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Publication Division

Directorate of Economics and Statistics
Department of Agriculture & Farmers Welfare
Ministry of Agriculture & Farmers Welfare
Government of India
103, F-Wing, Shastri Bhawan,
New Delhi-110 001
Phone: 23385988
(Email: publication.des-agri@gov.in)

Soft copy of the journal is also available at:
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For article submission, please refer to 'Note to Contributors'.
NAAS Score: 4.53 out of 6

VOL. LXXIX July, 2022 No. 04

CONTENTS

Dynamics of Maize Production across Major Producing States of India

SANSKALA PATEL[1], HARI OM SHARMA[2], N. KHAN[3] AND HARSHITA LAXKAR[4]

Abstract

National Food Security Mission has been undertaken by Government of India to increase maize production in the country to meet demand of food, feed for livestock and poultry, and industrial raw material, domestic as well as global demand. In this article, we have analysed the fluctuation, trend and growth rate in area, production and productivity of maize during the study period 2000-01 to 2019-20 with percent contribution of area, yield and their interaction effect towards production of maize across major producing states of India. The production of maize was found to have increased by 16250.96 thousand tonnes with fluctuation of 28.45% during the study period due to yield effect (48.51%), followed by area effect (31.22%) and their interaction effect (20.30%). It is also observed that area, production and yield of maize increased in all the major producing states except Andhra Pradesh, Uttar Pradesh and Rajasthan, where area under maize was found to have decreased at a highly significantly rate during the period under study. Hence, efforts should be made to find the reasons behind the decreasing area in these three prominent maize producing states and increase the extent of value addition for maize production.

Keywords: *Maize production, area, interaction effects, India.*

1. Introduction

Maize (Zea mays L.) is the third most important cereal crop in India after rice and wheat. It is the most versatile crop with wider adaptability to varied agro-climatic conditions and has highest genetic yield potential among cereals. Maize originated in Mexico and Central America and belongs to the tribe Maydae of the family Poaceae. Various studies reveal that maize crop was a significant crop in Mexico about 5000 years ago. Maize, known as queen of cereals, also called corn is the only grain crop with many types like normal yellow/white grain, sweet corn, baby corn, popcorn, quality protein maize (QPM), waxy corn, high amylase corn, high oil corn, fodder maize, etc. In addition to being a staple food for human beings and quality feed for animals, maize serves as basic raw material as an ingredient to thousands of industrial products that include starch, oil, protein, beverages, food, sweet, cosmetic, film, textile, paper industries, etc. which use maize directly/indirectly and provide large opportunity for value addition. The area under maize cultivation in the world was 193.7 million hectares with total production of 1147.7 million tonnes and an average yield of 5.75 t/ha (FAOSTAT, 2020). Maize is grown throughout the world with USA (31.36%), China (22.71%), Brazil (8.88%), European Union (5.67%), Argentina (4.35%), Ukraine (3.09%), India (2.53%), Mexico (2.17%), South Africa (1.22%) and Russia (1.22%) being the major producing countries in the world. Maize is principally grown in two seasons, Kharif and Rabi. Kharif maize represents around 83% of maize area in India, while rabi maize corresponds to 17% of the area. Over 70% of kharif maize area is grown under rainfed condition with a prevalence of many biotic and abiotic stresses. The stress prone ecology contributes towards lower productivity of kharif maize (2706 kg/ha) as compared to rabi (4436 kg/ha), which is predominantly grown under assured ecosystem. There is a wide variability in production across states and also varies over space of time.

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Article Received: 03 June, 2022
Editorial Decision: 31 August, 2022

The total area under maize in India in 2019-20 was 9720 thousand ha with a production of 28640 thousand tonnes, with an average yield of 3000 kg/ha. Among all the states, percent share of production in Karnataka (13.83%) was found to be maximum followed by Madhya Pradesh (13.65%), Tamil Nadu (8.21%), Maharashtra (7.82%), Andhra Pradesh (7.61%), Bihar (7.02%), Uttar Pradesh (6.22%), West Bengal (5.73%) and Rajasthan (4.22%).

National Food Security Mission (NFSM) was launched in 2007-08 to increase the production, area expansion and productivity of food grains (including wheat, rice and coarse cereals) in India. In 2019-20, it was decided to continue the programme with new targets to achieve 2 million tonnes nutri-cum-coarse cereals with an additional objective to enhance post harvest value addition at farm gate for better price realization to farmers through efficient market linkages. Under NFSM-Coarse Cereals, maize is being implemented in 237districts of 26 states & 2 UTs *viz.*; Jammu & Kashmir and Ladakh have been given flexibility to implement the programme.

