Assessment of Growth Pattern and Immediate and Sustained Effects of Oilseeds Mission on Groundnut Production in Andhra Pradesh

Abstract

High instability in crop area and yield in the major groundnut growing districts of Andhra Pradesh resulted in production shortfall. To enhance the production of groundnut through technological interventions, oilseeds mission was implemented in all the districts since the per ha yield is lower than the national average. Further, yield realized during the Kharif season is half of the productivity obtained during rabi/summer summer season. Therefore, understanding the pattern of production is critically important to analyze the future directions and strategies required to scale up the production. The present paper aims at assessing the growth performance of groundnut in various districts of Andhra Pradesh and examining the immediate and sustained effects of oilseeds mission on groundnut production and identifying the potentials for area increase and productivity improvement. Using the time series data, growth analysis and interrupted time series segmented regression analyses were employed to examine the growth pattern and immediate and sustained effects of oilseeds mission. Area under the groundnut in all the districts of Andhra Pradesh are declining at faster rate and the rate of decline was higher in the major groundnut growing districts namely Anantapur (2.13%), Chittoor (3.79%), Cuddapah (7.47%) and Kurnool (3.82 %). The area under groundnut in the State also registered a negative rate of growth and the area declined at the rate of 3.49 % per annum between 1997-98 and 2019-20 and maximum decline was 6 per cent, which is alarming. Anantapur district contributes on an average 57% of the state area and maximum share was 66 per cent. Since, the maximum decline in area in this district was 5.12%, the production growth was found low (1.39%) despite the productivity increased by 3.63 % per annum. Similarly, the rate of production in Chittoor district declined at 2.1% per annum overall, though the productivity increased at the rate of 4 % annum and this is mainly due to a decline in area by almost 4 % per annum. The Cuddapah, one of the major groundnuts producing districts in the state, also witnessed a negative growth rate in production and production decline was around 2% per annum. However, productivity in the Cuddapah district grew at faster rate compare to other major districts and the productivity has grown at the rate 6% per annum. Groundnut production in the state declined by 0.4% per annum due to decline in both productivity and area by 3% and 3.4% respectively. It is alarming to note that the maximum decline in production was 12.38% in the State mainly due to the maximum decline in production in major groundnut producing districts namely Anantapur (76%) followed by Kurnool (32.32%), Cuddapah (22.19%) and Chittoor (13.40%). The model results of interrupted time series show that though there is no significant intervention effect, there is sign of productivity improvement after the intervention. The coefficient of sustained effect for production turned to positive from negative though not significant (immediate effect) for the major growing districts. indicating the long-term effect of mission. The earlies studies have identified major technical constraints relating to adoption of improved technology, non-suitability of improved technology, and lack of technical guidance. Therefore addressing these issues through policy and technological interventions are crucial for sustaining the productivity and increasing the production in the major districts.

Introduction

In Andhra Pradesh, groundnut is cultivated in Rayalaseema regions and Coastal, Krishna and Guntur districts mostly concentrated in Palanadu regions of Guntur districts and Nuzeeveedu districts of Guntur districts. Since these regions are highly prone to erratic rainfall, crop size falls sizably. Only less than 7 % of the area under groundnut is irrigated which is the lowest compared to irrigated foodgrains and rice fallows in Andhra Pradesh (Reddy, 2022). Though Andhra

Pradesh is second major producer of groundnut in India sharing 51 % of the total country's production, groundnut acreage in this state is fluctuating over the years and from the last two decades and farmers in the major rainfed growing districts are shifting from groundnut to other remunerative crops particularly towards oil palm cultivation due to the incentives provided by the state government. Like announcement of remunerative price, which resulted in decreasing share of groundnut in total oilseeds production. Farmers have also been cultivating red gram and other commercial crops along with groundnut particularly during the kharif season resulting in lesser farming of groundnuts. Groundnut is cultivated in one or more (kharif, rabi and summer) seasons, but nearly 90% of acreage and production comes from kharif crop (June-October) (ANGRAU, 2021). Further, the farmers are shifting from groundnut to other remunerative crops mainly due to increase in cost of production and there is a widening gap between the cost and price as both are not moving parallelly.

