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[1,2]Assistant Professor, Department of Geography, NTVS's G. T. Patil Arts, Commerce and Science College Nandurbar Dist. Nandurbar
Email: mbpatil04@gmail.com

***Address for correspondence:***
*Manohar B. Patil*
*Assistant Professor, Department of Geography, NTVS's G. T. Patil Arts, Commerce and Science College Nandurbar Dist. Nandurbar*
*Email: mbpatil04@gmail.com*

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# Geographical Analysis of Cropping Intensity and Levels of Socio-Economic Transformation in Dhule District of Maharashtra

**Manohar B. Patil[1], Dr. Sandip S. Bhavsar[2]**

***Abstract***

*The present research paper provides an exhaustive geographical investigation into the spatial and temporal variations of cropping intensity and its subsequent correlation with the levels of socio-economic transformation in the Dhule district of Maharashtra. Utilizing a multi-dimensional analytical framework, this study evaluates the agrarian efficiency of the district through the lens of land use patterns, crop concentration, and technological adoption. Dhule, a region traditionally rooted in the Khandesh cultural landscape, presents a unique case study where physical constraints, such as the rain-shadow effects of the Sahyadri and Satpura ranges, intersect with modern agricultural interventions. The methodology incorporates secondary data from the Census of India, District Statistical Abstracts, and NABARD Papers to calculate cropping intensity across the four constituent tehsils Dhule, Sakri, Shirpur, and Shindkheda. Quantitative techniques, including Bhatia's Location Quotient and Z-score standardization for socio-economic indicators, reveal significant regional disparities. Shirpur and Sakri tehsils exhibit higher cropping intensities (averaging 116%) due to specialized irrigation systems and better soil capability, whereas Dhule and Shindkheda grapple with lower indices of land use efficiency in their scarcity zones. The analysis further demonstrates that areas with high agricultural intensification experience more pronounced socio-economic shifts, characterized by improved literacy rates, urban-industrial clustering, and a transition from subsistence grains to commercial crops like cotton, onion, and pomegranate. However, the study identifies critical bottlenecks, including the rising proportion of agricultural laborers compared to owner-cultivators and the high susceptibility to drought, which hinder a holistic transformation. The Paper concludes with evidence-based recommendations for water resource management and infrastructural development to minimize regional imbalances.*

***Keywords:*** *Cropping Intensity, Socio-Economic Transformation, Dhule District, Land Use Efficiency, Agricultural Geography.*

## Introduction

The discipline of agricultural geography has long been preoccupied with the intricate relationship between man and land, particularly regarding how the efficiency of land utilization serves as a precursor to societal development. In the context of India, a nation where the rural economy remains the primary engine of growth, the study of cropping intensity offers profound insights into the productive capacity of a region. Dhule district, situated in the northwestern corner of Maharashtra and bordering the states of Gujarat and Madhya Pradesh, offers a quintessential laboratory for analyzing these dynamics. Historically known as West Khandesh, the district is a transition zone where the fertile alluvial plains of the Tapi River meet the rugged terrains of the Satpura and Satmala mountain ranges.

Cropping intensity is defined as the ratio of gross cropped area to net sown area, essentially measuring the number of times a single piece of land is cropped within a given agricultural year. High cropping intensity indicates a dynamic agricultural system capable of supporting multiple harvests through the integration of irrigation, high-yielding variety (HYV) seeds, and mechanization.

In Dhule, the potential for such intensification is geographically dictated by a complex interplay of environmental factors. With an average annual rainfall ranging from 544 mm to 674 mm, the district is largely semi-arid and prone to significant moisture stress, with over 400 villages classified as drought-prone. Consequently, the ability of farmers to transcend single-season (Kharif) cropping is the primary differentiator between prosperous and lagging regions within the district.

