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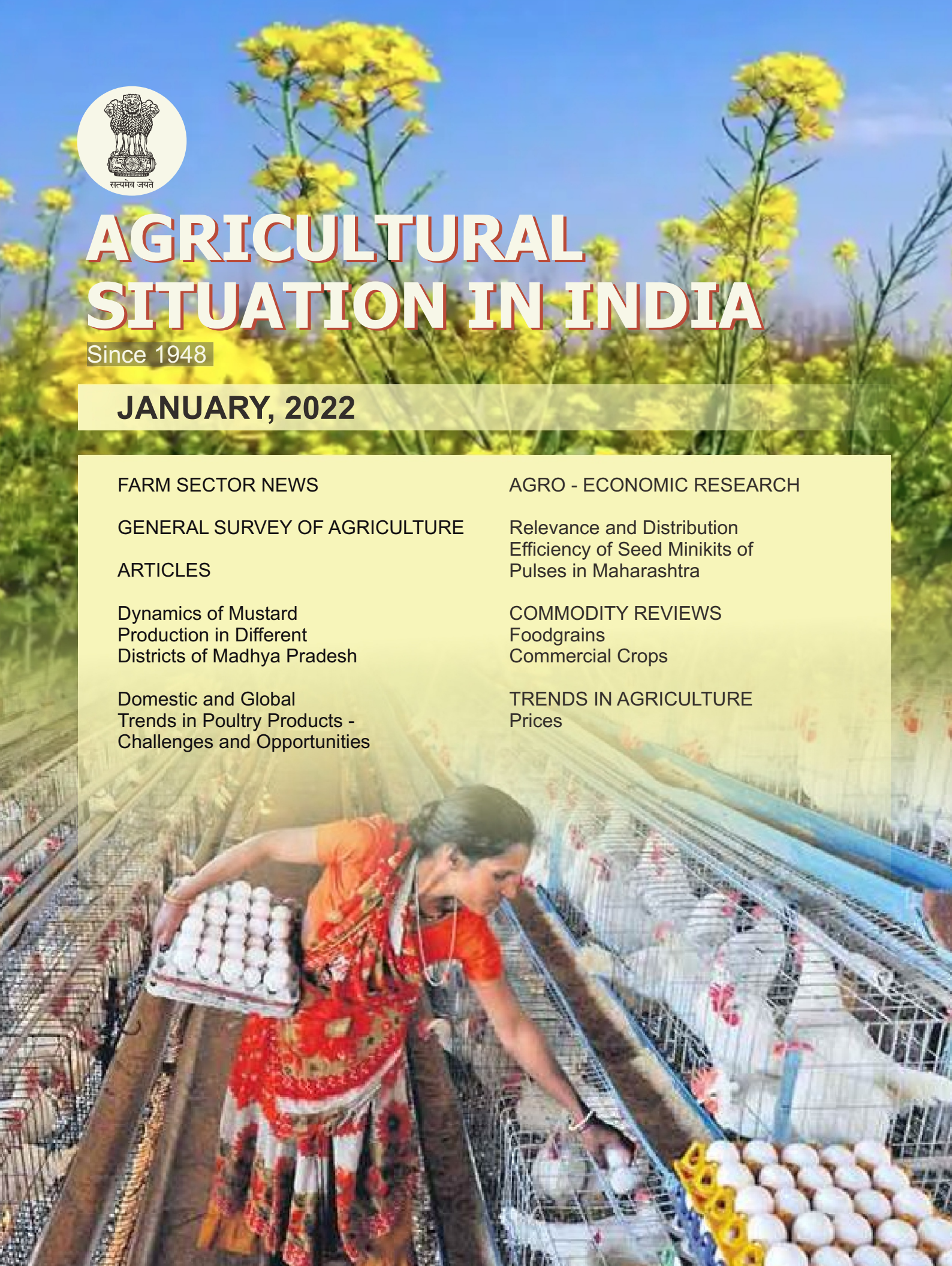

Articles

Dynamics of Mustard Production in Different Districts of Madhya Pradesh

PINTU PAUL[1], HARI OM SHARMA[2] AND H. K. NIRANJAN[3]

Abstract

National Mission on Oilseeds and Oil Palm (NMOOP) has been taken up by the Government of Madhya Pradesh to increase oilseed production in the state to meet domestic as well as global demand. A study has been undertaken to analyze changes, fluctuation, trend and growth rate in area, production and productivity during 2001-2019 of mustard with percent contribution of area, yield and their interaction effect towards production of mustard across major mustard growing districts of Madhya Pradesh. The study reveals that the initiatives taken under National Mission on Oilseed and Oil Palm have found to be proved in case of mustard as the area, production and productivity of mustard not only increased in major mustard producing districts but also in other districts of Madhya Pradesh. The production of mustard was found to have increased by 520.4 8 thousand tonnes in Madhya Pradesh during the period under study due to effective efforts of the agriculture department and the agricultural universities. Although, there is still a huge scope of enhancing area and yield of the crop as area allocated by the farmers was found to be only 4.35% of net sown area (15512 thousand ha) in cultivation of mustard. The average yield of mustard (1.36 tonnes/ha) was also found to be low as compared to the potential yield (1.9 tonnes/ha) of the mustard in the state.