Though the implementation of technology mission on oilseeds paved the way for increase in oil seeds productions in the State by increasing the productivity through technological intervention, variability in area under groundnut leads to variability in productivity resulting in inconsistent supply. Instability in crop area and yield of groundnut resulted in production shortfall in most of the districts. Hence, it is vital to understand the performance of groundnut in major districts in Andhra Pradesh in order to identify the determinants of performance and potentials for future expansion of area under groundnut through the implementation of strategies for scaling -up the productivity of groundnut-based production systems. The present paper aims at assessing the growth performance of groundnut in various districts of Andhra Pradesh and examining the immediate and sustained effects of oilseeds mission on groundnut production and identifying the potentials for area increase and productivity improvement.

Materials and Methods

(i) Growth Analysis:

Time series data on area, production, and productivity of groundnut for all the 13 districts of Andhra Pradesh for the period between 1997-98 and 2019-20 were sourced from various online publications. Compound growth rate was estimated for overall period using the formula [(Ending period (2019-20)/Initial value (1997-98)^(1/23)-1)*100] and for maximum decline and increase

in area/ production and productivity in the state and districts in terms of compound growth rate was estimated using the formula [(Min value/Max value)^(1/No. of years)-1*100].The growth rates were estimated in excel worksheet and the districts were classified based on compound growth rates.

(ii). Assessment of Immediate and Sustained Effect using Single Interrupted Time Series (ITS) Segmented Linear Regression:

The government of India implemented technology mission on oilseed and oil palm (TMOP) during the period 1985-2003 (7^{th} to 9^{th} plan), integrated scheme on oilseed, pulses, oil palm and maize (ISPOM) during 2004-2013 (10^{th} to 11^{th} plan) and national mission on oilseed and oil palm (NMOOP) during the period 2014-2017 (12^{th} plan) in order to increase oilseed production since a substantial portion of edible oil requirement is met through imports. In order to capture the impact, the above set programmes and classify the districts based on the potential the following interrupted time series segmented regression is employed.

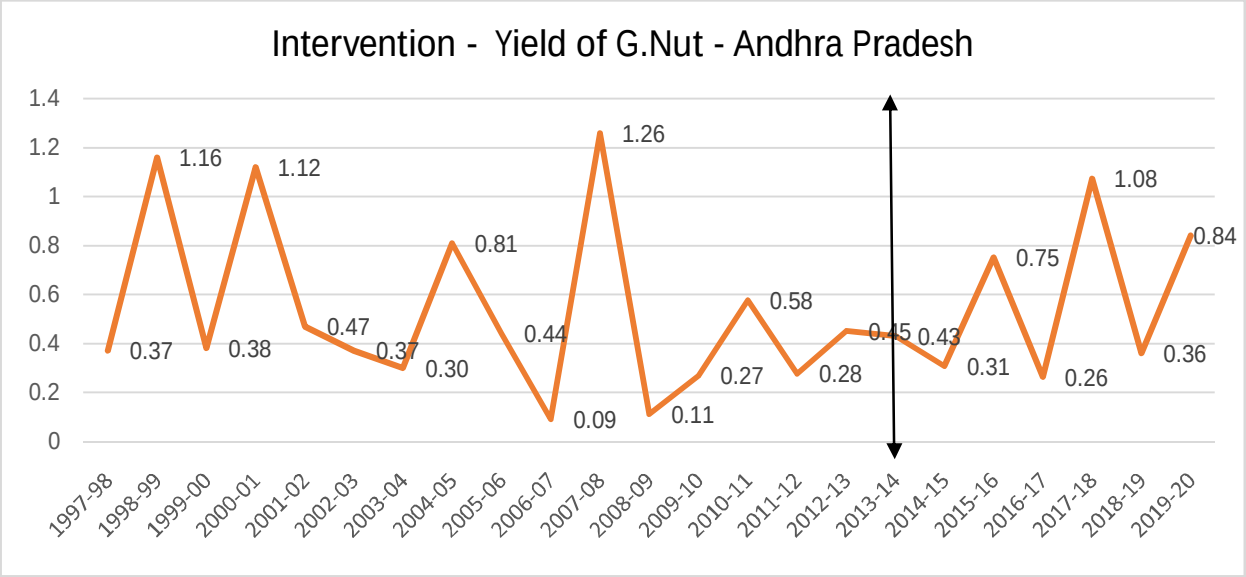
$$y = \alpha + \beta_1 T + \beta_2 X + \beta_3 XT + \varepsilon.$$

Where;

T refers to time period, X indicates the study phase and XT represents time after interruption. β_1 coefficient indicate pre-trend, β_2 shows the post level change, β_3 is the post trend change and ($\beta_1 + \beta_3$) is the post-trend.

