

# **A Study of Acreage Dynamics and Crop Variability in the Horticultural Sector of ODOP Scheme of Madhya Pradesh, India**

## **Abstract**

The objective of the present study was to analyse the dynamics of acreage of major horticultural crops included under the ODOP scheme in Madhya Pradesh. The research methodology used for the purpose of analysing the data includes absolute change, relative change, compound annual growth rate and coefficient of Variation. For analysis secondary data on area under various horticultural crops was collected from the official website of Directorate of Economics and Statistics, India for a period of 21 years (2000-01 to 2020-21). Nine major horticultural crops were selected in the study which were divided under spices (Chillies, Coriander, Ginger, Garlic, and Turmeric), vegetables (Potato, and Onion) and fruits (Mango and Banana). The change and growth rate of area under major crops were analysed by using absolute and relative change and compound annual growth rate and coefficient of variation. The analysis and research findings showed that area share under most of spices declined except for chillies in Khargone district. Highest growth rate in area under spices was for garlic in Mandsaur district. For vegetables onion showed increase in area in Shajapur and potato in Dewas and Ujjain, and positive growth rate was recorded for all districts in both crops except potato in Gwalior district. While in fruits banana showed considerable increase in share as well as growth rate in Burhanpur district. Mango showed positive growth rate in Anuppur district. The theoretical implications of the study was a decline in area share but a positive growth rate in majority of spices in Guna, Tikamgarh and Rewa. While the majority of vegetables showed positive growth in the state. The contribution of study is in bringing the attention of spice, vegetable and fruit growers towards the real potential of various districts for the growth of spices, fruit or vegetable in that region. This will ultimately contribute in profiting the farmers and increasing their production efficiency.

Keywords: ODOP, Horticultural crops, Compound annual growth rate

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## **1. INTRODUCTION**

Madhya Pradesh is situated at the centre of India, and is often known as the "Heart of India". Madhya Pradesh is the second-largest state in terms of area in India. It covers around 308 lakh hectares, about 9 per cent of the nation's total land area (Gulati, 2021) out of which nearly 49.49 per cent land is arable (Meena & Parmar, 2023). Madhya Pradesh has an agrarian economy, with

agriculture and related industries accounting for 35 per cent of the state's gross domestic product. Out of total 16 agro-climatic zones of India, Madhya Pradesh state is blessed with 11 agro-climatic zones with diversity in climatic condition and soil fertility leading to vast variety of agricultural commodities. The state is rich in horticultural crop production with nearly 20.18 lakh hectare area under horticultural crop. The various districts of Madhya Pradesh are specialised in production of different crops, local crafts and skills, horticultural crops and various other sectors and contribute significantly to their total production leading to sufficient stock for consumption as well as for export in global market. In order to assist districts in realising their full potential by promoting the product that the district is most widely recognised for; the One District One Product initiative was adopted by the government to transform every district in India into an export centre.

The one district one product scheme is alike to the one village one product (OVOP) programme started by the government of Japan during the year 1979 (Tripathi & Agrawal, 2021). In India, the Uttar Pradesh government launched the one district one product scheme on January 24, 2018, and the Central Government eventually embraced it due to its success. The "One District, One Product" (ODOP) initiative was started by the Ministry of Food Processing Industries. Two product categories are covered under this system. Agriculture-related goods make up one category, while handicrafts make up the other. The programme seeks to provide people with the knowledge they need to add value to one product in each district as well as to increase the state's gross domestic product growth (Misra et.al.,2021). Through focused efforts in the areas of rural entrepreneurship, marketing, and export, it has been developed to realise the full potential of each district. The programme also aspires to profit from economies of scale at every stage of the value chain, from input procurement to the creation of common service centres as well as marketing and branding. The goal of the ODOP project in Madhya Pradesh is to make the Hon'ble Prime Minister's vision of promoting balanced regional development throughout all of the state's districts a reality. The main objectives of the scheme include choosing, branding and promotion of one product from each district, promotion, preservation and development of indigenous knowledge and local crafts and skills, encouraging the production of food and plant products locally and to advertise state districts as a centre for exports. Under the scheme, 52 districts were selected from Madhya Pradesh, in which the following 33 products have been identified for adoption.

