An Economic Analysis of Maize Production across Major Producing States of India

ABSTRACT

National Food Security Mission has been taken by Government of India to increase coarse cereal Maize production in the country to meet food, feed for livestock and poultry and industrial raw material, domestic as well as global demand. The traditional and modern industrial uses have made it one of the fastest growing cash crops in the world. Considering its global as well as national importance, In this article, we have analysed the relative change, growth rate and CDVI (cuddy-della valle-index) in cost, returns, profitability and break-even production of maize during the study period 2000-01 to 2018-19 of Maize across major Maize growing states of India. The study found that Cost A_1, cost A_2, cost B_1, cost B2, cost C_1 and cost C_2 of maize was found to be increased higher in Madhya Pradesh with highly significant annual growth rate during the study period than other states. These cost concepts showed low to medium instability for almost all the leading states. The findings revealed that maize was more profitable in Bihar, followed by Andhra Pradesh and Karnataka, owing to higher net income and B:C ratios than in other states. Bihar states had higher differential yield and a greater discrepancy between the cost of production and the minimum support price. In some states, actual yields were lower than break-even, and production costs were greater than the minimum support price, resulting in losses for maize growers. The study's findings would help policymakers and governments devise appropriate development strategies and effective policies for less lucrative states.

KEY WORDS: Profitability, Cost of production, cuddy-della valle-index, *Break-even yield,*

1. INTRODUCTION

"Maize (Zea mays L.) is the most widely distributed crop of the world being grown in tropical, subtropical and temperate regions under irrigated to semi-arid conditions. It is the most versatile crop with wider adaptability to varied agro-climatic conditions and has highest genetic yield potential among the cereals" (Parihar et al., 2011). **"**In India, Maize is third most important cereal crop after rice and wheat. 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. 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. have been made using Maize directly/indirectly and provide large opportunity for value addition. It is primarily used for feed (64%) followed by human food (16%), industrial starch and beverage (19%) and seed (1%). Thus, Maize has attained an important position as industrial crop because 83% of its produce is used in starch and feed industries (Source: DMR). The maize grain contains 9 to 11% protein, 3.6% fat, 2.7% fibre, 66.2% other carbohydrates and 1.5% minerals" (NIN, 2002).

"The Government of India launched production-oriented programmes from time to time achieve growth rates in maize production and to narrow down the gaps between demand and supply. In 2007-08, the GOI of India launched National Food Security Mission (NFSM) to increase the production, area expansion and productivity of food grains (including wheat, Rice and Coarse Cereals-Maize). In 2019-20, it was decided to continue the programme with new targets to achieve 2 million tons 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" (Parihar et al., 2011).

"Maize production is important for global trade, agricultural economies and for food security worldwide. In world, top ten major maize producing countries with the share of 69.76 per cent of area and 83.15 per cent of production, namely these countries are USA followed by China, Brazil, European Union, Argentina, Ukraine, India, Mexico, South Africa and Russia" (Joshi et.al, 2005).

"In India there are six major maize producing states: Karnataka, Bihar, Andhra Pradesh, Madhya Pradesh, Rajasthan, and Uttar Pradesh, which account for about 60.61 per cent of area and 63.02 Per

cent of production share. India also earns sizeable foreign exchange through the export of many maize products. India has exported 370.07 thousand tonnes of maize to other countries and earned Rs 1019.29 Crore, and also imported 458.51 thousand tonnes of maize from other countries with the total cost of Rs 843.20 Crore in 2019-20" (Indiastate.com, 2021). The unprecedented growth of maize in India has been attributed to its increasing use in poultry, increasing interest of the consumers in nutri-rich products (Joshi *et.al*, 2005 and Kumar, Srinivas, & Sivaramane, 2013).