The interrupted time series enable to investigate no impact, immediate impact, sustained or long-term impact and both immediate and sustained impacts of oilseed mission on area, production, and productivity. In time series it is important to understand the counterfactual and the actuals. The time coefficient β_1 indicates the trends in area, production, and productivity of groundnut in before intervention. The positive and significant coefficients indicate that area, production, and productivity increase over the period or vice versa. The β_2 normally indicates the immediate effect of oilseed mission and the immediate effect is expected to be positive and significance. Time since intervention impact co-efficient β_3 indicates that trend has changed after the intervention i.e., the sustained effect of intervention.

Figure 1. Trend Pattern of Yield of Ground Nut in Andhra Pradesh and Period of Intervention



Results and Discussion

(i) Pattern of Growth and Production Potentials

Cultivation of groundnut in Andhra Pradesh is completely dependent on rains as this crop mostly grown in rainfed conditions. Area under the groundnut in all the districts of Andhra Pradesh are declining at faster rate and the rate of decline is higher in the major groundnut growing districts namely Anantapur (2.13%), Chittoor (3.79%), Cuddapah (7.47%) and Kurnool (3.82 %). The area under groundnut in the State also registered a negative rate of growth and the area declined at the rate of 3.49 % between 1997-98 and 2019-20 and maximum decline was 6 % per annum, which is alarming (Table 1). Anantapur district contributes on an average 57 % of the state's area and maximum share in area was 66 %. Since, the maximum decline in this district was 5.12 %, the production growth is found low (1.39%) despite the productivity increased by 3.63 % per annum. Similarly, the rate of production in Chittoor district declined at 2.1% overall, though the productivity increased at the rate of 4 % and this is mainly due to a decline in area by almost 4 % per annum. The Cuddapah, one of the major groundnuts producing districts in the state, also witnessed a negative growth rate in production and production decline was around 2% per annum. However, productivity in the Cuddapah district grew at faster rate compare to other major districts and the productivity has grown at 6% per annum (Table 2).

Table 1. Growth of area of peanuts in various districts of Andhra Pradesh during the period between 1997-98 and 2019-20

District	Area – Average Share (%)	Area – share – Max (%)	Area – Share – Min (%)	CGR (%) – Area (ha)	Max decline/increase in area- CGR (%)
Anantapur	56.58	66.38	44.79	-2.13	-5.12
Chittoor	13.51	17.63	9.12	-3.79	-4.13
East Godavari	0.04	0.14	0.02	-10.81	-11.64
Guntur	0.40	0.60	0.26	-1.73	-6.76
Cuddapah	8.09	13.30	2.64	-7.47	-14.82
Krishna	0.45	1.03	0.16	-9.68	-9.67
Kurnool	14.06	18.24	8.92	-3.82	-9.20
Prakasam	0.66	1.26	0.26	-7.65	-10.27
SPSR Nellore	1.05	1.64	0.66	-3.60	-3.94
Srikakulam	1.92	3.02	0.67	-8.97	-9.71
Visakhapatnam	0.57	1.43	0.22	-9.61	-10.57
Vizianagaram	2.31	4.68	0.23	-15.38	-16.90
West Godavari	0.36	0.21	0.57	-3.40	-13.90
Andhra Pradesh	100.00	-	-	-3.49	-6.00

The rate of growth in production in Kurnool district, in which groundnut occupies 14% area in the state, also witnessed very meager rate of growth in production (3.37%) due to an alarming rate of decline in area by 9.2% per annum and the overall rate of decline growth was estimated at 4% per annum. The rate of increasing in productivity was 4.34% per annum in this district and this rate of increase in productivity could be not able to push up the production due to alarming rate of decline in area. As part of the Andhra Pradesh Primary Sector Mission (APPSM), which is also known as 'Rythu Kosam', farmers in the district were advised through text messages on the best time of sowing and harvest depending on weather conditions, soil and other indicators. Farmers who sowed in the first week of June got meagre yields due to a long dry spell in August, while registered farmers who sowed in the last week of June and first week of July and followed advisories got better yields and are out of loss. Though there is a distinct example of technological success as the farmers in Andhra Pradesh's Kurnool district increased

their per hectare groundnut yield by 30% owing to the use of cloud technology and business intelligence, in many of the districts the productivity continues to decline. The lower spread of suitable high yielding varieties/hybrids, moisture stress, high costs of production; untimely availability of inputs; low and fluctuating prices were found to be some of the key production constraints confronted at the farm level for the cultivation of groundnut (Teja, 2022). Apart from few technological successes, the above issues confronting groundnut production should also be addressed for achieving higher production in the major groundnut producing districts.

