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Research Article

AN ECONOMIC ANALYSIS OF GROWTH AND ACREAGE RESPONSE OF GROUNDNUT IN INDIA

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Abstract: The present study is conducted with a view to analyse the growth in area, production and productivity of groundnut from 1965-66 to 2016-17 and also to analyse the acreage response of groundnut from 1985-86 to 2016-17 of major groundnut producing states in India. During the implementation of Technology Mission on Oilseeds (TMO) significantly increases the area, production and productivity of groundnut and it get decreased during the post- TMO period. The result of the acreage response with respect to MSP is negative for groundnut in short run, and their adjustment mechanism towards reaching the desired level is slow for the majgrownut or growing states except in Gujarat. This study also compared the growth in cost of production and MSP of groundnut and found that the announced MSP for groundnut in India in the year 2017-18 was found more than the cost of production in all the states except in Karnataka and Tamil Nadu. The study suggested that policy intervention of government is required to encourage the area and production of groundnut in India.

Keywords: *Area, Cost of production, MSP, Production, Supply response*

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Introduction

Groundnut (*Arachis hypogea* L.) is one of the major oilseed crops in India and also a significant agricultural export commodity. China is the world's largest producer with 166.24 lakh tonnes followed by India, Nigeria and the United States. In India, Groundnut ranks first in terms of area and second in terms of production and it is grown in an area of about 48 lakh hectares with the total production of 89 lakh tons in the year 2017-18 [1]. Its cultivation is mostly confined to the states of Gujarat, Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra and Rajasthan. More than 50 percent of the country's area and production is limited to the top five states. The highest productivity of groundnut (3078 kg/ha) is in Tamil Nadu, while in Gujarat it is about 2345 kg/ha. The Technology Mission on Oilseeds (TMO) was launched by the Central Government during 1986 to increase the production of oilseeds, to reduce import and to achieve self-sufficiency in edible oils at the end of the Seventh plan i.e., March 1990. This scheme was later reorganized as Integrated Scheme of Oil Seeds, Pulses, Oil palm and Maize (ISOPOM) in 2004 and converted into National Mission on Oilseeds and Oil Palm (NMOOP) in 2014. National Mission on Oilseeds and Oil palm (NMOOP) for was started in 2014-15 and continued till 2017-18. The economy of our country is influenced by groundnut production and its processing sectors and by generating direct and indirect employment. However, the government needs to protect the interest of groundnut producers and increase their production by ensuring the better price for the produce. The assurance of a stable price environment is considered to be important for increasing agricultural production. Therefore, Minimum Support Price (MSP) is one of India's Agricultural Price Policy announced at the beginning of the sowing season for certain crops based on the recommendations of the Commission for Agricultural Costs and Prices (CACP). The major objective of MSP is to avoid farmer from incurring losses against any sharp fall in market prices due to the market glut after harvest. Cost of production is the most important factor in fixing the MSP. The other factors include changes in input prices, trends in market prices, demand and supply situation, the effect on the general price level, effect on the cost of living etc.

Given the above facts, the present study was undertaken with the following objectives:

To analyze the impact of Technology mission on oilseeds (TMO) on area, production and productivity of major groundnut producing states in India.

To quantify the acreage response of groundnut and compare short run and long run MSP elasticities.

To compare the growth in the cost of production and MSP of groundnut in India.

Major Research Works reviewed

The effective implementation of the price policy has helped to improve rice production and productivity in Punjab. The study examined the effectiveness of MSP policy for rice in various rice-producing states of India and found to be more effective in surplus producing states such as Punjab and Andhra Pradesh, which is not so effective in the deficit states. [2]. Paltasingh and Goyari (2013) analysed the supply response of rice in the rainfed agriculture of Odisha. The results revealed that supply was inelastic for own price whereas supply is more elastic to weather [3]. Gangwar and Singh (2015) evaluated price and selected non-price factors on the area of rapeseed-mustard using double log Nerlovian lagged adjustment model and analysed the short and long-run price elasticities [4]. A similar study by Borah *et al*. (2016) analysed the acreage response of potato and factors affecting potato in the major districts in Lower Brahmaputra Valley Zones of Assam [5]. Mohan *et al*. (2017) estimated the supply response for major principal crops in the Andhra Pradesh from 1970 to 2005 using the Nerlovian adjustment adaptive expectation model and derived the supply response elasticities.