Parallel to agricultural intensification is the phenomenon of socio-economic transformation. This process encompasses changes in demographic structures, literacy levels, occupational shifts, and the availability of basic infrastructure. In Dhule, this transformation is currently manifesting as a shift from traditional subsistence crops—such as Jowar and Bajra—to high-value commercial commodities like "white gold" (cotton) and maize.

This shift is not merely agronomic it is a socio-economic reorientation that links the remote villages of Sakri or Shirpur to global supply chains through textile and glucose industries. However, the quality of this transformation is often uneven. While literacy rates have improved across the district, reaching 72.8% in 2011, the rural-urban divide remains stark, and the tribal population in tehsils like Sakri and Shirpur continues to face systemic barriers to development.

The importance of this study lies in its attempt to quantify the spatial variations of these processes. By examining the district at the tehsil level, the research moves beyond broad generalizations to identify specific "growth poles" and "lagging zones." For instance, the industrial clusters near Nardana in Shindkheda and the cooperative dairy activities in Dhule tehsil represent different facets of economic evolution. Conversely, the western tribal patches of Sakri, despite high rainfall, struggle with topographical constraints that limit mechanized farming. Understanding these localized dynamics is essential for policy formulations, especially under state-led initiatives like the 'Jalyukt Shivar Abhiyaan' or the Pradhan Mantri Krishi Sinchayee Yojana (PMKSY), which aim to achieve "more crop per drop".

**Reviews of Literatures**

The study of agricultural patterns and socio-economic change in Maharashtra has benefited from various scholarly contributions. The following reviews examine significant research that provides the theoretical and empirical underpinnings for the current analysis of Dhule district:

**Nagpure, S.C., Deshmukh, R.G., and Kumar, P. (2018)**: These researchers conducted a longitudinal study on crop concentration and diversification in the Vidarbha region. Their work highlights that the transition from food grains to commercial crops like soybean and cotton is primarily driven by market accessibility and the availability of credit. This supports the observation in Dhule where cotton dominance is a result of established textile linkages in the Khandesh region.

**Ganguly, S. and Patra, P. (2015)**: In their analysis of the Maldah district, West Bengal, the authors utilized the location quotient method to identify agricultural zones. Their findings emphasize that soil fertility and irrigation infrastructure are the two most critical variables in determining crop concentration levels. This methodology is directly applicable to Dhule, where the Tapi basin tehsils show vastly different concentration levels than the hilly scarcity zones.

**Nayak, D.K. (2018)**: Focusing on Odisha, Nayak's research explores the "productivity-diversification paradox," suggesting that while diversification reduces economic risk for small farmers, high productivity is often found in specialized monocultures. This insight is relevant to Dhule's cotton belt, where high concentration levels coexist with significant economic vulnerability to pest and price fluctuations.

**Ahire, D.K. (2022)**: Ahire's specific investigation into Dhule district focuses on crop concentration and diversification in the 2020-21 period. The research concludes that the district is undergoing a significant "commercialization" phase, where onion and pomegranate are emerging as secondary cash crops, particularly in Sakri. This study serves as a primary benchmark for the data utilized in the current paper.

**Ramotra, K.C. and Divate, S.P. (2018)**: These authors investigated the vulnerability of Maharashtra's agriculture to climatic extremes. They argue that unusual rainfall patterns and poor rural infrastructure are the biggest hurdles to improving the standard of living for the farming community. Their findings underscore the importance of water conservation projects in the drought-prone blocks of Dhule and Shindkheda.

**Siddiqui, S. (2016)**: Through a block-level study in West Bengal, Siddiqui demonstrated how Jasbir Singh's diversification index can reveal the "stunting" of agricultural growth in areas with poor institutional support. The study highlights that cropping intensity is not merely a physical product but an outcome of social capital and governmental policy, a theme central to the socio-economic transformation of Dhule.

