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OILSEED DIVERSIFICATION FOR SUSTAINABLE AGRICULTURAL DEVELOPMENT IN INDIA: A SPATIO-TEMPORAL ANALYSIS (2010-11 to 2025-26)

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ABSTRACT

Oilseed diversification is an important strategy for promoting sustainable agricultural development, improving resource-use efficiency, enhancing farm incomes, and strengthening India's edible-oil security. Against this background, the present study examines the spatio-temporal changes in the geographical distribution of oilseed production across Indian states and Union Territories during 2010–11, 2015–16, 2020–21, and 2025–26. The study is based on secondary data obtained primarily from the Ministry of Agriculture and Farmers Welfare, Government of India, and employs a percentage-share approach to assess changes in the spatial composition of oilseed production. The findings reveal a persistent geographical concentration of oilseed production in Madhya Pradesh, Rajasthan, Maharashtra, and Gujarat. However, the internal structure of this core region underwent significant transformation. Maharashtra recorded the largest increase in national share (+5.42 percentage points), followed by Rajasthan (+4.02), whereas Andhra Pradesh, Madhya Pradesh, and Karnataka registered notable relative declines. By 2025–26, the four leading states together accounted for approximately 83.69 percent of the national distribution. The study concludes that India's oilseed geography reflects continuity with substantial internal restructuring rather than widespread spatial diversification.

Keywords: Agricultural Development, Cropping Patterns, Oilseeds, Spatio-Temporal Analysis, Spatial Distribution.

INTRODUCTION

India is one of the leading oilseeds producing countries in the world. India ranks fourth among global oilseed producers, contributing roughly 5 percent to 10 percent of total world production across nearly 20 percent of global cultivation land. The country holds the number one spot worldwide for producing castor seed, sesame, safflower, niger, and rice bran oil (Reddy & Pati, 1998). India's total edible oil production was recorded at 12.18 million tons during the 2023-24 fiscal year. The country can meet only 44 percent of its domestic demand for edible oils through internal production. Despite being among the world's largest producers of oilseeds**,** India remains substantially dependent on imports to bridge its edible oil deficit (Jat et al., 2019). Notably, import dependence on edible oils has declined from 63.20 percent in 2015-16 to 56.25 percent in 2023-24, reflecting a modest improvement in self-sufficiency from 36.8 percent to 43.74 percent. However, this progress is tempered by the sharp rise in overall consumption, which continues to exert significant pressure on the nation's edible oil requirement (Mathur et al., 2023). Crop diversification has been recognized as an effective strategy for achieving the objectives of food security, nutritional security, income growth, employment generation, judicious use of land and water resources, and sustainable agricultural development (Kaur & Singh, 2023). The opportunities for crop diversification emerge from technological breakthroughs, changes in demand patterns, the development of irrigation, the availability of marketing infrastructure, and new trade arrangements. The necessity for crop diversification arises on account of the need for reducing risks associated with yield, market and prices; arresting the degradation of natural resources and the

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environment; and attaining national goals like employment generation, self-reliance in critical crop products, and earning foreign exchange. Crop diversification also acts as a powerful tool in minimizing risk in farming. These considerations make a strong case for farm/crop diversification in India. Crop diversification and a large number of crops are practiced in rainfed areas to reduce the risk factor of crop failures due to drought (Suresh and Mathur, 2025).

The diversification of crops holds significant potential as an economic driver within the agricultural sector, making it a crucial factor in addressing the challenges that have arisen in the post-green revolution era. Given the diminishing availability of agricultural land and smaller operational holdings due to urban expansion, the rapid growth of the population, and evolving consumer food preferences, farmers are grappling with the need to incorporate new high-value crops into their cropping systems, either alongside or as substitutes (Bhatt et al., 2016; Shergill, 2005). Many scholars have put forth the notion that agricultural diversification serves as a tool to elevate farm income, create job prospects, combat poverty, and contribute to the preservation of natural resources (Braun, 1995; Birthal et al., 2005, Johl et al., 1986; Johl, 1996; Pingali and Rosegrant, 1995; Ryan and Spencer, 2001; Vyas, 1996).

This paper explores the spatial-temporal changes in the cropping pattern of oilseeds in India during the four time periods 2010-11, 2015-16, 2020-21, and 2025-26. This paper tries to find out the state-wise oilseeds cropping patterns and changes therein. To provide deeper insight, this paper has been categorized into four sections. The first section deals with the arguments of how and why a region has changes in cropping patterns of oilseed scenarios. The second section deals with the study area and methodology. Section third deals with empirical considerations of oilseed cropping pattern and composition of oilseed crops from 2010-11 to 2025-26. The last (fourth) section deals with the broad conclusions.