1.1 Objectives of the study

The present study has been taken up with the following specific objectives;

1. To determine variation in area, production and productivity of maize.

2. To analyse trend and growth of area, production and productivity of maize.

3. To evaluate area, yield and interaction effects towards production of maize across states of the country.

2. Data sources and methodology

The study was confined to nine major maize producing states of India, *viz.*, Karnataka, Madhya Pradesh, Tamil Nadu, Maharashtra, Andhra Pradesh, Bihar, Uttar Pradesh, West Bengal and Rajasthan having a share of 74% in India's maize production basket. The secondary data for a period of 20 years *viz.*; 2000–01 to 2019–20 has been collected from various published records of Directorate of Economics and Statistics, MoA&FW and Agricultural Statistics at a Glance. The triennium average of first and last three years has been considered as the base year and the current year, respectively, for the study. The collected data was analysed using various statistical and econometrics tools such as absolute change, relative change, coefficient of variation, trend and compound growth rate. The following decomposition model has been used to analyse area effect, yield effect and interaction effect towards production of maize.

Change in Production = Yield effect + Area effect + Interaction effect

$$\text{Area effect} = \frac{(A_t - A_0)Y_0}{P_t - P_0} \times 100$$

$$\text{Yield effect} = \frac{(Y_t - Y_0)A_0}{P_t - P_0} \times 100$$

$$\text{Interaction effect} = \frac{(A_t - A_0)\,(Y_t - Y_0)}{P_t - P_0} \times 100$$

where,

A_0 = Triennium average of area in base year (average of the first triennium years *i.e.*, 2000-01 to 2002-2003),

P_0 = Triennium average of production in base year,

Y_0 = Triennium average of yield in base year,

A_t = Triennium average of area in current year (average of the last triennium *i.e.*, 2017-18 to 2019-20),

P_t = Triennium average of production in current year,

Y_t = Triennium average of yield in current year.

2.1 Trend and growth analysis

Trend

Linear equation $Y = a + bX$

$$a = \overline{Y} - b\overline{X}$$

where,
y = Dependent variable
X = Independent variable
a = Constant
b = Regression coefficient

Compound growth rate

CGR = (Antilog of b – 1) 100

3. Results and discussion

Concentration, fluctuation and growth in area, production and productivity of maize in major maize producing states of India has been analysed for the study. Area, yield and their interaction effect over production of maize has also been determined.

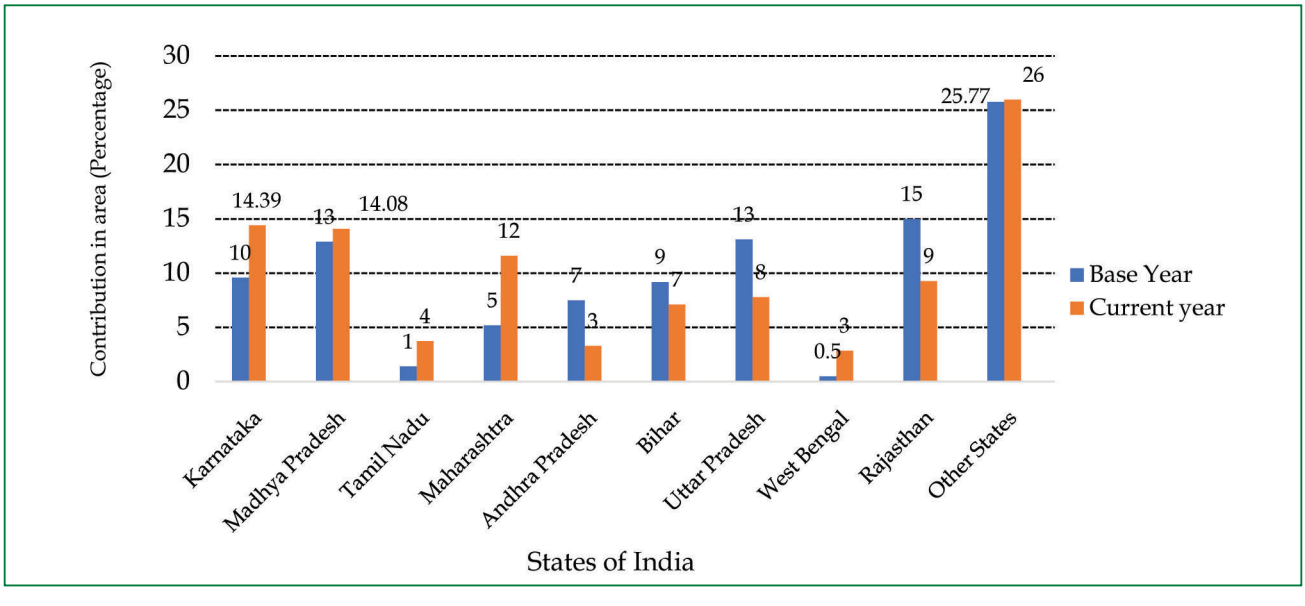
3.1 Area

The concentration of area, fluctuation and growth across states have been analysed during the period under study.