Keywords: *Dynamics, mustard production, Madhya Pradesh*

1. Introduction

Oilseeds have been considered as one of the oldest cultivated plants in human civilization and an indispensable part of the Indian diet. According to history, wild forms of mustard have been found near East and Southern Iran and in India. It is also grown as a leafy vegetable in China. U.S.A, China and India have emerged as top mustard producing countries due to their geography, adaptability and resource endowment. The transfiguration in agriculture sector over a long period through intensive production system and innovation has made India a self-reliant and self-sufficient country in terms of food grain production (297.50 million tonnes 2019-20).

Oilseed crops play a crucial role in Indian agricultural economy. The oil content varies from 37-49 percent. Oil is utilized for human consumption, seeds as spices and cake as cattle feed and manure (Soni *et al.*, 2018). Mustard is also an important oilseed crop containing over 30-40 percent oil on a dry weight basis, a slightly smaller proportion of protein and a strong enzyme called myrosin. As a condiment, mustard is sold in 3 forms: as seeds, as dry powder that is freshly mixed with water for each serving to obtain the most aroma and flavour, and prepared as a paste with other spices or herbs, vinegar or wine, and starch or flour to tone down the sharpness.

Mustard production in India stands in between 8-9 million tonnes with a significant growth in between 2000 and 2019. In India, major production regions of mustard are Rajasthan, Haryana, Uttar Pradesh, and Madhya Pradesh while the major consumption (as raw pellets) regions are Rajasthan, Uttar Pradesh, Haryana and Punjab. Being a major rabi (winter season) oilseed crop with advantage of soil moisture conserved during monsoon, it has greater potential to increase the availability of edible oil from domestic production. Despite the high quality of oilseed and adaptability for varied

[1]PG Student, Department of Agricultural Economics and Farm Management, JNKVV, Jabalpur
[2]Director, Agro Economic Research Centre, JNKVV, Jabalpur
[3]Research Associate, Agro Economic Research Centre, JNKVV, Jabalpur
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agro-climatic conditions, the area, production and yield in India have been fluctuating due to various biotic and abiotic stresses coupled with India's domestic price support programme (Kumar *et al*., 2016; Kumar *et al*., 2018). Nevertheless, the crop has potential to ensure the nutritional security and contribute to livelihood security of the farmers. The highest productivity states are Haryana (2058 kg/ha), Gujarat (1745 kg/ha), Rajasthan (1720 kg/ha), Punjab (1523 kg/ha), Uttar Pradesh (1483 kg/ha) and Madhya Pradesh (1422 kg/ha) with overall national yield of 1499 kg/ha (DES, DA&FW).

Among various oilseeds cultivated in Madhya Pradesh, mustard is the second major oilseed crop after soybean. It covers 4.35 percent of net sown area (15512 thousand ha.) in the state. Chambal and Gwalior divisions are the major rapeseed-mustard growing areas which account for 68.14 percent area and 75.42 percent production, respectively. It is grown in rain-fed as well as irrigated conditions. Under National Mission on Oilseeds and Oil Palm (NMOOP), various initiatives have been taken up to increase oilseed production in the State to meet domestic as well as global demand.

1.1 Objectives of the study

The present investigations were carried out in major rapeseed-mustard growing districts of Madhya Pradesh to analyze changes, fluctuation, trend and growth rate in area, production and productivity of mustard with percent contribution of area, yield and their interaction effect towards production of mustard across major mustard growing districts of Madhya Pradesh.

2. Data sources and methodology

The study confined to all the mustard producing districts *i.e.,* Morena, Bhind, Gwalior, Sheopurkala, Mandsaur, Neemuch, Betul, Ratlam, Shivpuri, Satna with other districts of Madhya Pradesh. The data used for the analysis were secondary in nature and collected for a period of 18 years *i.e.*, from 2001-02 to 2018-19. The data have been collected from various published records from Department of Economics and Statistics, Ministry of Agriculture, Government of Madhya Pradesh (mpkrishi.gov.in). Collected data have been analyzed through various statistical and econometrics tools such as absolute change, relative change, Coefficient of Variation, standard deviation, mean, trend and simple growth rate. The following decomposition model has been used to analyze area effect, yield effect and interaction effect.

Change in production = yield effect + area effect + interaction effect

$$\text{Area effect} = \frac{(A_n - A_o)}{(P_n - P_o)} \times 100$$

$$\text{Yield effect} = \frac{(Y_n - Y_o)}{(P_n - P_o)} \times 100$$

$$\text{Interaction effect} = \frac{(A_n - A_o)(Y_n - Y_o)}{(P_n - P_o)} \times 100$$

where,

A_o = Triennium average of area in base year,

P_o = Triennium average of production in base year (average of the first triennium years *i.e.*, 2001-02 to 2003-2004),

$Y_o = P_o/A_o$ or Triennium average of yield in base year,

A_n = Triennium average of area in current year (average of the last triennium *i.e.*, 2016-17 to 2018-19),

P_n = Triennium average of production in current year,

$Y_n = P_n/A_n$ or Triennium average of yield in current year.

3. Results and discussion

Concentration of area, production and productivity, absolute and relative change, fluctuation, trend and growth of mustard in different mustard growing districts of Madhya Pradesh has been analyzed for the study. Decomposition of area, yield and their interaction effect over production of mustard has also been determined for the study.

