



Growth and instability analysis of area, production and yield of groundnut in selected states of India

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ARTICLE INFO	ABSTRACT
Received : 29 July 2023 Revised : 21 November 2023 Accepted : 06 December 2023 Available online: 07 February 2024 Key Words: Groundnut Oilseed Growth rate Instability Trend	India is the largest producer of oilseeds in the world as oilseed sector occupies an important position in the agricultural economy of the country. The study was based on the secondary data from 2002-03 to 2019-20. Major five groundnut producing states were selected based on highest production last triennium average production. The growth rate and instability were computed by using Compound Annual Growth Rate and Cuddy-Della Valle Index. The growth pattern of groundnut witnessed a downward trend with respect to area except Rajasthan state (7.667%). Growth pattern of groundnut indicated a downward trend in respect to production in Andhra Pradesh, Karnataka and Tamil Nadu state. Growth rate in yield (4.442 %) of groundnut was observed highest in Gujarat state. The instability index showed that the fluctuation in production of groundnut was found to be higher in Andhra Pradesh (44.453%) and Gujarat (41.660%). Low rate of instability was observed in area under groundnut crop in Gujarat (9.690%), Karnataka (10.495%) and Tamil Nadu (11.802%).

Introduction

India produces 10.24 Million Tonnes (MT) of groundnuts, coming in second place to China. Additionally, according to the FAO, 5.96 million ha of India's land were used for groundnut farming in 2021. Gujarat (4.65 MT), Rajasthan (1.62 MT), Tamil Nadu (1.03 MT), Andhra Pradesh (0.85 MT), Karnataka (0.50 MT), Madhya Pradesh (0.35 MT), and Maharashtra (0.31 MT) are the major groundnut-producing states in India in 2019-20 (Anonymous, 2021). India has the best conditions for the cultivation of all nine oilseeds, including seven edible oilseeds groundnut, rapeseed-mustard, sunflower, soybean, sesame and safflower (Thapa *et al.*, (2019). Groundnuts are available all year in India due to a two-crop cycle harvested in March and October. Groundnuts are an important protein crop

in India, where they are grown primarily under rain-fed conditions. Nuts are consumed in a variety of forms or crushed to provide vegetable oil for human consumption as well as a protein-rich meal for livestock. Groundnut are also known as earthnuts, pea nuts, goober peas and monkey nut (Misra, 2017). The Technology Mission on Oilseeds (TMO) and the Oilseeds Production Programme (OPP), both started by the Indian government, are the two main interventions that have made a significant improvement to the oilseed industry in India. In May 1986, during the 8th Five-Year Plan, in order to increase national oilseed production and liberalise oilseed trade in the post-WTO era (Nayak *et al.*, 2021). Numerous oilseed crops are grown in various agro-climatic regions, but their growth performance

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Doi: <https://doi.org/10.36953/ECJ.24692665>

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is subject to a variety of risks over time and in various agro-climatic locales. Exploiting the yield potential of many oilseed crops is hindered by numerous biotic, abiotic, technological, institutional, and socioeconomic constraints, particularly in the case of groundnut.

Description of the study area

Groundnut is the major oil seed crop in India and it is growing in many states of the country. The states were selected on the basis of their average groundnut production from the year 2017-18 to 2019-20. The selected states namely Gujarat, Rajasthan, Tamil Nadu, Andhra Pradesh and Karnataka (Table 1). The study throws a light on growth and instability in area, production, productivity of groundnut in selected

states. Comprehending the growth trends facilitates policymakers' decision making with respect to subsidies, incentives, and farmer support system.

Source of data

The study is based on secondary data of area, production, productivity of groundnut from 2002-03 to 2019-20 (18 years) were collected from Directorate of Economics and Statistics, Directorate of Agriculture, Cooperation & Farmers Welfare, Government of India. Analyzing the growth rate can help farmer's policymakers and other stakeholders identify risks and vulnerabilities in the agricultural sector.