3.1.1 Concentration of area

Analysis of concentration of area under maize across major maize producing states of India reveals that the area increased in Karnataka (4.39 percent), Madhya Pradesh (1.08 percent), Tamil Nadu (3 percent), Maharashtra (7 percent), West Bengal (2.5 percent) and other states (0.23 percent) in the current year as compared to base year. However, the concentration of area was found to decrease in Andhra Pradesh (-4 percent), Bihar (-2 percent), Uttar Pradesh (-5 percent) and Rajasthan (-6 percent) in the current year over the base year.

Figure 1: Contribution in Area of Maize across States of India (2000-01 to 2019-20)



Source: Directorate of Economics and Statistics, MoA&FW.

3.1.2 Fluctuation in area

Absolute change, relative change and coefficient of variance were determined to know the fluctuation in maize area over time (Table 1). The area under maize was found to increase by 41.86 percent (2766.40 thousand ha) from 6609.33 thousand ha (in the base year) to 9375.73 thousand ha (in the current year) with a fluctuation of 11.93 percent during the period of study.

TABLE 1: FLUCTUATION IN AREA OF MAIZE ACROSS STATES OF INDIA (2000-01 TO 2019-20)

(000'ha)

States	Base year	Current year	Absolute change	Relative change (%)	SD	CV (%)
Karnataka	632.83	1348.83	716.00	113.14	288.17	26.20
Madhya Pradesh	851.37	1320.00	468.63	55.04	190.30	19.50
Tamil Nadu	91.87	348.36	256.49	279.20	91.55	36.88
Maharashtra	342.00	1086.84	744.84	217.79	302.79	39.99
Andhra Pradesh	494.00	307.33	-186.67	-37.79	229.30	42.76
Bihar	606.13	665.64	59.51	9.82	39.38	6.00
Uttar Pradesh	864.73	729.00	-135.73	-15.70	77.65	9.80
West Bengal	32.10	266.83	234.73	731.25	77.34	67.57
Rajasthan	990.97	868.22	-122.75	-12.39	87.08	8.82
Other States	1703.33	2434.67	731.34	42.94	359.24	17.06
All India	**6609.33**	**9375.73**	**2766.40**	**41.86**	**986.94**	**11.93**

Source: Directorate of Economics and Statistics, MoA&FW.

The area under maize in the current year when compared to the base year was found to have increased in all major maize producing states except Andhra Pradesh (-37.79%), Uttar Pradesh (-15.70%) and Rajasthan (-12.39%). The maximum increase in area under maize was found in West Bengal (731.25%), followed by Tamil Nadu (279.20%), Maharashtra (217.79%), Karnataka (113.14%), Madhya Pradesh (55.04%), other states (42.94%) and Bihar (9.82%). The fluctuation in area under maize was observed to be maximum in West Bengal (67.57%), followed by Andhra Pradesh (42.76%), Maharashtra (39.99%), Tamil Nadu (36.88%), Karnataka (26.20%), Madhya Pradesh (19.50%), other states (17.06%), Uttar Pradesh (9.80%), Rajasthan (8.82%) and Bihar (6.00%) during the period under study.

3.1.3 Trend and growth in area

Compound growth rate has been calculated in order to determine the rate of change in area under maize area each year. The area under maize is found to increase by 79.41 thousand ha/year with an annual growth of 2.02 percent during the period under study (Table 2).

TABLE 2: TREND AND GROWTH IN AREA OF MAIZE ACROSS STATES OF INDIA (2000-01 TO 2019-20)

States	Trend value (b)	S.E. (b)	Compound growth rate (% per year)
Karnataka	44.33**	4.76	4.65
Madhya Pradesh	25.09**	4.74	2.40
Tamil Nadu	14.59**	1.22	7.39
Maharashtra	49.27**	3.26	7.59

States	Trend value (b)	S.E. (b)	Compound growth rate (% per year)
Andhra Pradesh	-22.22**	7.48	-4.97
Bihar	5.12**	1.00	0.79
Uttar Pradesh	-10.47**	1.86	-1.28
West Bengal	12.04**	1.2	11.89
Rajasthan	-9.49**	2.65	-0.99
Other States	52.77**	7.07	2.53
All India	**79.41****	**6.83**	**2.02**

