

## A Geographical Analysis of Spatial and Temporal Changes in Agricultural Cropping Patterns in Bhandara District

**Minakshi Ganesh Ladse**

Research Scholar,  
Yashwantrao Chavan College  
Lakhandur. Dist. Bhandara

**Dr. Jagannath Dadve**

Principal  
Yashwantrao Chavan College  
Lakhandur. Dist. Bhandara

### Introduction

Agriculture is one of the most important economic activities in India and plays a significant role in the livelihood and socio-economic development of the rural population. The agricultural landscape of a region is influenced by a combination of physical, economic, social, technological and institutional factors. Among the various aspects of agricultural geography, the study of cropping patterns is particularly important because it provides an understanding of the spatial distribution and relative importance of different crops within a geographical area. Cropping pattern refers to the proportion of cultivated land allocated to different crops during a particular agricultural period. It is not a permanent phenomenon; rather, it changes over time in response to variations in natural conditions, irrigation facilities, agricultural technology, market demand, crop prices, government policies and farmers' decisions.

India has a highly diverse agricultural system due to variations in climate, soil, relief, rainfall and water resources. These variations result in considerable regional differences in cropping patterns. Maharashtra is characterized by significant spatial diversity in agricultural activities because of differences in rainfall, soil, irrigation and agro-climatic conditions. Within Maharashtra, the Vidarbha region has an important agricultural economy, and Bhandara district represents a distinctive agricultural landscape where physical and socio-economic conditions influence the selection and distribution of crops. The district's agricultural activities are closely associated with monsoon rainfall, soil characteristics, availability of surface and groundwater, irrigation facilities and the traditional agricultural practices of the rural population.

Bhandara district is situated in the eastern part of Maharashtra and forms an important part of the Vidarbha region. Agriculture is a major source of livelihood for a large section of the rural population. The district has favourable conditions for the cultivation of rice, which has traditionally occupied an important position in its agricultural economy. Along with rice, pulses, oilseeds, wheat, vegetables and other crops are also cultivated in different parts of the district. However, the distribution and relative importance of these crops are not uniform throughout the district. Differences in soil, rainfall, topography, drainage, irrigation facilities, agricultural infrastructure and market accessibility contribute to spatial variations in cropping patterns.

The cropping pattern of Bhandara district has also undergone changes over time. Agricultural land use is influenced by changing climatic conditions, development of irrigation facilities, availability of improved seeds and fertilizers, mechanization, changes in agricultural labour availability, fluctuations in crop prices, government agricultural policies and increasing market

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orientation. Farmers may change from one crop to another depending on expected profitability, availability of water, production costs and market opportunities. Consequently, the area under individual crops may increase or decrease over different periods. Studying these temporal changes is important for understanding the transformation of the agricultural landscape and the changing relationship between farmers and their physical and economic environment.

The concept of spatial and temporal change provides a useful geographical framework for analyzing these transformations. Spatial analysis examines differences in cropping patterns among different tehsils or geographical units of Bhandara district, while temporal analysis examines changes in the area and relative importance of crops over a selected period. The combined study of these two dimensions helps to identify areas of crop concentration, diversification, specialization and agricultural transformation. It also helps in understanding whether changes are uniform across the district or whether particular areas are experiencing more significant changes than others.

The study of agricultural cropping patterns is also important from the perspective of regional planning and sustainable agricultural development. Changes in cropping patterns can influence soil fertility, water demand, agricultural income, food security and environmental sustainability. Excessive dependence on particular crops may create economic and ecological risks, while appropriate crop diversification can potentially improve farm income and reduce agricultural risks. Therefore, an understanding of the geographical distribution and changing nature of cropping patterns can provide useful information for agricultural planning, irrigation development, resource management and rural development.

The present study, entitled Agriculture is one of the most important economic activities in rural areas of Maharashtra. The nature of agriculture varies from one region to another because of differences in rainfall, soil, temperature, irrigation, topography, availability of water, market conditions, technology, and government policies. Therefore, the study of cropping patterns is an important aspect of agricultural geography. A cropping pattern refers to the proportion of cultivated land devoted to different crops in a particular geographical area during a specific period. It reflects the relationship between the physical environment and the socio-economic conditions of farmers.

The cropping pattern is not static. It changes over time in response to changes in rainfall, irrigation facilities, agricultural technology, crop prices, government policies, availability of agricultural inputs, market demand, and farmers' decisions. These changes can be studied in two dimensions:

**Spatial change** – differences in cropping patterns from one part of Bhandara district to another.

**Temporal change** – changes in cropping patterns from one period or year to another.

Bhandara district provides an interesting geographical setting for such a study because agriculture is closely associated with the availability of water, soil conditions, monsoon rainfall, irrigation infrastructure, and the economic decisions of farmers. Rice has traditionally occupied an important place in the agricultural economy of the district, while other crops such as wheat, pulses, oilseeds and vegetables also contribute to the agricultural landscape.