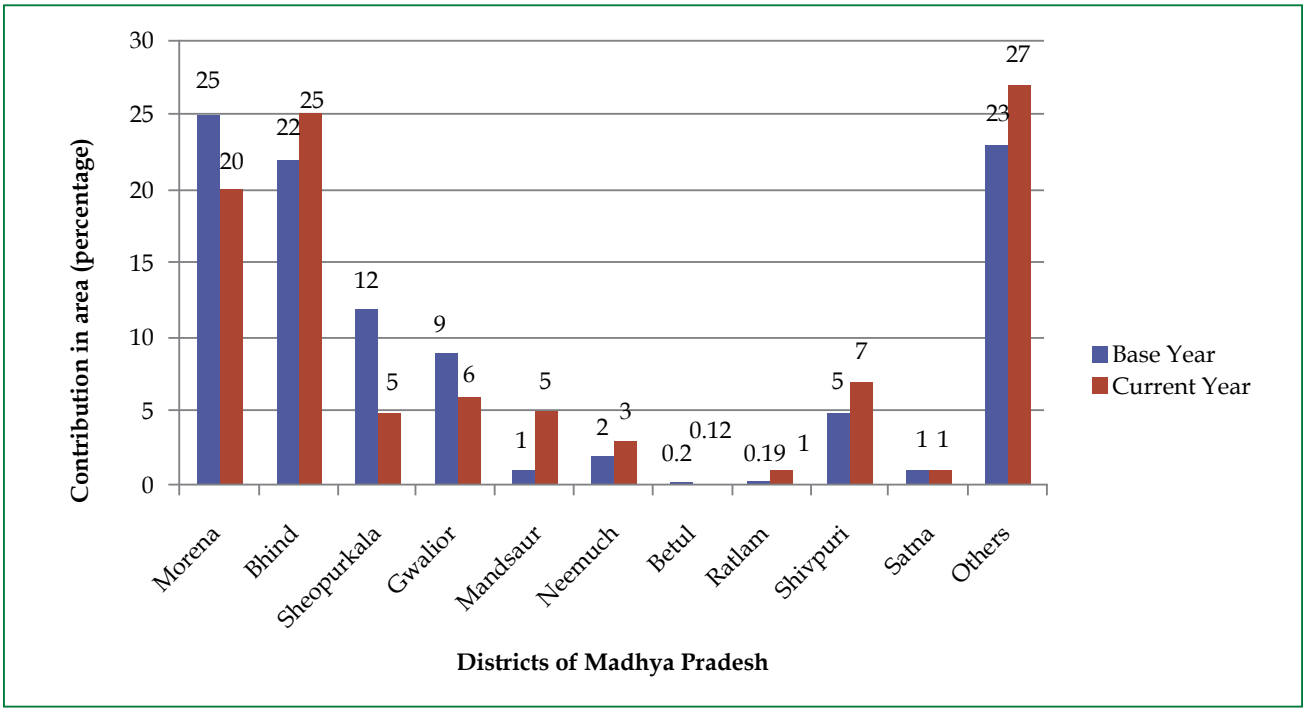
3.1 Change and fluctuation in area, production and productivity

The base year and the current year were considered to analyze the absolute and relative change in area, production and productivity in major mustard producing districts of Madhya Pradesh. The fluctuation in area, production and productivity was also analysed through Coefficient of Variation (%) in mustard producing districts of Madhya Pradesh.

3.1.1 Area

Concentration of area of mustard in different mustard growing districts to total mustard area in the districts of Madhya Pradesh in the base year and current year was examined (Fig. 1). The area of mustard was found to have increased in Bhind, Mandsaur, Neemuch, Ratlam, Shivpuri, and other districts of Madhya Pradesh from 22 percent, 1 percent, 2 percent, 0.19 percent, 5 percent and 23 percent (in the base year) to 25 percent, 5 percent, 3 percent, 1 percent, 7 percent and 27 percent(in the current year), respectively, while the concentration of area in districts of Morena, Sheopurkala, Gwalior and Betul was found to have decreased from 25 percent, 12 percent, 9 percent and 0.20 percent (base year) to 20 percent, 5 percent, 6 percent and 0.12 percent (current year), respectively, of the total area under mustard in the state. In Satna district of Madhya Pradesh, the area of mustard remained unchanged *i.e.*, 1 percent in both the current and base year of the study.

Figure 1: Contribution in Area of Mustard by Districts of Madhya Pradesh



Source: Secondary Data

Absolute change, relative change and coefficient of variation have been determined to know the variation in mustard area over time (Table 1). The area of mustard was found to have increased by 45.90 percent (227.18 thousand ha.) from 494.93 thousand hectares (in base year) to 722.11 thousand hectares (in current year) in Madhya Pradesh, with a fluctuation of 14.87 percent during the period under study.