Table 1 mentions the 33 agricultural products under the ODOP scheme in 52 districts of Madhya Pradesh. The potentially productive districts like Balaghat and Chhindwar were selected for Paddy and Maize. Sehore and Harda were selected for the production of Wheat. Mandla was selected for the production of millets. Bhind was selected for the production of Bajras. For the production of Pulses, Ashoknagar district has been selected. While Singrauli district has been referred for the production of Tur/Arhar. The major oilseeds like Soyabean, Sesame (*Sesamum Indicum L.*) and Til (*Sesamum Indicum*) were grown in selected districts of Dhar, Morena and Datia respectively. Anuppur, Sidhi and Umariya were selected for the production of Mango. Whereas major fruits crops like Banana, Guava and Custard apple were grown in the selected districts namely Burhanpur, Sheopur, Bhopal and Seoni respectively. The districts of Barwani, Jhabua, Katni, Raisen, Sagar, Satna, Shivpuri and Damoh were selected for the production of Tomato. Spices like Garlic was

grown in Mandsaur, Ratlam and Neemuch district whereas Ginger was grown in the districts of Tikamgarh and Niwari.

**Table 1 Agricultural products under ODOP scheme in Madhya Pradesh**

S.No.	Product	Districts
1.	Amla ( <i>Phyllanthus emblica</i> )	Panna
2.	Bajra ( <i>Pennisetum glaucum</i> )	Bhind
3.	Banana ( <i>Musa sp.</i> )	Burhanpur
4.	Betel vine ( <i>Piper bitle</i> )	Chhatarpur
5.	Custard apple ( <i>Annona reticulata</i> )	Seoni
6.	Cashewnut ( <i>Anacardium occidentale, Linn.</i> )	Betul
7.	Coriander ( <i>Coriandrum sativum</i> )	Guna
8.	Chilli ( <i>Capsicum annuum</i> )	Khargone
9.	Guava ( <i>Psidium guajava L.</i> )	Sheopur, Bhopal
10.	Green pea ( <i>Pisum sativum</i> )	Jabalpur
11.	Garlic ( <i>Allium sativum</i> )	Mandsaur, Ratlam, Neemuch
12.	Ginger ( <i>Zingiber officinale</i> )	Tikamgarh, Niwari
13.	Gram ( <i>Cicer arietinum</i> )	Vidisha
14.	Kodo ( <i>Paspalum scrobiculatum L.</i> ) -Kutki ( <i>Picrorhizakurrooa</i> )	Dindori
15.	Lemon ( <i>Citrus limon</i> )	Hoshangabad
16.	Mandarin orange ( <i>Citrus reticulata</i> )	Rajgarh
17.	Mango ( <i>Mangifera indica</i> )	Anuppur, Sidhi, Umaria
18.	Maize ( <i>Zea mays</i> )	Chhindwara
19.	Millet	Mandla
20.	Orange ( <i>Citrus sinensis</i> )	Agar Malwa
21.	Onion ( <i>Allium cepa</i> )	Shajapur, Khandwa
22.	Potato ( <i>Solanum tuberosum</i> )	Dewas, Gwalior, Indore, Ujjain
23.	Paddy ( <i>Oryza sativa</i> )	Balaghat
24.	Pulses ( <i>Leguminosae</i> )	Ashoknagar
25.	Sesame ( <i>Sesamum indicum L.</i> )	Morena
26.	Soybean ( <i>Glycine max</i> )	Dhar
27.	Sugarcane ( <i>Saccharum officinarum L.</i> )	Narsinghpur
28.	Til ( <i>Sesamum indicum</i> )	Datia
29.	Tur /Arhar ( <i>Cajanus cajan</i> )	Singrauli
30.	Tomato ( <i>Solanum lycopersicum</i> )	Barwani, Jhabua, Katni, Raisen, Sagar, Satna, Shivpuri, Damoh
31.	Turmeric ( <i>Curcuma longa</i> )	Rewa, Shahdol
32.	Wheat ( <i>Triticum aestivum</i> )	Sehore, Harda
33.	White musli ( <i>Chlorophytum borivillianum</i> )	Alirajpur