Table 2. Growth of production and yield of peanuts in various districts of Andhra Pradesh during the period between 1997-98 and 2019-20

District	Production Share (Average %)	Production share (Max %)	Production Share (Min %)	CGR (%) - Production (tonnes)	Max decline/increase -Production CGR (%)	CGR (%) - Yield (t/ha)
Anantapur	36.16	49.22	11.86	1.39	-76.54	3.63
Chittoor	18.98	26.47	13.42	-0.21	-13.40	3.74
East Godavari	0.13	0.36	0.05	-8.45	-8.81	2.65
Guntur	1.50	4.28	0.40	2.38	-6.08	4.17
Cuddapah	8.40	14.77	0.87	-1.77	-22.19	6.17
Krishna	1.39	3.10	0.54	-5.84	-8.98	4.25
Kurnool	18.24	26.84	8.11	0.37	-32.32	4.34
Prakasam	1.87	3.65	0.80	-2.89	-5.26	5.15
SPSR Nellore	4.10	8.29	1.03	-1.38	-28.44	2.31
Srikakulam	3.15	6.21	0.87	-7.28	-7.93	1.83
Visakhapatnam	1.01	2.93	0.31	-7.49	-11.72	2.34
Vizianagaram	3.47	8.97	0.29	-13.12	-15.13	2.65
West Godavari	1.25	2.47	0.37	-1.88	-10.56	1.57
Andhra Pradesh	100.00	-	-	-0.40	-12.38	1.56

The estimated growth rates clearly indicate that in the recent past the area under groundnut cultivation is declining as a farmer shifting to remunerative crops like tobacco, cotton, maize including oil palm as market for these crops are stable and the prices are higher and risk-free. The studies also found that market prices were below the minimum support price for the most of the days in the state and the highest average difference in the state was 14%. Groundnut

production in the state declined by 0.4% per annum due to decline in both productivity and area by 3% and 3.4% respectively. It is alarming to know that the maximum decline in production was 12.38% in the State mainly due to the maximum decline in production in major groundnut producing districts namely Anantapur (76%) followed by Kurnool (32.32%), Cuddapah (22.19%) and Chittoor (13.40%). Production of the groundnut in the state declined by 0.4% per annum due to decline in both productivity and area by 3% and 3.4% respectively. It is alarming to note that the maximum decline in production was 12.38% due to maximum decline in production in major districts namely Anantapur (76%) followed by Kurnool (32.32%), Cuddapah (22.19%) and Chittoor (13.40%). Due to instability in crop area, the yield of groundnut is falling down as a result production either fell drastically or increase meagerly in most of the districts. Though the rate of decline in growth in terms of area was higher in Cuddapah district, which accounts for 8% of the total area in the state, compare to other major districts, the rate of growth in productivity of this district is very high which is more than 6%. The district constituted almost 15% of the state production, its production trended to decline mainly due to area. Since high productivity potential exists in this district, in order to increase the production of groundnut in the state, the area under groundnut in this district must be sustained without any further decline through technological and policy interventions (Tables 3 and 4). Study showed that of the total farmers surveyed, 66 % adopted K-6 variety,18 % adopted K-9 and 23 % adopted Dharani Variety (Chowdary, 2021). Under various existing production constraints, increasing the adoption of suitable and high yield potential varieties signifies the timely distribution seeds.