Source: Directorate of Economics and Statistics, MoA&FW.
Note: ** Significant at 1% level, * Significant at 5% level

The growth in area under maize was found to be positive in all the states except Andhra Pradesh (-4.97%), Uttar Pradesh (-1.28%) and Rajasthan (-0.99%). The growth in area under maize was found to be maximum in West Bengal (11.89%/year), followed by Maharashtra (7.59%/year), Tamil Nadu (7.39%/year), Karnataka (4.65%/year), other states (2.53%/year), Madhya Pradesh (2.40%/year) and Bihar (0.79%/year) during the period under study. The growth of area was found be positive and highly significant in all the states of India.

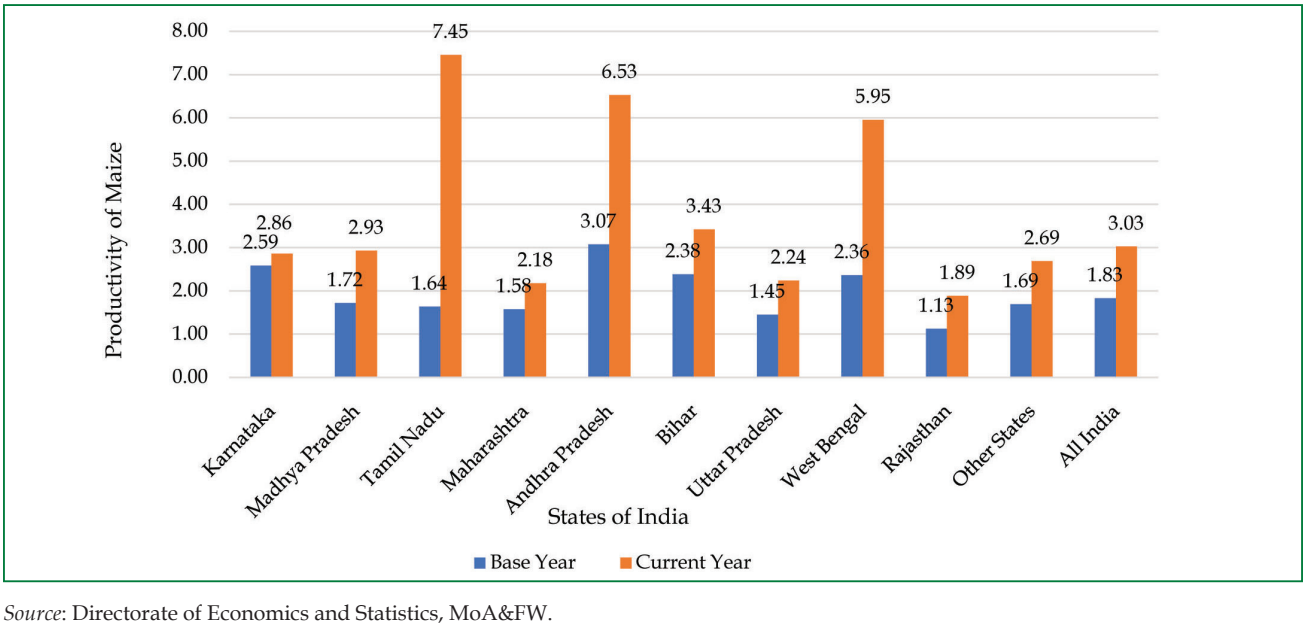
3.2 Productivity

The concentration of productivity, its fluctuation and growth across states has been analysed during the period under study.

3.2.1 Concentration of productivity

The productivity (t/ha) was found to have increased in the current year compared to the base year in all the states of India. The maximum increase was observed in the state of Tamil Nadu (5.81 t/ha), West Bengal (3.59 t/ha) and Andhra Pradesh (3.46 t/ha). This was mainly due to the adoption of improved technology and use of hybrids seeds.

Figure 2: Productivity (t/ha) of Maize across States of India (2000-01 to 2019-20)



Source: Directorate of Economics and Statistics, MoA&FW.

3.2.2 Fluctuation in productivity

Absolute change, relative change and coefficient of variance were calculated to determine the fluctuation in productivity of maize over time (Table 3). The productivity of maize was found to have increased by 65.07 percent (1.19 t/ha); from 1.83 t/ha (in the base year) to 3.03 t/ha (in the current year) with a fluctuation of 17.99 percent during the period of study.

