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Regional Growth Rates in Area, Production and Productivity of Soybean in Maharashtra State

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Abstract: *Soybean [*Glycine max *L.] is the world's natural source of protein. Soybean is the most important oilseed crop of the world. Soybean is grown successfully in various agro-climatic conditions. Investigation was carried out for the year 2012-13 in order to estimate the "Regional growth rates in area, production and productivity of soybean in Maharashtra state". Study categorized period as follows; Period I-1990-91 to 2001-02, Period-II- 2002-03 to 2012-13, and overall period-1990-91 to 2012-13. The growth in the area, production and productivity of soybean was estimated by using the compound growth function of the non linear form. The growth in the area, production and productivity of soybean was estimated by using the compound growth function of the non linear form. The study analyzed that area, production and productivity of soybean had increased during the study period i.e 13.23 percent, 14.15 percent and 2.09 percent per annum respectively.*

The increase in production of soybean in Maharashtra, during the period-I was relatively more as compared to period-I and overall period. This was due to the increase acreages under soybean and little due to increase in productivity of soybean. It is observed that, farmers in Maharashtra state are gradually switching over to soybean from cotton, jowar, tur and other traditional crops due to higher yield and remunerative price for soybean. Efforts should be made to improve the productivity of soybean in order to increase soybean production in Maharashtra.

Key words: *Soybean, Production, Compound Growth Rate, Maharashtra*

INTRODUCTION

Agriculture has been and will continue to be the lifeline of Indian economy. The progress made by agriculture in the last four decades is one of the biggest success story of free India. Agriculture and allied activities constitute the single largest contributor to the gross domestic product. This increase in agriculture product has been brought about by bringing additional area under cultivation, extension of irrigation facilities, the use of improved high yielding variety of seeds, water management and better techniques evolved through agriculture research, use of pesticides and cropping practices.

Soybean (*Glycine max*) belongs to the fabaceae or leguminosae (legume) family which also includes peanuts, chickpeas and other beans and pulses. The first domestication of soybean has been traced to the eastern half of North China in the eleventh century B.C. or perhaps a bit earlier. Soybean oil (20 per cent) and protein (40 per cent) content account for about 60 per cent of dry soybeans by weight. The main producers of soybean are the United States (35 per cent), Brazil (27 per cent), Argentina (19 per cent), China (6 per cent) and India (4 per cent). The U.S., Argentina, Brazil, China and India are the world's largest soybean producers and represent more than 90 per cent of global soybean production. The average worldwide yield of soybean crops, in 2010, was 2.5 tonnes per hectare.

In 2012-13, the area grown under soybean was 10.59 million hectare with production of 129.57 million tones and yield was 1192 kg per hectare in India. In Maharashtra, the area under soybean was 3010 thousand hectare with

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production of 3969 thousand hectare having yield 1319 kg per hectare.

METHODOLOGY

The present study was utilized the time series data (1990-91 to 2012-2013) on area, production and productivity of soybean was collected from various publications and websites of Directorate of Economics and Statistics Government of India, Agricultural Statistics at a glance and Bureau of Economics and Statistics of Maharashtra state.

Specification of time periods

To facilitate proper understanding of impact soybean cultivation on Maharashtra with regard to percentage increase in area, production and productivity, the overall period of 23 years i.e. from 1990-91 to 2012-13 were divided into two sub periods and one overall period as indicated below.

Period- I : 1990-91 to 2001-02

Period- II : 2002-03 to 2012-13

Overall period : 1990-91 to 2012-13

To understand the overall performance of soybean over the entire period of 23 years, i.e. 1990-91 to 2012-13, it were considered as one period.

Analysis of data

Functional analysis

In order to analyze the changes in area, production and productivity of soybean in Maharashtra during period I, period II and as well as overall period, annual compound growth rates were estimated. In the present study, the compound growth rates in area, production and productivity of soybean production in Maharashtra were estimated by fitting exponential type of equation.

$$Y = ab^t$$

Where,

Y = area, production and productivity

t = time period

b = regression coefficient

a = intercept

CGR = (Antilog b – 1) × 100

The simple tabular analysis was done for obtaining the results on changes in area, production and productivity of soybean in Maharashtra.

RESULTS AND DISCUSSION

Trends in area, production and productivity of soybean in Maharashta

The decade wise data on area, production and productivity of soybean in Maharashtra for the period of last 23 years i.e. from 1990-91 to 2012-13 have been analyzed and changes in area, production and productivity of soybean in Maharashtra for the period of 23 years have been worked out.