Source- Council of Scientific & Industrial research, Ministry of Science & technology, govt of India.  
[https://pmfme.cftri.res.in/odop/food\\_details.php](https://pmfme.cftri.res.in/odop/food_details.php)

## 1.2 RESEARCH OBJECTIVES AND QUESTIONS

**1.2.1 Research Objectives:** The present study is done with an objective of analysing the dynamics of acreage of major horticultural crops included under the ODOP scheme in Madhya Pradesh so that farmers get benefitted by the

**1.2.2 Research Questions :**What the performance of crops under the ODOP scheme in terms of change in area, growth and variation in them.

## 2. METHODOLOGY

**2.1 Research Design:** The current study used a type of Quantitative research design because it answered the questions of whowas being affected by the shift in dynamics of

area, growth rate and variation under crops, what had happened with the growth rate of crops, where was the study area, how was the shift taken place, and when was the study done. The outcome had been represented via table and graphs in quantitative terms for a complete understanding and interpretation of data for research.

## 2.2 Sampling Design:

For the present study out of 33 crops of ODOP only nine horticultural crops were considered randomly which are classified in to three groups spices (Chillies, Coriander, Ginger, Garlic, and Turmeric), vegetables (Potato, and Onion) and fruits (Mango and Banana) covering eighteen districts.

## 2.3 Instruments and data collections

The study is based on secondary data collected from the official website of Directorate of Economics and Statistics, India (<https://eands.dacnet.nic.in/>). For the study secondary data on area under the crops for ODOP districts for particular crop were collected for a period of 21 years (2000-01 to 2020-21).

## 2.4. Data and types of Statistical Analysis

For analysis purposes following analytical tools are used.

### Absolute change (AC):

Absolute change is the total change in the considered quantity for a given period of time. It is a simple difference between initial and final amount over a period of time. It is worked out to analyse the absolute changes in area under considered crops by using the following formula.

$$\text{Absolute change} = Y_n - Y_o$$

Where,

Y = Area of the selected crop.

n = Average of the last three years of the study period (current year).

o = Average of initial three years of the study period (base year).

### Relative change (RC):

Relative change is an indicator of difference between two similar quantities. It is used to express absolute change as percentage with respect to the initial point. Relative change in area of selected crops in selected districts was estimated by using the following formula.

$$\text{Relative change} = \frac{Y_n - Y_o}{Y_o} \times 100$$

Y, n and o have the same interpretations as given above in absolute change.

### Compound annual growth rate

The compound annual growth rate is used to quantify the growth of area of considered crops. To estimate compound annual growth rates, the exponential equation of the following form was fitted:

$$Y_t = a * b^t$$

Annual compound growth rate was given by

$$r = (\text{antilog } b - 1) * 100$$

Where,

Y<sub>t</sub> = Area under crop

T= Time in years

a = Constant

b= Regression coefficient

### Coefficient of Variation (CV)

The coefficient of variation is used to measure the level of dispersion around the mean. It is expressed as the ratio of Standard deviation to mean and is expressed in percentage.

$$CV = \frac{\text{Standard deviation} * 100}{\text{Mean}}$$

### 3. RESULTAND DISCUSSION

The results of absolute and relative changes in major spices grown in Madhya Pradesh under ODOP program is presented in table 2.

Data presented table 2 showed the absolute and relative change in area of selected spices under ODOP scheme in Madhya Pradesh. From data it can be observed that over the years for all of the spices, except chillies in Khargone, there was decline in the share of area. In Khargone district increase in share of area for chillies was observed with 63.92 per cent in current year from 29.49 per cent in base year. For ginger drastic decline in share of area in Tikamgarh district was observed from 20.87 per cent in base year to 0.74 per cent share in current year. Over the years chillies showed positive relative change in Khargone district as well as in Madhya Pradesh and garlic showed positive relative change in Mandsaur district while negative change in Neemuch and Ratlam districts. The rest of the spices showed negative relative change in their respective districts.