"The cultivation of maize has assumed critical importance due to its diversified use as food, feed and fodder. The high carotene content of yellow maize is considered to be very useful in importing yellow colour to egg yolk and yellow tinge to the milk. No other concentrate is yet known to substitute maize in this respect. On the other hand, returns over cost of cultivation are necessary not only for the farmer's survival but also for the long-term reinvestment in agriculture. The continuous flow of income on the farm helps in increasing investment in capital goods and thus encourages more investment in productive inputs for increasing production. The traditional and modern industrial uses have made it one of the fastest growing cash crops in the world" (Kumar et al. 2013). Thus, current study on economic analysis (cost of cultivation, return & profitability) of maize with varied income measures in it predominate states of India would contribute in the betterment of farmers.

2. METHODOLOGY

2.1 Sources of data

The study confined to the six major maize producing states of India. Viz., Karnataka, Madhya Pradesh, Andhra Pradesh, Bihar, Uttar Pradesh and Rajasthan contributed 63.02% share in India's Maize production basket. The data was secondary in nature and collected for a period of 19 years viz. from 2000–01 to 2018–19. The data have been collected from various published records of Directorate of Economics and Statistics, Ministry of Agriculture and Farmers Welfare, and Agricultural Statistics at a Glance.

2.2 Method of analysis:

The triennium average of first and last three years have been considered as the base year and the current year, respectively for the study. The collected data have been analysed through various statistical and econometrics tools such as relative change, CDVI, and simple growth rate.

Relative change (RC):

$$\text{Relative change } (\%) = \frac{(\text{Current year} - \text{Base year})}{(\text{Base year})} \text{x } 100$$

Where,

Base year (BY) = Triennium average for cost and return (average of the first triennium years i.e., 2000-01 to 2002-2003),

Current year (CY) = Triennium average for cost and return (average of the last triennium years i.e., 2016-17 to 2018-19),

Linear growth rate (LGR):

Linear growth rate shows over a single period of time. It is also called simple growth rate.

$$(\text{SGR}\%) = \frac{b}{\bar{y}} \text{ x } 100$$

Where, = Mean of the dependent variable

Cuddy-Della Valle Index (CDVI):

The index was originally developed by John Cuddy and Della Valle for measuring the instability in time series data (Cuddy and Della, 1978). Cuddy-Della Valle is a modification of the co- efficient of variation.

This accommodates trend present in the data, which is commonly found in economic time series data. It is also superior over the scale-dependent measures like standard deviation. It is calculated as follows:

$$\text{Cuddy} - \text{Della Valle Index}\ (\%)\ = \text{C.V.} * \sqrt{(1 - R^2)}$$

where, C.V. = Co-efficient of variation

R^2=Co-efficient of multiple determination.

The ranges of CDVI (Sihmar, 2014) are given as follows:

Low instability = 0 to 15

Medium instability = 15 to 30

High instability = more than 30.

Cost concepts:

Cost A_1: All actual expenses in cash and kind incurred in production by the owner-operator.

Cost A_2: Cost A_1 + rent paid for lease in the land.

Cost B_1: Cost A_2 + interest on the value of owned fixed capital assets (excluding land)

Cost B_2: Cost B_1 + rental value of owned land + rent paid for lease in the land.

Cost C_1: Cost B_1 + imputed value of family labour.

Cost C_2: Cost B_2 + imputed value of family labour.

$$\textbf{Total cost}\ (\textbf{Rs./q}) = \frac{\textbf{Total cost}\ (\textbf{Rs./ha})}{\textbf{Actual yield}\ (\textbf{Q/ha})}$$

Differential yield (q/ha) = Actual yield - Break even yield.

$$\textbf{Cost of production}\ \left(\frac{\textbf{q}}{\textbf{ha}}\right) = \frac{\textbf{Total cost} - \textbf{Value of by product}}{\textbf{yield}\ (\textbf{Q/ha})}$$

Gross income (Rs/ha) = (quantity of main product x price per unit) + (quantity of by- product x price per unit)

Net income (Rs/ha) = Gross income – Cost C_2

$$\textbf{Benefit} - \textbf{Cost ratio} = \frac{\textbf{Gross income}}{\textbf{Cost C}_2}$$