Table 1: Top five groundnut producing states in India

Sr. No.	States	Triennium average production ('000 tonnes)
1	Gujarat	3566.649
2	Rajasthan	1420.500
3	Tamil Nadu	982.840
4	Andhra Pradesh	786.790
5	Karnataka	480.870

Material and Methods

Compound growth rate analysis

The growth rates refers to the percentage change of a specific variable within a specific period of time. It also indicates the magnitude of the rate of variation in the variable per unit of time. The compound annual growth rate (CAGR) of area, production and productivity of groundnut for 18-year period (2002-03 to 2019-20) were calculated using the following growth model,

$$Y = ab^t u_t \quad (1)$$

Where,

- Y = Area, production and productivity of groundnut crop
- a = Intercept
- b = Regression coefficient
- t = Time (years)
- u_t = Error term

$$\text{Log } Y = \log a + t \log b + \log u_t$$

for ease in calculation.

Then, the CAGR was calculated using following relationship

$$G = [(\text{antilog } b) - 1] \times 100 \quad (2)$$

Instability Index

Instability index is a simple analytical technique to find out the fluctuation or instability in any time series data (Ramasamy *et al.*, 2005; Gupta and Sharma, 2010). Coefficient of Variation (CV) is the simplest measure of instability in area, production and productivity in selected groundnut states.

$$\text{CV}\% = \frac{\hat{\sigma}}{\bar{X}} \times 100 \quad (3)$$

The equation (1) was transformed as follow:

Where,

CV%	=	Coefficient of variation of area, production and productivity
$\hat{\sigma}$	=	Standard deviation of concerned variables
\bar{X}	=	Mean value of concerned variable

Though CV is one of the simplest measures of instability, it does not fully explain the variability in time series data due to the presence of the trend component. To address this issue, the formula proposed by Cuddy and Della (1978) was used. Rather than assessing variability over the mean of the data Cuddy and Della consider the data's time trend and measures variability over the time trend. The corrected coefficient of determination is the \bar{R}^2 coefficient of determination of the linear trend function that fits the time series. The Cuddy-Della instability index was calculated in this manner.

$$CDVI (\%) = CV \sqrt{(1 - \bar{R}^2)} \quad (4)$$

Where,

CDVI	=	Cuddy – Della Valle Index
CV	=	Coefficient of Variation in per cent
\bar{R}^2	=	Adjusted Coefficient of Determination

$$\bar{R}^2 = 1 - \frac{SS_{res}/(n-p)}{SS_{tot}/n-1} \quad (5)$$

When the test statistic t is significant, then the Cuddy- Della Valle index is calculated. When a test statistic is not significant or the adjusted \bar{R}^2 is less than zero, the CV is chosen. The high value of instability index shows that there were huge fluctuations in the time series data (Table 2).

Table 2: The ranges of instability index

Category	CDVI (%)
Low instability	0.00 – 15.00
Moderate instability	15.01 – 29.99
High instability	≥ 30.00

(Mulla, 2018)

Results and Discussion

Trend analysis is a type of technical analysis that employs time series analysis to comprehend a groundnut crop's past behaviour. The current research phase focuses on a trend analysis of the groundnut area, production and productivity of major groundnut producing states of India.

Gujarat

Gujarat is the leading producer of groundnut with an area of 1690 thousand hectares and production about 4560 thousand tonnes, which occupy 34.989 per cent of area and 45.829 per cent of the total production during 2019-20 in India. Gujarat showed negative growth rate in groundnut area at 1.564 per cent per annum with one per cent level of significance and low rate of instability (9.690 %) during the study period (Table 3 and Fig 1-3). Farmers' adherence to the same crop and lack of change could explain the low rate of instability. Kolar *et al.*, (2020) also found low rate of instability in area under groundnut crop during their study period (1995-96 to 2017-18) Groundnut production was 2202.82 thousand tonnes during 2018-19 and it increased and reached at 4560.00 thousand tonnes in 2019-20 due to good rainfall compared to last year. In case of production and yield, it showed 2.774 per cent and 4.442 per cent growth rate, respectively. However, groundnut production and yield registered high rate of instability of 41.600 per cent and 37.303 per cent, respectively. Adverse climatic conditions during the harvesting season contributes a major role in variation in yield and production.