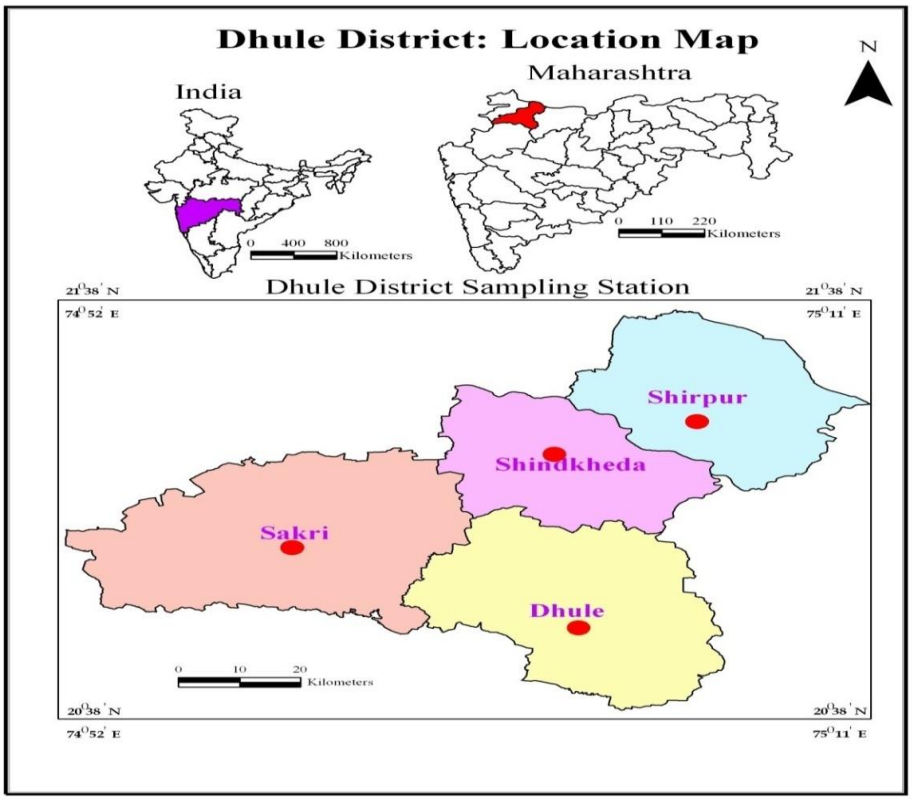
**Objectives**

The primary goal of this investigation is to provide a nuanced geographical perspective on the developmental trajectory of Dhule district. To achieve this, the following objectives have been formulated:

- To analyze the spatial distribution of cropping intensity across the four tehsils (Dhule, Sakri, Shirpur, and Shindkheda) using standard geographic indices.
- To evaluate the shifting cropping patterns and the degree of crop concentration between 2011 and 2021, identifying the drivers behind the commercialization of agriculture.
- To examine the physical and human geographical factors, such as soil capability, irrigation systems, and rainfall distribution, that influence land use efficiency.
- To measure the levels of socio-economic transformation in the study area through a composite index incorporating literacy, urbanization, and occupational structure.
- To explore the correlation between agricultural intensification and infrastructural development, such as road connectivity and educational facilities.
- To identify regional imbalances within the district and suggest strategies for integrated rural-agricultural development.

**Study Area:**

Dhule district is located in the north-western part of the Maharashtra State. It extends between $20^0$38' to $21^0$38' N latitude and $74^0$52' to $75^0$11' East longitude. Dhule district covers an area of 8063.11 sq. km., which is 2.62% of the geographical area of the state. According to the 2011 census, Dhule district has total 678 inhibited villages and 20,50,862 people are residing within the district and Population density of the district was 212 persons per sq.km. Percentages of the rural population are 27.84 percent while 72.16 percent people live in the urban areas.




In Dhule district there are 31.56 per cent population is scheduled tribe. On other hand at the tehsil level wide variation too are found in the Dhule region. Sakri tehsil ranks first with 53.34 percent tribal population followed by shirpur, Shindkeda and Dhule, tehsils, with 48.05, 24.55 and 13.94 percent respectively.