Since the main objective of the present study was to estimate growth rate of soybean in Maharashtra in general, and those in different divisions in particular, it was necessary to examine whether changes had occurred in soybean acreage in absolute terms during the different time periods selected for the study in various regions and for the entire state.

Districtwise and periodwise annual compound growth rates of area, production and productivity of soybean in Western Maharashtra

The compound growth rates were computed for area, production and productivity of soybean crop for the period of 23 years from 1990-91 to 2012-13 in the selected districts of Western Maharashtra of Maharashtra State and are presented in table 1. The compound growth rate of area under soybean for the period of 1990-91 to 2012-13 in the Western Maharashtra region was 9.07 percent per annum is positive and significant, which indicated the rapid increase in area.

The district wise growth rates of area, production and productivity of soybean in western Maharashtra region for period-I revealed that, the production increased due to area expansion as well as productivity in Nashik, Ahmednagar, Solapur, Satara and Western Maharashtra region. In case of Dhule, Jalgaon, Kolhapur and Sangli districts production increased both due to increase in area.

For period-II the production increased due to area expansion in Dhule, Jalgaon, Pune,

Table 1
Districtwise and periodwise annual compound growth rates in area, production and productivity of soybean in Western Maharashtra region

Sr. No.	District / Period-I	CGR (%) Period-II (1990-91 to 2001-02) A	P	Y	Overall (2002-03 to 2012-13) A	P	Y	Overall (1990-91 to 2012-13) A	P	Y
1	Nashik	25.46***	32.27***	5.85***	22.85***	20.71***	6.82***	23.86***	26.50***	1.22 NS
2	Dhule	19.70***	22.26***	2.65 NS	22.21***	13.90***	1.31 NS	15.19***	16.39***	1.21 NS
3	Jalgaon	22.68**	26.66**	3.36 NS	14.32**	11.71**	4.65***	18.74***	23.09***	-2.76**
4	Pune	6.50 NS	8.84 NS	4.68 NS	23.63***	19.68***	-2.86 NS	11.80***	16.90***	3.12***
5	Ahmednagar	23.92***	12.22***	4.72 **	12.99***	10.93*	-1.81 NS	26.87***	10.82***	1.12 NS
6	Solapur	3.99 NS	9.89***	8.90***	23.62***	20.88***	6.41 NS	12.35***	15.10***	3.68***
7	Kolhapur	13.20***	17.26***	3.57 NS	-3.64***	1.85 NS	5.70*	3.68***	5.98***	2.20***
8	Satara	18.47***	20.14***	9.96***	9.88***	10.62***	0.66 NS	13.66***	16.58***	3.05***
9	Sangli	10.30***	14.54***	3.40 NS	-0.07 NS	0.05 NS	0.12 NS	3.56***	4.40***	0.63 NS
10	Nandurbar	NA	NA	NA	6.12***	8.07*	-3.09 NS	6.12 NS	8.07 NS	-3.09 NS
	Western Maharashtra	13.01***	16.72***	5.46***	7.19***	7.46***	2.04 NS	9.07***	9.73***	2.51***

*, ** and *** indicate significance at 10, 5 and 1 per cent level

'#' – Newly formed district, area so far recorded is under Latur

Ahmednagar, Solapur, Satara and Nandurbar districts and production increased due to productivity improvement in Nashik district. In case of Nasik, Ahmednagar, Solapur, Sangali and Western Maharashtra region production increased both due to increase in production as well as productivity.

Pune, Solapur, Kolhapur, Satara and Western Maharashtra region show increased trend in production both due to increase in area as well as productivity in the entire period of study. In Dhule, Nashik, Ahmednagar, Sangli and Nandurbar districts production increased due to increase in area.

From the above discussion, it is clear that, the significant increase in production in all the selected districts of Western Maharashtra is attributed mainly to increase in the area and partly due to increase in the productivity. It is concluded that the production growth pattern in Western Maharashtra as a whole had been dominated mainly by area expansion factor.

Districtwise and periodwise annual compound growth rates of area, production and productivity of soybean in Marathwada

The district wise growth rates of area, production and productivity of soybean in Marathwada region for period-I from table 2 revealed that, the production increased due to increase in productivity in Nanded district. Also, the production shows increased trend due increase in area in Aurangabad, Parbhani, Jalna, Latur and Marathwada region.

In Parbhani and Nanded districts, the productivity was increased due to both increased in area as well as production in period-II. The production shows increasing trend in all districts except Aurangabad district. Highest production noticed in Latur district (26.21 percent per annum).