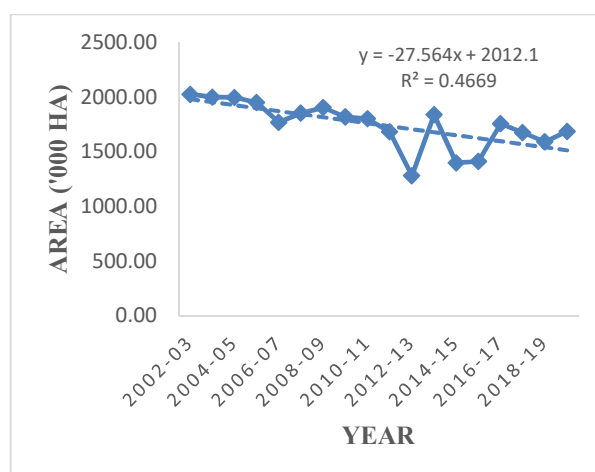


Fig. 1: Trends of groundnut area in Gujarat state

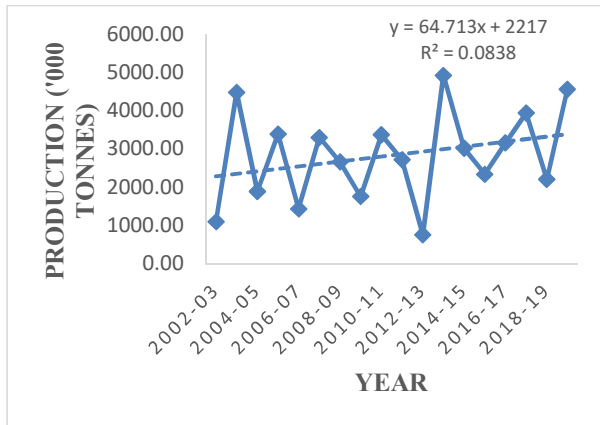


Figure 2: Trends of groundnut production in Gujarat state

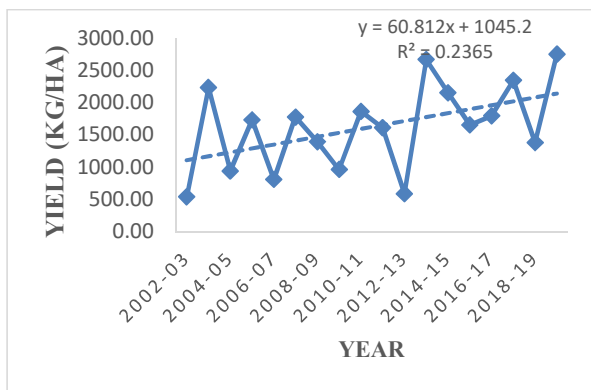


Figure 3: Trends of groundnut yield in Gujarat state

Rajasthan

Rajasthan state has emerged as one of the leading producers of groundnuts in India. In Rajasthan, area and production of groundnut were 740 thousand ha and 1620 thousand tonnes, respectively in 2019-20, which had notable share of 15.320 per cent and 16.281 percent of total area and production of groundnut, respectively in all India. Major groundnut growing districts are Jodhpur, Bikaner, Churu, Jaipur, Jaisalmer, Sikar, Hanumangarh, Sirohi and Nagaur. Area under groundnut crop has been positively increasing at 7.667 per cent per annum and also found statistically significant at one per cent level (Table 3 and Fig 4-6). Groundnut production increased by 11.012 per cent per annum. These results are supporting by Suman *et al.* (2019), who found positive growth rate in production (10.83 %) and yield (3.59 %) of groundnut during their

study period 2005-14 in Rajasthan. Area (16.723 %), production (20.216%) and productivity (16.390%) registered medium instability during entire study period. According to Kolar *et al.* (2020), they also found medium rate of instability in both area (18.42 %) and production (25.73%).