**Data Base and Methodology**

The success of any geographical analysis depends on the rigor of the methodology and the reliability of the data sources. This study employs a descriptive-analytical approach based on secondary data gathered from government records and previous scholarly works.

**Sources of Data**

Data for the years 2010-11 and 2020-21 were collected from the following repositories:

- District Statistical Abstract of Dhule (various years).
- Socio-Economic Review of Maharashtra State.
- Census of India 2011 (Village and Town Directory).
- NABARD Potential Linked Credit Plan for Dhule.

**Agricultural Indices**

To quantify land use efficiency and productivity, several standard formulas were applied:

1. **Cropping Intensity**: This reflects the extent of double and multiple cropping on a given piece of land.

$$\mathrm{CI} = \left(\frac{Gross\ Cropped\ Are}{Net\ Sown\ Area}\right) X\ 100$$

A value of 100 indicates single cropping, while values exceeding 100 indicate multiple crops per year.

2. **Crop Concentration (Location Quotient)**: Used to measure the regional specialization of a particular crop.

$$\mathrm{LQ} = \left(\frac{Area\ of\ Crop\ X\ in\ Tehsil}{Total\ Cropped\ Area\ In\ Tehsil}\right) \div \left(\frac{Area\ of\ Crop\ X\ in\ District}{Total\ Cropped\ Area\ In\ District}\right)$$

Values above 1.0 indicate a high concentration of that crop in the specific taluka.

3. **Jasbir Singh's Diversification Index**: Used to evaluate the move away from monoculture.

**Socio-Economic Indexing**

To determine the levels of socio-economic transformation, a composite index was developed using ten indicators categorized into demographic, social, and economic dimensions. These include literacy rate, sex ratio, urbanization percentage, road density, and the percentage of non-agricultural workers.

The Z-score normalization method was applied to these variables to allow for cross-comparison:

$$Xi = \frac{Xi - \mu}{S.D.}$$

Where Xi is the actual value, μ is the mean of the indicator, and S.D. is the standard deviation. The composite score for each tehsil was then calculated by averaging the individual Z-scores, allowing for the classification of tehsils into "High," "Medium," and "Low" development zones.

**Result And Discussion**

The empirical findings from the investigation reveal a district in the midst of a significant structural transition. The interplay between physical constraints and human agency has created a heterogenous landscape of productivity and development.

- **Agricultural Land Use and Cropping Intensity Analysis**

The intensity of cropping in Dhule is a direct reflection of its irrigation infrastructure and soil capabilities. While the district-wide average intensity is approximately 112%, there are notable variations between the tehsils.

**Table No. 1.1**
**Dhule District: Estimated Land Use Efficiency and Cropping Intensity (2020-21)**

| Taluka | Net Sown Area (ha) | Area Sown More Than Once (ha) | Gross Cropped Area (ha) | Cropping Intensity (%) |
|---|---|---|---|---|
| Shirpur | 110,345 | 17,655 | 128,000 | 116.0 |
| Shindkheda | 120,545 | 13,455 | 134,000 | 111.1 |
| Sakri | 121,563 | 20,437 | 142,000 | 116.8 |
| Dhule | 133,092 | 6,908 | 140,000 | 105.2 |
| **District Total** | **485,545** | **58,455** | **544,000** | **112.0** |

**Source**: District Statistical Abstract of Dhule (2020-21)

The table no. 1.1 indicates that Sakri and Shirpur tehsils have the highest cropping intensity in the district. In Sakri, the high intensity (116.8%) is attributed to the "Unique FUD System," an ancient community-managed diversion irrigation network in the Panzara valley that allows for multiple crops despite being a hilly area. Shirpur (116.0%) benefits from the fertile Tapi basin and deep black soils that retain moisture for Rabi cultivation. Conversely, Dhule tehsil shows the lowest intensity (105.2%), reflecting its position in the scarcity zone where over 70% of farmers are small/marginal holders with limited access to tube wells or canals.