### **Study Area: Bhandara District**

Bhandara district is located in the eastern part of Maharashtra and forms part of the Vidarbha region. The district has an important agricultural economy and is characterized by a combination of cultivated land, forests, water bodies and settlements. The geographical characteristics of the district have a direct influence on agricultural activities. The availability of surface water,

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rainfall, soils and irrigation facilities creates differences in agricultural productivity and cropping patterns across different parts of the district. The district is particularly significant for the study of rice cultivation. Low-lying areas and locations with better water availability are generally more suitable for paddy cultivation. In relatively well-drained and irrigated areas, farmers may cultivate other crops depending on soil, market demand and economic returns.

For a geographical study, Bhandara can therefore be examined at the district, tehsil and village levels, depending on the availability of statistical and spatial data.

### **Background of Agriculture in Bhandara**

Agriculture in Bhandara is strongly influenced by the monsoon. The agricultural calendar can broadly be divided into Kharif and Rabi seasons.

#### **Kharif season**

The Kharif season is particularly important because rainfall during the southwest monsoon provides much of the water required for crop cultivation.

Important Kharif crops may include:

Rice, Pigeon pea, Soybean, Maize, Other pulses, Oilseeds, Vegetables. Among these, rice is particularly important in the traditional agricultural landscape of Bhandara.

#### **Rabi season**

Rabi agriculture depends more strongly on residual soil moisture and irrigation.

Important Rabi crops may include:

Wheat, Gram, Other pulses, Oilseeds, Vegetables. The importance of these crops varies spatially depending on irrigation, soil moisture and market conditions.

### **Statement of the Problem**

The agricultural landscape of Bhandara district has been changing because of both environmental and socio-economic factors. Traditional crop combinations may be changing as farmers respond to new agricultural technologies, irrigation facilities, market opportunities and changing climatic conditions. However, these changes are not necessarily uniform throughout the district.

Therefore, the major problem of the present study is to understand:

“How and why has the agricultural cropping pattern of Bhandara district changed spatially and temporally, and what geographical factors are responsible for these changes?”

### **Need and Significance of the Study**

The study is important for several reasons.

#### **Understanding agricultural geography**

The research helps explain the relationship between physical geography and agricultural activities.

#### **Identification of changing crop patterns**

It can identify crops that are increasing or decreasing in area over time.

#### **Regional planning**

Knowledge of cropping patterns can help planners formulate suitable agricultural development strategies.

#### **Irrigation planning**

The study can identify areas where agricultural development is strongly dependent on irrigation.

#### **Food security**

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Understanding changes in food crops such as rice and wheat is important from the perspective of regional food security.

**Sustainable agriculture**

The research can help identify whether changes in cropping patterns are environmentally sustainable.

**Farmer-oriented planning**

The findings can provide useful information for agricultural extension agencies and local planners.

**Aim of the Study**

The main aim of the study is:

**To analyse the spatial and temporal changes in agricultural cropping patterns in Bhandara district and to examine the geographical, environmental and socio-economic factors responsible for these changes.**

**Objectives of the Study**

The following objectives can be used in a dissertation:

To study the geographical characteristics of Bhandara district.

To examine the existing agricultural cropping pattern of the district.

To analyse the spatial distribution of major crops.

To examine temporal changes in the area under different crops.

To identify changes in the relative importance of major crops.

To examine the influence of socio-economic factors on cropping-pattern changes.

To identify areas of crop diversification and crop specialization.

**Hypotheses**

- **Cropping patterns vary significantly from one part of Bhandara district to another because of differences in soil, rainfall and irrigation facilities.**
- **The cropping pattern of Bhandara district has undergone significant temporal changes due to changes in irrigation, technology, market conditions and agricultural policies.**
- **Areas with better irrigation facilities have greater crop diversification than predominantly rain-fed areas.**
- **Rice remains an important crop in Bhandara, but the relative importance of other commercial and food crops has changed over time.**

**Data Required for the Study**

A strong study should use both primary and secondary data & Secondary data

**REVIEW OF LITERATURE****Introduction**

The review of literature provides the theoretical and empirical foundation for the study entitled “A Geographical Analysis of Spatial and Temporal Changes in Agricultural Cropping Patterns in Bhandara District, Maharashtra.” Agricultural cropping patterns are dynamic and are influenced by physical, economic, technological, social and institutional factors. The distribution of crops

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varies from place to place because of differences in soil, rainfall, temperature, irrigation, relief, market accessibility and agricultural technology. Similarly, cropping patterns change over time because of changes in population pressure, agricultural modernization, government policies, market prices and climatic conditions.

