient of determination from a time-trend regression adjusted by the number of degrees of freedom.

#### b) Coppock Index:

Instability was also analyzed using Coppock's Index which is calculated as the antilog of the square root of the logarithmic variance using the following formula

Coppock Index = (Antilog)  $\sqrt{v \log - 1} * 100$ ,

$$V \log = \frac{1}{(N - 1)} \sum (\log p_{t+1} - \log_t - M)^2$$

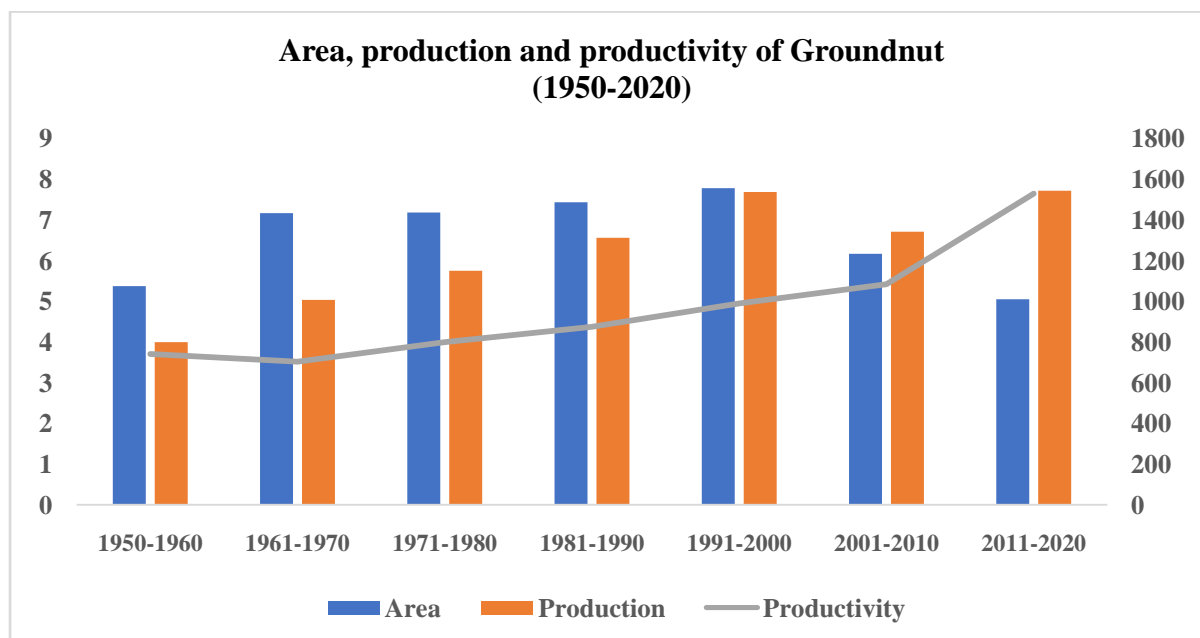
$$M = \frac{1}{(N + 1)} \sum (\log p_{t+1} - \log_t)$$

Coppock's Instability index is a close approximation of the average year-to-year percentage variation adjusted for trend and the advantage is that measures the instability in relation to the trend in the area. A higher numerical value for the index represents greater instability.

## 3. RESULTS AND DISCUSSION

### 3.1 Area, Production and Productivity of Groundnut

The decadal average of area, production and productivity of groundnut from 1950-2020 were shown in Fig. 1. Groundnut was cultivated in 5.37 million ha during the period 1950-60 and the area was decreased to 5.05 million ha during 2011-2020. The productivity of groundnut steadily increased from 741.7 kg/ha to 1528.6 kg/ha from 1950 to 2020 respectively.