Profitability:

$$\text{Average revenue}(\text{Rs./q}) = \frac{\text{Value of main product}\ \left(\frac{\text{Rs.}}{\text{ha}}\right)}{\text{Actual yield}\ \left(\frac{\text{Q}}{\text{ha}}\right)}$$

$$\text{Average variable cost}\ (\text{Rs/q}) = \frac{\text{Total variable cost}\left(\frac{\text{Rs.}}{\text{ha}}\right)}{\text{Actual yield}\ \left(\frac{\text{Q}}{\text{ha}}\right)}$$

$$\text{Break} - \text{Even yield}\ (\text{q/ha}) = \frac{\text{Total fixeed cost}\ \left(\frac{\text{Rs.}}{\text{ha}}\right)}{\text{Average revenue}\left(\frac{\text{Rs.}}{\text{q}}\right) - \text{Average variale cost}\ \left(\frac{\text{Rs.}}{\text{q}}\right)}$$

3. RESULTS AND DISCUSSION:

Cost of cultivation and Cost and return analysis of maize in different major maize producing states of India has been analysed for the study. Break-even production of maize has also been determined for the study.

3.1 Cost of cultivation of maize according to cost concepts

The relative change, Simple growth rate and cuddy-della valle index have been determined to know the Cost of cultivation according to cost concepts in maize production over time (Table 1).

All the Costs (Cost A_1, cost A_2, cost B_1, cost B_2, cost C_1 and cost C_2) of maize production was found to be increase in all major maize producing states in the current year as compared to the base year. The cost C_2 which is also known as total cost was found to be maximum increased by 525.66 per cent (Rs. 35616.02) from Rs. 6775.47 (in the base year) to Rs. 42391.49 (in the current year) in Madhya Pradesh followed by Andhra Pradesh (407.16%), Uttar Pradesh (325.04%), Bihar (281.87%), Karnataka (262.31%) and Rajasthan (255.78%) in the current year as compared to the base year.

Table 1. Per hectare Cost of cultivation of maize in major producing states of India

(Rs/ha)

States	Cost concepts	Cost A_1	Cost A_2	Cost B_1	Cost B_2	Cost C_1	Cost C_2
Karnataka	BY	7735.67	7745.14	8476.54	11232.82	9609.89	12366.17
	CY	26988.04	26988.04	29204.16	39725.97	34282.36	44804.17
	RC (%)	248.88	248.45	244.53	253.66	256.74	262.31
	SGR (%)	8.92**	8.91**	8.89**	8.72**	8.92**	8.76**
	CDVI (%)	20.66	20.67	20.79	18.00	20.21	17.64
Madhya Pradesh	BY	3257.00	3257.00	3865.03	5114.01	5526.52	6775.47
	CY	25365.62	25365.62	27004.21	35635.58	33868.90	42391.49
	RC (%)	678.80	678.80	598.68	596.82	512.84	525.66
	SGR (%)	12.02**	12.02**	11.58**	11.55**	10.76**	10.90**
	CDVI (%)	26.34	26.34	25.89	23.78	19.68	18.98
Andhra Pradesh	BY	7484.98	7507.41	8348.53	11795.72	10086.71	13533.90
	CY	37297.02	39368.27	40461.54	64397.39	44702.29	68638.13
	RC (%)	398.29	424.39	384.65	445.94	343.18	407.16
	SGR (%)	9.30**	9.50**	9.16**	9.77**	8.74**	9.43**
	CDVI (%)	10.48	12.21	12.28	11.66	13.03	12.35
Bihar	BY	7553.52	7553.52	7920.95	11070.68	9802.90	12952.62
	CY	26316.78	26316.78	27874.56	42275.42	35061.44	49462.31
	RC (%)	248.40	248.40	251.91	281.87	257.66	281.87
	SGR (%)	8.05**	8.05**	8.09**	8.30**	8.40**	8.50**
	CDVI (%)	11.57	11.57	11.59	15.12	14.68	16.48
Uttar Pradesh	BY	4137.79	4259.61	4865.60	6944.36	8912.86	10991.63
	CY	22574.48	22651.39	25156.82	36403.08	35472.04	46718.30
	RC (%)	445.57	431.77	417.03	424.21	297.99	325.04