TABLE 3: FLUCTUATION IN PRODUCTIVITY OF MAIZE ACROSS STATES OF INDIA (2000-01 TO 2019-20)

(in t/ha)

States	Base year	Current year	Absolute change	Relative change (%)	SD	CV (%)
Karnataka	2.59	2.86	0.27	10.57	0.36	13.02
Madhya Pradesh	1.72	2.93	1.21	70.57	0.62	33.56
Tamil Nadu	1.64	7.45	5.82	355.02	2.24	53.59
Maharashtra	1.58	2.18	0.60	38.25	0.52	23.66
Andhra Pradesh	3.07	6.53	3.46	112.38	1.44	29.73
Bihar	2.38	3.43	1.04	43.66	0.57	20.34
Uttar Pradesh	1.45	2.24	0.79	54.38	0.33	19.71
West Bengal	2.36	5.95	3.59	151.86	1.22	32.16
Rajasthan	1.13	1.89	0.76	67.23	0.38	24.81
Other States	1.69	2.69	1.00	58.81	0.45	21.89
All India	**1.83**	**3.03**	**1.19**	**65.07**	**0.43**	**17.99**

Source: Directorate of Economics and Statistics, MoA&FW.

The productivity under maize was found to increase in all major maize producing states. The maximum increase in productivity under maize was found in Tamil Nadu (355.02%), followed by West Bengal (151.86%), Andhra Pradesh (112.38%), Madhya Pradesh (70.57%), Rajasthan (67.23%), other states (58.81%), Uttar Pradesh (54.38%), Bihar (43.66%), Maharashtra (38.25%) and Karnataka (10.57%) in the current year as compared to the base year. The fluctuation in productivity of maize was observed maximum in Tamil Nadu (53.59%), followed by Madhya Pradesh (33.56%), West Bengal (32.16%), Andhra Pradesh (29.73%), Rajasthan (24.81%), Maharashtra (23.66%), other states (21.89%), Bihar (20.34%), Uttar Pradesh (19.71%) and Karnataka (13.02%) during the period under study (Table 3).

3.2.3 Trend and growth in productivity

Compound growth rate was calculated in order to determine the rate of change in productivity of maize each year. The productivity of maize increased by 0.07 thousand tonnes/year with an annual growth of 2.91 percent during the period under study (Table 4).

TABLE 4: TREND AND GROWTH IN PRODUCTIVITY OF MAIZE ACROSS STATES OF INDIA (2000-01 TO 2019-20)

States	Trend value (b)	S.E. (b)	Compound growth rate (% per year)
Karnataka	0.01	0.014	0.58
Madhya Pradesh	0.07**	0.018	3.46
Tamil Nadu	0.33**	0.045	9.41
Maharashtra	0.04	0.018	1.91

States	Trend value (b)	S.E. (b)	Compound growth rate (% per year)
Andhra Pradesh	0.22**	0.022	4.91
Bihar	0.08**	0.014	2.65
Uttar Pradesh	0.04**	0.008	2.59
West Bengal	0.19**	0.017	5.26
Rajasthan	0.03*	0.012	2.31
Other States	0.06**	0.010	3.09
All India	**0.07****	**0.006**	**2.91**

Source: Directorate of Economics and Statistics, MoA&FW.
Note: ** Significant at 1% level, * Significant at 5% level

The trend and growth in productivity of maize were found to be positive and increasing in all the states across the country. Tamil Nadu (9.41%/year), followed by West Bengal (5.26%/year), Andhra Pradesh (4.91%/year), Madhya Pradesh (3.46%/year), other states (3.09%/year), Bihar (2.65%/year) and Uttar Pradesh (2.59%/year) showed highly significant growth in production of maize, while in Rajasthan (2.31%/year), it was significant. In Maharashtra (1.91%/year) and Karnataka (0.58%/year), the growth in productivity was non-significant during the period under study.