**Table 2: Absolute- relative changes in acreage of selected spices under ODOP**

Spices	District	&	Base	Share to	Current	Share to	Absolute	Relative
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	state	year (00' ha)	State area (%)	year (00' ha)	State area (%)	change (00'ha)	change (%)
Chillies	Khargone	127.38	<b>29.49</b>	453.85	<b>63.92</b>	326.47	2.56
	Madhya Pradesh	431.96	<b>100.00</b>	710.01	<b>100.00</b>	278.05	0.64
Coriander	Guna	587.23	<b>62.01</b>	252.76	<b>24.16</b>	-334.47	-0.57
	Madhya Pradesh	947.05	<b>100.00</b>	1046.23	<b>100.00</b>	99.18	0.10
Garlic	Mandsaur	28.49	<b>16.23</b>	52.16	<b>15.64</b>	23.67	0.83
	Neemuch	17.56	<b>10.00</b>	17.30	<b>5.19</b>	-0.26	-0.01
	Ratlam	35.32	<b>20.12</b>	33.57	<b>10.06</b>	-1.75	-0.05
	Madhya Pradesh	175.52	<b>100.00</b>	333.54	<b>100.00</b>	158.02	0.90
Ginger	Tikamgarh	8.9	<b>20.87</b>	0.36	<b>0.74</b>	-8.54	-0.96
	Madhya Pradesh	42.65	<b>100.00</b>	48.6	<b>100.00</b>	5.95	0.14
Turmeric	Rewa	0.31	<b>8.31</b>	0.05	<b>0.28</b>	-0.26	-0.84
	Shahdol	0.23	<b>6.17</b>	0.12	<b>0.68</b>	-0.11	-0.48
	Madhya Pradesh	3.73	<b>100.00</b>	17.61	<b>100.00</b>	13.88	3.72

Base year = 2000-01,

Current year = 2020-21

Source : Research Findings (2024)

Data presented in table 3 showed that increase in share of area was observed for onion in Shajapur district with 6.00 per cent in base year and 13.05 per cent in current year and for potato increase was observed for Dewas and Ujjain districts while decline in share was observed for Gwalior districts and minor decline for Indore district with 33.59 per cent in base year and 32.39 per cent in current year. Highest increase in share was observed for potato in Ujjain district with increase from 3.87 per cent to 19.57 per cent. Both onion and potato showed positive relative change in all districts except for Gwalior where negative relative change of -0.74 per cent was observed.

**Table 3: Absolute- relative changes in acreage of selected vegetables under ODOP**

Vegetables	District	&	Base	Share to	Current	Share to	Absolute	Relative
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	state	year (00' ha)	State area (%)	year (00' ha)	State area (%)	change (00'ha)	change (%)
1.Onion	Khandwa	22.25	<b>11.51</b>	53.47	<b>5.68</b>	31.22	1.40
	Shajapur	11.6	<b>6.00</b>	122.88	<b>13.05</b>	111.28	9.59
	Madhya Pradesh	193.27	<b>100.00</b>	941.38	<b>100.00</b>	748.11	3.87
2. Potato	Dewas	27.02	<b>6.68</b>	78.07	<b>12.81</b>	51.05	1.89
	Indore	135.82	<b>33.59</b>	197.44	<b>32.39</b>	61.62	0.45
	Gwalior	10.96	<b>2.71</b>	2.84	<b>0.47</b>	-8.12	-0.74
	Ujjain	15.63	<b>3.87</b>	119.3	<b>19.57</b>	103.67	6.63
	Madhya Pradesh	404.33	<b>100.00</b>	609.62	<b>100.00</b>	205.29	0.51

Base year = 2000-01,

Current year = 2020-21

Source : Research Findings (2024)

From data presented in table 4 it can be observed that among fruits positive relative change was observed with 2.12 per cent for banana in Burhanpur district and for mango, positive change was observed only in Umaria districts with change of 1.29 per cent. Increase in share of area over the years was observed for banana in Burhanpur district with 84.58 per cent share in current year. For mango decline in area was observed for Sidhi district with only 2.89 per cent share in current year and minor increase in area share was observed in Annuppur district. In Umaria district the share increased with 0.40 per cent in base year to 1.95 per cent in current year. For mango negative relative change was observed for Madhya Pradesh state as a whole with -0.53 per cent however positive change was observed for banana with 1.12 per cent.