The present review discusses important geographical thinkers and scholars who contributed to the understanding of agricultural land use, crop distribution, crop combination, crop concentration, agricultural diversification and spatial and temporal changes. It also reviews selected studies relating to Maharashtra and Bhandara District.

#### **Johann Heinrich von Thünen – Agricultural Location Theory**

Johann Heinrich von Thünen developed the theory of agricultural location in his famous work *The Isolated State*. His theory explains the spatial distribution of agricultural activities around a market center. According to von Thünen, farmers select agricultural activities according to factors such as distance from the market, transportation cost, land rent and profitability. The theory is relevant to the present study because farmers in Bhandara District do not select crops solely on the basis of physical conditions. Distance from markets, transportation facilities, availability of buyers and expected returns can influence crop selection. Crops having higher value or requiring quick marketing may be concentrated closer to market centres, while crops with lower transport sensitivity may be cultivated farther away. Thus, von Thünen's theory provides a theoretical basis for examining the spatial relationship between crop distribution and market accessibility.

#### **Derwent Whittlesey – Agricultural Regions**

Derwent Whittlesey made an important contribution to agricultural geography through his classification of the world's major agricultural regions. He emphasized that agricultural systems can be understood through combinations of factors such as crop and livestock association, intensity of land use, degree of commercialization, labour and capital requirements and spatial distribution. Whittlesey's approach is useful for the present study because Bhandara District contains variations in agricultural intensity and crop combinations. Rice-dominated agricultural areas, pulse-growing areas and areas with greater crop diversification can be identified as different agricultural sub-regions. His approach provides a basis for identifying spatial agricultural regions within Bhandara District.

#### **D. R. Khullar – Concept of Cropping Pattern**

D. R. Khullar emphasized the importance of cropping pattern as a major component of agricultural geography. Cropping pattern refers to the proportion of cultivated land devoted to different crops at a particular time and place. It is not a static phenomenon but changes according to environmental and socio-economic conditions.

This concept is directly relevant to the present study. The agricultural landscape of Bhandara cannot be understood only by identifying the dominant crop. It is necessary to examine the relative share of rice, wheat, pulses, oilseeds and other crops, and how their proportions have changed over time.

#### **J. W. Weaver – Crop Combination Analysis**

J. W. Weaver developed a statistical method for identifying crop combinations. His method determines the optimum combination of crops in a geographical area by comparing the actual percentage of different crops with an ideal distribution.

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Weaver's crop-combination method is particularly useful for geographical studies of agricultural regions. It can be applied to identify whether a tehsil or administrative unit of Bhandara is characterized by a single-crop, two-crop, three-crop or multiple-crop combination.

The method therefore provides a useful tool for analyzing the spatial structure of cropping patterns in the district.

### **Bhatia – Crop Concentration**

S. S. Bhatia contributed to the quantitative analysis of agricultural geography through the study of crop concentration. Crop concentration refers to the degree to which a particular crop is concentrated in a particular geographical area compared with the wider region.

Crop concentration analysis is useful for the present research because it can identify areas of high, medium and low concentration of rice, pulses, wheat, oilseeds and other crops in Bhandara District.

The method can therefore help determine the spatial specialization of agriculture and identify areas where particular crops dominate.

### **Jasbir Singh – Agricultural Geography and Quantitative Techniques**

Jasbir Singh made important contributions to Indian agricultural geography by applying quantitative methods to the study of agricultural land use, crop combinations, crop concentration and agricultural productivity.

His work emphasized the importance of systematic statistical analysis in understanding agricultural regions. Quantitative techniques such as crop concentration, crop combination, diversification and productivity analysis can reveal spatial variations that may not be visible through descriptive analysis alone.

For the present study, such techniques are useful for comparing agricultural characteristics among the different administrative units of Bhandara District.

### **Deokate and Bandgar (2013)**

T. B. Deokate and D. P. Bandgar examined changes in land use and cropping patterns in Maharashtra over five decades. Their study found that cropping intensity increased considerably, while the share of cereals in the gross cropped area declined. At the same time, commercial crops became increasingly important.

The study also pointed to environmental consequences associated with changing agricultural land use, including pressure on groundwater and changes in soil conditions.

The findings are relevant to Bhandara because they demonstrate that changes in cropping patterns can have consequences not only for agricultural productivity but also for natural-resource sustainability.

### **Thakare, Shende, Tingre and Dangore (2024)**

A. B. Thakare, N. V. Shende, A. S. Tingre and U. T. Dangore studied changes in Maharashtra's cropping pattern using time-series data from 2001–02 to 2020–21. They analysed absolute change, relative change and coefficient of variation.

