**A Study on Instability and Acreage Dynamics of Spices and Condiments in Malwa Plateau Agro-Climatic Zone of Madhya Pradesh, India**

**Abstract**

Considering the rising value of spices in the global market or the outstanding health benefits, the economic importance and utility of Spices and Condiments are undeniable. The present study uses descriptive statistical tools such as, proportional analysis and graphical representation techniques such as Column Graphs, Trend Lines and Simple Growth Rate to analyse the distribution, trend and growth of area under spices. Cuddy Della Vella Index (CDVI) was used to analyse the instability of spices and condiments in the Malwa plateau agro-climatic zone for a period of 22 years from 1998 to 2019 for which the data was collected from the official government sources. Area under all the spices except black pepper had moved in a positive trend but most spices were found to follow a zig-zag pattern of trend from 1999-2009. Coriander (41.03%) and Garlic (32.06%) were the most dominant spices in the region covering more than half of the total spices and condiments. They expanded at the linear rate (b value) of 2938.2 hectares and 3813.6 hectares per year on an average. Betel nut, Cardamom and Black pepper was found negligible in the region. Turmeric (9.16%), garlic (7.02%) and ginger (6.86%) had the highest simple growth rate. Coriander expanded at a slow rate of 4.23 per cent. Betel nut, Black pepper, Turmeric had very high CDVI index values due to non-uniform cultivation pattern. Ginger (36.75%) and Coriander (32.24%) showed a high instability whereas area under garlic (25.87%) and chillies (22.72%) had a moderate growth in area.

**Key words:** *Cuddy Della Vella index (CDVI), Instability, Simple Growth Rate,* *Spices and Condiments, Trend Lines.*

1. **INTRODUCTION**

Spices and Condiments are an integral part of Indian agriculture. It not only contributes to medicinal and nutritional value but also plays a crucial role in nation’s income and exports. In the Financial Year 2024-25, India retained its position as the leading exporter of spices globally. Among the leading spice producing states in India, Madhya Pradesh ranked first with 3.63 million tonnes in 2023-24. Among various agro-climatic zones in Madhya Pradesh, Malwa plateau has shown the potential for growth of spices and condiments. This one agro-climatic zone alone covers more than 50 per cent of the total area under spices and condiments in the state of Madhya Pradesh. Considering the distribution of spices is crucial for a focused approach towards proper resource utilization for better spices growth. Analyzing trend and growth of spices is important for agro economic planning to avoid losses and to conduct proper operations for manufacturing of raw and value added products which directly benefits the farmers and ultimately helps in growth of economy. Understanding regional trends supports to align local production with export demand and global competitiveness (Vinothini & Suthacini, 2024). Instability in area under spices is needed to be analyzed in order to check the consistency in acreage of spices and also to check the results of utilization of resources done for the growth and expansion of acreage under it. Spices and condiments frequently encounter the problem of price volatility due to change in cultivation area. Working on instability helps to identify which regions and crops are more prone to market shocks and climate changes, ensuring better risk management (Rajanbabu *et al*., 2022).

The study of area under spices is crucial as it contributes to the rural livelihood and market economies. Spices has a good potential for profit generation for farmers. Studying its cultivation, supports sustainable agricultural practices and helps identify high-value crops, especially in local and traditional markets (Wendimu & Tekalign, 2022). Spices and condiments has tremendous health benefits and understanding the cultivation of spices can support public health interventions (Maidebura *et al*., 2021), (Dini & Laneri, 2021). Therefore, a study has been undertaken to find the Instability and Acreage Dynamics of Spices and Condiments in Malwa Plateau agro-climatic zone of Madhya Pradesh, India with the following objectives:

**Objective 1:** To analyse the distribution and contribution of spices in various districts of Malwa Plateau

**Objective 2:** To analyse the Trend of area under spices and condiments in Malwa Plateau

**Objective 3:** To study the growth in area under spices and condiments in Malwa Plateau

**Objective 4:** To analyze the instability in area under spices and condiments in Malwa Plateau

1. **METHODOLOGY**
   1. **Study Period:** The study is conducted for a period of 22 years from 1998 to 2019.
   2. **Selection of Study Area:** The study is conducted in the Malwa Plateau agro-climatic zone and its constituent districts namely Agar Malwa, Dewas, Dhar, Indore, Mandsaur, Neemuch, Rajgarh, Ratlam, Shajapur and Ujjain. It was purposively selected as it covers more than 50 per cent (57.10 percent) of the total cropped area under spices and condiments in Madhya Pradesh as presented in Table 1. Also, the selection of Malwa plateau has been done considering the presence of eight districts from Malwa plateau agro-climatic zone among the top ten leading districts of spices and condiments in terms of area in Madhya Pradesh (Table 2).