For the entire period of study, production increased due to both increase in area as well as production in Hingoli district at 10.11 percent, 8.52 percent and 1.46 percent per annum respectively. Also the production increased due to increased in area in Aurangabad, Parbhani, Beed, Nanded, Osmanabad, Jalna, Latur and Marathwada region.

It could be conclude that, from last fifteen years have witnessed noticeable changes in soybean cultivation in Marathwada region with introducing agro technologies across the soybean chain.

Table 2
Districtwise and periodwise annual compound growth rates in area, production and productivity of soybean in Marathwada region

Sr. No.	District / Period-I	CGR (%) Period-II (1990-91 to 2001-02) A	P	Y	Overall (2002-03 to 2012-13) A	P	Y	Overall (1990-91 to 2012-13) A	P	Y
1	Aurangabad	19.69**	23.73*	3.23 NS	6.37*	4.71 NS	4.92 NS	11.04***	13.06***	1.78 NS
2	Parbhani	16.03***	28.70***	3.86 NS	15.41***	15.16***	8.22**	21.72***	26.31***	1.30NS
3	Beed	10.80 NS	13.40 NS	2.37 NS	16.33 NS	17.51**	1.02 NS	28.12***	27.60***	0.16 NS
4	Nanded	19.27***	13.68***	6.65**	13.01***	13.66***	9.04*	31.18***	28.81***	1.71 NS
5	Osmanabad	34.30***	18.32 NS	-8.81**	24.76***	27.72***	2.33 NS	33.85***	32.26***	0.29 NS
6	Jalna	24.68***	23.53**	8.69NS	22.39***	19.42***	-2.38 NS	24.36***	26.83***	2.05 NS
7	Latur	25.68***	25.74***	0.27 NS	17.22***	26.21***	7.67 NS	34.18***	35.09***	0.72 NS
8	Hingoli	-	-	-	8.52**	10.11*	1.46 NS	8.52**	10.11**	1.46***
Marathwada		22.07***	27.94***	1.10 NS	14.44***	16.76***	4.49NS	29.48***	31.58***	1.38 NS

*, ** and *** indicates significance level at 10, 5 and 1 per cent level

Table 3
District and periodwise annual compound growth rates in area, production and productivity of soybean in Vidarbha region

Sr. No.	District / Period-I	CGR (%) Period-II (1990-91 to 2001-02) A	P	Y	Overall (2002-03 to 2012-13) A	P	Y	Overall (1990-91 to 2012-13) A	P	Y
1	Buldhana	18.24***	15.43***	2.18 NS	12.48***	14.13**	1.46 NS	13.86***	11.79***	0.76 NS
2	Akola	29.78***	25.27***	2.63 NS	20.27***	23.62***	2.78 NS	17.70***	18.68***	1.26 NS
3	Amravati	19.06***	20.83***	3.68 NS	8.67***	12.09*	3.14 NS	10.58***	12.29***	1.37 NS
4	Yavatmal	15.36***	26.08***	4.94**	9.43**	9.68*	0.16 NS	21.20***	20.32***	-0.73 NS
5	Wardha	18.50***	23.20***	3.94**	-0.77 NS	-4.16 NS	-3.41 NS	8.90***	8.82***	-0.08 NS
6	Nagpur	8.41***	10.38***	1.20 NS	1.48 NS	-0.92 NS	-2.36**	3.69***	4.71***	0.76 NS
7	Bhandara	-0.58 NS	3.26 NS	3.85*	-2.80***	-5.31*	-2.61 NS	-2.07**	-1.43 NS	0.65 NS
8	Chandrapur	11.40***	12.60***	10.38 NS	0.87 NS	-3.32 NS	-4.16 NS	8.71***	9.50***	2.85 NS
9	Gadchiroli	2.03 NS	-6.22 NS	2.08 NS	3.76***	5.07***	-1.57 NS	3.19***	2.59***	2.31*
10	Gondia#	–	–	–	–	–	–	–	–	–
11	Washim	NA	NA	NA	6.85***	6.31 NS	-0.51 NS	6.85***	6.31*	-0.51 NS
	Vidharbha	18.20***	22.68***	5.31**	6.14NS	6.30NS	-0.25NS	11.57***	12.76***	1.84NS

*, ** and *** indicate significance at 10, 5 and 1 per cent level

'#' – Newly formed district, area so far recorded is under Bhandara

Districtwise and periodwise annual compound growth rates of area, production and productivity of soybean in Vidarbha

From the table 3, it is notice that, for period-I, the production increased both due to area expansion and increase in productivity in Yavatmal and Wardha districts. In Yavatmal, Wardha and Chandrapur district production declined due to both decrease in area as well as productivity.