Their results showed different trends across Maharashtra's agricultural regions. In Vidarbha, for example, soybean showed an increase in area, while some other crops showed declining or variable trends. The study demonstrates that agricultural change is regionally differentiated, rather than uniform throughout Maharashtra. This finding is highly relevant to Bhandara because

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the district forms part of eastern Maharashtra and its agricultural pattern may differ from that of western and central Maharashtra. **Thakare, Shende and Tingre – Markov Chain Analysis**

Another study by Thakare, Shende and Tingre applied Markov chain analysis to examine the stability and dynamics of cropping patterns in Maharashtra between 2001–02 and 2020–21.

The study found that crop stability differed between regions and periods. In the Vidarbha region, certain crops retained a substantial proportion of their previous area, while others showed greater changes.

The study is useful for the present research because it demonstrates that crop areas can be studied not only in terms of increase or decrease but also in terms of stability, persistence and transition between crops.

### 1. What is the main source of irrigation for your agricultural land?

To get the information about What is the main source of irrigation for your agricultural land? following information was received.

#### Sr. No. Main Source of Irrigation Number of Respondents Percentage (%)

|              |            |            |              |
|--------------|------------|------------|--------------|
| 1            | Canal      | 18         | 18.0         |
| 2            | Well       | 27         | 27.0         |
| 3            | Borewell   | 22         | 22.0         |
| 4            | River/Tank | 13         | 13.0         |
| 5            | Rainfall   | 20         | 20.0         |
| <b>Total</b> | <b>—</b>   | <b>100</b> | <b>100.0</b> |

#### Interpretation

The above table presents the main sources of irrigation used by 100 respondents in the study area of Bhandara District. The data indicate that wells are the most important source of irrigation, reported by 27 respondents, accounting for 27.0% of the total respondents. This indicates the importance of groundwater-based irrigation in agricultural activities. Borewells are the second most commonly reported source, used by 22 respondents (22.0%). Together, wells and borewells account for 49.0% of the respondents, indicating that groundwater plays a major role in supporting agricultural activities. About 20 respondents (20.0%) depend mainly on rainfall for agricultural activities. This indicates that a considerable proportion of farmers remain dependent on monsoon rainfall and may therefore be more vulnerable to irregular rainfall, drought and climatic variability. Canal irrigation is the main source for 18 respondents (18.0%), while 13 respondents (13.0%) depend primarily on rivers or tanks. Thus, surface-water sources also contribute significantly to agricultural irrigation in the district. Overall, the table indicates that irrigation in the study area is based on a combination of groundwater, surface water and rainfall. Groundwater sources—wells and borewells—are particularly important, while one-fifth of the respondents remain primarily dependent on rainfall. This variation in irrigation availability may influence the spatial distribution, intensity and diversification of cropping patterns in Bhandara District. Areas with reliable irrigation are likely to have greater opportunities for multiple cropping and cultivation of crops requiring assured water supply, whereas rain-fed areas may have more restricted crop choices.

### 2. What type of agriculture is mainly practiced on your farm?

To get the information about What type of agriculture is mainly practiced on your farm? following information was received.

#### Sr. No. Type of Agriculture Number of Respondents Percentage (%)

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**Sr. No. Type of Agriculture Number of Respondents Percentage (%)**

|              |                             |            |              |
|--------------|-----------------------------|------------|--------------|
| 1            | Rain-fed                    | 24         | 24.0         |
| 2            | Irrigated                   | 31         | 31.0         |
| 3            | Both Rain-fed and Irrigated | 45         | 45.0         |
| <b>Total</b> | <b>—</b>                    | <b>100</b> | <b>100.0</b> |

**Interpretation**

The above table shows the type of agriculture practiced by 100 respondents in the study area of Bhandara District. The findings indicate that 45 respondents (45.0%) practice both rain-fed and irrigated agriculture, representing the largest proportion of the surveyed farmers. This suggests that many farmers combine rainfall with available irrigation facilities to reduce dependence on a single source of water and to cultivate crops in different agricultural seasons. A total of 31 respondents (31.0%) practice mainly irrigated agriculture. These farmers have relatively better access to assured water sources, which may provide greater opportunities for intensive cultivation, multiple cropping and diversification of crops. On the other hand, 24 respondents (24.0%) depend mainly on rain-fed agriculture. This indicates that nearly one-fourth of the surveyed farmers remain dependent primarily on rainfall. Such farmers may be more vulnerable to irregular monsoon conditions, drought and variations in rainfall. Overall, the data indicate that 76% of the respondents have access to some form of irrigation, either exclusively or in combination with rainfall, while 24% depend mainly on rain-fed agriculture. The availability of irrigation is therefore an important factor influencing the cropping pattern and agricultural intensity in Bhandara District. Farmers with assured irrigation may have greater flexibility in selecting crops, whereas rain-fed farmers may tend to select crops according to rainfall availability and seasonal conditions.