The result showed that the elasticity of acreage response and relative price were found crucial factors for the commercial crops like groundnut, tobacco, chillies, cotton and sugarcane validated that the farmers respond to price incentives similarly to non-price factors [6]. Geetha and Mahesh (2019) assessed the growth in area, production and MSP of cotton from 1995-2017, indicating the positive relationship during period II (2006 to 2017).

The MSP of cotton in the year 2017-18 was lower than the projected C2 and C3 costs with negative managerial profit. Therefore, the study suggests modifying the cost concept to be considered for determining MSP [7]. Patel and Singh (2019) compared the MSP and cost of production from 2011 to 2017 for rice and wheat and suggested to increases the MSP with proportion to the increases in production costs [8]. The regression analysis of the impact of MSP on cropping pattern of important crops in Punjab resulted that with one percent increase in lagged MSP, the area under wheat and paddy crops increased by 0.12 and 0.48 percent, respectively whereas for the cotton crop, the area decreased by 0.06 percent. The study suggested that there is a need for various Government initiatives to ensure assured prices to farmers by providing input subsidies to the crops [9].

Materials and Methods

The present study was based on secondary data. The time series data on area, production and productivity of groundnut in India and its minimum support price (MSP) were collected from 1966 to 2017. The data required for the study were collected from the Department of Agriculture and Cooperation, Ministry of Agriculture and Farmers' Welfare, Government of India, New Delhi. The analysis was done using Stata software.

Method 1: Annual Compound growth rate Model

In order to fulfil the objectives, the annual compound growth rates of area, production and the productivity of groundnut were estimated. The growth rates were calculated by fitting the exponential type growth function of the form:

$Y=ab^te^t$

Where,

Y= dependent variable for which growth rate was estimated,

a = Intercept,

b = Regression co-efficient,

t = Time variable and

e = Error term

The above equation was estimated by transforming in to log form as follows;

log y = log a + t log b + log et

Then, the compound annual growth rate (percent) was calculated by using the following relationship

r = {antilog of (logb)-1} x 100

Method 2: Nerlovian's Partial Adjustment Supply Response Model

To estimate the acreage response of groundnut, the Nerlovian's Partial Adjustment Mechanism will be followed:

$A_t - A_{t-1}=\delta(A_t^* - A_{t-1})$ (1)

Where,

At = Area under groundnut in the current year.

A_{t-1} = Area under groundnut in the last year.

δ = Coefficient of adjustment ($0\leq\delta\geq1$)

A_{t^*} = Desired equilibrium level of the area under groundnut [which is not observable]

$[A_t - A_{t-1}]$ = Actual change in the area

$[A_{t^*} - A_{t-1}]$ = Desired change in the area

The long-run linear supply response function will be specified as follows:

$A_t^*=b_0+b_1P_{t-1}+b_2Y_{t-1}+b_3R_{t-1}+e_t$ (2)

Where, A_t= Area under groundnut, P_{t-1}= MSP in the previous year, Y_{t-1}= Yield in the previous year, R_{t-1}= Total rainfall of the previous year. To estimate the long-run supply [Acreage] response function, the equation (2) is substituted in equation (1) to obtain the short-run supply response function.

$A_t - A_{t-1}=\delta(b_0+b_1P_{t-1}+b_2Y_{t-1}+b_3R_{t-1}+e_t-A_{t-1})$ (3)

$A_t=\delta b_0+\delta b_1P_{t-1}+\delta b_2Y_{t-1}+\delta b_3R_{t-1}+(1-\delta)A_{t-1}+\delta e_t$ (4)

The above equations can be rewritten as,

$A_t=a+bP_{t-1}+cY_{t-1}+dR_{t-1}+\lambda A_{t-1}+u_t$ (5)

Where, $a=\delta b_0$, $b=\delta b_1$, $c=\delta b_2$, $d=\delta b_3$, $\lambda=1-\delta$, $u_t=\delta e_t$

The equation (5) can be estimated in the log-linear model as follows:

$\ln A_t= a+b \ln P_{t-1}+c \ln Y_{t-1}+d \ln R_{t-1}+\lambda \ln A_{t-1}+u_t$ (6)

The above model can be estimated through the ordinary least square method. In the log-linear model, the coefficient of lagged MSP yielded short-run price elasticity directly. Then the long-run price elasticity could be estimated as given below:

Long run elasticity= SRE/δ

Where, δ=1- λ. As the value of the coefficient of adjustment usually lies between zero and one, the value of 'δ' close to the one indicates that the adjustment process is very fast. When the value of 'δ' is close to zero, the implication is that the adjustment process is very slow to the changing prices.