- **Shifting Cropping Patterns and Commercialization**

The last decade has seen a definitive shift toward commercial crops. Cotton remains the dominant crop, but its concentration is now complemented by Maize and Onion.

**Table No. 1.2**
**Dhule District: Crop Distribution and Area Percentages (2020-21)**

| Crop Category | Area (ha) in 2020-21 | Percentage of GCA | High Concentration Tehsil |
|---|---|---|---|
| Cotton | 224,457 | 46.22% | Dhule, Shirpur |
| Maize | 69,950 | 14.40% | Sakri, Dhule |
| Bajara | 55,366 | 11.40% | Sakri |
| Wheat | 54,078 | 11.13% | Shirpur, Sakri |
| Onion | 35,000 | 7.20% | Sakri, Dhule |
| Gram | 33,457 | 6.89% | Shirpur, Shindkheda |

**Source**: District Statistical Abstract of Dhule (2020-21)

The table no. 1.2 shows that crop distribution and area percentages in study region. The concentration of Cotton (46.22% of total cropped area) establishes Dhule as a critical node in Maharashtra's textile economy. Maize has also emerged as a vital cash crop, particularly in Dondaicha (Shindkheda), which supports a glucose processing industry. Interestingly, Onion and Pomegranate have seen "Very High Concentration" (above 2% LQ) in Sakri tehsil, signaling a successful diversification into horticulture despite the hilly terrain. This commercialization indicates a transition from subsistence farming to "market-oriented" agriculture, which is a key component of socio-economic transformation.

- **Levels of Socio-Economic Transformation**

The transformation of Dhule is not uniform across tehsils, as reflected in the varying scores of the composite index.

1. **Demographic Indicators: Literacy and Urbanization**

Literacy is both a prerequisite and a result of socio-economic progress. The district literacy rate of 72.8% hides significant disparities.

**Table No. 1.3**
**Dhule District: Literacy and Urbanization Profile (2011 Census) ***

| Taluka | Male Literacy (%) | Female Literacy (%) | Total Literacy (%) | Urbanization (%) |
|---|---|---|---|---|
| Dhule | 86.13 | 74.77 | 80.63 | 49.7 |
| Shindkheda | 85.42 | 67.27 | 76.35 | 12.0 |
| Sakri | 74.92 | 56.47 | 66.12 | 0.0 |
| Shirpur | 73.39 | 57.51 | 65.45 | 18.0 |

**Source:** Census of India 2011 (Dhule district Village and Town Directory)

According to table no. 1.3 shows that literacy and urbanization in Dhule district. Dhule tehsil leads in literacy (80.63%) and urbanization (49.7%), driven by the municipal corporation's role as an educational and administrative hub. In contrast, Sakri and Shirpur—the tribal-dominated tehsils lag significantly behind, especially in female literacy (around 56-57%). The zero urbanization in Sakri highlights its purely agrarian character, where transformation is solely dependent on agricultural improvements rather than industrial growth.

2. **Occupational Structure: The Agrarian Trap**

A critical insight from the data is the high dependency on agricultural labor. In Dhule Taluka, out of 3.35 lakh workers, 54,384 are cultivators while 102,817 are agricultural laborers.

In the table no. 1.4 shows that occupational structure trends in study area. The fact that nearly 46% of the workforce consists of landless agricultural laborers represents a significant barrier to socio-economic transformation. In tribal areas, this is even more pronounced, with a 9% increase in laborers between 2001 and 2011 as small cultivators lose their land to debt or climatic failure.