Table 1. Sum of Area under Condiments and Spices in various agro-climatic zones of Madhya Pradesh during the study period

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S.N** | **Agro-climatic Zones** | **Area under Condiments and Spices (ha)** | **Share (%)** | **Cumulative share (%)** |
| 1. | **Malwa Plateau** | 3726151 | 57.10 | 57.10 |
| 2. | **Gird region** | 1269119 | 19.45 | 76.54 |
| 3. | **Nimar Plains** | 673046 | 10.31 | 86.86 |
| 4. | **Vindhya Plateau** | 258655 | 3.96 | 90.82 |
| 5. | **Satpura Plateau** | 193494 | 2.96 | 93.78 |
| 6. | **Kymore Plateau and Satpura Hills** | 141540 | 2.17 | 95.95 |
| 7. | **Bundelkhand** | 95208 | 1.46 | 97.41 |
| 8. | **Central Narmada Valley** | 63955 | 0.98 | 98.39 |
| 9. | **Jhabua Hills** | 42390 | 0.65 | 99.04 |
| 10. | **Northern Hill region of Chhattisgarh** | 40335 | 0.62 | 99.66 |
| 11. | **Chhattisgarh Plains** | 22215 | 0.34 | 100.00 |
|  | **Grand Total** | **6526108** | 100.00 |  |

Table 2 depicts that, eight of the top ten Districts in terms of area under cultivation of spices and condiments belongs from Malwa plateau agro-climatic zone. These districts together cover more than 50 percent (54.56 %) of the total cultivated area under spices and condiments in Madhya Pradesh. Mandsaur (14.54%), Rajgarh (9.99%) and Ratlam (6.80%) districts were the leaders in share of area in the Malwa Plateau agro-climatic zone.

Table 2. Sum of Area under Condiments and Spices in top ten leading districts of Madhya Pradesh

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Districts** | **Area under Condiments and Spices** | **Share** | **Cumulative share** | **Agro-climatic zone** |
| **Guna** | 1023381 | 15.68 | 15.68 | Gird region |
| **Mandsaur** | 949450 | 14.54 | 30.23 | Malwa Plateau |
| **Rajgarh** | 652544 | 9.99 | 40.22 | Malwa Plateau |
| **Ratlam** | 444028 | 6.80 | 47.03 | Malwa Plateau |
| **Khargone** | 392902 | 6.02 | 53.05 | Nimar Plains |
| **Neemuch** | 392868 | 6.02 | 59.07 | Malwa Plateau |
| **Ujjain** | 349704 | 5.36 | 64.43 | Malwa Plateau |
| **Shajapur** | 324766 | 4.97 | 69.40 | Malwa Plateau |
| **Dhar** | 306811 | 4.70 | 74.10 | Malwa Plateau |
| **Khandwa** | 142541 | 2.18 | 76.29 | Malwa Plateau |
| **Grand Total** | 6526108 | 100.00 |  |  |

* 1. **Selection of Data:** Theresearch is based on secondary data obtained from the official website of Ministry of Agriculture and Farmers Welfare (2023), Land use statistics information system, Government of India (aps.dac.gov.in).
  2. **Selection of Crops:** All the spices and condiments cultivated in the Malwa Plateau agro-climatic zone has been selected for the purpose of the research namely: Cardamom, Turmeric, Ginger, Coriander, Garlic, Black pepper, Chilies and Betel nut.
  3. **Objectives:** The study was undertaken with the following objectives-

**Objective 1:** To analyse the distribution and contribution of spices in various districts of Malwa Plateau

**Objective 2:** To analyse the Trend of area under spices and condiments in Malwa Plateau

**Objective 3:** To study the growth in area under spices and condiments in Malwa Plateau

**Objective 4:** To analyze the instability in area under spices and condiments in Malwa Plateau

* 1. **Analytical Tools and methods:**
     1. **Absolute change (AC)**

It is defined as the difference between the initial irrigated area and final irrigated area over a period of time. It has a unit same as that of irrigated area (Vani *et al.,* 2023). The absolute change has been worked out to find the difference in irrigated area under various irrigation sources from the initial base year period (Triennium Ending (TE) 1970) to final current year period (TE 2019).

**Absolute change =**

Where,

= Average of the irrigated area in current three years (TE 2019) of the study period (Current year)

= Average of the irrigated area in initial three years (TE 1970) of the study period (Base year).