	SGR (%)	10.03**	9.96**	9.64**	9.71**	8.63**	8.91**
	CDVI (%)	25.41	25.48	22.93	20.10	16.00	15.86
Rajasthan	BY	5447.00	5633.16	7142.82	8755.50	11833.75	13446.43
	CY	17589.91	17941.18	21205.35	27621.11	41424.18	47839.94
	RC (%)	222.93	218.49	196.88	215.47	250.05	255.78
	SGR (%)	7.63**	7.52**	7.45**	7.82**	8.94**	8.96**
	CDVI (%)	15.45	15.48	16.06	15.13	18.07	17.02

Source: Directorate of Economics and Statistics
Note: ** Significant at 1 per cent level of significance
Significant at 5 per cent level of significance

Simple growth rate has been calculated in order to determine the rate of change in cost of Maize production each year. The growth in all the costs of Maize production was found to be positive in all the major maize producing states of the country. The growth in cost C_2 of Maize production was found maximum in Madhya Pradesh (10.90%/year) followed by Andhra Pradesh (9.43%/year), Rajasthan (8.96%/year), Uttar Pradesh (8.91%/year), Karnataka (8.76%/year) and Bihar (8.50%/year) during the period under study. The growth of all the costs was found be positive and highly significant in all the states of the country.

Cuddy della-valle index showed instability of cost concepts among all major maize producing states. All the cost concepts in Karnataka, Madhya Pradesh, Uttar Pradesh and Rajasthan were found to show medium instability while, All the cost concepts for Andhra Pradesh and Bihar were found to show the low instability during the period under study.

3.2 Cost and return analysis of maize production:

Per hectare costs and returns in maize cultivation is depicted in table 2. The relative change, Simple growth rate and cuddy della valle index across states have been analysed during the period under study (Table 2).

The total cost were analysed by using the sum of variable and fixed cost for cultivation of maize in major maize producing States of the country (Table 2). The expenditure on total cost in cultivation of maize was found to be increased in all major maize producing States of the country. Amongst all the major maize growing States, highest increased was observed in Madhya Pradesh (525.66%) followed by Andhra Pradesh (407.16%), Uttar Pradesh (325.04%), Bihar (281.87%), Karnataka (261.42%) and Rajasthan (255.78%) in the current year as compared to the base year. The expenditure on total cost in cultivation of maize found to be more with the magnitude of (Rs 4211.93/ha/year) and growth of 9.43 per cent per year in Andhra Pradesh, as compared to Rajasthan (Rs 2726.08/ha/year), Karnataka (Rs 2633.85/ha/year), Bihar (Rs 2511.56/ha/year), Madhya Pradesh (Rs 2504.71/ha/year), Uttar Pradesh (Rs 2452.49/ha/year), resulted positive and significant growth 8.96, 8.76, 8.50, 10.90 and 8.91 per cent per year respectively, in these states during the period under study. CDVI of total cost in cultivation of maize showed low to medium instability among the major maize producing states of the country.

Thus, it can be concluded that the expenditure on total cost in maize cultivation was found to be highest in Andhra Pradesh followed by Rajasthan, Karnataka, Bihar, Madhya Pradesh and Uttar Pradesh during the period under study, due to intensive inputs in maize (*viz*. higher cost of seeds, fertilizer application and human labour).

The actual yield of maize was found to be increased in all major maize producing states of the country. Amongst all the major maize growing States the highest increased in yield of maize was observed in Madhya Pradesh (271.96%) followed by Andhra Pradesh (111.69%), Uttar Pradesh (87.37%), Rajasthan (78.52%), and Karnataka (22.97%) in the current year as compare to the base year, resulted positive and significant growth 7.77, 4.14, 3.13, 3.19 and 1.62 per cent per year respectively in the states during the period under study. Although the yield of maize was found to be increased in Bihar (48.25%) with the growth of 1.03 per cent per year but it was found non-significant. CDVI of actual yield showed medium instability for all the states except Andhra Pradesh, which showed low instability.