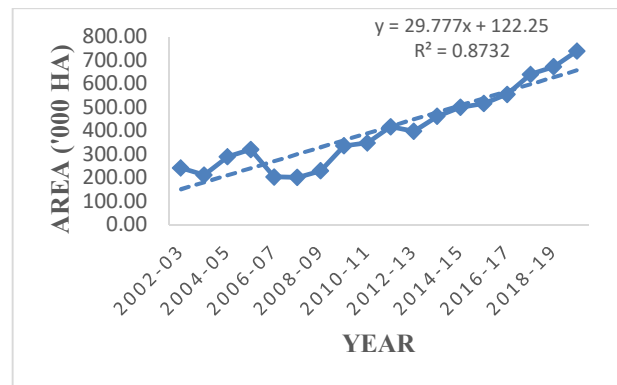


Figure 4: Trends of groundnut area in Rajasthan state

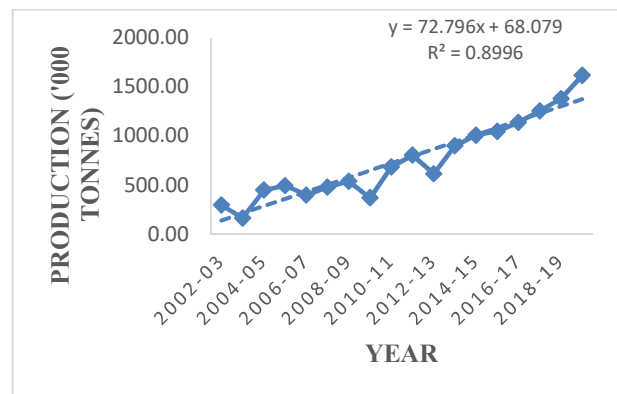


Figure 5: Trends of groundnut production in Rajasthan state

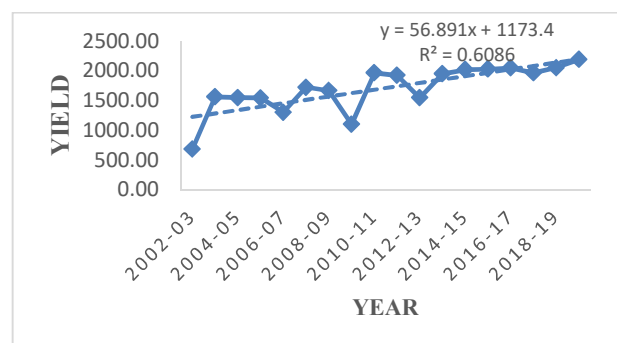


Figure 6: Trends of groundnut yield in Rajasthan state

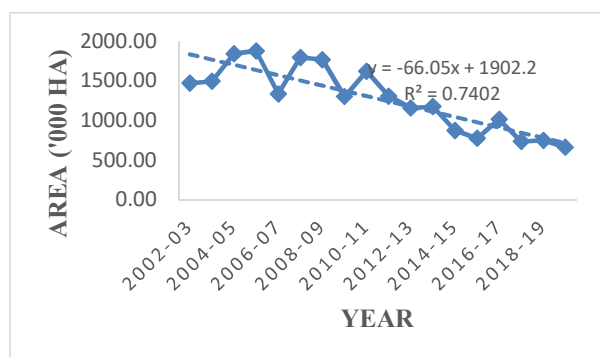
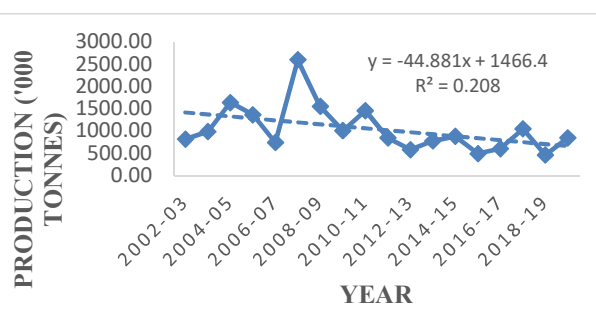
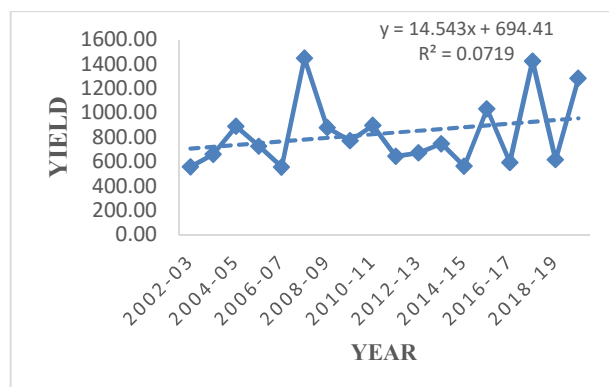
Table 3: Compound annual growth rate (CAGR) and Cuddy- Della Valle index (CDVI) in area, production and yield of groundnut crop during 2002-03 to 2019-20

States	Area		Production		Yield	
	CAGR (%)	CDVI (%)	CAGR (%)	CDVI (%)	CAGR (%)	CDVI (%)
Gujarat	-1.564**	9.690	2.774	41.600	4.442*	37.303
Rajasthan	7.667**	16.723	11.012**	20.216	3.875**	16.390
Tamil Nadu	-4.109**	11.802	-0.336	14.097	3.958**	10.099
Andhra Pradesh	-5.540**	15.865	-4.289*	44.453	1.506	34.680
Karnataka	-3.568**	10.495	-1.511	22.541	2.133**	16.283

Note: * and ** denotes significance at 5 per cent and 1 per cent levels, respectively.