TABLE 1: CHANGE AND FLUCTUATION IN AREA OF MUSTARD IN DISTRICTS OF MADHYA PRADESH

(000'ha)

Districts	Base year	Current year	Absolute change	Relative change (%)	S.D	CV (%)
Morena	124.07	143.31	19.25	15.51	11.43	8.10
Bhind	109.57	182.21	72.64	66.30	32.49	20.93
Sheopurkala	60.23	33.22	-27.01	-44.84	19.25	34.33
Gwalior	43.93	45.82	1.88	4.29	11.93	23.65
Mandsaur	6.03	33.24	27.20	450.87	16.17	47.22
Neemuch	8.13	18.68	10.55	129.69	9.35	46.21
Betul	1.00	0.89	-0.11	-11.37	1.65	115.90
Ratlam	0.93	7.81	6.88	736.64	4.11	56.66
Shivpuri	25.90	52.12	26.22	101.23	15.59	32.17
Satna	2.30	6.14	3.84	166.83	1.51	47.03
Major mustard producing districts	382.10	523.43	141.33	36.99	82.53	15.94
Other districts	112.80	198.68	85.88	76.14	36.40	22.51
Madhya Pradesh	494.93	722.11	227.18	45.90	14.53	14.87

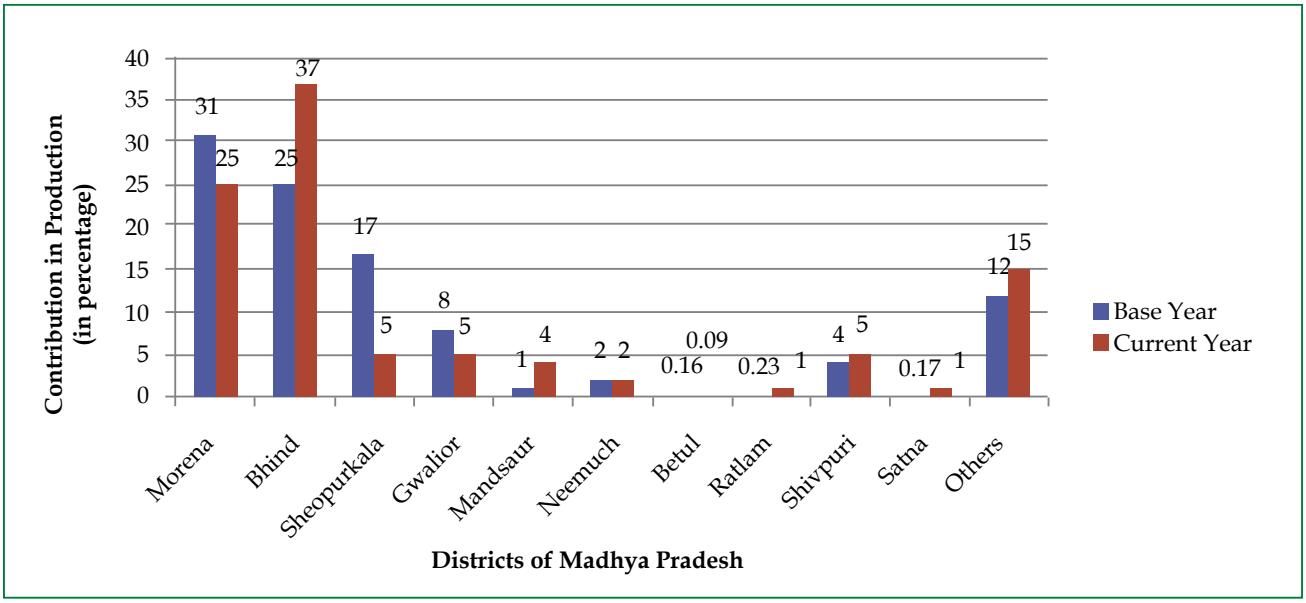
Source: Secondary Data

The area under mustard was found to increase in all mustard growing districts except Sheopurkala (-44.84%) and Betul (-11.37%) during the period under study. Ratlam (736.64%) showed the highest increase in area under mustard, followed by Mandsaur (450.87%), Satna (166.83%), Neemuch (129.69%), Shivpuri (101.23%), other districts (76.14%), Bhind (66.30%), Morena (15.51%) and Gwalior (4.29%). The highest variation in area under mustard was in Betul (115.90%), followed by Ratlam (56.66%), Mandsaur (47.22%), Satna (47.03%), Neemuch (46.21%), Sheopurkala (34.33%), Shivpuri (32.17%), Gwalior (23.65%), other districts (22.51%), Bhind (20.93%) and Morena (8.10%). The area under mustard was found to increase more in other districts (76.14%) compared to major mustard producing districts (36.99%) during the period under study.

3.1.2 Production

The concentration of mustard production in different districts was observed in the base year and current year.

Figure 2: Contribution in Production of Mustard by Districts of Madhya Pradesh



Source: Secondary Data

The production of mustard was found to be increased in Bhind, Mandsaur, Shivpuri, Satna, Ratlam, and other districts of Madhya Pradesh from 25 percent, 1 percent, 4 percent, 0.23 percent, 0.17 percent in the base year to 37 percent, 4 percent, 5 percent, 1 percent, 1 percent in the current year, respectively, while production of mustard decreased in Morena, Sheopurkala, Gwalior, and Betul districts of M.P, from 31 percent, 17 percent, 8 percent, 0.16 percent in the base year to 25 percent, 5 percent, 5 percent, 0.09 percent in the current year, respectively to the total production of mustard in the state (Fig. 2). During the study period, production of mustard in Neemuch district of Madhya Pradesh was found to remain unchanged *i.e.*, 2 percent in both the current and base year.

The production of mustard in Madhya Pradesh was increased by 113.55 percent (520.48 thousand tonnes) from 458.37 thousand tonnes (the base year) to 978.85 thousand tonnes (the current year), with a fluctuation of 25.70 percent during the study period (Table 2).