**3. Which is the major crop cultivated on your farm?**

To get the information about Which is the major crop cultivated on your farm? following information was received.

**Sr. No. Major Crop Number of Respondents Percentage (%)**

|              |                |            |              |
|--------------|----------------|------------|--------------|
| 1            | Rice           | 42         | 42.0         |
| 2            | Wheat          | 15         | 15.0         |
| 3            | Gram           | 14         | 14.0         |
| 4            | Tur/Pigeon Pea | 12         | 12.0         |
| 5            | Soybean        | 10         | 10.0         |
| 6            | Other Crops    | 7          | 7.0          |
| <b>Total</b> | <b>—</b>       | <b>100</b> | <b>100.0</b> |

**Interpretation**

The above table presents the major crops cultivated by the 100 surveyed farmers in Bhandara District. The data indicate that rice is the dominant crop, cultivated as the major crop by 42 respondents (42.0%). This reflects the traditional and geographical importance of rice cultivation in Bhandara, where suitable rainfall, soil and water availability support paddy cultivation. Wheat is reported as the major crop by 15 respondents (15.0%), followed by gram, cultivated by 14 respondents (14.0%). These crops are particularly important during the Rabi season and are associated with areas having suitable soil moisture and irrigation facilities. Tur/Pigeon pea is the

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major crop for 12 respondents (12.0%), while 10 respondents (10.0%) reported soybean as their major crop. These crops contribute to agricultural diversification and provide farmers with alternatives to traditional rice cultivation. The remaining 7 respondents (7.0%) cultivate other crops, including potentially vegetables, oilseeds and other agricultural crops. Overall, the results show that rice has the highest agricultural importance among the surveyed respondents, while wheat, gram, tur and soybean contribute to diversification of the cropping pattern. The dominance of rice can be linked to the agro-climatic conditions of Bhandara District, whereas the presence of other crops indicates variation in farmers' crop choices based on irrigation, soil conditions, profitability, market demand and seasonal factors. This variation is important for understanding the spatial and temporal changes in agricultural cropping patterns in the district.

#### 4. Which agricultural season is most important for your farm?

To get the information about Which agricultural season is most important for your farm? information was received.

##### Sr. No. Agricultural Season Number of Respondents Percentage (%)

|              |                      |            |              |
|--------------|----------------------|------------|--------------|
| 1            | Kharif               | 48         | 48.0         |
| 2            | Rabi                 | 17         | 17.0         |
| 3            | Both Kharif and Rabi | 35         | 35.0         |
| <b>Total</b> | <b>—</b>             | <b>100</b> | <b>100.0</b> |

#### Interpretation

The above table shows the importance of different agricultural seasons among 100 respondents in Bhandara District. The findings indicate that Kharif is the most important agricultural season, reported by 48 respondents (48.0%). The dominance of the Kharif season can be attributed mainly to the importance of the southwest monsoon, which provides essential water for agricultural activities. Crops such as rice, tur and soybean are commonly associated with this season. A total of 35 respondents (35.0%) reported that both Kharif and Rabi seasons are important for their farms. This indicates that a substantial proportion of farmers are engaged in agriculture during both seasons, probably due to better irrigation facilities, adequate soil moisture and access to water resources. Such farmers have greater opportunities for multiple cropping and agricultural diversification. Only 17 respondents (17.0%) identified the Rabi season as the most important season. Rabi cultivation depends more strongly on residual soil moisture and irrigation, with crops such as wheat and gram being important during this period. Overall, the results indicate that Kharif agriculture plays the dominant role, while a significant proportion of farmers practice agriculture during both Kharif and Rabi seasons. The importance of the two-season farming system suggests that irrigation availability and water resources are important factors influencing agricultural intensity and cropping patterns in Bhandara District.

#### 5. What is the approximate size of your agricultural holding?

To get the information about What is the approximate size of your agricultural holding? following information was received.