Table 2. Cost and return analysis of maize production across states of India

States	Economic parameters Unit	Fixed cost (Rs/ha)	Variable cost (Rs/ha)	Total cost (Rs/ha)	Actual yield (Q/ha)	Gross income (Rs/ha)	Net income (Rs/ha)	Benefit -cost ratio	Cost of production (Rs/Q)
Karnataka	BY	3717.76	8648.41	12366.17	25.14	12550.04	183.86	1.02	472.39
	CY	13070.51	31623.61	44804.17	30.91	47895.54	3091.37	1.08	1340.01
	RC (%)	251.57	265.66	262.31	22.97	281.64	1581.34	5.88	183.67
	SGR (%)	8.13**	9.00**	8.76**	1.62**	8.12**		-0.23	7.70**
	CDVI (%)	16.24	20.30	17.64	18.01	16.74		15.69	21.12
Madhya Pradesh	BY	2054.44	4721.03	6775.47	7.60	4995.94	-1779.57	0.74	754.91
	CY	10846.13	31545.36	42391.49	28.26	40735.83	-1764.45	0.79	1268.75
	RC (%)	427.94	568.19	525.66	271.96	715.38	-0.85	6.41	68.06
	SGR (%)	10.20**	11.18**	10.90**	7.77**	12.28**		0.97	3.71**
	CDVI (%)	21.80	20.23	18.98	24.56	27.05		13.96	18.99
Andhra Pradesh	BY	4513.72	9020.18	13533.90	23.55	11640.59	-1893.31	0.86	526.09
	CY	27253.99	41384.15	68638.13	49.85	80564.05	11925.92	1.17	1362.85
	RC (%)	503.80	358.80	407.16	111.69	592.10	-729.90	36.22	159.05
	SGR (%)	10.29**	8.91**	9.43**	4.14**	10.60**		1.81**	6.54**
	CDVI (%)	15.83	12.22	12.35	12.41	12.99		6.49	15.69
Bihar	BY	3657.74	9294.88	12952.62	26.16	13622.98	670.36	1.05	450.55
	CY	16555.45	32906.86	49462.31	38.79	58675.47	9213.16	1.18	1077.53
	RC (%)	352.61	254.03	281.87	48.25	330.71	1274.36	12.20	139.16
	SGR (%)	8.78**	8.37**	8.50**	1.03	7.80**		0.41	7.41**
	CDVI (%)	25.57	14.20	16.48	15.18	18.83		30.74	29.53
Uttar Pradesh	BY	3054.13	7937.50	10991.63	13.65	7313.60	-3678.03	0.67	834.50
	CY	14340.07	32378.23	46718.30	25.57	40256.36	-6461.94	0.86	1581.55
	RC (%)	369.53	307.91	325.04	87.37	450.43	75.69	29.63	89.52
	SGR (%)	9.05**	8.85**	8.91**	3.13**	10.04**		1.37*	5.29**
	CDVI (%)	16.07	17.50	15.86	18.36	19.35		13.54	21.34
Rajasthan	BY	3725.84	9720.59	13446.43	11.72	9463.36	-3983.07	0.70	860.82
	CY	10738.64	37101.30	47839.94	20.92	39970.98	-7868.96	0.83	1885.69
	RC (%)	188.22	281.68	255.78	78.52	322.38	97.56	18.41	119.06
	SGR (%)	7.85**	9.31**	8.96**	3.19**	9.16**		0.82	6.48**
	CDVI (%)	19.02	18.40	17.02	20.80	20.05		16.29	26.23

Source: Directorate of Economics and Statistics
*Note: ** Significant at 1 per cent level of significance*
Significant at 5 per cent level of significance

Among all the major maize producing states, the Gross income was found to be increased at a highly significant rate during the study period. The highest overall increase was noticed in Madhya Pradesh (715.38%) and lowest in Karnataka (281.64%). Highest SGR was found in Madhya Pradesh 12.28 per cent per year and lowest in Bihar 7.80 per cent per year. CDVI of gross income was highest in Madhya Pradesh (27.05%) and lowest in Andhra Pradesh (12.99%).