TABLE 2: FLUCTUATION IN PRODUCTION OF MUSTARD IN DISTRICTS OF MADHYA PRADESH

(000' tonnes)

Districts	Base year	Current year	Absolute change	Relative change (%)	S.D	CV (%)
Morena	141.43	248.13	106.69	75.44	46.28	22.71
Bhind	113.50	357.84	244.34	215.28	105.33	49.13
Sheopurkala	76.80	45.96	-30.84	-40.16	23.78	32.04
Gwalior	38.87	49.35	10.49	26.98	15.55	30.62
Mandsaur	4.30	38.09	33.79	785.75	27.53	67.64
Neemuch	7.00	22.37	15.37	219.50	10.30	47.58
Betul	0.73	0.88	0.14	19.59	1.19	116.05
Ratlam	1.03	9.75	8.72	843.77	6.39	59.15

Districts	Base year	Current year	Absolute change	Relative change (%)	S.D	CV (%)
Shivpuri	16.70	47.77	31.07	186.02	16.47	45.13
Satna	0.77	7.03	6.26	817.09	3.16	150.82
Major mustard producing districts	401.13	827.16	426.03	106.21	173.99	26.52
Other districts	57.23	151.69	94.46	165.04	40.17	37.32
Madhya Pradesh	458.37	978.85	520.48	113.55	26.92	25.70

Source: Secondary Data

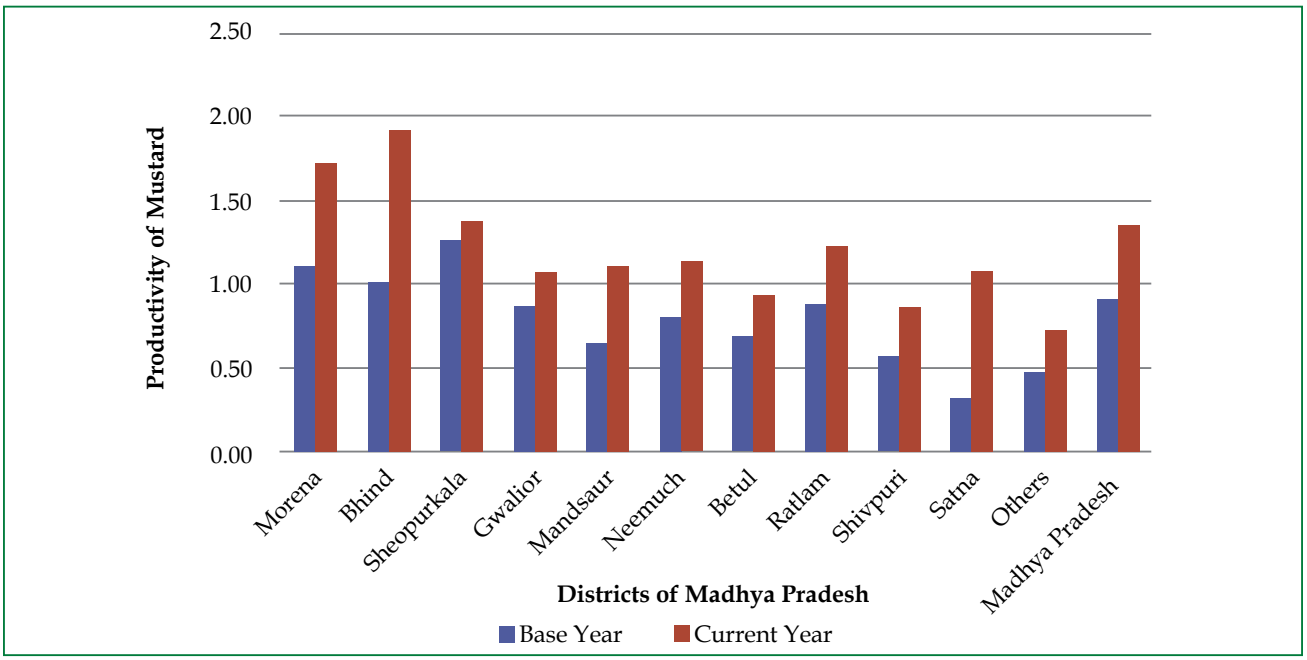
The production of mustard was found to have increased in all the districts of Madhya Pradesh except Sheopurkala, where it was found to have decreased by 40.16 percent during the study period. Ratlam (843.77%) showed the highest increase in mustard production, followed by Satna (817.09%), Mandsaur (785.75%), Neemuch (219.50%), Bhind (215.28%), Shivpuri (186.02%), other districts (165.04%), Morena (75.44%), Gwalior (26.98%) and Betul (19.59%). Satna (150.82%) showed the highest fluctuation in mustard production, followed by Betul (116.05%), Mandsaur (67.64%), Ratlam (59.15%), Bhind (49.13%), Neemuch (47.58%), Shivpuri (45.13%), other districts (37.72%), Sheopurkala (32.04%), Gwalior (30.62%) and Morena (22.17%).

The production mustard is more in 'other districts' (165.04%) compared to major mustard producing districts (106.21%) during the period under study (Table 2).

3.1.3 Productivity

The productivity (tonnes/ha.) was found to have increased in all the districts of Madhya Pradesh (Fig. 3).