**Table 4: Absolute- relative changes, in acreage of selected fruits under ODOP**

Fruits	District & state	Base year (00' ha)	Share to State area (%)	Current year (00' ha)	Share to State area (%)	Absolute change (00'ha)	Relative change (%)
1.Banana	Burhanpur	131.16	<b>57.50</b>	409.45	<b>84.58</b>	278.29	2.12
	Madhya Pradesh	228.1	<b>100.00</b>	484.11	<b>100.00</b>	256.01	1.12
2. Mango	Annuppur	0.18	<b>0.23</b>	0.12	<b>0.33</b>	-0.06	-0.33
	Sidhi	4.87	<b>6.26</b>	1.05	<b>2.89</b>	-3.82	-0.78
	Umaria	0.31	<b>0.40</b>	0.71	<b>1.95</b>	0.4	1.29
	Madhya Pradesh	77.75	<b>100.00</b>	36.32	<b>100.00</b>	-41.43	-0.53

Base year = 2000-01

Current year = 2020-21

Source : Research Findings (2024)

Data presented in table 5 shows the growth rate in area under spices in various ODOP districts. From the table it can be observed that for most of spices positive growth rate was observed over the years. For coriander in Guna, ginger in Tikamgarh and turmeric in Rewa, negative growth rate was observed

with -4.94, -18.75 and -9.31 per cent respectively. From the data it can be observed that positive but non-significant growth rate was observed for Chillies in Khargone district, for garlic in all three districts positive and significant growth was seen. For turmeric positive growth rate was observed only in Shahdol district. Among spices highest growth rate was observed for garlic in Mandsaur district with 32.09 per cent. Highest CV of 134.23 per cent was observed for ginger in Tikamgarh district while lowest CV value of 18.94 per cent was observed for coriander in Guna district.

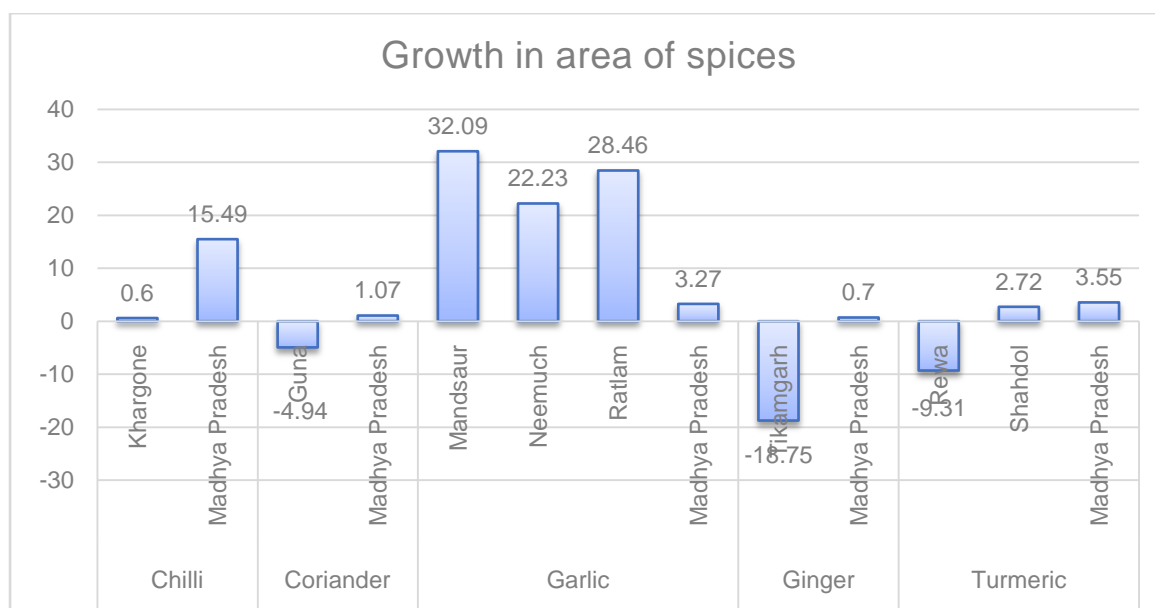
**Table 5. Variability and Growth rate of area of selected spices in various districts of Madhya Pradesh under ODOP scheme**