Speed of adjustment implies the number of years required to realize 95 percent of the price effect; it was estimated using the formula:

$$N=\frac{\ln 0.05}{\ln (1-\delta)}$$

Where δ = Coefficient of area adjustment and N = Number of years

Results and discussion

Out of the nine-oilseed crops grown in India, groundnut accounts for about 45 percent of the total area under oilseeds and 55 percent of the total production. Therefore, the edible oil economy in India is primarily depending on groundnut production. Though India leads the world both in groundnut area and production of groundnut, whereas India's productivity of groundnut is 1,642 kg/ha which is less than the world average productivity of 1,777 kg/ha (NMOOP, 2017) [10]. This low and unstable yield is mainly contributed by the cultivating the crops in rainfed condition particularly in marginal lands with low inputs, low technology, poor plant population, inadequate fertilization and lack of plant protection [11].

To ascertain the temporal growth in area, production and productivity of groundnut in major growing states of India, the three-year moving average was calculated for the four periods *viz*., period I (1966 to 1968); period II (1986 to 1988); period III (2000 to 2002) and period IV (2015 to 2017). [Table-1] depicted the percent changes in the area, production and productivity of groundnut in each period. [Fig-1] provides the state-wise trend in the area, production and productivity of Groundnut in India from 1966 to 2017.

Table-1 *Impact of TMO on groundnut performance in the major groundnut growing state*

State	P I to II	Period II to III	Period III to IV
Area			
All India	1.89	-16.20	-20.87
Andhra Pradesh	54.66	-13.10	-49.89
Gujarat	-18.99	20.52	-14.31
Karnataka	42.53	-18.07	-34.83
Maharashtra	-26.21	-39.87	-28.65
Tamil Nadu	12.53	-38.69	-48.70
Production			
All India	44.78	-17.90	33.54
Andhra Pradesh	96.07	-21.76	-41.78
Gujarat	35.01	2.87	112.94
Karnataka	88.40	-17.47	-38.05
Maharashtra	10.57	-31.40	-22.20
Tamil Nadu	37.66	-7.71	-25.20
Productivity			
All India	40.34	-1.10	69.96
Andhra Pradesh	26.11	-11.85	25.19
Gujarat	47.56	-3.38	148.02
Karnataka	32.28	-1.47	-1.65
Maharashtra	45.06	17.51	8.46
Tamil Nadu	22.57	47.57	47.13

Note: Percent change over the previous period is estimated using 3 years average values for Period I (1966-68); Period II (1986-88); Period III (2000-02); Period IV (2015-17)

Groundnut is mostly grown as a rainfed Kharif crop, which is being sown from May to June, depending on the monsoon rains. [Fig-2] represents the state-wise growth performance of Kharif season groundnut in India during period I (1966-68), period II (1986-88) and period III (2015-17). After the implementation of TMO during 1986 compared with period I, the area was found to increase drastically in Andhra Pradesh, Karnataka and Tamil Nadu whereas it was highly reduced in Maharashtra and Gujarat. The impact of Technology mission on oilseeds increases both the production and productivity of groundnut in all the major growing states.

Table-2 *State-wise Annual Compound Growth Rate of Area, Production and Productivity of Groundnut in India (1966-2017)*

States	Area		Production		Productivity	
	Period 1	Period 2	Period 1	Period 2	Period 1	Period 2
India	-0.04	-1.78***	1.11*	-0.10	1.11**	1.82***
Andhra Pradesh	0.90*	-2.96***	1.61*	-3.44***	0.70	-0.50
Gujarat	0.80*	-0.30	1.61	4.08***	0.80	4.39***
Karnataka	0.10	-2.47***	1.82**	-2.96***	1.82**	-0.50
Maharashtra	-1.49***	-3.44***	0.50	-2.86***	2.43**	0.60**
Tamil Nadu	-0.20	-4.59***	0.50	-1.78***	0.70	2.94***