Net income of maize among all the major maize producing states was found to be negative except in Karnataka and Bihar. Due to the total costs were noticed higher than the gross income. Andhra Pradesh's net income in the base year was negative, but it was positive in the current year during the study period. Hence, maize in Karnataka and Bihar was profitable than other states as the gross income was more than the total costs. The benefit- cost ratio of maize was found to higher in Bihar, Andhra Pradesh and Karnataka than other state and it was more than one in the current year by 12.20, 36.22 and 5.88 per cent.

In Andhra Pradesh, the SGR of B:C ratio was noticed highly significant with the annual growth rate of 1.81 per cent per year. Therefore, maize was more profitable in Bihar, Andhra Pradesh and Karnataka due to higher net income and B:C ratio. Cost of production in maize among all the states was increased at a highly significant rate during the study period. Karnataka (183.67%) had the highest overall increase and the highest annual growth rate in Karnataka 7.70 per cent per year, which was highly significant during the study period.

3.3 Break-even production of maize:

Table 3 here represents the break-even production of maize across the major maize producing states in India. Relative change, simple growth rate and CDVI in per cent were computed and presented in the Table 3. Differential yield is the difference between actual yield and break-even yield.

Table: 3 Break-even Production of maize

States	Particulars	Actual yield (Q/ha)	Break-even yield (Q/ha)	Differential Yield (Q/ha)	Cost of production (Rs/Q)	Minimum support price (Rs/Q)	COP-MSP (Rs/Q)
Karnataka	BY	25.14	29.32	-4.18	472.39	471.67	86.11
	CY	30.91	31.54	-0.63	1340.01	1496.67	-20.02
	RC (%)	22.97	7.57		183.67	217.31	
	SGR (%)	1.62**	1.54		7.70**	7.63**	
	CDVI (%)	18.01	19.23		21.12	11.17	
Madhya Pradesh	BY	7.60	20.41	-12.81	754.91	471.67	283.24
	CY	28.26	29.14	-0.88	1268.75	1496.67	-227.92
	RC (%)	271.96	522.92		68.06	217.31	
	SGR (%)	7.77**	-3.86		3.71**	7.63**	
	CDVI (%)	24.56	26.19		18.99	11.17	
Andhra Pradesh	BY	23.55	40.30	-16.75	526.09	471.67	54.42
	CY	49.85	36.39	13.46	1362.85	1496.67	-133.82
	RC (%)	111.69	9.70		159.05	217.31	
	SGR (%)	4.14**	-1.15		6.54**	7.63**	
	CDVI (%)	12.41	21.54		15.69	11.17	
Bihar	BY	26.16	25.73	0.43	450.55	471.67	-21.12
	CY	38.79	37.73	1.06	1077.53	1496.67	-419.14
	RC (%)	48.25	46.63		139.16	217.31	
	SGR (%)	1.03	2.33		7.41**	7.63**	
	CDVI (%)	15.18	20.61		29.53	11.17	
Uttar Pradesh	BY	13.65	17.23	-3.58	834.50	471.67	362.83
	CY	25.57	38.74	-13.17	1581.55	1496.67	84.88
	RC (%)	87.37	124.84		89.52	217.31	
	SGR (%)	3.13**	1.08		5.29**	7.63**	
	CDVI (%)	18.36	41.37		21.34	11.17	
Rajasthan	BY	11.72	9.93	-1.79	860.82	471.67	389.15
	CY	20.92	18.28	-2.64	1885.69	1496.67	389.02
	RC (%)	78.52	84.18		119.06	217.31	
	SGR (%)	3.19**	2.14		6.48**	7.63**	
	CDVI (%)	20.80	39.84		26.23	23.14	