##### Sr. No. Size of Agricultural Holding Number of Respondents Percentage (%)

|   |                     |    |      |
|---|---------------------|----|------|
| 1 | Less than 1 hectare | 28 | 28.0 |
|---|---------------------|----|------|

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**Sr. No. Size of Agricultural Holding Number of Respondents Percentage (%)**

|              |                       |            |              |
|--------------|-----------------------|------------|--------------|
| 2            | 1–2 hectares          | 34         | 34.0         |
| 3            | 2–5 hectares          | 27         | 27.0         |
| 4            | 5–10 hectares         | 8          | 8.0          |
| 5            | More than 10 hectares | 3          | 3.0          |
| <b>Total</b> | <b>—</b>              | <b>100</b> | <b>100.0</b> |

**Interpretation**

The above table shows the distribution of agricultural holdings among 100 respondents in Bhandara District. The data indicate that the largest proportion, 34 respondents (34.0%), have agricultural holdings of 1–2 hectares. This is followed by 27 respondents (27.0%) having holdings of less than 1 hectare and 27 respondents (27.0%) having holdings between 2 and 5 hectares. Only 8 respondents (8.0%) possess agricultural holdings of 5–10 hectares, while just 3 respondents (3.0%) have holdings of more than 10 hectares. Thus, large agricultural holdings represent a very small proportion of the surveyed farmers. Overall, the table indicates that small and marginal farmers constitute the majority of the surveyed agricultural population. Farmers with holdings below 2 hectares account for 62.0% of the respondents. This fragmented landholding structure can influence cropping decisions, agricultural investment, mechanization and the ability of farmers to diversify their crops. The predominance of small holdings also suggests that farmers may prefer crops that provide relatively stable returns and are suitable for their available land and water resources. Therefore, landholding size is an important socio-economic factor in analyzing spatial and temporal changes in agricultural cropping patterns in Bhandara District.

**6. What is the major type of soil on your farm?**

To get the information about What is the major type of soil on your farm? following information was received.

**Sr. No. Type of Soil Number of Respondents Percentage (%)**

|              |               |            |              |
|--------------|---------------|------------|--------------|
| 1            | Black soil    | 38         | 38.0         |
| 2            | Red soil      | 16         | 16.0         |
| 3            | Alluvial soil | 18         | 18.0         |
| 4            | Mixed soil    | 23         | 23.0         |
| 5            | Other         | 5          | 5.0          |
| <b>Total</b> | <b>—</b>      | <b>100</b> | <b>100.0</b> |

**Interpretation**

The above table presents the distribution of major soil types reported by 100 respondents in Bhandara District. The data indicate that black soil is the most commonly reported soil type, with 38 respondents (38.0%) cultivating land having predominantly black soil. Black soils generally have good moisture-retention capacity and can support a variety of agricultural crops, although crop suitability depends on the specific soil characteristics and local conditions. Mixed soil is reported by 23 respondents (23.0%), making it the second-largest category. Alluvial soil is reported by 18 respondents (18.0%), while 16 respondents (16.0%) reported red soil. The remaining 5 respondents (5.0%) reported other soil types. The results indicate that there is

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considerable soil diversity among the surveyed farms. Such spatial variation in soil characteristics can influence crop selection, productivity and agricultural practices. Farmers may select crops according to soil fertility, moisture-retention capacity, drainage and suitability for particular crops. Overall, the distribution of soil types demonstrates that soil is an important physical factor influencing the agricultural cropping pattern. The variation in soil conditions across Bhandara District can contribute to spatial differences in the cultivation of rice, wheat, pulses, oilseeds and other crops. Therefore, soil characteristics should be considered along with rainfall, irrigation and economic factors when analyzing spatial and temporal changes in cropping patterns.

### 7. Has the area under rice cultivation changed during the last 10–20 years?

To get the information about Has the area under rice cultivation changed during the last 10–20 years? following information was received.

#### Sr. No. Response Number of Respondents Percentage (%)

|              |            |            |              |
|--------------|------------|------------|--------------|
| 1            | Increased  | 46         | 46.0         |
| 2            | Decreased  | 24         | 24.0         |
| 3            | No change  | 22         | 22.0         |
| 4            | Cannot say | 8          | 8.0          |
| <b>Total</b> | <b>—</b>   | <b>100</b> | <b>100.0</b> |

#### Interpretation

The above table presents the respondents' perceptions regarding changes in the area under rice cultivation during the last 10–20 years in Bhandara District. Out of 100 respondents, 46 respondents (46.0%) reported that the area under rice cultivation has increased. This represents the largest proportion of respondents and indicates that rice continues to have an important position in the agricultural landscape of the district. On the other hand, 24 respondents (24.0%) reported a decrease in the area under rice cultivation. This decline may be associated with factors such as changes in rainfall, water availability, rising production costs, labour shortages, changes in market prices, or a shift towards alternative crops. A total of 22 respondents (22.0%) stated that there had been no significant change in the area under rice cultivation. This suggests that rice cultivation has remained relatively stable for a considerable proportion of farmers. The remaining 8 respondents (8.0%) could not provide a definite answer. Overall, the findings indicate that 46% of respondents perceived an increase in rice cultivation, while 24% perceived a decline. Therefore, although rice remains an important crop, its spatial and temporal distribution may be changing in response to changing environmental and socio-economic conditions. The variation in responses also suggests that changes in rice cultivation are not uniform throughout Bhandara District and may differ according to local irrigation facilities, soil conditions, rainfall and market opportunities.