* + 1. **Relative change (RC)**

It is a representation of Absolute change in terms of percentage which gives a broader perspective of interpretation and comparison for the researcher. It is represented as a percentage change in the current year with respect to the base year (Vani *et al.,* 2023). Relative change has been computed in order to find the difference in irrigated area under various sources of irrigation from initial base year period (TE 1970) to current year period (TE 2019) in terms of percentage which provides a better perspective of comparison between the two periods.

Relative change in area under irrigation was estimated by using the following formula-

**Relative change = × 100**

= Average of the irrigated area in current three years (TE 2019) of the study period (Current year)

= Average of the irrigated area in initial three years (TE 1970) of the study period (Base year)

* + 1. **Trend analysis**

The direction of change in a time series data is represented geometrically by a trend line. The relationship between two variables in a dataset is represented by a trend line, which usually takes the form of a linear equation known as trend equation. It often includes an independent variable and a slope (Singh *et al.*, 2025). For the purpose of the research, the trend of cultivated area uncer Spices and condiments present in Malwa Plateau agro-climatic zone has been computed using linear trend equation.

**Y =a + bT**

Where,

Y = Dependent Variable (Gross Cropped Area, Share of Major Cereals and Millets)

a = Constant (Intercept of trend line). Value when T=0.

b = Rate of change (Slope of trend line)

T = Time (Years)

* + 1. **Simple Growth Rate (SGR)**

It represents the growth rate from the linear trend curves. It does not takes into regard the fluctuations and variations in the time series data. Simple growth rate is computed to analyse the growth of area under various spices and condiments in different districts of Malwa Plateau agro-climatic zone. The formula represents the growth rate from the linear trend curves. These are generally found appropriate for the analysis of grown in area under crops (Singh *et al*., 2025), (Sananse and Maidapwad, 2009). Following formula of SGR has been used to calculate the growth

Where,

b : Regression Coefficient

: Mean of Dependent Variable (Gross Cropped Area, Share of Major Cereals and Millets)

* + 1. **Coefficient of Variation (CV)**

Instability is one of the crucial parameter in the decision making process while dealing with agricultural outputs. Apart from growth, fluctuations in crop area plays a key role in bringing extensive variations in disposable income of the farmers. The volatility in crop area depends on several factors like availability of inputs, resources, weather conditions, economic environment and several other factors. High growth in area with a low level of fluctuation in area of any crop is desirable for sustainable development of any crop. In the present study, the extent in variation is analysed using Coefficient of variation. (Rajanbabu *et al*., 2022). It was computed using the formula:

CV=σ/X ̅ \*100

Where,

σ = Standard deviation of variable considered (Area under particular spices and condiments)

X ̅= Mean of area under spices and condiment

* + 1. **Cuddy-Della Valle Instability Index (CDVI)**

The CDVI is a statistical metric used to examine the instability of time series data, notably in agricultural applications. The index, which was created by Cuddy and Della Valle in 1978, is especially helpful for data that shows patterns since it accounts for these patterns to give a more accurate view of variability. It calculates the area’s relative instability. The direct use of CV overestimates the instability in long term time series data whereas CDVI corrects the coefficient of variation (Rajanbabu *et al*., 2022).

Cuddy-Della Valle usedthis index to compute the instability in the production. Krishan and Chanchal (2014), Deb and Pramanik (2015), Vekariya *et al*., (2020), Mishra *et al.,* (2023), Singh *et al.,* (2025) also used Cuddy Della Valle Index to analyse the instability and considered the coefficient of determination from a time-trend regression adjusted by the number of degrees of freedom. This Index corrects the coefficient of variation in long term trend. It shows the exact direction of instability. Therefore, it is a better measure to capture instability in agricultural production (Vilhekar *et al.*, 2022).The instability in the growth of area under spices and condiments had been analyzed using CDVI.

**CDVI =**

Where,

σ : Standard Deviation

: Arithmetic Mean of Gross cropped area of different crops in the study period

: Adjusted coefficient of Determination

The index categorizes instability into three levels:

Low Instability: 0% to 15%

Medium Instability: 15% to 30%

High Instability: Above 30%

1. **RESULTS** 
   1. **Analysis of the distribution and contribution of spices in various districts of Malwa Plateau**

Table 3 and Figure 1 shows the top 3 major contributors of spices and condiments in Malwa plateau were Mandsaur, Rajgarh and Ratlam districts. Mandsaur contributed 25.48 percent, Rajgarh contributed 17.51 percent and Ratlam district contributed 11.92 percent of the total cropped area under spices in the region. These three districts together holds 54.91 percent of the total spices and condiments. The top crops which hold maximum area were Coriander (15,28,789 ha), Garlic (11,94,596 ha), other spices and condiments (696013 ha) and Chillies (278735 ha). Agar Malwa (3.11%), Indore (2.51%) and Dewas (2.59%) districts were the least contributors of spices and condiments in the region. It is evident from the graph (Figure 1) that Rajgarh and Mandsaur were the major contributors of coriander, Cardamom is not growth in the region. Whereas, Black pepper is grown in a negligible quantity (only 6 ha of the cropped area).