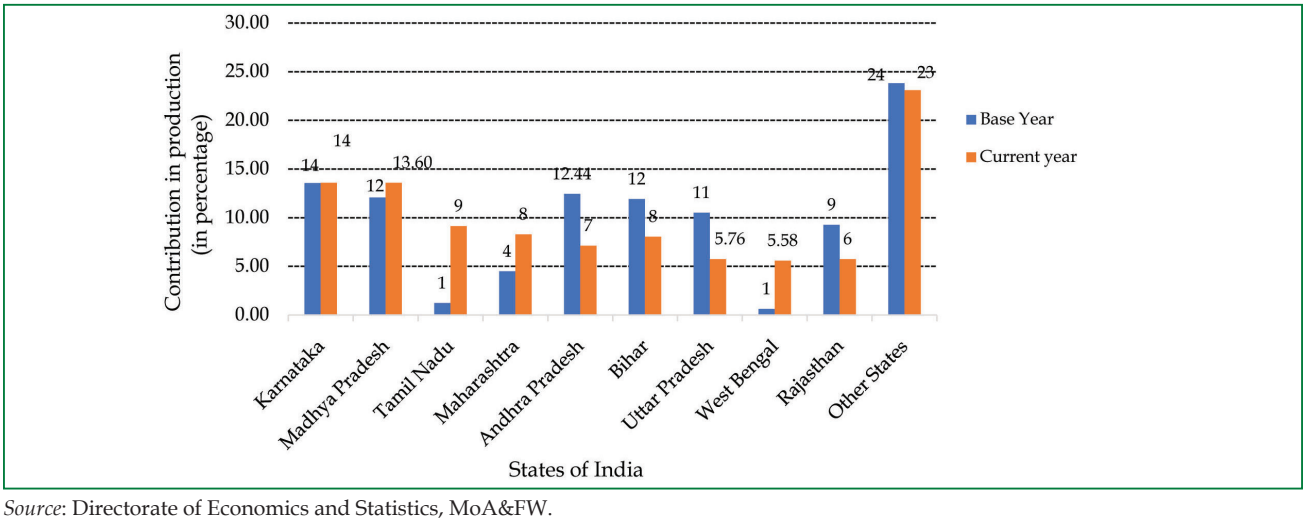
3.3 Production

The concentration of production, its fluctuation and growth across states of India has been analysed during the period under study.

3.3.1 Concentration of production

The production of maize was found to have increased in the current year when compared to the base year in the states of Madhya Pradesh (1.60 percent), Tamil Nadu (8 percent), Maharashtra (4 percent), and West Bengal (4.58 percent). Over the base year, the concentration of production in Andhra Pradesh (-5.44 percent), Bihar (-4 percent), Uttar Pradesh (-5.24 percent), Rajasthan (-3 percent) and other states (-1 percent) was found to have decreased. However, the production of maize in Karnataka was found to have remained unchanged *i.e.*, 14 percent in both the current and the base year.

Figure 3: Contribution in production of Maize across States of India (2000-01 to 2019-20)



Source: Directorate of Economics and Statistics, MoA&FW.

3.3.2 Fluctuation in production

Absolute change, relative change and coefficient of variance were calculated to determine the fluctuation in production of maize over time (Table 5). The production of maize was found to have increased by 134.10 percent (16250.96 thousand tonnes) from 12118.37 thousand tonnes (in the base year) to 28369.33 thousand tonnes (in the current year) with a fluctuation of 28.45 percent during the study period.

TABLE 5: FLUCTUATION IN PRODUCTION OF MAIZE ACROSS STATES OF INDIA (2000-01 TO 2019-20)

(000't)

States	Base year	Current year	Absolute change	Relative change (%)	SD	CV (%)
Karnataka	1643.47	3857.85	2214.38	134.74	966.36	31.28
Madhya Pradesh	1464.23	3859.63	2395.40	163.59	1031.22	54.36
Tamil Nadu	149.83	2592.06	2442.23	1629.96	902.61	75.16
Maharashtra	544.70	2352.30	1807.60	331.85	876.99	50.71
Andhra Pradesh	1508.00	2020.82	512.82	34.01	874.49	36.57
Bihar	1445.10	2282.52	837.42	57.95	465.84	25.16
Uttar Pradesh	1275.13	1634.88	359.75	28.21	223.84	17.04
West Bengal	76.67	1584.05	1507.39	1966.16	505.70	97.80
Rajasthan	1122.60	1632.27	509.67	45.40	370.63	24.86
Other States	2888.63	6552.94	3664.30	126.85	1687.02	37.98
All India	**12118.37**	**28369.33**	**16250.96**	**134.10**	**5667.33**	**28.45**

Source: Directorate of Economics and Statistics, MoA&FW.

The production of maize was found to have increased in all major maize producing states in the country. The maximum increase in production was found in West Bengal (1966.16%), followed by Tamil Nadu (1629.96%), Maharashtra (331.85%), Madhya Pradesh (163.59%), Karnataka (134.74%), other states (126.85%), Bihar (57.95%), Rajasthan (34.10%) and Uttar Pradesh (28.21%). The fluctuation in production of maize was observed to be maximum in West Bengal (97.80%), followed by Tamil Nadu (75.16%), Madhya Pradesh (54.36%), Maharashtra (50.71%), other states (37.98%), Andhra Pradesh (36.57%), Karnataka (31.28%), Bihar (25.16%), Rajasthan (24.86%) and Uttar Pradesh (17.04%) during the period under study.