### 8. Has the area under pulses changed during the last 10–20 years?

To get the information about Has the area under pulses changed during the last 10–20 years? following information was received.

#### Sr. No. Response Number of Respondents Percentage (%)

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**Sr. No. Response Number of Respondents Percentage (%)**

|              |            |            |              |
|--------------|------------|------------|--------------|
| 1            | Increased  | 38         | 38.0         |
| 2            | Decreased  | 27         | 27.0         |
| 3            | No change  | 26         | 26.0         |
| 4            | Cannot say | 9          | 9.0          |
| <b>Total</b> | <b>—</b>   | <b>100</b> | <b>100.0</b> |

**Interpretation**

The above table shows the respondents' perceptions regarding changes in the area under pulse cultivation during the last 10–20 years in Bhandara District. Out of 100 respondents, 38 respondents (38.0%) reported that the area under pulses has increased. This represents the largest group and suggests that pulse cultivation has gained importance among a considerable proportion of farmers. In contrast, 27 respondents (27.0%) reported a decrease in the area under pulses. The decline may be associated with factors such as changing market prices, availability of irrigation, production costs, labour availability and the preference for more profitable or market-oriented crops. A total of 26 respondents (26.0%) reported no significant change in the area under pulses. This indicates that pulse cultivation has remained relatively stable on the farms of more than one-fourth of the respondents. The remaining 9 respondents (9.0%) were unable to provide a definite response. Overall, the findings indicate a moderate positive trend in pulse cultivation, as 38% of respondents reported an increase compared with 27% reporting a decrease. Pulses are important for crop diversification and can contribute to maintaining soil fertility through their nitrogen-fixing characteristics. However, the variation in responses indicates that the change in pulse cultivation is spatially uneven and may depend on local soil conditions, rainfall, irrigation, market demand and farmers' economic decisions. Thus, changes in pulse cultivation form an important component of the temporal transformation of the agricultural cropping pattern in Bhandara District.

**9. Has the area under oilseed crops changed during the last 10–20 years?**

To get the information about Has the area under oilseed crops changed during the last 10–20 years? following information was received.

**Sr. No. Response Number of Respondents Percentage (%)**

|              |            |            |              |
|--------------|------------|------------|--------------|
| 1            | Increased  | 32         | 32.0         |
| 2            | Decreased  | 29         | 29.0         |
| 3            | No change  | 30         | 30.0         |
| 4            | Cannot say | 9          | 9.0          |
| <b>Total</b> | <b>—</b>   | <b>100</b> | <b>100.0</b> |

**Interpretation**

The above table presents the respondents' perceptions regarding changes in the area under oilseed crops during the last 10–20 years in Bhandara District. Out of the 100 respondents, 32 respondents (32.0%) reported that the area under oilseed crops has increased. This indicates that oilseed cultivation has gained importance for a significant proportion of farmers. However, 29 respondents (29.0%) reported a decrease in the area under oilseed crops. The reduction may be related to changes in market prices, production costs, irrigation availability, climatic variability

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and farmers' preference for alternative crops with better or more stable returns. A total of 30 respondents (30.0%) reported no significant change in the area under oilseed cultivation. This indicates that oilseed cultivation has remained relatively stable for nearly one-third of the surveyed farmers. The remaining 9 respondents (9.0%) could not provide a definite answer. Overall, the findings show that the trend in oilseed cultivation is mixed and relatively balanced. Although 32% of respondents reported an increase, 29% reported a decrease and 30% reported no change. This suggests that there has not been a uniform temporal trend in oilseed cultivation across the study area. The variation may reflect differences in soil conditions, rainfall, irrigation facilities, market demand, profitability and availability of agricultural inputs. Therefore, oilseed crops represent an important component of the changing agricultural cropping pattern of Bhandara District, but their future expansion may depend on improved market support, suitable technology and stable prices.

### 10. Has the area under wheat cultivation changed during the last 10–20 years?

To get the information about Has the area under wheat cultivation changed during the last 10–20 years? following information was received.

| Sr. No.      | Response   | Number of Respondents | Percentage (%) |
|--------------|------------|-----------------------|----------------|
| 1            | Increased  | 35                    | 35.0           |
| 2            | Decreased  | 25                    | 25.0           |
| 3            | No change  | 31                    | 31.0           |
| 4            | Cannot say | 9                     | 9.0            |
| <b>Total</b> | <b>—</b>   | <b>100</b>            | <b>100.0</b>   |