Source: Directorate of Economics and Statistics
*Note: ** Significant at 1 per cent level of significance*
Significant at 5 per cent level of significance

“The study found that it was negative for all the states except Bihar, which means the maize's actual yield was below the break-even production. It indicates that farmers of maize producers cannot meet the break-even. leading them into losses. The total cost was higher than the total revenue. The differential yield was positive in Bihar. This shows that the actual yield was above the break-even level, and farmers can profit from growing maize enterprises. Comparatively, maize was more profitable in Bihar” (Joshi et.al, 2005).

Cost of production and minimum support price of maize among all the major states were increased at a highly significant rate during the study period. Cost of production was found highest in Karnataka, which increased by (164.73%) from base year to the current year with the annual growth rate of 7.70 per cent per year. CDVI was highest in (29.53%), which means that maize production costs during the past 19 years showed medium instability. The minimum support price of maize was increased by (217.31%) from a base year with an annual growth rate of 7.63 per cent per year, which was highly significant. It showed low instability during the study period.

This is a good indicator as the government is increasing MSP following the cost of production. It reduces the loss by the farmer in case of lower market prices. Bihar saw a negative difference between the minimum support price and the cost of production for maize in both the base year and the current year, but Karnataka, Madhya Pradesh, and Andhra Pradesh only experienced a negative difference in the current year. The fact that the production cost was lower than the MSP prices established by the government is a positive sign that farmers in these states are making money from growing maize, and the COP is lower in these states than in others. All other states, with the exception of Rajasthan and Uttar Pradesh, displayed a positive difference, indicating that farmers lost money since production costs exceeded the minimum support price of maize.

4. Conclusion:

There are six major maize producing states in India, out of which maize is the third most important cereal crop after rice and wheat. The maize grain contains 9 to 11% protein, 3.6% fat, 2.7% fibre, 66.2% other carbohydrates and 1.5% minerals. Six states, namely Karnataka, Madhya Pradesh, Andhra Pradesh, Bihar, Uttar Pradesh and Rajasthan, account for about 60.61 per cent of the area and 63.02 per cent of the production share in India. India also earns sizeable foreign exchange through the export of many maize products. From the present study, it can be concluded that the cost of cultivation and production of maize in all the major maize producing states were increased at a highly significant rate during the study period. However, net income, B:C ratio was found higher in Bihar followed by Andhra Pradesh and Karnataka state during the entire study period. The B:C ratio (return per rupee) was found to be less than one in these states namely- Madhya Pradesh, Uttar Pradesh and Rajasthan, because the reason behind this the expenditure on total cost was found to be highest in these states due to intensive use of inputs in maize cultivation (*viz*. higher cost of seeds, fertilizer application and human labour).
Hence, efforts should be made to find the reasons behind the decreasing net income and B:C ratio in these three prominent maize producing states *viz.,* Madhya Pradesh, Uttar Pradesh and Rajasthan, efforts should be made to promote the adoption of improved cultivars, intercropping, etc. and increase the extent of value addition for maize production. A comprehensive study may be undertaken by NFSM, Agriculture Universities to identify the problem faced by them in cultivation of maize.

Policy implications:

Based on the present study following measures can be suggested:

a. The Maize's actual yield can be enhanced by using high yielding varieties, the latest technology and practices. Because the study found that actual yield in most of the states was unable to meet the break-even production, leading to the Maize grower's loss.

b. The production cost in maize should be lowered using proper management practices because, in most states, COP was higher than the govt's minimum support prices.

c. The minimum support price of Maize should be fixed based on its cost of production. MSP should be more than the cost of production.

d. All the Maize growers should be made aware of the minimum support prices fixed by the government. It helps in planning the crop and its costs accordingly.

e. The study would be useful for policymakers and to take appropriate strategies and effective efforts should be taken by the govt. for all the maize growing states for betterment of maize growers

Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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Details of the AI usage are given below:

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