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Advancement and Productivity Enhancement of Mustard Cultivation in Uttar Pradesh: A Critical Analysis

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Abstract

This research paper presents a comprehensive analysis of mustard cultivation in Uttar Pradesh, India, covering the period from 1966 to 2021. The study examines long-term trends in the area under cultivation, production output and yield efficiency to assess the advancement and productivity enhancement of mustard farming in the state. Using historical data, the research identifies significant growth patterns, evaluates the impact of improved agricultural practices and explores the role of technological innovations and policy interventions in shaping the mustard cultivation scenario. District-level analysis highlights regional disparities and the heterogeneous nature of agricultural development across Uttar Pradesh. Statistical tools are employed to forecast future trends and evidence-based recommendations are proposed to promote sustainable cultivation practices. The study aims to enhance productivity, profitability and environmental sustainability in mustard farming.

Keywords: Mustard, Cultivation, Productivity, Technological Advancement, Policy Interventions, Sustainability

Introduction

Mustard, a crucial oilseed crop, plays a vital role in the agricultural and economic landscape of Uttar Pradesh, a state known for its substantial contribution to India's agrarian economy. The cultivation of mustard in Uttar Pradesh has a rich historical background, marked by evolving farming practices that have continuously adapted to changing climatic conditions, technological advancements and market demands. This research paper undertakes an in-depth exploration of the advancement and productivity enhancement of mustard cultivation in Uttar Pradesh from 1966 to 2021, providing a detailed analysis of trends in the area under cultivation, production levels and yield efficiency. The significance of mustard cultivation extends beyond its economic importance, contributing to food security, employment generation and the socio-economic development of rural

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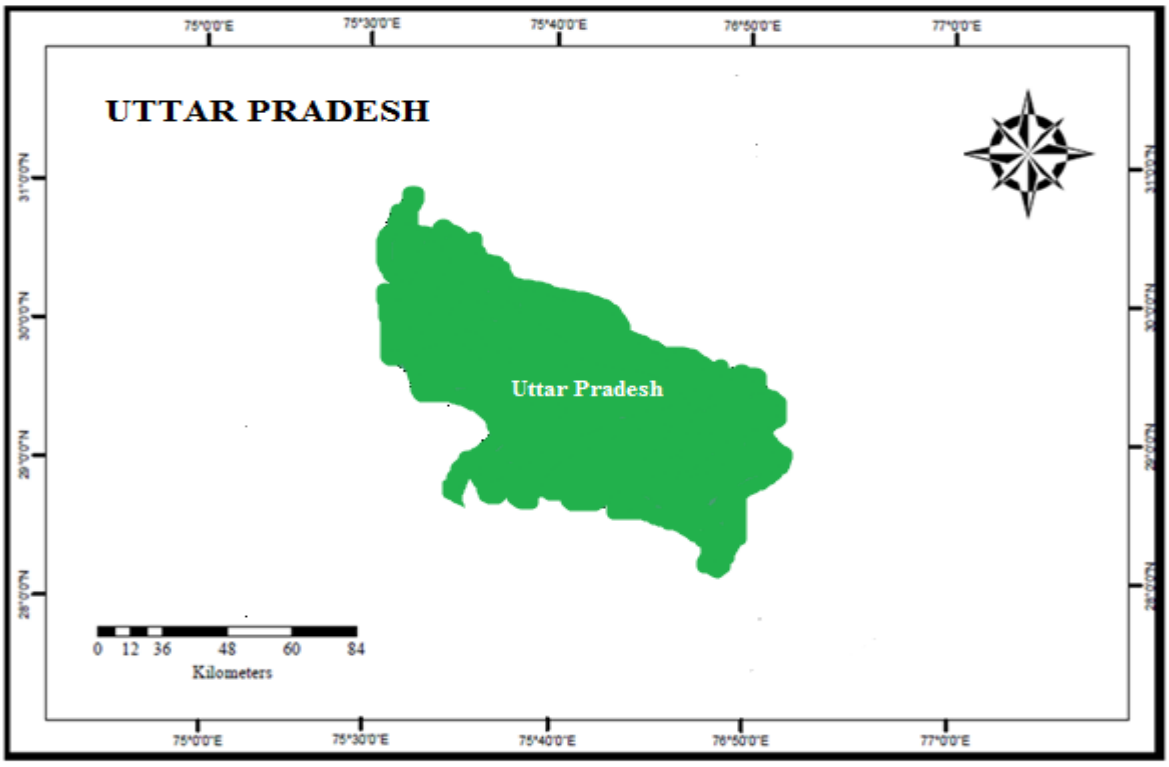
communities. In this context, the study aims to trace the trajectory of mustard cultivation in Uttar Pradesh by highlighting the impact of key factors such as technological innovations, government policies and environmental challenges on its growth patterns. Through a comprehensive examination of historical data and district-level variations, the paper seeks to uncover the dynamics that have shaped mustard cultivation in the state, offering insights into both the achievements and challenges faced by the farming community. Furthermore, the study examines the implications of these trends for future agricultural practices, the sustainability of mustard cultivation and the overall well-being of the agrarian society in Uttar Pradesh. By analyzing past and present patterns, the research attempts to forecast future developments and propose strategic measures to optimize mustard cultivation, enhance productivity and ensure sustainable agricultural growth in the state.