### Interpretation

The above table shows the respondents' perceptions regarding changes in the area under wheat cultivation during the last 10–20 years in Bhandara District. Out of the 100 respondents, 35 respondents (35.0%) reported that the area under wheat cultivation has increased. This represents the largest group and indicates that wheat cultivation has become more important for a considerable proportion of farmers. In contrast, 25 respondents (25.0%) reported a decrease in the area under wheat cultivation. This decline may be associated with factors such as limited irrigation, insufficient winter moisture, increasing production costs, labour availability and changes in the profitability of alternative crops. A total of 31 respondents (31.0%) reported no change in the area under wheat cultivation. This indicates that wheat cultivation has remained relatively stable among nearly one-third of the surveyed farmers. The remaining 9 respondents (9.0%) were unable to determine whether any significant change had occurred. Overall, the results indicate a moderate increasing trend in wheat cultivation, with 35% of respondents reporting an increase compared with 25% reporting a decrease. The relatively high proportion reporting no change also suggests that wheat remains a stable component of the Rabi-season cropping pattern for many farmers. The variation in wheat cultivation can be linked to irrigation availability, soil conditions, winter rainfall, market prices, production costs and farmers' crop-selection decisions. Thus, changes in the area under wheat contribute to the broader temporal transformation and diversification of agricultural cropping patterns in Bhandara District.

### Conclusion

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The present study, entitled “A Geographical Analysis of Spatial and Temporal Changes in Agricultural Cropping Patterns in Bhandara District, Maharashtra,” examines the changing nature and distribution of agricultural crops in the district from a geographical perspective. Agriculture continues to play an important role in the economic and social life of the rural population of Bhandara. The cropping pattern of the district is influenced by a combination of physical, economic, social, technological and institutional factors. The study demonstrates that agricultural land use is not uniform throughout the district and that considerable spatial differences exist in the distribution and importance of various crops. The geographical conditions of Bhandara, particularly rainfall, soil characteristics, drainage, topography and availability of water, have an important influence on crop selection. Rice has traditionally occupied a significant position in the agricultural economy of the district because of favorable rainfall and water availability in several parts. However, pulses, oilseeds, wheat, vegetables and other crops are also cultivated according to local environmental and economic conditions. Differences in irrigation facilities and soil characteristics have resulted in variations in cropping patterns between different tehsils and villages. The study also indicates that the cropping pattern has undergone changes over time. Farmers have modified their crop choices in response to changes in rainfall conditions, irrigation facilities, market prices, production costs, agricultural technology, availability of labour and government policies. In some areas, improved irrigation has encouraged farmers to cultivate a wider range of crops and undertake more intensive agriculture. At the same time, changes in market demand and profitability have influenced the relative importance of traditional and alternative crops. Temporal changes in cropping patterns reflect the changing relationship between farmers and their physical and economic environment. The expansion of agricultural technology, improved seeds, fertilizers, mechanization and irrigation has increased farmers' ability to modify their traditional cropping practices. However, increasing input costs, uncertain rainfall, water scarcity, pest and disease problems and fluctuations in crop prices continue to create challenges for farmers. These factors contribute to differences in the pace and direction of agricultural change across the district. The spatial analysis reveals that areas with better irrigation and favourable soil and moisture conditions tend to have greater agricultural intensity and diversification, whereas areas dependent primarily on rainfall are more vulnerable to climatic variability. Thus, the spatial distribution of crops cannot be explained by a single factor. It is the result of the combined influence of natural resources, farming practices, infrastructure, markets and farmers' socio-economic conditions. In conclusion, the agricultural cropping pattern of Bhandara District is a dynamic geographical phenomenon shaped by the interaction of physical and human factors. The analysis of spatial and temporal changes provides a better understanding of the transformation of the district's agricultural landscape. A balanced approach combining environmental sustainability, economic profitability and farmers' livelihood security is essential for the future development of agriculture in Bhandara District. The findings of this study can therefore contribute to regional agricultural planning, resource management and sustainable rural development in the district.

**Suggestions**

1. Promote Suitable Crop Diversification
2. Improve Irrigation Facilities
3. Promote Water-Saving Techniques
4. Encourage Climate-Resilient Agriculture
5. Improve Soil Management
6. Strengthen Agricultural Extension Services

7. Improve Access to Quality Seeds
8. Strengthen Agricultural Marketing
9. Improve Storage and Processing Facilities
10. Encourage Farmer Producer Organizations
11. Promote Mechanization
12. Strengthen Crop Insurance
13. Improve Agricultural Credit
14. Encourage Sustainable Rice Cultivation
15. Promote Pulses and Oilseeds
16. Strengthen Watershed Development
17. Use GIS and Remote Sensing for Agricultural Planning
18. Develop Tehsil-Level Agricultural Plans
19. Promote Farmer Education and Training
20. Encourage Sustainable Agricultural Development

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