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Area, production and productivity of major foodgrain crops in western Maharashtra

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Abstract

The present study has been undertaken to study the trends in area, production and productivity of major foodgrain in western Maharashtra. The study has been conducted based on secondary data. Three major foodgrain crops from the western Maharashtra region viz; *rabi* Sorghum, Soybean and Gram were selected on the basis of important crop from cereals, oilseeds and pulses of the region. The data was collected for the periods from 1960-61 to 2017-18 from various governmental publications and web sites. The exponential function was fitted in order to analysis the trend in area, production and productivity of foodgrains. At overall level compound growth rates of the production and productivity of *rabi* Sorghum in western Maharashtra region was significantly increased at the rate of 0.52 and 0.91 per cent per annum and area under *rabi* Sorghum in western Maharashtra region was significantly decreased at the rate of 0.39 per cent per annum, respectively for the overall period of 57 years. Thus, it clearly indicates that, the production of *rabi* Sorghum was mainly increased due to only productivity improvement. At overall level compound growth rates of area and production of Soybean in western Maharashtra region was significantly increased at the rate of 7.98 and 8.28 per cent per annum and productivity of Soybean in western Maharashtra region was non-significantly increased at the rate of 0.28 per cent per annum, respectively for the overall period of 27 years. Thus, it clearly indicates that, the production of Soybean was mainly increased due to area expansion. It is observed that, cultivators in western Maharashtra are gradually switching over to Soybean from other traditional crops like, Groundnut, Onion etc. due to higher yield and remunerative price for Soybean. At overall level compound growth rates of the area, production and productivity of Gram in western Maharashtra region was significantly increased at the rate of 2.51, 4.3 and 1.75 per cent per annum, respectively for the overall period of 57 years. Thus, it clearly indicates that, the production of Gram was increased due to both area expansion and productivity improvement.

Keywords: Trends, area, production, productivity and compound annual growth rates

Introduction

Sorghum [*Sorghum bicolor* (L.), Moench.] belongs to family *Graminae*. Sorghum is considered to be originated in Ethiopia or East Central Africa. It is the fourth most important cereal following Wheat, Rice and Maize in the World as far as area under Sorghum and its production is concerned. It is grown as *kharif*, *rabi* and also as summer Sorghum. The production of Sorghum in India has decreased by 27.56 per cent over a period of time from 1960-61 to 2017-18. Maharashtra ranks first in the Sorghum production. In case of productivity, it shows an increasing trend over a period of time from 1960-61 to 2017-18. India's Sorghum productivity has increased by 78.61 per cent as compared to productivity in the year 1960-61. The major reasons for productivity improvement were use of high yielding varieties and increased utilization of input for Sorghum cultivation. In India, Andhra Pradesh, ranks first while Maharashtra ranks third in the productivity of Sorghum. The area, production and productivity of *rabi* Sorghum in Maharashtra was 1705 thousand hectares, 1510 thousand tons and 886 kg/ha, respectively in the year 2017-18. The area under *rabi* Sorghum in Maharashtra has shown decreasing trend. As compared to area under *rabi* Sorghum in the year 1960-61, it showed 13.20 per cent decline in area in 2017-18. The area, production and productivity of *rabi* Sorghum in western Maharashtra was 1771 thousand hectares, 1187 thousand tons and 898 kg/ha, respectively in the year 2017-18. Soybean (*Glycine max*) belongs to the family *fabaceae* or *leguminosae* (legume), which also includes peanuts, chickpea, other beans and pulses. The area grown under soybean was 11.39 million hectare with production of 129.47 million tones and yield was 1195 kg per hectare in India in the year 2017-18. The area, production and productivity of soybean in Maharashtra was 3840 thousand hectares, 3886 thousand tons and 1012 kg/ha, respectively in the year 2017-18. Western Maharashtra contributes 09.48 and 16.90 per cent of the states area and production of Soybean in the year 2017-18.

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Chickpea (*Cicer Arietinum* L.) commonly known as Gram or Bengal Gram is the most important pulse crop of India which alone has nearly 68 per cent of the World acreage. area, production and productivity of Gram in Maharashtra was 1847 thousand hectares, 1880 thousand tons and 1018 kg/ha, respectively in the year 2017-18. The area, production and productivity of Gram in western Maharashtra was 412 thousand hectares, 348 thousand tons and 861 kg/ha, respectively in the year 2017-18. (Department of Agriculture, Govt. of Maharashtra, 2017-18).