Table 3. Classification of districts based on the rate of growth of area

Rate of growth (%)	No of districts	Name of the district
-1 to - 2	1	Guntur
-2 to -4	5	Anantapur, Chittoor, Kurnool, SPSR Nellore and West Godavari
-6 to -8	2	Cuddapah and Prakasam
-8 to -10	3	Krishna, Srikakulam and Visakhapatnam
> -10	2	East Godavari and Vizianagaram
Total	13	-

Table 4. Classification of districts based on the rate of growth of production

Rate of growth	No of districts	Name of the district
- < 1 to -2	4	Chittoor, Cuddapah, SPSR Nellore, and West Godavari
-2 to -4	1	Prakasam
- 4 to -6	1	Krishna
- 6 to -8	2	Srikakulam and Visakhapatnam
- 8 to -10	1	East Godavari
>-10	1	Vizianagaram
< 1 to 2	2	Anantapur, Kurnool
2 to 4	1	Guntur
Total	13	

Maximum productivity was recorded was 1.26 t/ha during 2007-08 in the Anantapur district and at present the productivity was 0.84 t/ha. The yield gap between the achieved productivity and the present productivity is 0.42 t/ha. The yield gap clearly reveals that if the maximum achieved productivity is the potential productivity of the district, then if this productivity could have been sustained over the period through technological and policy interventions, the production could have improved even at fall in area. Similarly, in case of

Chittoor district the highest productivity was 2.03 t/ha and which was achieved during 2017-18 thereafter the yield declined to 1.88 t/ha at present losing almost 1.5 t/ha as a result production declined despite overall increase in productivity growth. Cuddapah district achieved 2.42 t/ha at present which is comparatively higher than the other major producing districts. Hence, given production potential in this district, sustaining area through rainfed technological dissemination is critical for higher level of production in the state as this district contributes more than 8 % of the production in the State (Table 5). By interventions there could be a reduction in the cost of production paving the way for farmers to allocate more area under groundnut thereby sizeable fall in area in major districts can be reduced. The earlier study estimated that per hectare groundnut net income was found to be Rs.28, 971, whereas the competing crop maize was Rs.37, 710 per hectare. Per hectare cost of cultivation (C2) increased by 40% in the period II (2012-13 to 2016-17) over period I (2007-08 to 2011-12) and the operational costs increased by 52% compared to fixed costs which increased by 18%. (Sunandini and Devi, 2020, Naidu, et.al;2019). Cost reduction by achieving the higher productivity through various interventions with assured market is paramount important for increasing the production in the state.

Table 5. Classification of districts based on the rate of growth of yield

Rate of growth (%)	No of districts	Name of the district
1-2	2	Srikakulam and West Godavari
2-4	6	Anantapur, Chittoor, East Godavari, SPSR Nellore, Visakhapatnam and Vizianagaram
4-6	4	Guntur, Krishna, Kurnool and Prakasam
>6	1	Cuddapah
Total	13	

(ii) Immediate and Sustained effects of Oilseeds Mission

India is one of the major edible oil consuming and producing countries in the world. National Mission on Oilseeds and Oil Palm (NMOOP) was implemented during the 12th Five Year Plan to expand the oil palm areas and increase the production of edible oils. Considering the growing domestic demand for edible oils, the staggering deficiency, and the cost to the exchequer on account of imports, the urgency of scaling up the oilseeds production does not need

over-emphasis. It has now been planned to achieve a production of 45.64 Million tonnes (mts) from nine (9) annual oilseed crops by 2022-23, expecting an additional production of about 15.58 mt over and above the 30.06 Million tonnes production (Quinquennium Ending 2016-17). The projected demand for groundnut will be 20 million tonnes 2050. A growth rate of 4% to 5% in productivity is required to meet the demand both domestically and internationally. The strategies for enhancing the productivity of oilseed-based production system are prepared for the annual oilseeds and for oil palm in the country with low-cost technologies with high impact on productivity resulting in higher income. Technologies with high impact that involve reasonable investment with high return on investment (ROI), with emphasis on eco-friendliness, high input use efficiency, and strategies with emphasis on quality improvement and value addition leveraging technologies with a bearing on the employment through skill development.

Groundnut holds the first place in India presently growing in an area of 50.89 lakh hectares (2020-21) with annual production of 101.46 lakh tonnes (2020-21). The major groundnut producing states are Gujarat, Rajasthan, Tamil Nadu, Andhra Pradesh, Karnataka, Madhya Pradesh, West Bengal and Telangana contributing more than ‘00 thousand tonnes each. Among the various states Tamil Nadu stands first in terms of productivity with an average of 2,980 kg per hectare followed by Gujarat (2001 kg/ha), Rajasthan (2064 kg/ha), Andhra Pradesh (957 kg/ha), Karnataka (802 kg/ha), Madhya Pradesh (1571 kg/ha), West Bengal (2363 (kg/ha), Telangana (2148 (kg/ha). MMI on Oilseeds under NMOOP was implemented in all 13 districts of Andhra Pradesh since the state average yield of oilseeds is less than the national average.