**Table 3: Distribution of area under spices and condiments in various districts of Malwa plateau agro-climatic zone**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Districts** | **Cardamom** | **Turmeric** | **Ginger** | **Coriander** | **Garlic** | **Black pepper** | **Chillies** | **Betul nut** | **Other Condiments and Spices** | **Total Condiments and spices** | **Share**  **(%)** |
| **Agar Malwa** | - | 1572 | 2 | 72585 | 9926 | - | 2207 | 14333 | 15187 | 115812 | 3.11 |
| **Dewas** | - | 193 | 1849 | 2433 | 87984 | - | 2649 | - | 1490 | 96598 | 2.59 |
| **Dhar** | - | 1065 | 5862 | 2725 | 88827 | 1 | 189650 | - | 18681 | 306811 | 8.23 |
| **Indore** | - | 33 | 552 | 1884 | 85453 | 4 | 2923 | - | 2721 | 93570 | 2.51 |
| **Mandsaur** | - | 11 | 8 | 480951 | 209688 | - | 15491 | - | 243301 | 949450 | 25.48 |
| **Neemuch** | - | 87 | 1 | 122429 | 167398 | - | 2476 | - | 100477 | 392868 | 10.54 |
| **Rajgarh** | - | 14 | 39 | 578002 | 40845 | - | 11890 | - | 21754 | 652544 | 17.51 |
| **Ratlam** | - | 133 | 1965 | 23316 | 230309 | - | 40455 | - | 147850 | 444028 | 11.92 |
| **Shajapur** | - | 8 | 93 | 222157 | 66727 | 1 | 8836 | - | 26944 | 324766 | 8.72 |
| **Ujjain** | - | 57 | 135 | 22307 | 207439 | - | 2158 | - | 117608 | 349704 | 9.39 |
| **Grand Total** | **-** | **3173** | **10506** | **1528789** | **1194596** | **6** | **278735** | **14333** | **696013** | **3726151** | 100 |

*Units in hectares (ha)*

Figure 1: Distribution of area under spices and condiments in various districts of Malwa plateau agro-climatic zone

Table 4 and Figure 2 represents the crop specialization and regional variation in spices and condiments cultivation in Malwa Plateau agro-climatic zone. It shows that Malwa plateau as mainly Coriander and Garlic dominant belt. The Coriander emerges as the dominant spice, accounting for the highest average share with 41.03 per cent across all the districts. It is particularly prominent in Rajgarh (88.58%), Shajapur (68.41%) and Agar Malwa (62.67%). Garlic is the second most dominant spice in Malwa plateau with a substantial share of 32.06 per cent. It is heavily concentrated in the districts of Indore (91.33%), Dewas (91.08%) and Ratlam (51.87%). Chillies covered 7.48 per cent among the total spices. It was mainly cultivated in Dhar district indicating a localized preference with 61.81 percent area.

Table 4: Percentage contribution of various spices and condiments in different districts of Malwa Plateau agro-climatic zone.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Districts** | **Cardamom** | **Turmeric** | **Ginger** | **Coriander** | **Garlic** | **Black pepper** | **Chillies** | **Betel nut** | **Other Condiments and Spices** | **Total Condiments and spices** |
| **Agar Malwa** | - | 1.36 |  | 62.67 | 8.57 |  | 1.91 | 12.38 | 13.11 | 100.00 |
| **Dewas** | - | 0.20 | 1.91 | 2.52 | 91.08 |  | 2.74 |  | 1.54 | 100.00 |
| **Dhar** | - | 0.35 | 1.91 | 0.89 | 28.95 |  | 61.81 |  | 6.09 | 100.00 |
| **Indore** | - | 0.04 | 0.59 | 2.01 | 91.33 |  | 3.12 |  | 2.91 | 100.00 |
| **Mandsaur** | - |  |  | 50.66 | 22.09 |  | 1.63 |  | 25.63 | 100.00 |
| **Neemuch** | - | 0.02 |  | 31.16 | 42.61 |  | 0.63 |  | 25.58 | 100.00 |
| **Rajgarh** | - |  | 0.01 | 88.58 | 6.26 |  | 1.82 |  | 3.33 | 100.00 |
| **Ratlam** | - | 0.03 | 0.44 | 5.25 | 51.87 |  | 9.11 |  | 33.30 | 100.00 |
| **Shajapur** | - |  | 0.03 | 68.41 | 20.55 |  | 2.72 |  | 8.30 | 100.00 |
| **Ujjain** | - | 0.02 | 0.04 | 6.38 | 59.32 |  | 0.62 |  | 33.63 | 100.00 |
| **Total** | **-** | 0.09 | 0.28 | 41.03 | 32.06 | 0.00 | 7.48 | 0.38 | 18.68 | 100.00 |