Objectives

To examine the production performance of major foodgrain crops.

Materials and methods.

i. Specification of Time Periods

To facilitate proper understanding of *rabi* Sorghum, Soybean and Gram cultivation with regard to percentage increase in area, production and productivity of *rabi* Sorghum, Soybean and Gram production, the overall period of 57 years i.e. from 1960-61 to 2016-17 were divided into five sub periods and one overall period as indicated below.

Period-I	:	1960-61 to 1969-70
Period-II	:	1970-71 to 1979-80
Period-III	:	1980-81 to 1989-90
Period-IV	:	1990-91 to 1999-2000
Period-V	:	2000-01 to 2016-17
Overall period	:	1960-61 to 2016-17

ii. Collection of Data

The data of area, production and productivity formed the basis for this study. The district wise yearly data on *rabi* Sorghum, Gram and Soybean crop for the entire period (i.e. 1960–61 to 2016-17) were obtained from the Season and Crop Reports, District Statistical Abstracts, Economic Survey of Maharashtra and Epitomes Published by the Department of Agriculture (Maharashtra) etc.

iii. Analysis of Data

a) Estimation of growth rates in area, production and productivity of *rabi* Sorghum, Gram and Soybean

On going through the available literature on growth rates, it was revealed that, the compound growth rates obtained from exponential trend equation give the best fit to the time-series data and have been used widely for estimating growth rates in area, production and productivity of *rabi* Sorghum, Gram and Soybean. In order to analyze the growth in area, production and productivity of the crops under study, western Maharashtra as a whole, Compound Annual Growth Rates (CAGR) were computed by using the following form of the relationship.

$$Y = ab^t$$

Where,

Y = Area/ Production/ Productivity

a = Constant

b = Regression coefficient

t = Time period in years

CAGR (%) = $(\text{Antilog } b-1) \times 100$

The significance of the estimated compound growth rates were tested with the help of student “t” test.

Results

Districtwise and Periodwise Annual Compound Growth Rates

i. Districtwise and periodwise annual compound growth rates in area, production and productivity of *rabi* sorghum in western Maharashtra

The Periodwise and districtwise annual compound growth rates in area, production and productivity of *rabi* sorghum in western Maharashtra were estimated and presented in Table 1. At the overall period (1960-61 to 2016-17), it is revealed that, the production and productivity of *rabi* sorghum was increased by 0.52 and 0.91 per cent per annum in western Maharashtra. However, the area of *rabi* sorghum was decreased by 0.39 per cent per annum. It indicates that, the production of *rabi* sorghum was increased mainly due to the productivity improvement. The area of *rabi* sorghum decline due to by other competing crops viz; Gram, *rabi* Onion, Wheat etc. The productivity of *rabi* Sorghum was increased due to new improved varieties viz; Phule Vasudha, Phule Anuradha, Phule Chitra etc. released by MPKV Rahuri.

At the overall period, the production of *rabi* Sorghum was increased by both area expansion and productivity improvement, in Jalgaon, Kolhapur and Sangli district of western Maharashtra. The production of *rabi* Sorghum was declined by reduction in area in Nasik and Dhule district of the western Maharashtra.

ii. Districtwise and periodwise annual compound growth rates in area, production and productivity of Soybean in western Maharashtra

The periodwise and districtwise annual compound growth rates in area, production and productivity of Soybean in western Maharashtra were estimated and presented in Table 4.5.

It is observed from the Table 2 that, at overall level the area and production of soybean in western Maharashtra region was significantly increased at the rate of 7.98 and 8.28 per cent respectively per annum. However, productivity of soybean in western Maharashtra region was increased at the rate of 0.28 per cent per annum. Thus it clearly indicates that, the production of soybean was mainly increased due to area expansion and slightly due to productivity improvement. The same trend was observed in all the district of western Maharashtra except Solapur district where productivity was declined by 0.6 per cent per annum.

iii. Districtwise and periodwise annual compound growth rates in area, production and productivity of Gram in western Maharashtra

The periodwise and districtwise annual compound growth rates in area, production and productivity of Gram in western Maharashtra has been estimated and presented in Table 3.

The performance of gram crop in respect of area expansion, production and productivity improvement was quite satisfactory in all the districts of western Maharashtra. The production of gram in all the districts was significantly increased by both area expansion and productivity improvement. The highest increase in the Compound Annual Growth Rate of productivity was noticed in Nandurbar (04.46 %) followed by Jalgaon (02.26 %) and Dhule (02.21 %) district respectively at overall period.