The production increased due to area expansion in Amravati district in period-II. Also Akola, Buldhana, Amravati and Gadchiroli districts

have increased production by increase in area under soybean crop. Production declined by decrease in area in Wardha and Bhandara districts and due to decrease in productivity in Nagpur district.

For the overall study period, production increased due to area expansion in all districts except Bhandara district of due to bifurcation of Bhandara district and diversion of cultivated land towards different developmental activities. As well as productivity increased in Gadchiroli district due to area expansion and increased in production. In case of Gondia and Washim district production decline due to decrease in productivity.

Soybean is mostly grown in Vidarbha region (Amravati and Nagpur divisions). It can be seen that, area and production of soybean increased significantly at the rate of 11.57, 12.76 percent, respectively during 1990-91 to 2012-13. Except Bhandara district, all other major soybean growing districts have recorded substantial increase in area and production during the period under study. It is observed that, farmers in Vidarbha region are gradually switching over to soybean from cotton, jowar, tur and other traditional crops due to higher yield and remunerative price for soybean.

Districtwise and periodwise annual compound growth rates of area, production and productivity of soybean in Maharashtra

The area, production and productivity of soybean crop have changed widely during the period under consideration in all the district and regions and state as a whole. The growth rates of area, production and productivity of soybean for Maharashtra as a whole were observed to be positive and significant for the entire period of 23 years is presented in table 4. The area and production of soybean as a whole has increased at the rate of 13.23 percent and 14.15 percent per annum, respectively, during this period. However, the productivity of soybean has increased by only 2.09 per cent per annum, which is significant at 1 per cent level. This indicates that the production of soybean has increased mainly due to area expansion and partly due to productivity improvement. The area and production of soybean crop have increased at higher rate during Period-I period-II and Overall period. The productivity of soybean has shown dismal picture. It decreases up to period-II and increased for Overall period.

The performance of soybean crop in respect of area expansion and production increase was quite satisfactory in all the zones. But, it was poor in respect of productivity improvement in Vidarbha and Marathwada region during Overall period. The highest increase in the production was notice in Marathwada region (22.07 percent) followed by Vidarbha and Western Maharashtra region in Period-I.

From the above discussion it could be concluded that, Maharashtra is the second largest soybean growing state in the country accounting for about 25 percent of area and 33 percent of India's production. Farmers in Maharashtra state are gradually switching over to soybean from cotton,

Table 4
District and periodwise annual compound growth rates in area, production and productivity of soybean in Maharashtra

Sr. No.	District	CGR (%)								
	Period-I	Period-II (1990-91 to 2001-02)			Overall (2002-03 to 2012-13)			(1990-91 to 2012-13)		
		A	P	Y	A	P	Y	A	P	Y
1	Vidharbha	18.20***	22.68***	5.31**	6.14^{NS}	6.30^{NS}	-0.25^{NS}	11.57***	12.76***	1.84^{NS}
2	Marathwada	22.07***	27.94***	1.10^{NS}	14.44***	16.76***	4.49^{NS}	19.48***	21.58***	1.38^{NS}
3	Western Maharashtra	13.01***	16.72***	5.46***	7.19***	7.46***	2.04^{NS}	9.07***	9.73***	2.51***
	Maharashtra	17.43***	21.34***	4.32***	8.03***	9.02***	1.82^{NS}	13.23***	14.15***	2.09***

*, ** and *** indicate significance at 10, 5 and 1 per cent level

jowar, tur and other traditional crops due to higher yield and remunerative price for soybean.

CONCLUSIONS

1. State as whole, the area under soybean had increased in all the regions. The area, production and productivity of soybean were positively significant at the rate of 13.23, 14.15 and 2.09 percent per annum, respectively in the state.
2. The study has revealed that, area under soybean in Maharashtra and in all districts and states as whole have been increased during period-I, II and overall period. The performance of soybean in area and production was quite satisfactory mainly due to the productivity improvement and area expansion.
3. With the technological breakthrough in wheat and rice, attention was focused on other crops and soybean was one such oilseed crop. New varieties of soybean were introduced for commercial usage in India in 1970's. There was a marked increase in the area as well as production of this crop. Today soybean or the 'miracle bean' has come to occupy an important position as a global crop. In the world, India and Maharashtra, area under cultivation of this crop is growing continuously.

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