Figure 3: Productivity (tonnes/ha) of Mustard in Districts of Madhya Pradesh in Base Year (2001-02 to 2003-04) and Current Year (2016-17 to 2018-19)



Source: Secondary Data

It increased by 47.88 percent (0.44 tonnes/ha) from 0.92 tonnes/ha (in base year) to 1.36 tonnes/ha (in current year) in Madhya Pradesh, with a fluctuation of 17.78 percent during the period under study (Table 3).

TABLE 3: FLUCTUATION IN PRODUCTIVITY OF MUSTARD IN DISTRICTS OF MADHYA PRADESH

(tonnes/ha)

Districts	Base year	Current year	Absolute change	Relative change (%)	S.D	CV (%)
Morena	1.12	1.73	0.61	54.26	0.29	20.07
Bhind	1.02	1.93	0.90	88.43	0.40	30.55
Sheopurkala	1.27	1.39	0.11	8.87	0.17	12.99
Gwalior	0.89	1.08	0.19	21.62	0.26	25.67
Mandsaur	0.67	1.12	0.45	67.86	0.60	52.91
Neemuch	0.82	1.14	0.32	39.61	0.29	26.94
Betul	0.70	0.95	0.25	35.90	0.34	37.49
Ratlam	0.89	1.24	0.35	39.11	0.56	38.99
Shivpuri	0.58	0.87	0.29	51.26	0.19	26.28
Satna	0.33	1.10	0.77	231.27	0.40	78.53
Major mustard producing districts	1.04	1.58	0.54	52.16	0.24	19.60
Other districts	0.48	0.74	0.26	54.28	0.13	20.17
Madhya Pradesh	0.92	1.36	0.44	47.88	0.20	17.78

Source: Secondary Data

The absolute change, relative change and fluctuation in mustard productivity were found to have increased in all the districts of Madhya Pradesh. Satna (231.27%) showed the highest increase in productivity, followed by Bhind (88.43%), Mandsaur (67.86%), other districts (54.28%), Morena (54.26%), Shivpuri (51.26%), Neemuch (39.61%), Ratlam (39.11%), Betul (35.90%), Gwalior (21.62%) and Sheopurkala (8.87%). Satna (78.53%) district also showed the highest variation in mustard productivity, followed by Mandsaur (52.91%), Ratlam (38.99%), Betul (37.49%), Bhind (30.55%), Neemuch (26.94%), Shivpuri (26.28%), other districts (20.17%) and Sheopurkala (12.99%). The productivity of mustard was found to have increased more in other districts (54.28%) as compared to major mustard producing districts (52.16%) during the period under study (Table 3).

3.2 Trend and growth in area, production and productivity

Simple growth rate has been calculated in order to determine the rate of change in mustard area, production and productivity each year.

3.2.1 Area

The area under mustard increased by 6.95 thousand ha/year in Madhya Pradesh. It was found to be more in 'other districts' of Madhya Pradesh (4.45 thousand ha/year) in comparison to 'major mustard producing districts' (2.50 thousand ha/year) during the period under study (Table 4).

TABLE 4: TREND AND GROWTH IN AREA OF MUSTARD IN DISTRICTS OF MADHYA PRADESH

Districts	Trend value (b)	S.E (b)	Simple growth rate (% per year)
Morena	0.57	2.69	0.41
Bhind	3.70	7.66	2.38
Sheopurkala	-2.72	4.54	-4.84
Gwalior	-0.66	2.81	-1.30
Mandsaur	0.79	3.81	2.30
Neemuch	-0.07	2.20	-0.37
Betul	-0.11	0.39	-7.83
Ratlam	0.12	0.97	1.67
Shivpuri	0.67	3.67	1.38
Satna	0.21	0.36	6.53
Major mustard producing districts	2.50	19.46	0.48
Others districts	4.45	8.58	2.75
Madhya Pradesh	6.95	23.80	1.02

Source: Secondary Data

The trend and growth in area under mustard was found to be positive and increasing in all the districts of Madhya Pradesh except Sheopurkala, Gwalior, Neemuch and Betul. The Satna district (6.53%/year) showed the highest positive growth rate in area of mustard, followed by other districts (2.75%/year), Bhind (2.38%/year), Mandsaur (2.30%/year), Ratlam (1.67%/year), Shivpuri (1.38%/year) and Morena (0.41%/year) during the period under study while it was found be negative in Betul (-7.83%/year), Sheopurkala (-4.84%/year), Gwalior (-1.30%/year) and Neemuch (-0.37%/year).

3.2.2 Production

The production of mustard increased by 25.92 thousand tonnes/year in Madhya Pradesh, which was found to be more in 'major mustard producing districts' (20.38 thousand tonnes/year) compared to 'other districts of Madhya Pradesh' (5.54 thousand tonnes/year) during the period under study (Table 5).