Map 1: Uttar Pradesh



This study includes recommendations for adopting sustainable farming practices, integrating modern agricultural technologies and implementing supportive policies that promote the economic and environmental sustainability of mustard cultivation. In doing so, the paper seeks to contribute to the ongoing discourse on agricultural development in

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Uttar Pradesh, providing a strong foundation for future research and policy formulation aimed at enhancing the productivity, profitability and sustainability of mustard cultivation in the state.

Figure 1: Mustard Farming in Uttar Pradesh

Objective

- This study aims to analyze the trends and factors influencing mustard cultivation in Uttar Pradesh.

Literature Review

Dhingra (2022), The present study aimed to examine the market arrival pattern and price behavior of mustard in major regulated markets of Uttar Pradesh during two distinct periods 2010 to 2016 (pre e-NAM) and 2017 to 2021 (post e-NAM). The National Agriculture Market (e-NAM) was implemented in Uttar Pradesh in 2016 and its impact began to reflect from 2017 onwards. For the analysis, two prominent mustard markets, namely Agra and Aligarh, were selected. The results revealed that mustard arrivals were comparatively higher in both markets during the pre e-NAM period. After the introduction of e-NAM, a significant decline in market arrivals and price levels was observed in both markets. While mustard prices showed an increasing trend in the Agra market, a declining trend was recorded in the Aligarh market during the post e-NAM period. The awareness and adoption of e-NAM services were found to be higher among traders and farmers in Agra compared to Aligarh. Prior to and during the implementation of e-NAM, strong

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market integration was observed between the Agra and Aligarh markets. However, the Granger causality **test** indicated a unidirectional price transmission from Agra to Aligarh in the post e-NAM period, implying that price changes in Agra significantly influenced mustard prices in Aligarh. In contrast, no such price interdependence existed between the two markets in the pre e-NAM period. The findings suggest that although e-NAM has improved market connectivity and transparency, its impact on mustard arrivals and price stabilization in Uttar Pradesh remains limited. Strengthening digital infrastructure, enhancing farmer awareness and improving market access can further maximize the benefits of e-NAM, thereby supporting the objectives of productivity enhancement and market efficiency in mustard cultivation.

Ministry of Agriculture & Farmers Welfare (2022) provides a comprehensive overview of the performance, policies, and institutional initiatives shaping Indian agriculture during 2021–22. The annual report situates crop production within the broader framework of food security, farmer income enhancement, and sustainability. It documents trends in major crops, irrigation expansion, soil health initiatives, and technology adoption, offering contextual evidence for understanding regional agricultural outcomes. The report is particularly relevant for analysing oilseed crops such as mustard, as it outlines policy support mechanisms, minimum support price operations, and mission-mode programmes aimed at improving productivity. By integrating statistical summaries with policy narratives, the report helps bridge macro-level planning and micro-level agricultural practices. Its emphasis on irrigation efficiency, input management, and farmer-centric reforms provides an institutional backdrop against which empirical studies on crop productivity can be interpreted. As a government-authored source, it serves as an authoritative baseline for situating district- and state-level agricultural performance within national priorities and development strategies.

Verma and Singh (2022) examine the relationship between irrigation efficiency and crop productivity, highlighting irrigation as a critical determinant of agricultural output in water-stressed regions. Their study demonstrates that efficient water management significantly enhances crop yields while reducing resource wastage, particularly in semi-arid agro-climatic zones. By employing empirical data and comparative analysis, the authors show that modern irrigation practices contribute not only to yield stability but also to improved input-use efficiency. The findings are especially relevant for oilseed

cultivation, where moisture stress during key growth stages can substantially affect productivity. The study underscores the need for region-specific irrigation strategies rather than uniform approaches, reinforcing the argument that infrastructural investments must be aligned with local agronomic conditions. This work contributes to the literature by linking irrigation efficiency with sustainable agricultural growth and supports policy discussions on micro-irrigation and water conservation in enhancing crop productivity.

Directorate of Economics and Statistics (2021) offers a detailed statistical compendium on Indian agriculture through Agricultural Statistics at a Glance. The publication provides time-series data on area, production, and yield of major crops, serving as a foundational reference for empirical agricultural research. Its strength lies in presenting disaggregated data that allow comparisons across crops, states, and years. For studies focusing on mustard cultivation, the report supplies essential quantitative benchmarks to identify trends, fluctuations, and regional disparities. By consolidating data from multiple official sources, it ensures consistency and reliability, making it suitable for trend analysis and policy evaluation. The publication also facilitates linkage between agricultural performance and broader economic indicators, such as input usage and productivity growth. As a secondary data source, it plays a crucial role in validating findings from field-based or district-level studies and situating them within national agricultural patterns.