STUDY AREA

The study area comprises of the entire region of India located on the southern part of Asian continent. The country lies to the north of the equator between 8°4’ and 37°6’ north latitude and 68°7’ and 97°25’ east longitude, with a total land area of 3,287,263 sq. km. Bounded by the Indian Ocean on the south, the Arabian Sea on the south-west, and the Bay of Bengal on the south-east, India has a coastline of 7517 km. The wide variety of physical features and climatic conditions have led to many diversified ecological habitats such as forests, grasslands, wetlands, coastal and marine ecosystems, and desert ecosystems, which harbour and sustain the immense biodiversity.

METHODOLOGY

This research work is based on secondary sources of data. The data from the Ministry of Agriculture, from the websites of the Government of India has been used to collect relevant information regarding areas under oilseeds crops. Various issues of the Agricultural Glance of India have been pressed into service. To look into the policy change and its effects, the data was divided into four periods of time i.e. 2010-11, 2015-16, 2020-21, and 2025-26. A simple percentage share method is used to examine the area under oilseeds crop across the state-wise scenario in India.

EMPIRICAL CONSIDERATIONS

The table explore the changing geographical distribution of oilseed production among the states and Union Territories of India during the period 2010–11 to 2025–26. The values are expressed as percentage shares of the national total, thereby facilitating an assessment of the relative contribution of individual states and the changing spatial concentration of oilseed production. Since the aggregate for India is maintained at 100 per cent in each reference year, the observed variations represent changes in

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the relative spatial composition of oilseed production rather than changes in the national percentage base.

SPATIAL STRUCTURE AT THE BEGINNING OF THE PERIOD

The distribution in 2010–11 reveals a pronounced spatial concentration of oilseed production in a limited number of states. Madhya Pradesh occupied the first position, contributing 29.51 per cent of the national share, followed by Rajasthan (19.76 per cent), Maharashtra (14.76 per cent), and Gujarat (11.95 per cent). The combined contribution of these four states amounted to approximately 76 per cent, indicating a very high degree of geographical concentration in the oilseed economy. These states constitute an important oilseed-producing belt extending primarily across the central and western parts of the country. Other relatively important contributors included Andhra Pradesh (5.98 per cent) and Karnataka (5.02 per cent). However, their shares were considerably lower than those of the four leading states. Haryana (2.95 per cent) and Uttar Pradesh (2.74 per cent) occupied an intermediate position, while most eastern, northeastern, Himalayan and Union Territory regions accounted for less than one per cent individually.

From a geographical perspective, this pattern indicates that the national oilseed economy was strongly anchored in the semi-arid, dry sub-humid and rainfed agricultural regions of central and western India. The exceptionally high share of Madhya Pradesh, Rajasthan, Maharashtra and Gujarat demonstrates the importance of broad regional agricultural specialization rather than an evenly distributed national production structure.

TRANSITIONAL PHASE: 2010–11 TO 2015–16

The 2015–16 distribution indicates the beginning of a significant restructuring in the spatial composition of oilseed production. Madhya Pradesh remained the leading contributor, although its share declined marginally from 29.51 to 28.59 per cent. Rajasthan, in contrast, increased from 19.76 to 20.01 per cent, while Maharashtra recorded a substantial increase from 14.76 to 18.56 per cent. The increase of approximately 3.80 percentage points in Maharashtra represents an important shift in the regional balance of oilseed production. Gujarat experienced a decline from 11.95 to 9.94 per cent, while Karnataka increased slightly from 5.02 to 5.36 per cent. Andhra Pradesh, however, declined from 5.98 to 4.18 per cent. Thus, the mid-period distribution suggests that the dominance of the central-western oilseed belt persisted, but its internal composition was changing, particularly through the increasing relative importance of Maharashtra.