Figure 2: Share of particular spices and condiments in various districts of Malwa Plateau agro-climatic zone

**3.2. Trend of area under spices and condiments in Malwa Plateau**

Table 5 reveals the value of slope (b) obtained from the linear trend equation representing average rate of change of area per year. It shows that Garlic had the highest ‘b value’ followed by Coriander with 3813.6 hectares and 2938.2 hectares respectively, indicating rapidly expanding cultivation in the region. Despite having the negative absolute change (-1292.33), chillies had the positive ‘b value’ (126.62 ha), this shows that area under chilli had already peaked earlier. Although Betel nut did not had observable Relative change or Absolute change as per the base year and current year period, it had a ‘b value’ of just 72.83 hectares because it was cultivated in Agar Malwa district on a single year and then discontinued totally. Turmeric and Ginger had moderate ‘b value’ indicating a moderate average linear growth. Turmeric had the highest relative change (1543.48 per cent) which indicates a higher increase in its area in the current year (TE 2019) over the base period (TE 2000). Lowest relative change was observed in the area under coriander with only 53.22 percent indicating a smaller increase in its area in the current year over base year. Total spices and condiments in Malwa plateau agro-climatic zone showed a small change in its cropped area with 72.60 per cent over the base year but simultaneously it had very good rate of linear increase (7684.7 ha) on an average per year over the study period. Similar study was conducted by Rana et al., (2021) which analysed the trend in growth and instability of major spices (onion, garlic, chilli and ginger) in Bangladesh for the last 58 years from 1961-70 to 2011-18. The study observed low growth rate (from 3.04% to 3.97%) and high instability in area. Another nationwide study by Rajanbabu et al., (2022) conducted for a three period. First period from 1990-91 to 1999-2000 recorded positive, significant and stable growth whereas the second period from 2000-01 to 2009-10 witnessed a slow growth in cardamom and pepper and negative growth in area. In the third period from 2010-11 to 2018-19, unexpected behaviour is observed for the area under spices.

Table 5: Trend value (b), Relative change and Absolute change of various spices in Malwa Plateau

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Crop** | **Base year (TE 2000)** | **Current year (TE 2019)** | **Absolute change** | **Relative change (%)** | **b value (ha/year)** |
| **Garlic** | 33803.33 | 98953.33 | 65150 | 192.73 | 3813.6 |
| **Coriander** | 52858.67 | 80992 | 28133.33 | 53.22 | 2938.2 |
| **Chillies** | 10817.33 | 9525 | -1292.33 | -11.95 | 126.62 |
| **Betel nut** | 0 | 0 | 0 | 0 | 72.83 |
| **Ginger** | 285.33 | 928.25 | 642.92 | 225.32 | 32.77 |
| **Turmeric** | 7.67 | 126 | 118.33 | 1543.5 | 13.21 |
| **Cardamom** | 0 | 0 | 0 | 0 | 0 |
| **Black pepper** | 0.33 | 0 | -0.33 | -100 | -0.03 |
| **Other Spices and condiments** | 31595.67 | 32908 | 1312.33 | 4.15 | 687.51 |
| **Total spices and condiments** | 129368 | 223298 | 93929 | 72.6 | 7684.7 |