The State need to make effort for improving productivity of oilseeds particularly in case of groundnut which is less than national average. Under MM-I, Annual Action Plan (AAP) for 2016-17 has been approved with a total outlay of Rs. 2918.33 lakh (central share Rs 1751. lakh & state share Rs. 1167.33 lakh) which is being implemented by the State Department of Agriculture. The Components under MM-I on Oilseeds are classified broadly in three categories namely Seed Components, Production inputs, Transfer of Technology, Farm Machineries and irrigation tool, Mission Management expenses and Flexi funds. Increasing the certified seed availability by maintaining seed chain of recently released varieties, integrated crop management by increasing area under IPM / INM / Micro irrigation and demonstrating latest production / protection technologies at farmers’ field through FLD / demonstrations, promotion of mechanization through distribution of improved farm implements / equipment and capacity

building of farmers / extension workers through inter / intra trainings including FFS are major initiatives.

The interrupted time series model results for major groundnut growing districts are presented in the Tables 6- 9. In Andhra Pradesh, groundnut production and area are highest in Anantapur district. However, due to vagaries of rainfall, about 55-60 percent of groundnut cultivation acreage remained uncultivated in the district and groundnut seed sowing was confined to only 45 percent of the total area. Those farmers, who ventured to cultivate, are those with guaranteed water sources and having the ability to withstand financial vagaries. Farmers and believed since there were no guarantees for marketing and remunerative price are fluctuating and volatile the farming operations have become expensive and investment burden has increased considerably. The model results of interrupted time series show that (Table 6) though there is no significant intervention effect, there is sign of productivity improvement after the intervention. Productivity increased from 0.45 t/ha to 0.84 t/ha after the intervention. The coefficient of sustained effect for production turned out to positive from negative though not significant (immediate effect), indicating the effect of mission. It is evident from the study (Tej, 2021) that, the growth performance of groundnut in Ananthapuramu district declined over the years, particularly in Period III, which implies that, despite lot of efforts from researchers and government to encourage groundnut production at macro level, the contribution of groundnut at district level showed a declining trend. This scenario could be attributed to low farm level yields with higher farm level inefficiencies, gaps in production technology, geographical location of the district under rain shadow region, declining scenario in the length of growing period, shift towards competing crops, poor post-harvest support, changing climate, lower yields, low extension contact at field level, low market prices and high abiotic and abiotic stresses.

Table 6. Impact of Oilseeds Mission: Interrupted Time Series Model Results for Anantapur District.

	Area (ha)	Production (tonnes)	Yield (t/ha)
	β Coefficient		
Before Intervention (β_1)	-2282.05 (-0.44)	-22573.40* (-1.48)	-0.03* (-1.47)
Immediate Effect (β_2)	-163269.95* (-1.63)	-39656.50 (-0.13)	0.05 (0.12)
Sustained Effect (β_3)	-23976.06 (-1.02)	40132.66 (0.58)	0.09 (1.09)
Constant (β_0)	790634.25*** (14.47)	639458.90*** (3.97)	0.80*** (3.97)

(Figures in parentheses are t ratios). * P < 0.10; *** P< 0.01

Figure 2. Interrupted Times Series – Model Results for Yield of Groundnut in Anantapur District