Table No: 1

Changes in the overall Scenario of Oilseeds Status in India (In Percent)

State/ UT's	2010-11	2015-16	2020-21	2025-26	Over the Change 2010-11 to 2025-26
Andhra Pradesh	5.98	4.18	2.78	1.42	-4.55
Arunachal Pradesh	0.12	0.14	0.13	0.12	0.01
Assam	1.09	2.20	1.14	1.16	0.07
Bihar	0.44	0.45	0.42	0.43	0.00
Chhattisgarh	1.03	1.14	0.81	0.39	-0.64
Goa	0.01	0.01	0.00	0.00	-0.01
Gujarat	11.95	9.94	11.55	12.47	0.51
Haryana	2.95	1.99	2.42	2.54	-0.41
Himachal Pradesh	0.04	0.05	0.04	0.03	-0.01
Jammu & Kashmir	0.23	0.23	0.18	0.15	-0.08
Jharkhand	0.98	1.04	1.35	1.57	0.58

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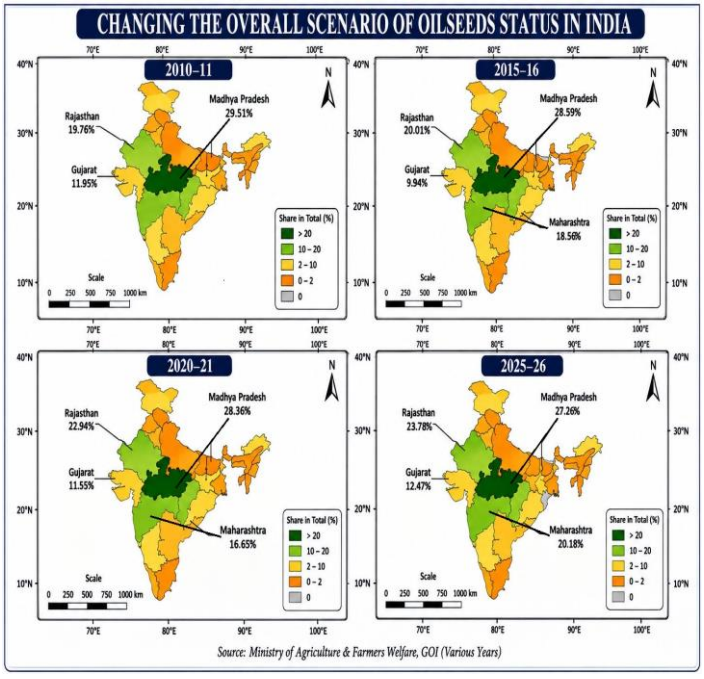
Karnataka	5.02	5.36	3.73	2.94	-2.08
Kerala	0.00	0.00	0.00	0.00	0.00
Madhya Pradesh	29.51	28.59	28.36	27.26	-2.25
Maharashtra	14.76	18.56	16.65	20.18	5.42
Manipur	0.13	0.14	0.12	0.12	-0.01
Meghalaya	0.05	0.05	0.05	0.05	0.00
Mizoram	0.01	0.01	0.01	0.01	0.00
Nagaland	0.23	0.25	0.25	0.12	-0.11
Odisha	0.79	0.83	0.50	0.53	-0.27
Punjab	0.17	0.18	0.15	0.16	-0.01
Rajasthan	19.76	20.01	22.94	23.78	4.02
Sikkim	0.03	0.03	0.02	0.01	-0.02
Tamil Nadu	1.65	1.41	2.70	1.54	-0.11
Tripura	0.02	0.03	0.06	0.04	0.02
Uttharakhand	0.29	0.12	0.10	0.11	-0.18
Uttar Pradesh	2.74	3.03	3.52	2.83	0.09
West Bengal	0.00	0.00	0.00	0.00	0.00
D & N Haveli	0.00	0.00	0.01	0.02	0.02
Delhi	0.00	0.00	0.00	0.00	0.00
Puducherry	0.00	0.00	0.00	0.00	0.00
Telangana	0.00	0.00	0.00	0.00	0.00
Ladakh	0.00	0.00	0.00	0.00	0.00
India	**100.00**	**100.00**	**100.00**	**100.00**	**0.00**

Source: Ministry of Agriculture and Farmer Welfare, Government of India, 2010-11 to 2020-21.