*Units in hectare (ha)*

Figure 3 shows the pattern of growth in area under spices and condiments over 22 year period. The line graph shows a positive and increasing trend in coriander, garlic, chillies, betel nut and other spices and condiments. The total area under spices fell during the years 2000, 2002, 2005 and 2008. It increased well around the years 2010-11 and 2016-17. This continuous fluctuation or zig-zag trend in area under spices may be a result of combination of environmental, economic or policy related factors. Post 2000, Spices faced a tough competition in the global markets. Volatile domestic & international prices and frequent price fluctuations led to frequent shift and inconsistent farmers’ interest in cropping pattern (Mahesha, 2011). The decision of expansion of area under spices was influenced by macroeconomic factors like recession and inflation (Babu, 2017). Spices had high input cost. During that period, farmers may have shifted between spices and other crops based on short term returns, especially during uncertain rainfall and price shock of inputs (Raju & Nagarajan, 2023). Malwa plateau constitutes black cotton soils and is a rainfed region. The success of spices depend heavily on the availability of monsoon. The inconsistent rainfall may have become one of the factors promoting farmers to shift or abandon spice cultivation in certain years (Panigrahi *et al*., 2011). The spikes during the years may have caused as a result of high export incentives due to export oriented policies promoted by government during early 2000s. The fall may have caused due to policy uncertainty (Rajanbabu *et al.,* 2022).

Figure 3: Trend of spices and condiments in Malwa Plateau agro-climatic zone

Figure 4 shows the trend of area under turmeric, ginger and black pepper. The area under turmeric rose from 202 hectares in 2012 to 1642 hectares in the succeeding year. Similar peak was observed in 2016 for ginger and 2017 for turmeric. The area under ginger increased from 733 hectares in 2015 to 1333 hectares in 2016 then again fell down to 870 hectares in the succeeding year.

Figure 4: Trend of area under turmeric, ginger and black pepper in Malwa Plateau

**3.3.** **Growth in area under spices and condiments in Malwa Plateau**

Table 6 shows that area under turmeric is expanding quickly with a simple growth rate of 9.16 percent. Garlic and Ginger had moderate growth rate of 7.02 percent and 6.86 percent respectively. Although Coriander had the highest area among all the spices and condiments, it is expanding very slowly at Simple growth rate of only 4.23 per cent. The area under Black pepper had reduced by 11 percent. Overall total spices and condiments expanded slowly at a simple growth rate of 4.54 per cent. The area under black pepper has reduced by 11 percent. Overall total spices and condiments expanded slowly at a simple growth rate of 4.54 per cent. A similar study was conducted by Anusha *et al.,* 2023, examined the growth and instability of turmeric in India and major turmeric growing districts of Telangana for the period of 20 years. The study mentioned a positive and significant growth in area of turmeric in India and few districts of Telangana during whole period. It was found out that, variations in prices, rainfall, increased cost of production, lack of harvesting equipment are some of the factors effecting growth and instability. To stabilize the area under turmeric, Adoption of new technologies, selection of location specific varieties should be done. Another finding by Gayathri *et al*., (2022) indicated the growth in area using compound growth rate under garlic and found that from 1990-91 to 2019-20 the area grew significantly at 5.42 percent.

Table 6: Growth rate of various spices and condiments in Malwa Plateau region

|  |  |
| --- | --- |
| **Crop** | **SGR (%)** |
| Turmeric | 9.16 |
| Garlic | 7.02 |
| Ginger | 6.86 |
| Coriander | 4.23 |
| Chillies | 1 |
| Cardamom | 0 |
| Betel nut | 0 |
| Black pepper | -11 |
| Other Spices and condiments | 2.17 |
| Total spices and condiments | 4.54 |

*Note: The growth of Betel nut has been considered negligible because it had been cultivated for a single year during the study period*.

**3**.**4. Analysis of Instability in area under spices and condiments in Malwa Plateau**

Table 7 represents the instability in the area under various spices and condiments. Betel nut and Black pepper were cultivated partially during one or two years during the study period. Their irregular cultivation pattern made them most unstable. The area under turmeric cultivation varied significantly over time which made it highly unstable with a CV of 236.50 per cent and CDVI of 234.54 per cent. The area under ginger and coriander was found to be highly unstable with a CDVI index value of 36.75 per cent and 32.24 per cent respectively. Garlic and Chilli were found to be moderately unstable with a CDVI index value of 25.87 per cent and 22.72 per cent respectively which is under the moderate range of CDVI index. The area under other spices and condiments had a very unstable growth of 30.92 per cent. Overall the total area under spices and condiments had a moderate instability having a CV of 37.55 per cent and CDVI index of 23.86 per cent. A study conducted by Nagaveni *et al.,* (2024) in Karnataka found that CDVI index value of more than 15% denoted a low to moderate level of variability in the area under Spice crops, indicating unstable cultivation of spice crops. Gayathri *et al.,* (2022) also presented a similar result showing a higher instability (CV) of 49.95% in area under garlic in India

Table 7. Variation and Instability in area under various spices and condiments in Malwa Plateau region.