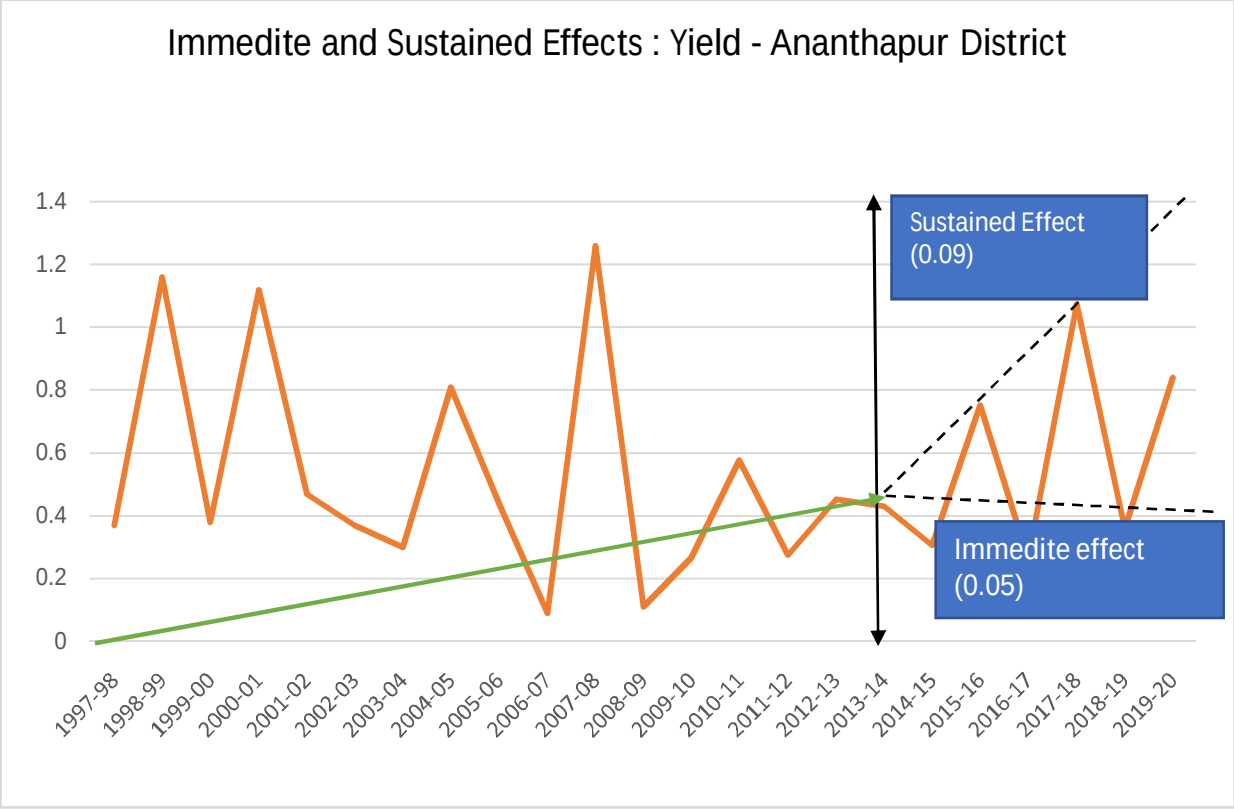


Table 7. Impact of Oilseeds Mission: Interrupted Time Series Model Results for Chittoor District.

	Area (ha)	Production (tonnes)	Yield (t/ha)
	β Coefficient		
Before Intervention (β_1)	-5172.55*** (-3.07)	-4747.98 (-1.39)	0.004 (0.19)
Immediate Effect (β_2)	7889.91 (0.24)	-34138.29 (-0.51)	-0.36 (-1.03)
Sustained Effect (β_3)	-88.13 (-0.01)	20718.99 (1.34)	0.18** (2.21)
Constant (β_0)	223961.60*** (12.59)	220545.76*** (6.11)	0.97*** (5.06)

(Figures in parentheses are t ratios). **P < 0.05; *** P< 0.01

The estimated coefficient of immediate effect for yield is -0.36 in the case of Chittoor district (Table 7) and turned to significant and positive (0.18) implying the sustained effect of the intervention. After intervention productivity of groundnut in this district increased from 0.85 t/ha to 2.03 t/ha with variability. Similarly, it is also found that there are no immediate and sustained effects of oilseed mission in Cuddapah district. Though there is no immediate effect of oilseed mission, the long-term effects of the co-efficient was positive and estimated at 0.15 indicating that as the time passes after the intervention the productivity of groundnut increases to 0.15 t/ha (Table 8). As a result, the productivity of groundnut in the Cuddapah district reached to 2.42 t/ha, which was achieved in the year 2019-20. Predominant crop is rainfed groundnut, which accounts for more than 50% of the annual cropped area in the district. The studies conducted in Cuddapah districts identified major technical constraints relating to adoption of improved technology, non-suitability of improved technology, and lack of technical guidance (Veeraiah., et.al,2019). Not much impact of intervention both in during short and longer periods was observed in the Kurnool district (Table 9). Addressing these issues through policy and technological interventions are crucial for sustaining the productivity and increasing the production of groundnut.