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EMERGING SPATIAL RE-ORGANIZATION: 2015–16 TO 2020–21

By 2020–21, the restructuring of the oilseed-producing geography became more evident. Rajasthan's share increased considerably to 22.94 per cent, while Maharashtra maintained a substantial 16.65 per cent. Madhya Pradesh continued to occupy the first position, but its contribution declined further to 28.36 per cent. Gujarat recovered to 11.55 per cent, suggesting some fluctuation rather than a continuous linear trend. A noteworthy feature of this phase was the weakening of the relative contribution of some southern states. Karnataka's share fell to 3.73 per cent, while Andhra Pradesh declined to 2.78 percent. Conversely, Jharkhand increased from 1.04 percent in 2015–16 to 1.35 percent in 2020–21, although its absolute contribution to the national structure remained comparatively small. Uttar Pradesh also showed a gradual increase, reaching 3.52 per cent. The geographical implication is that the national oilseed structure was not undergoing a complete spatial displacement; rather, it was experiencing a relative redistribution within the existing major producing belt, accompanied by modest gains in selected states outside the traditional core.

SPATIAL PATTERN BY 2025–26

The 2025–26 distribution demonstrates the cumulative outcome of these changes. Madhya Pradesh remained the largest contributor, but its share declined to 27.26 per cent, representing a net reduction of 2.25 percentage points over the study period. Rajasthan increased substantially to 23.78 per cent, registering a net gain of 4.02 percentage points. The most pronounced positive change was observed in Maharashtra, whose share rose to 20.18 per cent, corresponding to a net increase of 5.42 percentage points—the largest increase recorded among the states in the table. Gujarat also recorded a modest net increase of 0.51 percentage points, reaching 12.47 per cent. The resulting hierarchy in 2025–26 was therefore Madhya Pradesh (27.26 percent), Rajasthan (23.78 percent), Maharashtra (20.18 percent), and Gujarat (12.47 percent). Together, these four states contributed approximately 83.69 per cent of the national distribution. Statistically, this indicates that although individual state rankings changed in relative magnitude, the overall production structure remained highly concentrated geographically.

STATES SHOWING RELATIVE DECLINE

The long-term change column provides further evidence of spatial differentiation. Andhra Pradesh recorded the largest negative change, with its share declining by 4.55 percentage points, followed by Madhya Pradesh (−2.25 percentage points) and Karnataka (−2.08 percentage points). Chhattisgarh (−0.64), Haryana (−0.41), Odisha (−0.27) and Uttarakhand (−0.18) also experienced reductions. These changes should be interpreted as relative changes in national share, and not necessarily as evidence of an absolute decline in oilseed production in every state. A declining percentage share can occur either because a state's production falls or because production elsewhere grows more rapidly. The table itself does not provide sufficient absolute production figures to distinguish between these two processes. In contrast, Maharashtra registered the highest positive change (+5.42 percentage points), followed by Rajasthan (+4.02 percentage points). Jharkhand also recorded a comparatively notable increase of 0.58 percentage points, while Gujarat increased by 0.51 percentage points. Assam, Uttar Pradesh, Tripura and Dadra and Nagar Haveli also registered small positive changes. The expansion of Maharashtra and Rajasthan is particularly important from the perspective of spatial restructuring. Their increasing shares indicate a strengthening of their relative position within the national oilseed-producing system. Nevertheless, this expansion has occurred within an already concentrated national structure rather than producing a geographically dispersed pattern.

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CONCLUSION

From a geographical and statistical perspective, the table demonstrates continuity accompanied by internal restructuring in India's oilseed-producing geography during 2010–11 to 2025–26. The basic spatial concentration remained intact, with Madhya Pradesh, Rajasthan, Maharashtra and Gujarat consistently forming the principal production core. However, the internal balance of this core changed substantially. Madhya Pradesh experienced a gradual reduction in its relative share, while Rajasthan and particularly Maharashtra strengthened their positions. Simultaneously, Andhra Pradesh and Karnataka experienced notable reductions in their national shares. The overall pattern can therefore be characterized as a shift in the relative dominance among major oilseed-producing states rather than a fundamental dispersal of oilseed production across India. The increasing shares of Rajasthan and Maharashtra, alongside the declining share of Madhya Pradesh, suggest a gradual reorganization of the national oilseed landscape. However, because the table reports percentages rather than absolute output, conclusions regarding actual increases or decreases in production should be made cautiously. For a comprehensive PhD-level assessment, these findings can subsequently be supplemented with production, area and yield data, as well as measures such as the concentration ratio, location quotient, coefficient of variation and state-wise growth rates, to establish the magnitude and determinants of spatial transformation more rigorously.

CONFLICT OF INTEREST

The authors declare that there is no financial or commercial relationship that could be elucidated in this research as a conflict of interest.

AUTHOR CONTRIBUTION

Gorakh Singh: Formal analysis, interpretation, methodology, conceptualization, writing review, editing, and writing the original draft.

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