**Fig.1.TREND ANALYSIS OF AREA, PRODUCTION AND PRODUCTIVITY OF GROUNDNUT (1950-2020)**

### 3.2 Compound Annual Growth Rate (CAGR) of Groundnut

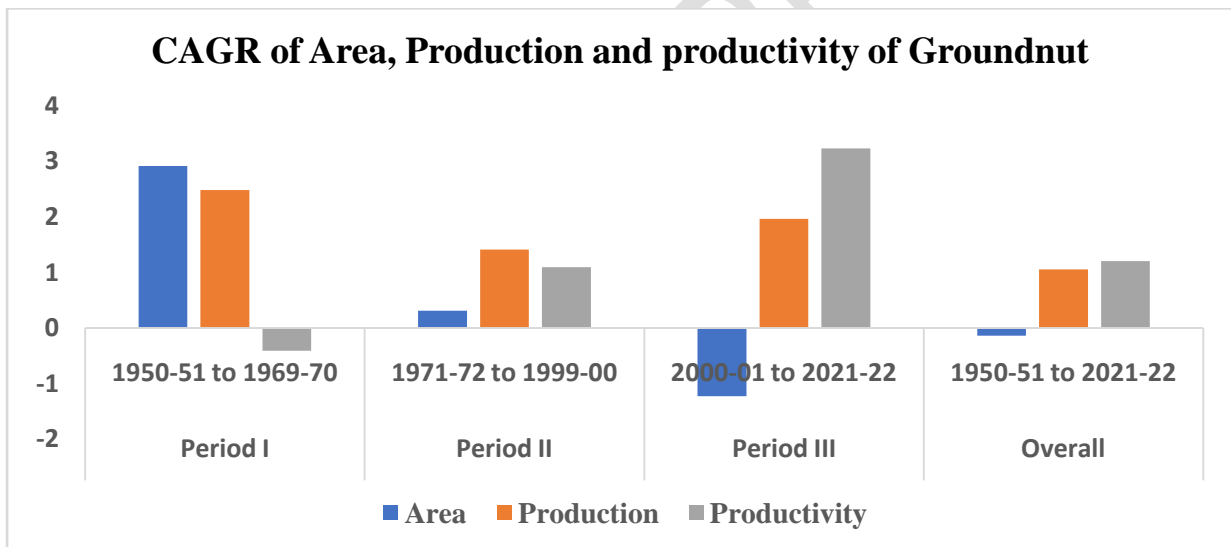
The time series data on area, production and productivity of groundnuts in India were analyzed and presented in Table 1.

**Table 1. CAGR of area, production and productivity of groundnuts in India**

Crop	Period I 1950-51 to 1969-70	Period II 1971-72 to 1999-00	Period III 2000-01 to 2021-22	Overall 1950-51 to 2021-22
Area	2.91	0.31	-1.23	-0.14
Production	2.48	1.41	1.96	1.05

Productivity	-0.41	1.09	3.23	1.2
--------------	-------	------	------	-----

The period-wise compound growth rates of area, production and productivity were worked out and presented in Table 1. The data presented in Table 1 revealed that during the period I area, production showed a positive growth rate (2.91 per cent, 2.48 per cent respectively.) and productivity showed a negative growth rate (-0.41 per cent) while during the period II area, production and productivity showed positive growth rate (0.31 per cent, 1.41 per cent and 1.09 per cent respectively.) and in period III and overall period, growth rates of area were negative (-1.23 per cent and -0.14 per cent) with production (1.96 per cent and 3.23 per cent) and productivity (1.05 per cent and 1.2 per cent) being positive for both the periods. The negative growth in area might be due to decrease in groundnut area under cultivation..



**Fig.2. CAGR of area, production and productivity of groundnuts in India**

### 3.3. Decomposition analysis of groundnut

The total change in the production of groundnut was decomposed into three effects (i.e) area effect, yield effect and interaction effect during the period 1950-2022. The results are presented in Table 2.

**Table 2. Decomposition analysis of groundnut**

(in percentage)

Particulars	Period I 1950-51 to 1969-70	Period II 1971-72 to 1999-00	Period III 2000-01 to 2021-22	Overall (1950-2022)
Area effect	86.71	-6.75	-15.8	7.76
Yield effect	8.67	109.1	130.82	79
Interaction effect	4.61	-2.35	-15.01	13.23

Decomposition analysis in groundnut production of area, yield and their interaction for changing production of groundnut for three periods and overall period was estimated and presented in Table 3. It is evident from Table 3 that during the period I Area effect (86.71 percent) was the most responsible factor for changing production whereas the yield effect was 8.67 per cent and the interaction effect was 4.61 percent while during period II yield effect was the most responsible factor for changing production in India i.e. 130.82 percent whereas but area effect and interaction effect were found to be negative i.e. -6.75 and -2.35 per cent respectively. Similar results were seen during period III with a yield effect of 130.82 per cent as the most responsible factor but the area effect and interaction effect were found to be negative i.e. -15.8 and -15.01 per cent respectively. In the case of the overall period, Yield effect was seen as the most responsible factor for changing the production in India i.e. 503.97 per cent with the Interaction effect being 13.23 per cent and area effect 7.76 per cent. For the overall period in India, the Yield effect (79 per cent) contributed the highest to production compared to the area and interaction effect (7.76 per cent and 13.23 per cent) in groundnut under study.