*Note: Period 1: (1966-1985); Period 2: (1986-2017); *, ** & *** indicate the level of significant at 10, 5 & 1 percent level, respectively*

Table-3 Factors determining supply behavior of groundnut

Variables	India	Andhra Pradesh	Gujarat	Karnataka	Maharashtra	Tamil Nadu
Lag MSP	-0.098**	-0.164**	-0.002	-0.147**	-0.178**	-0.159**
Lag yield	0.031	0.088	-0.066	-0.143	0.108*	-0.093
Lag Rainfall	-0.131	-0.261	0.078	-0.011	-0.210***	-0.191
Lag Area	0.572***	0.622***	0.226	0.629***	0.581***	0.741***

, ** & * indicate the level of significant at 10, 5 & 1 percent level, respectively*

Table-4 *Analysis of Short- Run and Long- Run elasticities*

State	Coefficient of adjustment	Short Run elasticity	Long Run elasticity	Speed of Adjustment (δ) (No. of years to realize 95 % price effect)
India	0.427	-0.098**	-0.230	5.380
Andhra Pradesh	0.378	-0.164**	-0.434	6.309
Gujarat	0.774	-0.002	-0.003	2.014
Karnataka	0.371	-0.147**	-0.396	6.462
Maharashtra	0.419	-0.178**	-0.425	5.517
Tamil Nadu	0.258	-0.159**	-0.616	10.039

, ** & * indicate the level of significant at 10, 5 & 1 percent level, respectively*

Table-5 *Compound Annual Growth rate of Minimum Support Price and Cost of Production for Groundnut (2009-17)*

Cost of Production					MSP
Andhra Pradesh	Gujarat	Karnataka	Maharashtra	Tamil Nadu	
9.33	6.71	6.49	19.28	7.78	10.97

In India, NFSM- NMOOP for oilseeds programme was started in 2014-15 and continued up to 2017-18. From [Fig-2], it has been interpreted that Andhra Pradesh, Karnataka, Maharashtra and Tamil Nadu were found to be declined after the implementation of NFSM-NMOOP, when compared with period II (post-TMO). But in the case of Gujarat, the area, production and productivity were found increased during the TE average 2015-17 compared with period II.

The compound growth rates of area, production and productivity of groundnut for period-I (1966-1985) and period-II (1986-2017) were computed for India and also for the major groundnut producing states and it was presented in [Table-2].

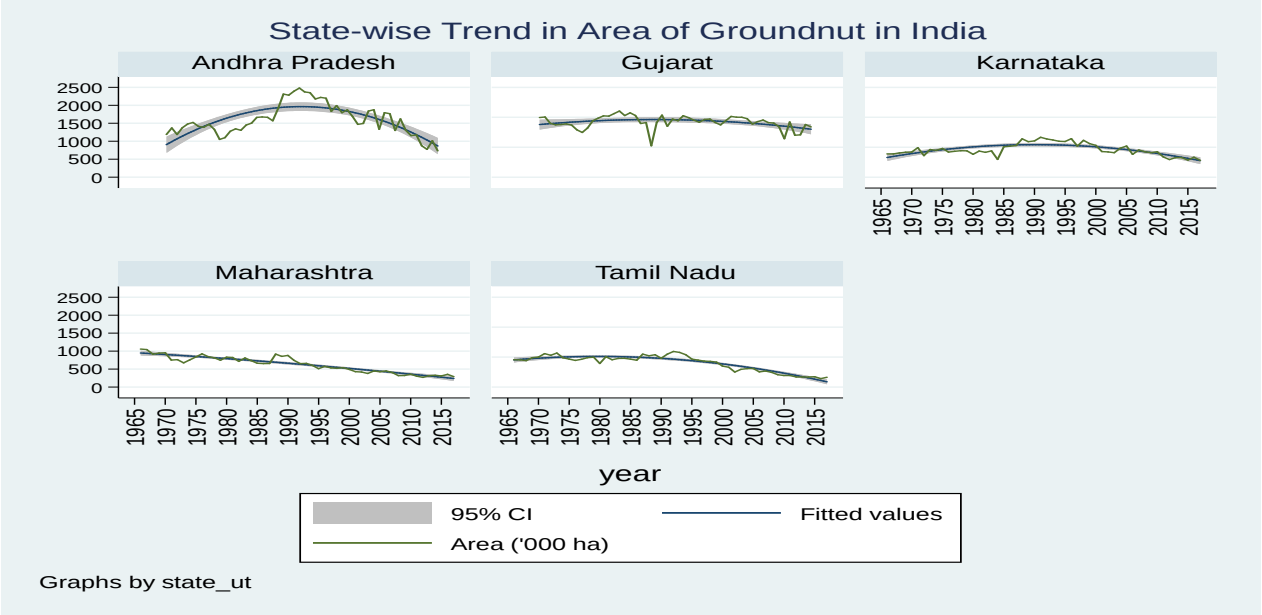
It is evident from the table that during period-I, the production and productivity of groundnut in India showed a positive growth of 1.11 percent per annum, which was found significant at 10 and 5 percent level of significance, respectively. During the second period, the negative growth rate of -1.78 in the groundnut area was found with one percent level of significance whereas productivity exhibited positive growth rate of 1.82 with one percent level of significance.