TABLE 5: TREND AND GROWTH IN PRODUCTION OF MUSTARD IN DISTRICTS OF MADHYA PRADESH

Districts	Trend value (b)	S.E (b)	Simple growth rate (% per year)
Morena	5.05	10.91	2.48
Bhind	14.22	24.83	6.63
Sheopurkala	-2.93	5.61	-3.94
Gwalior	0.13	3.67	0.26
Mandsaur	2.13	6.49	5.24

Districts	Trend value (b)	S.E (b)	Simple growth rate (% per year)
Neemuch	0.38	2.43	1.75
Betul	-0.06	0.28	-5.92
Ratlam	0.30	1.51	2.79
Shivpuri	0.83	3.88	2.28
Satna	0.32	0.74	15.32
Major mustard producing districts	20.38	41.03	3.10
Other districts	5.54	9.47	5.15
Madhya Pradesh	25.92	46.25	3.39

Source: Secondary Data

The trend and growth in mustard production in Madhya Pradesh was also found to be positive and increasing in all the districts of Madhya Pradesh, except Sheopurkala and Betul. Satna (15.32%/year) district showed highest positive simple growth rate in mustard production, followed by Bhind (6.63%/year), Mandsaur (5.24%/year), other districts (5.15%/year), Ratlam (2.79%/year), Morena (2.48%/year), Shivpuri (2.28%/year), Neemuch (1.75%/year) and Gwalior (0.26%/year), while negative simple growth rate is seen in Betul (-5.92%/year) and Sheopurkala (-3.94%/year).

3.2.3 Productivity

The productivity of mustard increased by 0.028 tonnes/ha in Madhya Pradesh, which was found to be more in 'major mustard producing districts' (0.034 tonnes/ha) compared to 'other districts of Madhya Pradesh' (0.017 tonnes/ha) during the period under study and presented in Table 6.

TABLE 6: TREND AND GROWTH IN PRODUCTIVITY OF MUSTARD IN DISTRICTS OF MADHYA PRADESH

Districts	Trend value(b)	S.E(b)	Simple growth rate (% per year)
Morena	0.03	0.07	2.23
Bhind	0.06	0.10	4.24
Sheopurkala	0.01	0.04	0.92
Gwalior	0.02	0.06	1.59
Mandsaur	0.05	0.14	4.37
Neemuch	0.03	0.07	2.54
Betul	0.02	0.08	2.44
Ratlam	0.04	0.13	2.83
Shivpuri	0.01	0.04	1.34
Satna	0.04	0.10	8.08
Major mustard producing districts	0.034	0.05	2.74
Other districts	0.017	0.03	2.67
Madhya Pradesh	0.028	0.05	2.52

Source: Secondary Data

The trend and growth in mustard productivity were found to be positive and increasing in all the districts of Madhya Pradesh. Satna (8.08%/year) showed highest simple growth rate in mustard productivity per year, followed by Mandsaur (4.37%/year), Bhind (4.24%/year), Ratlam (2.83%/year), other districts (2.67 %/year), Neemuch (2.54%/year), Betul (2.44%/year), Morena (2.23%/year), Gwalior (1.59%/year), Shivpuri (1.34%/year) and Sheopurkala (0.92%/year) during the period under study.

3.3 Area, yield and their interaction effect on production of mustard

A simple decomposition model was used to estimate the contribution of area and yield towards increase/decrease in mustard production in the study period. In order to get the effect on production of mustard, the area effect, yield effect, and interaction effect were analyzed (Table 7).

The yield effect (41.02%) contributed more to the increase in mustard production in Madhya Pradesh than the area effect (40.04 %) and interaction effect (19.00%) during the study period.

TABLE 7: AREA, YIELD AND INTERACTION EFFECTS (%) ON PRODUCTION OF MUSTARD IN DISTRICTS OF MADHYA PRADESH

Districts	Area Effect (%)	Yield Effect (%)	Interaction Effect (%)	Absolute change in production (000'tonnes)
Morena	20.01	69.89	10.10	106.69
Bhind	31.17	40.97	27.86	244.34
Sheopurkala	111.54	-22.06	10.52	-30.84
Gwalior	15.98	80.56	3.46	10.49
Mandsaur	53.67	9.90	36.43	33.79
Neemuch	57.67	18.12	24.21	15.37
Betul	-55.21	174.36	-19.14	0.14
Ratlam	69.09	3.72	27.21	8.72
Shivpuri	48.54	25.58	25.88	31.07
Satna	21.32	30.16	48.52	6.26
Major mustard producing districts	34.34	48.23	17.71	426.03
Other districts	43.84	32.25	23.92	94.46
Madhya Pradesh	40.04	41.02	19.00	520.48