|  |  |  |
| --- | --- | --- |
| **Crop** | **CV (%)** | **CDVI (%)** |
| Betel nut | 469.04 | 474.83 |
| Black pepper | 257.58 | 250.67 |
| Turmeric | 236.50 | 234.54 |
| Ginger | 57.21 | 36.75 |
| Coriander | 41.76 | 32.24 |
| Garlic | 52.13 | 25.87 |
| Chillies | 23.10 | 22.72 |
| Cardamom | 0.00 | 0.00 |
| Other Spices and condiments | 33.31 | 30.92 |
| Total spices and condiments | 37.55 | 23.86 |

1. **CONCLUSION**

The district of Mandsaur (25.48%), Rajgarh (17.51 %) and Ratlam (11.92 %) had the highest contribution of spices and condiments. Together they covered more than half of the cropped area in the region. This agro climatic zone is dominated by Coriander and Garlic which covers the largest area with 41.03 per cent and 32.06 per cent respectively. Cardamom is not grown in this region whereas Black pepper and Betelnut were grown in negligible quantity. 88 per cent of the total spices and condiments in Rajgarh, 68.41 per cent in Shajapur and 62 per cent in Agar malwa is covered by Coriander. 91.08 per cent of area in Dewas and 91.33 per cent in Indore was dominated by Garlic, whereas, 61.81 percent of Dhar is dominated by Chillies. All the spices and condiments had a positive trend except black pepper which suffers a small negative trend of -0.03 hectare. Garlic and Coriander had the highest b value with 3813.6 hectares and 2938.2 hectares per year on an average. A unique zig-zag pattern of fluctuation in area had been observed, more prominent from 1999 to 2009. Turmeric and Garlic experienced highest growth of 9.16 and 7.02 per cent respectively. Betel nut, Black pepper and Turmeric experienced a very high instability due to discontinued cultivation pattern. Although coriander and garlic were the most dominant spices, area under Ginger and Coriander had a high CDVI indicating a higher instability. The area under total spices and condiments had a moderate instability of 23.86 per cent (CDVI) in the region.

**Policy Recommendation**

A focused policy framework is necessary to guarantee steady growth and better farmer outcomes in light of the trends and instability in spice cultivation that have been noted throughout the Malwa Plateau, especially the predominance of coriander and garlic, regional differences, and shifting cultivation patterns. First, by encouraging zone-specific crop planning and consistent farming methods, efforts should concentrate on stabilizing the area under important spices like coriander, garlic, and chillies. Priority should be given to districts exhibiting high levels of variability, particularly in crops like ginger and turmeric, for extension assistance and risk-reduction measures like input subsidies and crop insurance. Rainfall dependency can be addressed, particularly in high garlic-growing zones like Dewas and Indore, by bolstering irrigation infrastructure and encouraging water-efficient techniques like drip irrigation. Investing in infrastructure for spice processing, storage, and marketing will increase farmer profits and lower post-harvest losses. Furthermore, the creation of farmer producer organizations (FPOs) and the facilitation of access to export and digital markets, especially for garlic and coriander, might stabilize prices and motivate farmers to continue or increase agriculture. Crops that are highly unstable should also receive special attention, with disease-resistant cultivars being promoted and assistance offered during discontinuity years. By reducing area swings and increasing productivity, these combined strategies will help maintain the long-term viability of the region's spice crop.

1. **REFERENCES**

Anusha, J., Lavanya, T., Kumari, V. R., Radhika, P., & Supriya, K. (2023). Growth and instability of turmeric in Telangana. *International Journal of Statistics and Applied Mathematics*, **8**(5), 120-124. DOI: <https://doi.org/10.22271/maths.2023.v8.i5Sb.1179>

Babu, P. H. (2017). Export performance of spices in India: an empirical study. *Parikalpana: KIIT Journal of Management,* **13**(1), 66-74.DOI https://doi.org/10.23862/KIIT-PARIKALPANA/2017/V13/I1/151275.

Deb, U., & Soumitra, P. (2015). Groundnut production performance in Bangladesh: A district level analysis. *Economic Affairs*, *60*(03):391-400.

Dini, I., & Laneri, S. (2021). Spices, Condiments, Extra Virgin Olive Oil and Aromas as Not Only Flavorings, but Precious Allies for Our Wellbeing. Antioxidants, **10**(6), 868. <https://doi.org/10.3390/antiox10060868>

Krishan, B., & Chanchal, A. (2014). Agricultural growth and instability in western himalayan region: an analysis of Himachal Pradesh, India. *Journal of Agriculture and Life Sciences,* **1**(1):21-27.