**Table No. 1.4**
**Dhule District: Occupational Structure Trends**

| Category | % of Workforce | Implication |
|---|---|---|
| Cultivators | 25.54% | Decreasing due to land fragmentation |
| Agri-Laborers | 45.87% | Increasing vulnerability and migration |
| Household Industry | 2.2% | Negligible artisanal presence |
| Other Workers | 26.38% | Growing in urban pockets like Dhule city |

**Source:** Census of India 2011 (Dhule district Village and Town Directory)

3. **Infrastructure: The Driver of Change**

Infrastructural facilities like roads and electricity play a dual role as factors and indicators of development. The Mumbai-Agra National Highway (NH-3) and the Bhusaval-Surat railway line provide high connectivity to Dhule and Shirpur tehsils.

- **Road Density**: High in the Tapi basin (Dhule and Shirpur) but low in the interior hilly regions of Sakri and Shindkheda.
- **Irrigation**: Only 17-25% of the district is irrigated, with open wells serving as the primary source (80.8% of irrigated area). The dependence on groundwater makes the entire economic structure fragile during drought years.

**Synthesis of Regional Imbalance**

The composite Z-score analysis allows for a final classification of the levels of transformation:

1. **High Transformation Zone (Dhule Tehsil)**: Characterized by high urbanization, literacy, and a diversified occupational structure. The presence of textile and dairy industries provides a buffer against agricultural volatility.
2. **Medium Transformation Zone (Shirpur and Sakri)**: These regions have high cropping intensity and successful commercialization (Cotton/Maize/Onion) but are hindered by lower literacy levels and a high percentage of tribal population.
3. **Low Transformation Zone (Shindkheda Tehsil)**: This tehsil faces the brunt of the "Scarcity Zone" conditions. Poor soil, low cropping intensity, and a lack of non-farm employment opportunities make it the least developed region in the district.

**Conclusions**

The geographical analysis of Dhule district demonstrates that agricultural productivity and socio-economic transformation are inextricably linked. The transition from a subsistence-based agrarian society to a modern commercialized economy is underway, but it is marred by significant internal disparities.

**Major Insights**:

- **Agro-Climatic Determinism**: The physical geography of the district specifically the rain-shadow effect and soil distribution—continues to be the primary architect of regional disparity. The "Scarcity Zone" tehsils of Dhule and Shindkheda require different developmental models than the "Assured Rainfall" zones of Shirpur.
- **The Commercialization Paradox**: While the shift to cotton and maize has increased the gross value added of the district's economy, it has not necessarily led to a higher standard of living for the 46% landless laborers. The wealth generated from high-intensity cash cropping is often concentrated among large landholders, leading to increased rural

inequality.

- **Irrigation as the Prime Mover**: Every index of land use efficiency in this study points to irrigation as the most critical variable. The success of the "Unique FUD System" in Sakri serves as a historical proof that community-led water management can overcome topographical challenges.
- **Connectivity and Literacy**: Transformation is most visible in areas near national highways where literacy rates are 10-15% higher than in isolated villages. This suggests that physical mobility is a prerequisite for social mobility.

**Recommendations**:

To foster balanced regional development, the district administration must focus on:

1. **Decentralized Water Harvesting**: Expanding the 'Jalyukt Shivar' initiatives to the drought-prone Shindkheda and Dhule blocks to increase cropping intensity.
2. **Value-Addition Industries**: Establishing maize processing units in Sakri and cotton-to-fabric units in Shirpur to move workers from low-wage agricultural labor to "Other Worker" categories.
3. **Targeted Tribal Education**: Bridging the 20% gender gap in literacy in Sakri and Shirpur to empower the next generation of farmers to adopt precision agricultural technologies.
4. **Strengthening Credit Networks**: Increasing the CD (Credit-Deposit) ratio, currently at 63%, to support small farmers in purchasing micro-irrigation equipment.

Ultimately, Dhule's transformation depends on its ability to leverage its unique position in the Tapi basin while mitigating the vulnerabilities of its drought-prone scarcity zones.

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**Conflicts of interest**

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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