Andhra Pradesh

Andhra Pradesh is one of the important groundnut producing states in India. Additionally, the Krishna-Godavari delta region as well as the districts of Anantapur, Kurnool, Chittoor, Kadapa, Vizianagaram, and Srikakulam produce groundnuts. Area and production under groundnut crop were 660 thousand ha and 850 thousand tonnes, respectively in 2019-20 and notable share 13.664 per cent and 8.542 per cent of total area and production of groundnut in India. Area and production of groundnut crop both registered significant decrease with 5.540 per cent and 4.289 per cent, respectively (Table 3 and Fig 7-9). The similar results also found by Pusadekar (2018) during their study period (1995-96 to 2015-16), who found that growth rate in area and production of groundnut declined at 3.01 per cent and 2.40 per cent per annum. Groundnut crop production and yield both showed high levels of instability, at 44.453 and 34.680 percent, respectively. Groundnut production is negatively impacted by extreme weather conditions like cyclones, heavy rains, hailstorms, dry spells, drought, and frost.

**Fig 7: Trends of groundnut area in Andhra Pradesh****Fig 8: Trends of groundnut production in Andhra Pradesh****Fig 9: Trends of groundnut yield in Andhra Pradesh**

Tamil Nadu

Tamil Nadu is one of the major groundnut producing states as far as productivity is concerned. Major groundnut-growing districts in Tamil Nadu include Namakkal, Salem, Erode, Pudukkottai, Kachipuram, Cuddalore, Harmapuri, Krishnagiri and Ariyalur. Area under groundnut crop in Tamil Nadu has 7.246 per cent share in total area and 10.351 per cent share in total groundnut production of India. Area under groundnut crop was declined at the rate of 4.109 per cent per annum with one per cent level of

significance (Table 3 and Fig 10-12). The reason might be area of other crops which grow in same season of groundnut has increased *i.e.* rice, cotton and soy bean. However, production showed negative growth rate at 0.336 per cent and yield registered significant increase with 3.958 per cent growth rate at one per cent level of significance. This results also supporting by Kolar *et al.* (2020) who also observed a negative growth rate in groundnut crop area and production by (- 5.29%) and (-1.46%) respectively, from 1995–1996 to 2016–17 in Tamil Nadu state. Additionally, a low rate of instability was seen in the area, production, and yield during the study period.