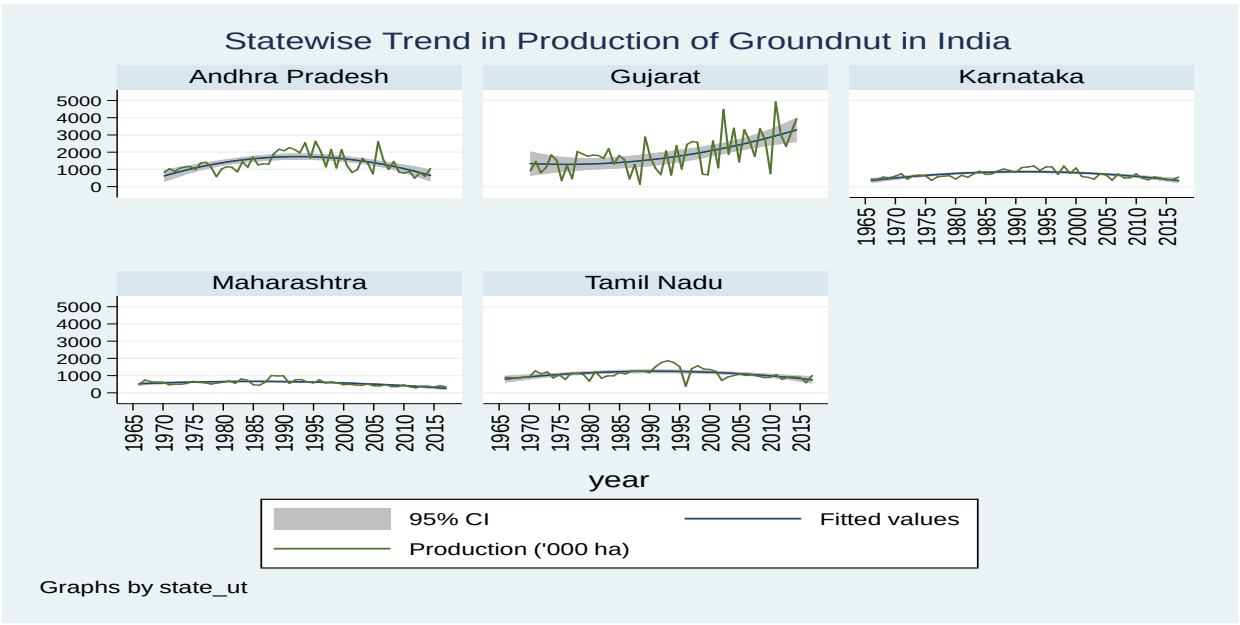
In case of area, Andhra Pradesh, Gujarat and Karnataka exhibited positive growth rate of 0.90, 0.80 and 0.10 percent per annum, respectively whereas in Maharashtra and Tamil Nadu were found to have a negative growth rate of -1.49 (significant at one percent level) and -0.20 percent per annum, respectively during period I. In case of period-II, all the major states was to have a declining trend in the area (shown in [Fig-1.a] with the negative compound annual growth rate. With respect to production, all the states were showing a positive growth rate during the period- I. Whereas in the period- II, the negative growth rates were found in all the states except in Gujarat. This results could be evident from [Fig-1.b], where there was a decreasing trend in the production of groundnut in Andhra Pradesh, Karnataka, Maharashtra and Tamil Nadu, whereas Gujarat was found to have an increasing trend in production over the period. The annual compound growth rate of productivity was found to have positive in both the periods, but except in period II of Karnataka. This can be evident from the [Fig-1.c], that there was an increasing trend in the productivity of groundnut in the states of Andhra Pradesh, Gujarat, Maharashtra and Tamil Nadu whereas Karnataka having declining trend in productivity.