<b>Spices</b>	<b>District &amp; state</b>	<b>b value (SE)</b>	<b>CV (%)</b>	<b>CAGR (%)</b>
Chillies	Khargone	0.14 (0.04)	50.51	15.49
	Madhya Pradesh	0.006 (0.0043)	27.44	0.60
Coriander	Guna	-0.05 (0.02)	18.94	-4.94***
	Madhya Pradesh	0.011(0.0038)	25.80	1.07**
Garlic	Mandsaur	0.28(0.05)	60.60	32.09**
	Neemuch	0.20(0.05)	46.73	22.23**
	Ratlam	0.25(0.06)	61.30	28.46**
	Madhya Pradesh	0.032(0.0054)	50.90	3.27**
Ginger	Tikamgarh	-0.21(0.12)	134.23	-18.75
	Madhya Pradesh	0.007(0.0057)	34.68	0.70
Turmeric	Rewa	-0.10(0.08)	49.08	-9.31
	Shahdol	0.03(0.06)	44.20	2.72
	Madhya Pradesh	0.035(0.0044)	57.21	3.55**

\*\*\*significant at 5 per cent level of significance

\*\* significant at 1 per cent level of significance

Source : Research Findings (2024)



**Figure 1. Growth rate of area under spices in ODOP districts and Madhya Pradesh state**  
Source: Research Findings (2024)

Figure 1 depicts the growth in area of spices graphically. It can be clearly observed from the graph that crop of Garlic showed the highest growth in the districts where it is taken namely Mandsaur (32.09%), Ratlam (28.46%) and Neemuch (22.23%). Ginger, turmeric and Coriander showed a negative growth of -18.75 per cent, -9.312 per cent and 4.94 per cent respectively. Chilli had the highest growth Madhya Pradesh with 15.49 per cent while all the other crops showed a growth of less than 4 per cent in the state.

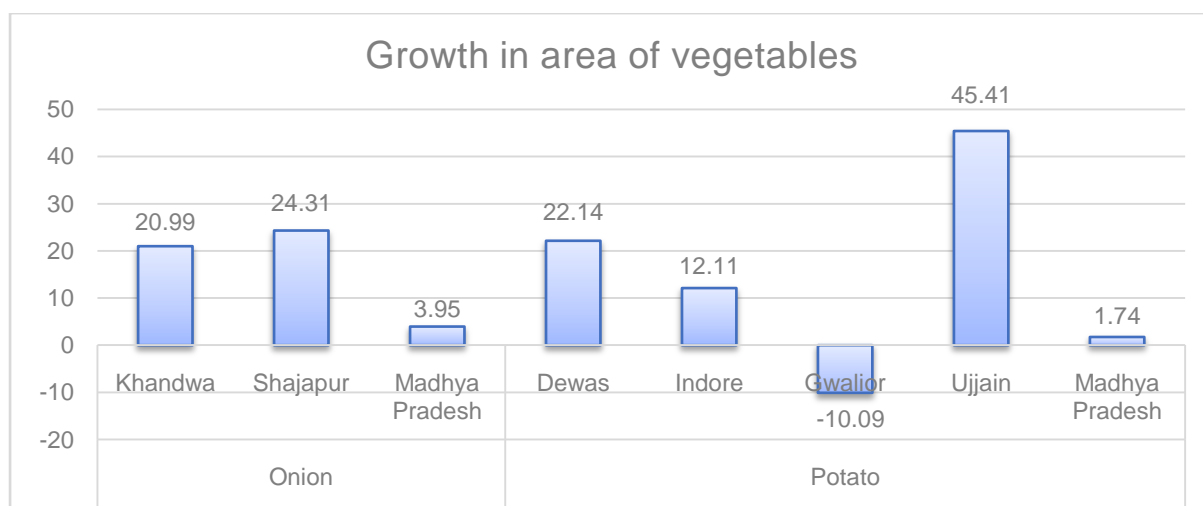
From data presented in table 6 it can be observed that positive and significant growth of 3.95 and 1.74 per cent respectively was observed for both onion and potato in Madhya Pradesh. For onion higher growth rate was observed in Shajapur compared to Khandwa district. For potato positive and significant growth rate was observed in all the districts except for Gwalior district. In vegetables highest growth rate was observed for potato in Ujjain district with 45.41 per cent. Highest CV of 62.83 per cent was observed for potato in Ujjain district and lowest was for Indore district (24.23 per cent).