3.3.3 Trend and growth in production

Compound growth rate was calculated in order to determine the rate of change in the production of maize each year. The production of maize increased by 930.78 thousand tonnes/year with an annual growth of 4.99 percent during the period under study (Table 6).

TABLE 6: TREND AND GROWTH IN PRODUCTION OF MAIZE ACROSS STATES OF INDIA (2000-01 TO 2019-20)

States	Trend value(b)	S.E. (b)	Compound growth rate (% per year)
Karnataka	132.05**	22.66	5.25
Madhya Pradesh	129.58**	27.47	5.94
Tamil Nadu	137.92**	15.37	17.52
Maharashtra	123.19**	19.44	9.64
Andhra Pradesh	-10.54	34.75	-0.30

States	Trend value(b)	S.E. (b)	Compound growth rate (% per year)
Bihar	64.25**	10.73	3.46
Uttar Pradesh	16.25	8.05	1.27
West Bengal	74.26**	9.97	17.78
Rajasthan	15.52	14.3	1.29
Other States	248.32**	33.05	5.70
All India	**930.78****	**53.39**	**4.99**

Source: Directorate of Economics and Statistics, MoA&FW.
Note: ** Significant at 1% level, * Significant at 5% level

The growth in production of maize was found to be positive in all the states of the country except Andhra Pradesh (-0.30%). The growth rate was found to be maximum in West Bengal (17.78% per year), followed by Tamil Nadu (17.52% per year), Maharashtra (9.64% per year), Madhya Pradesh (5.94% per year), other states (5.70% per year), Karnataka (5.25% per year) and Bihar (3.46% per year). Also the production growth was found to be positive and highly significant in all these states. However, Andhra Pradesh (-0.30% per year), Rajasthan (1.29%per year) and Uttar Pradesh (1.27% per year) had non-significant growth during the period under study.

3.4 Area, yield and their interaction effect on production

The yield effect (48.51%) contributed more than the area effect (31.22%) and interaction effect (20.30%) to increase production of maize (16250.96 thousand tonnes) in India during the period under study (Table 7).

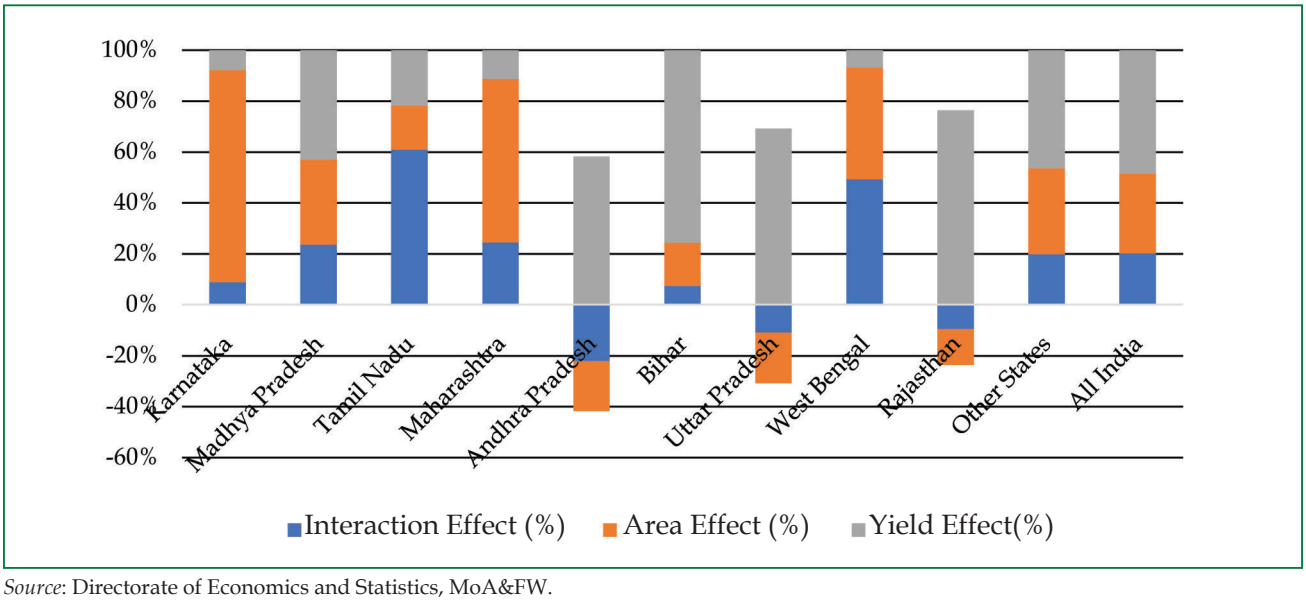
TABLE 7: AREA, YIELD AND INTERACTION EFFECTS (%) ON PRODUCTION OF MAIZE ACROSS STATES OF INDIA (2000-01 TO 2019-20)