The acreage response of groundnut was estimated for the period from 1985-86 to 2016-17. The impact of independent variables on the groundnut acreage has been presented in [Table-3]. The result of the acreage response of groundnut to the MSP was negative in all the states and it significant in all the states, except in Gujarat. The last year yield of groundnut was found to be a positive impact on the country as a whole and also the similar response in Andhra Pradesh and Maharashtra. Whereas in the case of Gujarat, Karnataka and Tamil Nadu, last year productivity reported a negative impact. Last year rainfall was not found to respond to the groundnut acreage in all the regions except Gujarat. However, one-year lagged area under groundnut found to most responsible in deciding the groundnut acreage which was positive and significant for all the states and country as a whole.

The estimates of short-run and long-run elasticities of supply and speed of adjustment coefficient (δ) were presented in [Table-4]. The range of short-run elasticity varied from -0.002 in Gujarat to -0.178 in Maharashtra. The speed of adjustment coefficients indicates the number of years required to realize 95 percent of price effect. Compared to other states, the farmers of Gujarat took less number of years to realize 95 percent of price effect. In the case of Tamil Nadu, the number of years to adjust their area to the desired level was found to be higher than the other states and country as a whole.

Government of India estimates the cost of production for groundnut in rupees per quintal. CACP recommends the government for Minimum support price of groundnut. An analysis was done for the period from 2009 to 2017 to find the relationship between the cost of production and minimum support price of Groundnut for the major producing states in India. [Table-5] resulted that growth in the cost of production of groundnut for the period was found positive in all the states whereas growth in MSP has found 10.97 percent per annum for the period 2009-17. [Table-6] associated with the information of weighted average of different cost concepts for the year 2017-18 i.e., A2 (paid out expenses), A2+FL (paid out costs+ imputed value of unpaid family labour), C2 (comprehensive cost including imputed rent and interest on owned land and capital) for groundnut. The announced MSP for groundnut was Rs.4450 per quintal in the year 2017-18.