**Table 6. Variability & Growth rate of area of selected vegetable in various districts of Madhya Pradesh under ODOP scheme**

Vegetables	District & state	b value (SE)	CV (%)	CAGR (%)
1. Onion	Khandwa	0.19 (0.02)	32.46	20.99**
	Shajapur	0.22 (0.15)	57.44	24.31
	Madhya Pradesh	0.038(0.002)	50.21	3.95**
2. Potato	Dewas	0.20 (0.03)	42.15	22.14**
	Indore	0.11 (0.02)	24.23	12.11**
	Gwalior	-0.11 (0.03)	25.37	-10.09**
	Ujjain	0.37 (0.04)	62.83	45.41**
	Madhya Pradesh	0.017 (0.0026)	26.57	1.74**

\*\* significant at 1 per cent level of significance

Source : Research Findings (2024)



**Figure 2. Growth rate of area under vegetables in ODOP districts and Madhya Pradesh**

Figure 2 shows that Potato had the highest growth rate in area in Ujjain district (45.41%) followed by Dewas (22.14%) and Indore (24.31%). Whereas it had a negative growth rate of -10.09 per cent in Gwalior. Onion had a positive growth of 24.31 per cent in Shajapur and 20.99 per cent in Khandwa respectively.

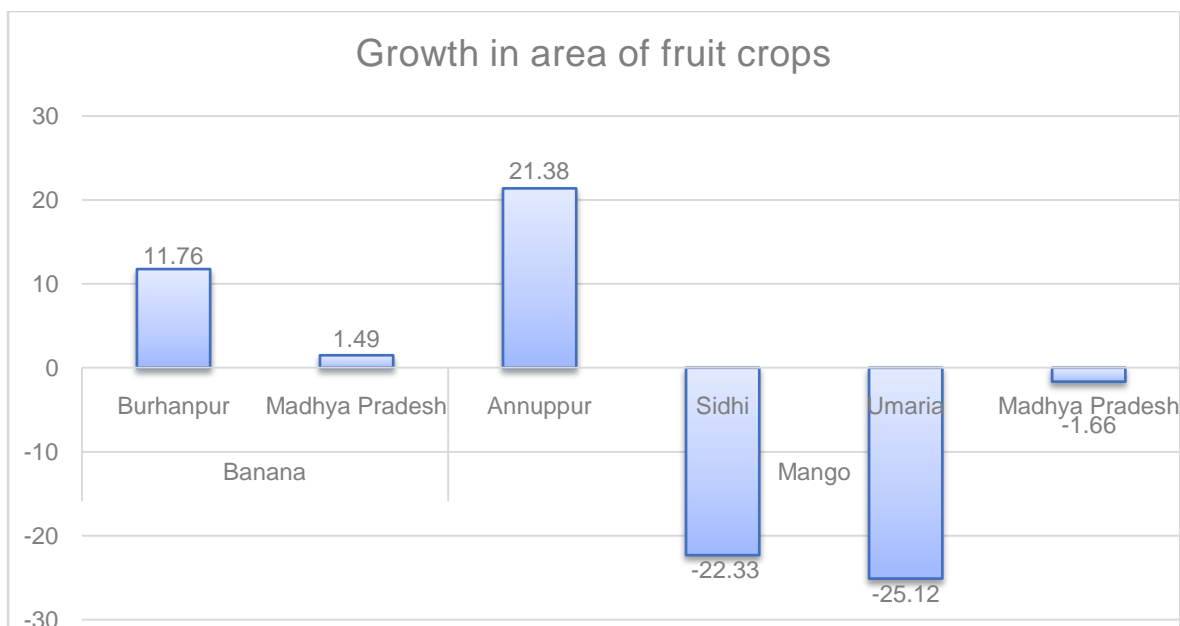
Data presented in table 7 shows that among fruits Burhanpur district showed positive and significant growth rate for banana and for mango positive but non-significant growth rate was observed only in Annuppur district with 21.38 per cent and Sidhi and Umaria districts showed negative growth rate. In Madhya Pradesh positive and significant growth rate was observed for banana with 1.49 per cent growth and negative but significant growth was observed for mango with -1.66 per cent. Highest CV value of 117.20 percent was observed for Umaria district followed by Annuppur district (99.56 per cent).