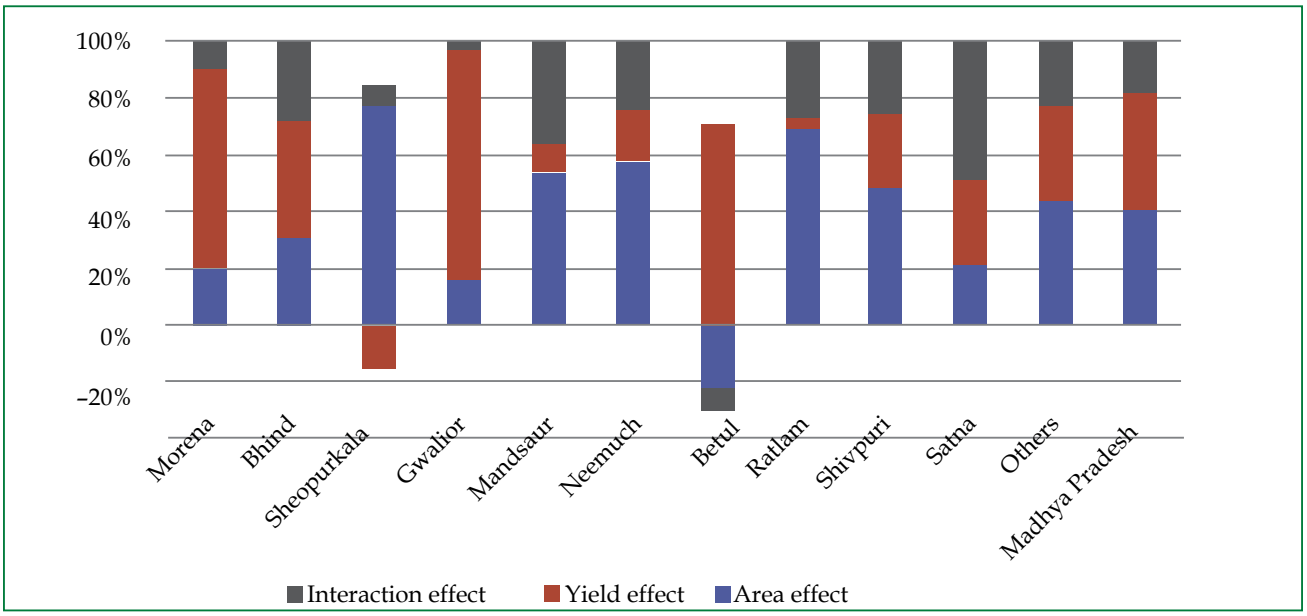
Source: Secondary Data

The production of mustard was found to increase by 520.48 thousand tonnes in Madhya Pradesh. It was found to be increase by 426.03 thousand tonnes in 'major mustard producing districts' and 94.46 thousand tonnes in 'other districts' of the state during the period under study. The production of mustard in the state was found increase due to area (40%), yield (41%) and interaction (19%) effect.

The area effect was found to be prominent in Sheopurkala (111.54%) followed by Ratlam (69.09%), Neemuch (57.67%), Mandsaur (53.67%) and Shivpuri (48.54%). The yield effect was found to be prominent in Betul (174.36%) followed by Gwalior (80.56%), Morena (69.89%), Bhind (40.97%) and Satna (30.16%). The interaction effect was found to be maximum in Satna (48.52%) followed by Mandsaur (36.43%). Inspite of maximum

area effect in Sheopurkala across major mustard producing districts of the State, the production of mustard was found to have decreased by 30.84 thousand tonnes. Also due to very high yield effect (174.36%), the production was found to have increased by 0.14 thousand tonnes in Betul district of the State.

Figure 4: Area, Yield and Interaction Effects (%) on Production of Mustard in Districts of Madhya Pradesh



Source: Secondary Data

Thus in Madhya Pradesh, area as well as yield effect was found to be the most important factor. The increase in mustard production in Sheopurkala, Mandsaur, Neemuch, Ratlam, Shivpuri, and other districts of Madhya Pradesh was mostly due to area effect while the increase in mustard production in Morena, Bhind, Gwalior, Betul, and Satna was primarily due to yield effect (Fig. 4).

4. Conclusions and suggestions

It can be concluded from the findings of study that:

- Initiatives taken under National Mission on Oilseed and Oil palm are found to be proved in case of mustard as the area, production and productivity of mustard not only increased in major mustard producing districts but also in other districts of Madhya Pradesh.
- The production of mustard was found to have increased by 520.4 8 thousand tonnes in Madhya Pradesh during the period under study due to effective efforts of the agriculture department and the agricultural universities. Although, there is still a huge scope of enhancing area and yield of the crop as area allocated by the farmers was found to be only 4.35% of net sown area (15512 thousand ha.) in cultivation of mustard. The average yield of mustard (1.36 tonnes/ha) was also found to be low as compared to the potential yield (1.9 tonnes/ha) of mustard in the State.
- The increase in production of the crop through area (40.04%), yield (41.02%) and their interaction (19.00%) effects reveals that the production of crop increased through increase in the productivity as well as enhancement in area under mustard during the study period.

- Amongst different major mustard producing districts, yield effect was found to dominate over area and interaction effect in Morena, Gwalior and Betul, while area effect was found to dominate over yield and interaction effect in Mandsaur, Neemuch and Ratlam districts towards increase in production of mustard in the State. In Sheopurkala, a major mustard producing district, the yield effect was found to be negative which is responsible for decrease in production of mustard, although the area effect was found to be 111.54% in the district.

- The interaction effect was found to dominate over the area and yield effect in Satna district of Madhya Pradesh. The district has emerged as a new destination of mustard production in the State as the production of mustard is found to increase with an annual growth rate of 15.32% during the period under study.

- Efforts are required to be made to improve processing by replacing existing system with modern technology in major mustard producing districts of the State.

- The efforts are also required to enhance productivity of mustard with technological breakthrough in the districts where the productivity is found to be less than the state average (1.36 tonnes/ha) *viz.*, Gwalior (1.08 tonnes/ha), Mandsaur (1.12 tonnes/ha), Neemuch (1.14 tonnes/ha), Betul (0.95 tonnes/ha), Shivpuri (0.87 tonnes/ha) and Satna (1.10 tonnes/ha).

- The untapped potential of mustard in the State is required to harnesses through introduction of value added technologies, apiculture, etc. which will not only increase production of the mustard but will also lead to manifold increase in the income of mustard growers.

- Yield gap analysis is required to be conducted to identify constraints in achieving desired production level in mustard growing districts of the State.

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