Mahesha, M. (2011). International Price Volatility of Indian Spices Exports–An Empirical Analysis Asia and Pacific. *Journal of Research in Business Management,* **2**(1), 110-116.

Maidebura, O. P., Korylchuk, N. I., & Kavetska, A. V. (2021). Use of spices and spices as natural antioxidants and anti-carcinogenic factors. *Likars’ka Sprava*, (3-4), 80-85. <https://doi.org/10.31640/JVD.3-4.2021(11)>

Ministry of Agriculture and Farmers Welfare. (2023). Web based land use statistics information system, agriculture and production statistics. Retrieved on 12 April 2023, from https://aps.dac.gov.in

Mishra, S., Nahatkar, S. B. & Patel, S. (2023) Growth and Instability of Soybean in Central India: A district-level Analysis. *The Pharma Innovation Journal*, **12**(1): 3058-3061.

Nagaveni, M., Kulkarni, G., Guledagudda, S., Venugopal, C., & Rajkumara, S. (2024). Trends and status of horticultural crops in Karnataka. *Journal of Farm Sciences*, **37**(02), 167-171. Doi: <https://doi.org/10.61475/JFS.2024.v37i2.13>

Panigrahi D., Acharya M, Senapati P.C., Mohanty P.K. (2011). Effect of Increasing area underspices on Agricultural sustainability in rainfed hill plateaus. *Agricultural Science Research Journal*, **1**(2): 38-43. ISSN-L: 2026-6073

Pavuluri Gayathri, D. V., & Nemade, D. K. (2022). Growth and instability of garlic in India. *The Pharma Innovation Journal,* **11**(10):603-606.

Rajanbabu, R., Parimalam, E. J., & Sathishkumar, V. (2022). Growth and Instability in significant spices in India: An empirical analysis. *Agricultural Science Digest-A Research Journal,* **42**(4), 449-453.) doi: : <https://doi.org/10.18805/ag.D-5487>

Raju, M., & Nagarajan, R. (2023). Area of Cultivation and Production of Spices in India. Shanlax *International Journal of Economics*, **12**(1), 140-147. DOI: 10.34293/economics.v12i1.7056

Rana, M. J., Islam, S., & Kamruzzaman, M. (2021). Growth and instability in area, production and productivity of major spices in Bangladesh. *Journal of Agriculture and Food Research*, *6*, 100216. Doi: <https://doi.org/10.1016/j.jafr.2021.100216>

Sananse, S.L., & Maidapwad, S.L. (2009). On Estimation of Growth Rates using Linear Model. *International Journal of Agricultural and Statistical Sciences*, **5**(2): 463-469.

Singh, A., Vani, G. K., Rathi, D., Naberia, S., & Kumar, U. (2025). An Analysis of Trend, Growth and Instability of Major Cereals and Millets in Chhindwara District of Madhya Pradesh, India. *Asian Journal of Agricultural Extension, Economics and Sociology,* **43**(6), 207-219. http://dx.doi.org/10.9734/ajaees/2025/v43i62776

Vani, G. K., Shrivastav, A., Chaturvedi, P., & Rajput, A. (2023). Analysis and Comparison of Policy Regimes for the Value Added in Agricultural Sector. *Asian Journal of Agricultural Extension, Economics & Sociology,* **41**(10), 387-392. DOI: https://doi.org /10.9734/AJAEES/2023/v41i102182

Vekariya, P. R., Dudhat, A. S., Shitap, M. S., & Patel, D. V. (2020). Growth and Instability Analysis of Groundnut Price of Major Markets in Saurashtra Region of Gujarat State. *Advances in Research***, 21**(12):16-22. https://doi.org/10.9734/air/2020/v21i1230276

Vilhekar, R. A., Pokharkar, V. G. & Yadav, D. B. (2022). Growth and instability of area, production and productivity of acid lime in India and Maharashtra. *The Pharma Innovation Journal,* SP-11(5): 101-105.

Vinothini, P., & Suthacini, V. (2024). Analyzing Production, Productivity, and Export Performance of Key Spices in India. *Shanlax International Journal of Economics*, **12(**2), 56-61. https://doi.org/10.34293/economics.v12i2.7210

Wendimu, A., Tekalign, W. (2022). Spice and Condiment Plants for the Traditional Beverages and, Food Stuff Preparation and Utilization, Southern Ethiopia. *Proceedings of the National Academy of Sciences, India Section B: Biological Sciences,* **92**, 239–247. <https://doi.org/10.1007/s40011-021-01302-6>