States	Area Effect	Yield Effect	Interaction Effect	Absolute change in Production (000′ t)
Karnataka	83.67	7.90	8.93	2214.38
Madhya Pradesh	33.62	43.15	23.75	2395.40
Tamil Nadu	17.21	21.77	60.79	2442.23
Maharashtra	64.95	11.41	24.85	1807.60
Andhra Pradesh	-111.91	331.61	-125.30	512.82
Bihar	16.94	75.12	7.38	837.42
Uttar Pradesh	-54.81	190.68	-29.93	359.75
West Bengal	36.81	5.67	41.49	1507.39
Rajasthan	-27.18	147.25	-18.24	509.67
Other States	33.80	46.30	19.88	3664.30
All India	**31.22**	**48.51**	**20.30**	**16250.96**

Source: Directorate of Economics and Statistics, MoA&FW.

The area effect was found to be prominent in Karnataka (83.67%), followed by Maharashtra (64.95%). The yield effect was found to be prominent in Andhra Pradesh (331.61%), Uttar Pradesh (190.68%), Rajasthan (147.25%), Bihar (75.12%), other states (46.30%) and Madhya Pradesh (43.15%) while the interaction effect was found to be maximum in Tamil Nadu (60.79%), followed by West Bengal (41.49%). Inspite of maximum area effect in Karnataka across major maize producing states of the country, the production of maize was found to have increased by 2214.38 thousand tonnes only.

Figure 4: Area, Yield and Interaction Effects (%) on Production of Maize across States of India (2000-01 to 2019-20)



Source: Directorate of Economics and Statistics, MoA&FW.

Thus in the country, area as well as yield effect was found to be the most important factor. The increase in maize production in Karnataka and Maharashtra was mostly due to area effect while the increase in production in Madhya Pradesh, Andhra Pradesh, Bihar, Uttar Pradesh, Rajasthan and other states was primarily due to yield effect (Figure 4).

4. Conclusion and suggestions

- National Food Security Mission has been undertaken by the Government of India to increase coarse cereal production in the country to meet demand of food, feed for livestock and poultry, and industrial raw material. Initiatives taken under NFSM have proved beneficial in case of maize as the production and productivity increased in major maize producing states of India.
- Production was found to have increased by 16250.96 thousand tonnes with fluctuation of 28.45 % in India as well as all the major maize growing states of the country except Andhra Pradesh, Uttar Pradesh and Rajasthan, where area was found to have decreased at highly significant rate during the period under study.
- The increase in production of maize was found mainly due to yield effect (48.51%), area effect (31.22%) and their interaction effect (20.30%). Thus the production of crop increased through increase in the yield as well as enhancement in area under maize during the study period.
- Interaction effect was found to dominant over the area and yield effect in the state of Tamil Nadu. The state has emerged as a new destination of maize production in the country through adoption of improved technology

(*viz.,* demonstration of inter-cropping and distribution of hybrid seeds/HYVs), with an annual growth rate of 17.52% during the period under study.

- Adoption of improved cultivars is common in non-traditional areas (*viz.,* Tamil Nadu) and seasons but low in traditional areas (*viz.*, Uttar Pradesh, Rajasthan). Lack of short-duration hybrids, unsuitable environment, and absence of a strong seed sector impose major obstacles to adoption of hybrids in traditional maize growing areas. This is the main reason for negative growth in area of Rajasthan and Uttar Pradesh (Joshi *et al.,* 2005).

- Hence, it can be suggested that as the production of maize crop at the state level has increased, efforts should be made to increase the extent of value addition for maize production, *viz.*, corn starch, maize cob meals, high fructose corn syrup, etc. through establishment of processing plants in these major maize producing states. Efforts should be made to strengthen the existing storage and processing technology in these areas. In the states where area coverage at present is poor *viz.*, Andhra Pradesh, Uttar Pradesh and Rajasthan, efforts should be made to promote the adoption of improved cultivars, intercropping, etc. A comprehensive study may be undertaken by NFSM, Agriculture Universities to identify the problem faced by them in cultivation of maize.

- Efforts are required to identify the constraints in achieving desired production level in maize growing states of the country. The Central and State Government are required to provide the various initiatives to maize growers (*viz.,* distribution of hybrid seeds, cluster demonstration of improved packages, to promote the inter-cropping for all states) so as to enhance their income.

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