Table 8. Impact of Oilseeds Mission: Interrupted Time Series Model Results for Cuddapah District.

	Area (ha)	Production (tonnes)	Yield (t/ha)
	β Coefficient		
Before Intervention (β_1)	-5872.48** (-2.64)	-2774.70 (-0.75)	0.02 (0.91)
Immediate Effect (β_2)	-38074.04 (-0.88)	-27197.70 (-0.38)	-0.18 (-0.37)
Sustained Effect (β_3)	1833.34 (0.18)	1433.58 (0.08)	0.15 (1.30)
Constant (β_0)	190268.58*** (8.12)	130948.30*** (3.35)	0.57** (2.17)

(Figures in parentheses are t ratios). * P < 0.05; *** P< 0.01

Table 9. Impact of Oilseeds Mission: Interrupted Time Series Model Results for Kurnool District.

	Area (ha)	Production (tonnes)	Yield (t/ha)
	β Coefficient		
Before Intervention (β_1)	-5518.27*** (-3.32)	-5796.45* (-1.69)	-0.01 (-0.42)
Immediate Effect (β_2)	-51118.60* (-1.59)	-50244.90 (-0.75)	-0.02 (-0.07)
Sustained Effect (β_3)	3790.70 (0.50)	13162.88 (0.84)	0.10 (1.41)
Constant (β_0)	254203.32*** (14.49)	241317.00*** (6.66)	0.97*** (5.78)

(Figures in parentheses are t ratios). * P < 0.10; *** P< 0.01

Conclusion and Implications

Area under the groundnut in all the districts of Andhra Pradesh are declining at faster rate and the rate of decline is higher in the major groundnut growing districts namely Anantapur (2.13%), Chittoor (3.79%), Cuddapah (7.47%) and Kurnool (3.82 %). The area under groundnut in the State also registered a negative rate of growth and the area declined at the rate of 3.49 % between 1997-98 and 2019-20 and maximum decline was 6 per cent, which is alarming. Anantapur district contributes on an average 57 % of the state area and maximum share was 66 %. Since, the maximum decline is in this district was 5.12 %, the production growth was found low (1.39%) despite the productivity increased by 3.63 % per annum. Similarly, the rate of production in Chittoor district declined at 2.1% overall, though the productivity increased at the rate of 4 % annum and this is mainly due to a decline in area by almost 4 % per annum. The Cuddapah, one of the major groundnuts producing districts in the state, also witnessed a negative growth rate in production and the production decline was around 2% per annum. However, productivity in the Cuddapah district grew at faster rate compare to other major districts and the productivity has grown at 6% per annum. Groundnut production in the state declined by 0.4% per annum due to decline in both productivity and area by 3% and 3.4% respectively. It is alarming to know that the maximum decline in production was 12.38% in the State mainly due to the maximum decline in production in major groundnut producing districts namely Anantapur (76%) followed by Kurnool (32.32%), Cuddapah (22.19%) and Chittoor (13.40%)

Hence, given production potentials in the major groundnut producing districts, sustaining area through rainfed technological dissemination is critical for higher level of production in the state as these districts contributes more than 80 % of the production in the State. By interventions there could be a reduction in the cost of production paving the way for farmers to allocate more area under groundnut thereby sizeable fall in area in major districts can be reduced. The yield gap clearly reveals that if the maximum achieved productivity is the potential productivity of the districts, then this productivity could have been sustained over the period through technological and policy interventions, the production could have improved even at fall in area.

Those farmers, who ventured to cultivate, are those with guaranteed water sources and having the ability to withstand financial vagaries. Farmers believed that since there are no guarantees for marketing and remunerative prices are fluctuating and volatile, the farming

operations have become expensive and investment burden has increased considerably. The model results of interrupted time series show that though there is no significant immediate intervention effect, there is sign of productivity improvement in the long run after the intervention. The coefficient of sustained effect for production turned to positive from negative though not significant (immediate effect), signifying the effect of oilseeds mission in the major districts. The studies identified major technical constraints relating to adoption of improved technology, non-suitability of improved technology, and lack of technical guidance. Addressing these issues through policy and technological interventions are crucial for sustaining the productivity and increasing the production.

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