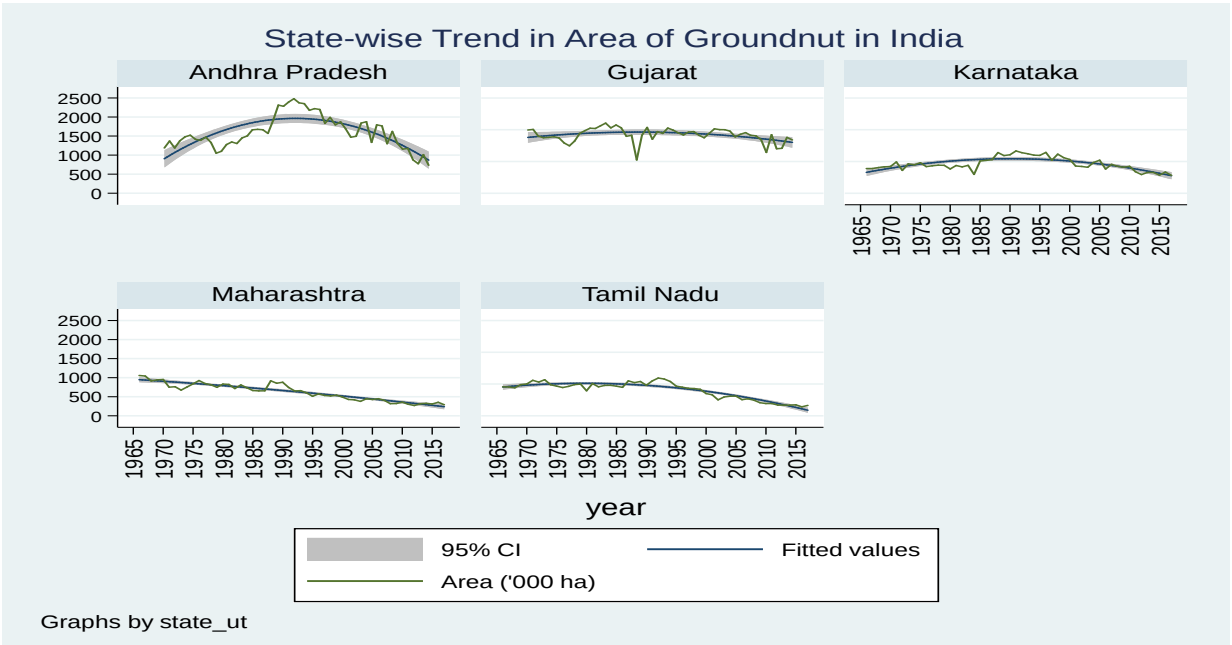


Fig-1 State-wise trend in Area, Production and Productivity of Groundnut in India from 1966 to 2017

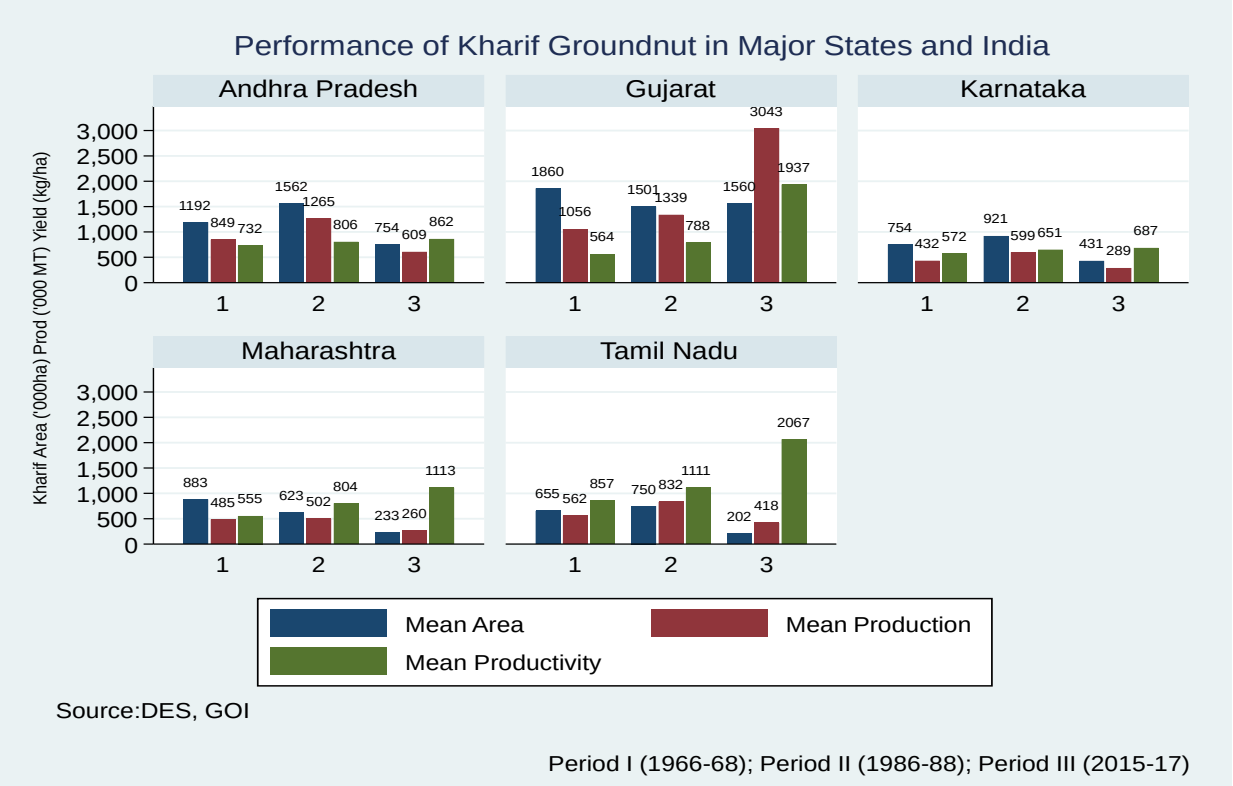


Fig-2 State-wise growth performance of Kharif season groundnut in India

The MSP found higher than the different cost except in case of A2+FL and C2 cost of Karnataka and C2 cost of Tamil Nadu. This may be due to the cost of labour in sowing and manual harvesting due to the higher wage rate. The above result for the comparison of the cost of production (C2) and MSP for the period of 2017-18 was showed in [Fig-3].