#### 3.4 . Measure of instability in area, production and productivity of groundnut in India

Instability analysis on the area, production and productivity of groundnut for a period of 1950-2022 was carried out. Instability measures such as coefficient of variation, Cuddy-della Valle index and Coppock index were determined and presented in Table 3.

The fluctuation in agriculture is measured with the help of a simple coefficient of variation (CV) but often contains the trend component and thus over times the level of instability in time series data characterized by long-term trends. To overcome this problem, this study used Cuddy-Della and Coppock's instability Index which corrects the coefficient of variation.

**Table 3. Measure of instability in area, production and productivity of groundnut in India**

S.No	Particulars	Instability Indices	Period I 1950-51 to1969-70	Period II 1971-72 to 1999-00	Period III 2000-01 to 2021-22	Overall (1950- 2022)
1	Area	CV	17.5	7.55	11.96	16.811
		CDVI	6.91	7.1	9.08	16.68
		CI	53.08	48.6	50.45	52.69
2	Production	CV	18.21	20.41	23.76	28.57
		CDVI	12.5	16.42	20.65	19.45
		CI	53.33	53.87	55.95	57.69
3	Productivity	CV	10.37	15.98	26.27	33.79
		CDVI	10.38	12.89	17.16	20.41
		CI	49.96	52.02	56.84	58.03

Period-wise coefficient of variation, Cuddy Della Valle Instability Index and Coppock index of area, production and productivity of groundnut in India was estimated and presented in Table 3. It is seen from Table 3 that, CDVI of the area was lowest (6.91 per cent, 7.1 per cent, 9.08 per cent and 16.68 per cent respectively) than production (12.5 per cent, 16.42 per cent, 20.65 per cent and 19.45 per cent respectively) and productivity (10.38 per cent, 12.89 per cent, 17.16 per cent and 20.41 per cent respectively) during the period I, period II, period III and overall period respectively. Coppock Index was found to be more in productivity (58.03 per cent) in India whereas followed by area (52.69 per cent) and production (57.69 per cent).

#### 4. Conclusion

The compound growth rate of area under crop was negative whereas it shows a positive trend in production and productivity. The negative growth in the area might be due to a decrease in the groundnut area under cultivation. Yield effect (79 per cent) was seen to be responsible for change in the production of groundnuts in India compared to an area (7.76 per cent) and interaction effect (13.23 per cent) therefore, it is necessary to provide high-yielding varieties to the farmers. The level of instability was higher in yield while it was lowest in Area. Policies and programmes should concentrate on increasing the area under cultivation to include non-traditional areas to increase groundnut production.

#### References

- Gaddi, G. M., M. B. Koppad, K. C. Gummagolmath, and A. D. Naik. "An economic analysis of growth performance of oilseed crops in India." *Karnataka Journal of Agricultural Sciences* 12, no. 1/4 (1999): 93-98.
- Government of India (GOI). 2022. "Agriculture Statistics at a Glance: 2022". Directorate of Economics and Statistics, Ministry of Agriculture and Farmers' Welfare, New Delhi.
- Joseph, Jaison V. "Growth and instability in area, production, and productivity of oilseed in India." *Edit Board* 9, no. 4 (2020): 43-49.
- Kumar, Vinod, and Abhishek Tiwari. "Sparking yellow revolution in India again." *Rural Pulse* 34 (2020): 1-4.
- Narayan, Prem. "Recent demand-supply and growth of oilseeds and edible oil in India: an analytical approach." *International Journal of Advanced Engineering Research and Science* 4, no. 1 (2016): 32-46.
- Reddy, Viswanatha K., and Kingsly T. Immanuelraj. "Area, production, yield trends and pattern of oilseeds growth in India." *Economic Affairs* 62, no. 2 (2017): 327.
- Sonnad, J. S., N. Raveendaran, N. Ajjan, and K. N. Selvaraj. "Growth analysis of oilseed crops in India during pre and post-WTO periods." *Karnataka Journal of Agricultural Sciences* 24, no. 2 (2011).
- Uma Gowri, M. and Prabhu, R. 2017. Millet Production and Its Scope for Revival in India with special reference to Tamil Nadu. *International Journal of Farm Sciences* 7(2): 88-93.