Table 1: Districtwise and periodwise compound annual growth rates in area, production and productivity of *rabi* Sorghum in western Maharashtra

Sr. No.	District	Compound Annual Growth Rate (CAGR) (%)								
		Period-I (1960-61 to 1969-70)			Period-II (1970-71 to 1979-80)			Period-III (1980-81 to 1989-90)		
		Area	Production	Productivity	Area	Production	Productivity	Area	Production	Productivity
1	Nashik	-13.5 ***	-13.09 **	0.46 NS	8.34 ***	27.72 ***	17.83 **	-1.52 NS	-1.25 NS	0.26 NS
2	Dhule	-5.66 ***	-7.19 ***	-1.63 NS	5.14 ***	15.3 ***	9.68 ***	-3.44 ***	-2.19 NS	1.29 NS
3	Jalgaon	-6.5 **	-5.82 NS	0.71 NS	9.82 ***	18.04 ***	7.47 *	2.76 NS	6.05 NS	3.21 NS
4	Pune	-0.59 ***	-2.96 NS	-2.38 NS	2.54 **	17.86 ***	14.93 ***	1.59 ***	3.04 NS	1.42 NS
5	Ahmednagar	-2.19 ***	-2.09 NS	0.1 NS	-0.84 NS	14.09 **	15.06 **	0.58 NS	1.64 NS	1.05 NS
6	Solapur	-0.56 **	-2.3 NS	-1.75 NS	1.03 NS	12.16 NS	11.02 *	-0.62 NS	3.9 NS	4.55 NS
7	Kolhapur	-0.98 NS	4.55 NS	5.42 *	9.79 *	20.56 **	9.91 NS	3.95 **	11.95 ***	7.67 NS
8	Satara	-3.01 ***	-3.55 NS	-0.56 NS	-1.72 NS	9.01 *	10.91 **	-0.33 NS	3.06 NS	3.41 *
9	Sangli	-2.37 ***	-6.19 *	-3.91 NS	-3.55 NS	10.01 NS	14.04 NS	4.78 ***	10.29 *	5.26 NS
10	Nandurbar	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Western Maharashtra	-1.82 ***	-3.1 NS	-1.31 NS	-1.2 NS	12.44 **	13.8 **	0.42 NS	2.98 NS	2.55 NS

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

NA=Not Available NS=Non Significant

Source: Epitome of Agriculture and District Statistical Abstract M.S., Pune

Table 2: Districtwise and periodwise compound annual growth rates in area, production and productivity of *rabi* Sorghum in western Maharashtra

Sr. No.	District	Compound Annual Growth Rate (CAGR) (%)								
		Period-IV (1990-91 to 1999-2000)			Period-V (2000-01 to 2016-17)			Overall (1960-61 to 2016-17)		
		Area	Production	Productivity	Area	Production	Productivity	Area	Production	Productivity
1	Nashik	1.59 NS	8.39 NS	6.7 **	-6.26 ***	-4.4 **	1.98 ***	-3.92 ***	-2.03 ***	1.97 ***
2	Dhule	0.12 NS	2.99 NS	2.86 NS	6.17 ***	9.99 ***	3.6 *	-4.97 ***	-3.35 ***	1.71 ***
3	Jalgaon	2.78 NS	3.13 NS	0.35 NS	0.19 NS	0.37 NS	0.18 NS	0.73 **	2.86 ***	2.12 ***
4	Pune	-0.98 NS	2.61 NS	3.62 NS	-4.54 ***	-3.06 NS	1.56 NS	-0.47 **	0.73 **	1.21 ***
5	Ahmednagar	5.35 NS	1.54 NS	-3.61 NS	-0.84 **	1.81 NS	2.67 NS	-0.47 ***	-0.08 NS	0.39 NS
6	Solapur	-0.63 NS	-0.71 NS	-0.08 NS	-1.19 NS	0.96 NS	2.17 NS	-0.41 NS	0.15 NS	0.56 NS
7	Kolhapur	7.63 ***	6.6 **	-0.96 NS	2.59 ***	3.6 ***	0.98 NS	4.26 ***	8.11 ***	3.7 ***
8	Satara	-0.64 NS	1.65 NS	2.3 NS	0.75 NS	2.66 *	1.9 *	-0.13 NS	0.89 ***	1.02 ***
9	Sangli	1.25 **	7.42 **	6.09 **	1.56 *	1.51 NS	-0.06 NS	1.23 ***	2.95 ***	1.7 ***
10	Nandurbar	NA	NA	NA	-5.02 ***	0.2 NS	5.49 ***	-5.02 ***	0.2 NS	5.49 ***
	Western Maharashtra	0.51 NS	1.69 NS	1.17 NS	-1.3 **	0.58 NS	1.91 NS	-0.39 ***	0.52 *	0.91 ***