Table-6 Comparison of cost concepts with MSP (Rs 4450 per qtl. of pods) among different states for Groundnut for (2017-18) (Rs.per quintal of pods)

State	A2	A2+FL	C2
Andhra Pradesh	2195 (102.73)	2598(71.29)	3962(12.32)
Gujarat	2731(62.94)	3341(33.19)	4166(6.82)
Karnataka	3834(16.07)	4543(-2.05)	5675(-21.59)
Maharashtra	2424(83.58)	3213(38.50)	4246(4.80)
Tamil Nadu	3157(40.96)	4093(8.72)	4893(-9.05)
All India Weighted Average	2546(74.78)	3159(40.87)	4089(8.83)

Figure in the parentheses represent the percentage of MSP over the different costs (MSP>Cost)

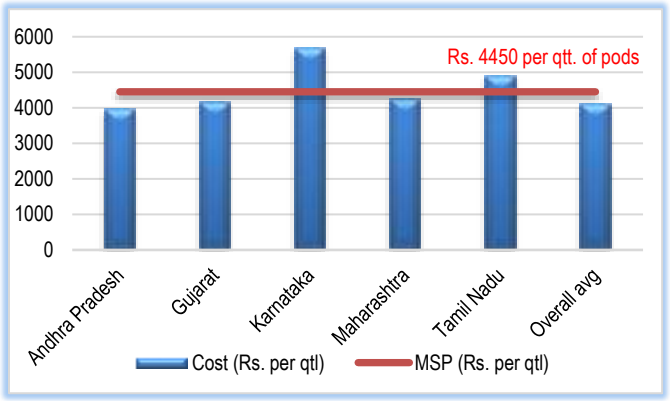


Fig-3 Comparison of cost of production (C2) and Minimum Support price (2017-18)

Conclusions and Policy suggestion

Groundnut is the most important oilseed crop in India. As groundnut is mostly cultivated in rainfed condition with low inputs and poor management practices, farmers have to gamble with the monsoon to get the expected yield. This study has revealed that the country has made significant progress in groundnut cultivation both in terms of area and production after the yellow revolution but the production has become stagnant. The results from the supply response of groundnut with respect to MSP revealed that farmers' response to MSP is negative in the short-run, and their adjustment mechanism towards reaching the desired level is slow for all the states except in Gujarat. Cost of production is known to be the major determinant of MSP. Hence, the announced MSP of groundnut in India in the year 2017-18 was found more than the cost of production in all the states except in Karnataka and Tamil Nadu. In order to make the groundnut farming profitable, the cost cutting measure by using seed drill in sowing and machine in harvesting is to be promoted in large way to revive the area under groundnut in major groundnut growing states. Finally, the study suggested that the efforts are needed to create the necessary infrastructure like government assured procurement centre and storage facility and efficient execution of groundnut development schemes like National Food Security Mission (NFSM) to provide favourable conditions for groundnut production and also to increase its acreage in India. Further, the groundnut productivity needs to be improved through high yielding varieties of seed, improved cultivation technologies and better soil and water management.

Application of research: The findings of the study would be useful to groundnut producers in the states of Andhra Pradesh, Gujarat, Karnataka, Maharashtra and Tamil Nadu in identifying the pitfalls in the present pattern of groundnut production and also, it's prices.

Research Category: Agricultural Economics

Abbreviations: Annual Compound growth rate (ACGR), Commission for Agricultural Costs and Prices (CACP), Integrated Scheme of Oil Seeds, Pulses, Oil palm and Maize (ISOPOM), Minimum Support Price (MSP), National Mission on Oilseeds and Oil Palm (NMOOP), National Food Security Mission (NFSM), Technology Mission on Oilseeds (TMO).

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Study area / Sample Collection: Tamil Nadu Agricultural University, Coimbatore, 641 003, Tamil Nadu, India.

Cultivar / Variety / Breed name: Groundnut

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.
Ethical Committee Approval Number: Nil

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