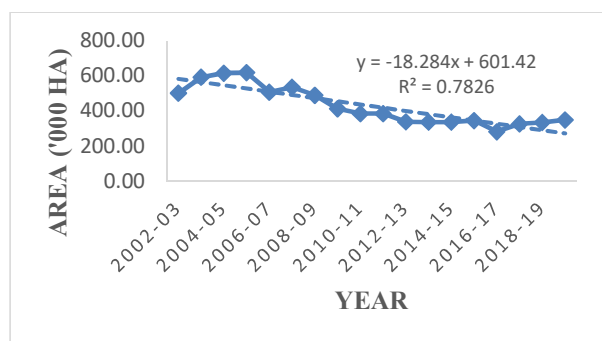


Fig 10: Trends of groundnut area in Tamil Nadu

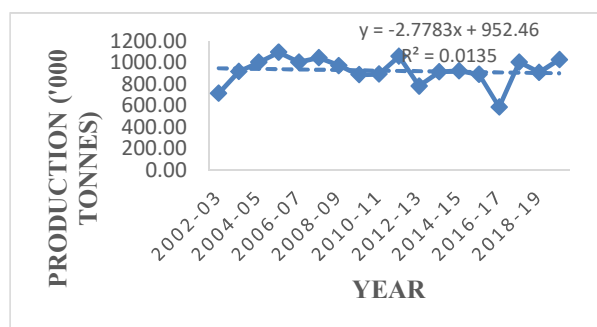


Fig 11: Trends of groundnut production in Tamil Nadu

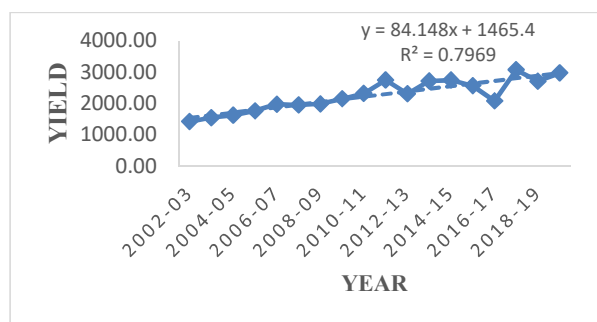


Figure 12: Trends of groundnut yield in Tamil Nadu

Karnataka

In terms of area and oilseed production in India, Karnataka is the second-largest state, followed by South India in terms of area, production, and yield. Area and production under groundnut crop declined at the rate of 3.568 per cent and 1.511 per cent per annum, respectively (Table 3 and Fig 13-15). This results supported by Mulla (2018) who found the area and production of groundnut crops decreased by 1.13 percent and 0.40 percent annually, respectively during the study period (1975–1976 to 2015–2016). Area under groundnut crop had a low rate of instability (10.495%), whereas production and yield had a medium rate of instability (22.541% and 16.283%, respectively).

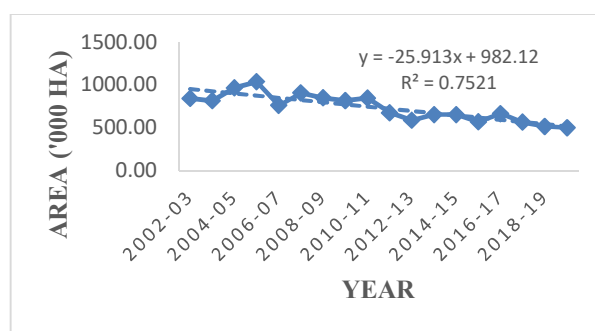


Figure 13: Trends in groundnut area in Karnataka

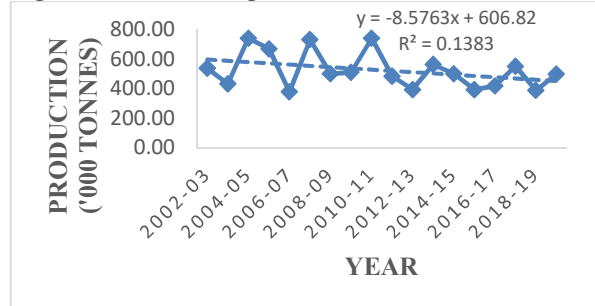


Fig 14: Trends in groundnut production in Karnataka

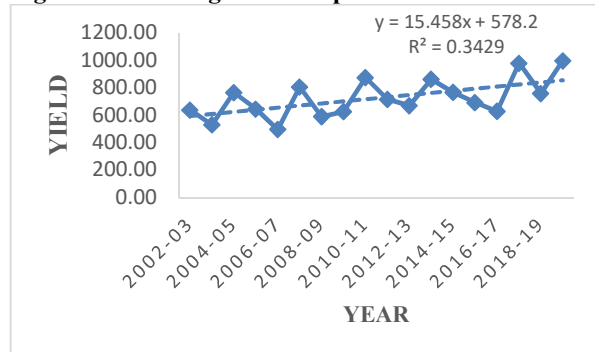


Fig 15: Trends in groundnut yield in Karnataka

Conclusion

The world's largest producer of oilseeds is India. In Gujarat, Tamil Nadu, Andhra Pradesh, and Karnataka, groundnut growth has been declining in terms of area. The rate of instability was low in groundnut crop areas in Gujarat, Tamil Nadu, and Karnataka. Rajasthan had the highest rate of growth in production. According to the findings, researchers and policymakers must pay closer attention to developing location-specific cultural practises in order to increase and sustain groundnut production and yield in the country. Policies and programmes

should focus on expanding the area under cultivation to include non-traditional areas in order to increase groundnut production.

Acknowledgment

The author grateful to the Dept. of Agricultural Economics, B.A. College of Agriculture, Anand, Gujarat and for giving guidance in the study.

Conflict of interest

The authors declare that they have no conflicts of interest.

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