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

NA=Not Available NS=Non Significant

Source: Epitome of Agriculture and District Statistical Abstract M.S., Pune

Table 3: Districtwise and periodwise compound annual growth rates in area, production and productivity of Soybean in western Maharashtra

Sr. No.	District	Compound Annual Growth Rate (CAGR) (%)								
		Period-IV (1990-91 to 1999-2000)			Period-V (2000-01 to 2016-17)			Overall (1960-61 to 2016-17)		
		Area	Production	Productivity	Area	Production	Productivity	Area	Production	Productivity
1	Nashik	29.8 ***	37.74 ***	6.11 ***	20.95 ***	16.96 ***	-3.31 **	21.09 ***	22.51 ***	1.17 NS
2	Dhule	28.59 ***	34.89 ***	4.9 *	19.62 ***	19.89 ***	0.22 NS	14.73 ***	15.13 ***	0.35 NS
3	Jalgaon	30.82 **	36.59 **	4.41 NS	14.51 ***	12.56 ***	-1.71 NS	16.64 ***	18.54 ***	1.63 *
4	Pune	-0.55 NS	6.68 NS	7.26 *	24.14 ***	28.15 ***	3.24 *	14.6 ***	19.5 ***	4.28 ***
5	Ahmednagar	43.99 ***	54.2 ***	7.09 *	11.81 ***	8.39 **	-3.06 NS	26.25 ***	26.25 ***	0 NS
6	Solapur	7.24 NS	14.29 **	6.57 NS	24.67 ***	18.97 ***	-4.57 NS	14.47 ***	13.78 ***	-0.6 NS
7	Kolhapur	16.83 ***	22.12 ***	4.53 NS	-1.75 ***	0.85 NS	2.65 **	21.09 ***	22.51 ***	1.17 NS
8	Satara	22.14 ***	33.84 ***	9.58 ***	10.28 ***	9.79 ***	-0.44 NS	12.36 ***	15.05 ***	2.4 ***
9	Sangli	13.22 ***	18.1 ***	4.31 NS	-0.75 NS	-1.3 NS	-0.55 NS	2.33 ***	2.87 **	0.53 NS
10	Nandurbar	NA	NA	NA	23.62 ***	24.56 ***	0.77 NS	18.36 ***	19.49 ***	0.95 NS
	Western Maharashtra	16.43 ***	21.43 ***	4.29 NS	6.32 ***	5.3 ***	-0.95 NS	7.98 ***	8.28 ***	0.28 NS

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

NA=Not Available NS=Non Significant

Source: Epitome of Agriculture and District Statistical Abstract M.S., Pune

Table 3: Districtwise and periodwise compound annual growth rates in area, production and productivity of Gram in western Maharashtra

Sr. No.	District	Compound Annual Growth Rate (CAGR) (%)								
		Period-I (1960-61 to 1969-70)			Period-II (1970-71 to 1979-80)			Period-III (1980-81 to 1989-90)		
		Area	Production	Productivity	Area	Production	Productivity	Area	Production	Productivity
1	Nashik	-2.89 **	-2.61 NS	0.27 NS	4.79 **	10 *	4.98 NS	7.1 ***	8.76 **	1.54 NS
2	Dhule	-2.77 NS	-5.74 NS	-3.06 NS	4.15 NS	7.39 *	3.1 NS	14.54 ***	18.63 ***	3.58 NS
3	Jalgaon	4.37 NS	2.01 NS	-2.26 NS	-0.06 NS	2.06 NS	2.12 NS	23.19 ***	28.55 ***	4.37 NS
4	Pune	-14.28 ***	-11.7 ***	3.02 NS	12.51 ***	10.92 **	-1.42 NS	0.43 NS	2.81 NS	2.35 NS
5	Ahmednagar	-2.38 *	-0.09 NS	2.34 NS	3.7 NS	4.58 NS	0.85 NS	6.5 ***	10.59 **	3.84 NS
6	Solapur	12.28 **	12.77 NS	0.41 NS	4.51 NS	7.97 NS	3.31 NS	0.56 NS	9.87 NS	9.26 NS
7	Kolhapur	8.42 **	17.89 **	8.68 **	22.99 **	23.11 *	0.1 NS	1.39 NS	4.91 NS	3.46 **
8	Satara	-7.58 *	-6.32 NS	1.34 NS	8.13 ***	5.87 NS	-2.1 NS	-0.9 NS	2.68 NS	3.61 NS
9	Sangli	1.72 NS	8.99 NS	7.15 *	8.27 **	10.45 NS	2.01 NS	1.63 NS	5.66 NS	4 NS
10	Nandurbar	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Western Maharashtra	0.1 NS	2.35 NS	2.5 NS	5.96 ***	6.89 *	1.04 NS	5.32 ***	9.78 ***	3.95 *