**Table 7. Growth rate of area of selected fruit crops in various districts of Madhya Pradesh under ODOP scheme**

Fruits	District & state	b value (SE)	CV (%)	CAGR (%)
1. Banana	Burhanpur	0.11 (0.03)	37.35	11.76**
	Madhya Pradesh	0.015(0.0034)	37.60	1.49**
2. Mango	Annuppur	0.19 (0.12)	99.56	21.38
	Sidhi	-0.25 (0.05)	47.52	-22.33**
	Umaria	-0.29 (0.14)	117.20	-25.12
	Madhya Pradesh	-0.02(0.0025)	22.73	-1.66**

\*\* significant at 1 per cent level of significance

Source: Research Findings (2024)



**Figure 3. Growth rate of area under fruits in ODOP districts and Madhya Pradesh**

Source: Research Findings (2024)

Figure 3 depicts the decline in growth rate in area of mango in the state by -1.66 per cent and in the districts of Umaria and Sidhi by -25.12 per cent and -22.33 per cent respectively while the area in Anuppur grew by 21.38 per cent. Banana had a positive growth in area of 11.76 per cent in Burhanpur district.

#### 4. CONCLUSION

In conclusion, the comprehensive analysis of horticultural crop dynamics under the ODOP scheme in Madhya Pradesh provides valuable insights into the agricultural landscape of the region. The study highlights both promising trends and challenges across different districts. The positive growth rates observed in various spices and vegetables underscore the potential for agricultural prosperity. However, the contrasting performance of specific crops like coriander, ginger, turmeric, potato, mango, and banana in different districts emphasizes the need for nuanced strategies and targeted interventions. These findings serve as a crucial foundation for policymakers, researchers, and farmers alike, guiding future initiatives to optimize crop cultivation and enhance overall agricultural sustainability in the region.

#### 5. RECOMMENDATIONS

##### 5.1 Recommendations to the study :

It can be recommended through the study that district specific action plan based on the contrasting performance of crops should be encouraged. This approach will ensure that the resources are efficiently utilized. Incentives and support to the farmers should be provided to diversify into crops showing positive growth rates, especially in spices and vegetables. Crop diversification should be encouraged through financial incentives, training programs and access to market that value these crops. The risk associated with

specific crops should be recognized. Risk mitigation strategies including insurance schemes and pest control measures should be implemented. These measures will help farmers safeguard their investments and improve overall yield stability. Establishment of cold storages, transportation networks and market information systems should be done in the districts showing more profit and productivity. Strengthening of research and extension services to bridge knowledge gaps and disseminate best practices should be done. By incorporating these recommendations, stakeholders can build on the insights provided by the study and work accordingly to optimize crop cultivation, address challenges and enhance overall sustainability of agriculture under ODOP scheme in Madhya Pradesh.

## **5.2 Recommendations to the future researchers:**

Based upon the study, future researchers should prioritize district-specific analyses, recognizing the heterogeneity in crop performance. Future researchers should investigate opportunities for crop diversification, incorporate risk assessment in crop studies, evaluate the impact of technology adoption, investigate market dynamics for specific crops. Future researchers should collaborate with the Agricultural Extension services to bridge the gap between research findings and practical implementation, Prioritize Climate-Resilient Agriculture Research, Encourage Participatory Research Methods, Assess the long-term sustainability impacts of interventions and policies. By considering these recommendations, future researchers can contribute to the ongoing improvement of agricultural practices, policy frameworks, and sustainability initiatives in the studied region.

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