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

NA=Not Available NS=Non Significant

Source: Epitome of Agriculture and District Statistical Abstract M.S., Pune

Table 3: Districtwise and periodwise compound annual growth rates in area, production and productivity of Gram in western Maharashtra

Sr. No.	District	Compound Annual Growth Rate (CAGR) (%)								
		Period-IV (1990-91 to 1999-2000)			Period-V (2000-01 to 2016-17)			Overall (1960-61 to 2016-17)		
		Area	Production	Productivity	Area	Production	Productivity	Area	Production	Productivity
1	Nashik	3.12 **	6.49 **	3.29 *	2.52 **	4.67 ***	2.09 ***	1.76 ***	3.41 ***	1.63 ***
2	Dhule	2.58 NS	4.15 NS	1.53 NS	9.01 ***	15.33 ***	5.79 ***	2.55 ***	4.81 ***	2.21 ***
3	Jalgaon	3.44 *	4 NS	0.54 NS	2.78 NS	4.88 **	2.04 **	6.11 ***	8.51 ***	2.26 ***
4	Pune	1.48 NS	2.84 NS	1.38 NS	1.38 NS	5.04 ***	3.61 ***	2.49 ***	4.49 ***	1.96 ***
5	Ahmednagar	8.83 ***	10.68 ***	1.71 NS	5.36 ***	6.72 **	1.29 NS	3.4 ***	4.98 ***	1.53 ***
6	Solapur	6.75 ***	11.42 **	4.37 NS	1.8 NS	3.05 NS	1.23 NS	0.67 ***	2.11 ***	1.43 ***
7	Kolhapur	-0.52 NS	0.22 NS	0.73 NS	-3.63 ***	-1.36 NS	2.35 **	2.65 ***	4.47 ***	1.78 ***
8	Satara	8.29 ***	11.63 ***	3.08 NS	2.32 **	5.22 **	2.84 **	2.13 ***	3.51 ***	1.35 ***
9	Sangli	3.58 **	9.19 ***	5.42 **	-3.05 NS	0.93 NS	4.11 NS	1.35 ***	3.34 ***	1.96 ***
10	Nandurbar	NA	NA	NA	5.61 ***	10.32 ***	4.46 ***	5.61 ***	10.32 ***	4.46 ***
	Western Maharashtra	4.42 ***	6.61 ***	2.81 **	2.96 ***	5.49 ***	2.46 ***	2.51 ***	4.3 ***	1.75 ***

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

NA=Not Available NS=Non Significant

Source: Epitome of Agriculture and District Statistical Abstract M.S., Pune

The study revealed that, at overall period the area, production and productivity of Gram in western Maharashtra region were significantly increased at the rate of 2.51, 04.30 and 01.75 per cent per annum. Thus it clearly indicates that, the production of Gram was increased due to both area expansion and productivity improvement. From the above discussion, it could be concluded that, there existed wide variation in the performance of *rabi* Sorghum, Soybean and Gram crops in terms of changes in area, production and productivity among the districts over a period of time. The results are in line with the reports of Farkade (2008) [3], Sharma (2013) [6], Nikam (2013) [5], Solanki *et al.* (2013) [7], Agarwal (2014) [2] and Kumar *et al.* (2019) [4].

Conclusion

The production of *rabi* Sorghum increased over the years due to only productivity improvement, production of Soybean increased significantly due to only area expansion and production of Gram increased significantly due to both area expansion and productivity improvement.

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