Government of Uttar Pradesh (2021) presents a state-specific statistical overview through the Statistical Abstract of Uttar Pradesh 2020–21. This document compiles district-level data on agriculture, irrigation, land use, and crop production, making it particularly valuable for regional analysis. It enables researchers to assess intra-state variations in crop performance and resource distribution, which are often masked in national datasets. In the context of mustard cultivation, the abstract provides insights into acreage, yield patterns, and irrigation coverage across districts. Such data are essential for identifying spatial trends and correlating productivity with infrastructural and environmental factors. The publication supports evidence-based regional planning by offering granular statistics that inform both academic analysis and policy formulation. Its official status enhances its credibility, and its detailed coverage allows for meaningful comparisons over time, contributing significantly to studies focused on agricultural development in Uttar Pradesh.

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National Mission on Oilseeds and Oil Palm (2021) outlines the operational guidelines for promoting oilseed production in India, with a focus on enhancing self-sufficiency and reducing import dependence. The document details strategic interventions such as improved seed distribution, extension services, and financial incentives aimed at increasing productivity. For mustard cultivation, the guidelines highlight targeted support mechanisms designed to address yield gaps and regional constraints. The mission framework emphasises an integrated approach combining technology adoption, input management, and farmer capacity building. By articulating implementation strategies, the guidelines provide insight into how policy intentions translate into ground-level action. This source is relevant for understanding the policy environment influencing oilseed farmers and for assessing the alignment between institutional support and observed production trends. It contributes to the literature by contextualising empirical findings within structured government programmes.

Singh and Yadav (2021) focus on soil fertility management practices in mustard cultivation, emphasising the role of balanced nutrient application in achieving optimal yields. Their study highlights how soil health directly influences crop performance and long-term sustainability. Using agronomic evidence, the authors demonstrate that appropriate fertiliser use and organic amendments can significantly improve mustard productivity while maintaining soil quality. The research underscores the importance of site-specific nutrient management rather than blanket recommendations. This work adds to the literature by linking soil science principles with practical cultivation outcomes, particularly relevant for regions facing soil degradation. It also supports policy initiatives promoting soil health cards and integrated nutrient management. By addressing a key agronomic factor, the study complements broader analyses of irrigation and policy support, contributing to a holistic understanding of productivity determinants in mustard farming.

Factors Influencing Mustard Cultivation in Uttar Pradesh

Mustard cultivation in Uttar Pradesh is shaped by a complex interplay of natural, technological, socio-economic and institutional factors that collectively determine its productivity, profitability and sustainability. One of the most important determinants is the agro-climatic condition of the state. Uttar Pradesh experiences a subtropical climate with cool winters, which is highly suitable for rabi crops like mustard. Optimal temperature ranging between 10°C and 25°C during germination and flowering stages supports healthy

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crop growth. Adequate winter sunshine and low humidity further enhance seed development and oil content. However, climatic variability such as untimely rainfall, fog, frost and rising temperature trends due to climate change often disrupt sowing schedules and affect yield stability, making climate resilience a crucial factor influencing mustard production. Another significant factor is soil characteristics. Mustard thrives best in well-drained loamy and sandy loam soils with moderate fertility. The Indo-Gangetic plains of Uttar Pradesh provide fertile alluvial soils rich in essential nutrients, which support good crop performance. Soil pH between 6.0 and 7.5 is considered ideal. However, declining soil health due to overuse of chemical fertilizers, inadequate organic matter and soil erosion has adversely affected productivity in several districts. Adoption of soil testing, balanced fertilization and organic amendments plays a critical role in sustaining mustard yields. Availability of irrigation facilities also strongly influences mustard cultivation. While mustard is relatively drought tolerant, timely irrigation at critical stages such as flowering and pod formation significantly increases yield. In Uttar Pradesh, canal irrigation, tube wells and increasingly micro-irrigation systems like sprinklers and drip irrigation provide water support. Regions with assured irrigation facilities show higher productivity compared to rainfed areas.

However, rising groundwater depletion, erratic rainfall and energy costs associated with pumping water pose challenges to sustainable irrigation management. The role of seed quality and varietal improvement is another major factor. The development and dissemination of high-yielding and disease-resistant mustard varieties such as RH-749, RH-725 and Pusa Bold have contributed to increased production. Improved seed varieties offer better oil content, shorter maturity duration and higher tolerance to pests and diseases. Nevertheless, limited access to certified seeds, dependence on traditional varieties and lack of awareness among farmers still restrict the full potential of varietal innovation. Technological adoption has emerged as a transformative factor in mustard cultivation. Modern farming practices such as line sowing, seed treatment, balanced fertilizer application, integrated pest management (IPM), mechanized harvesting and precision farming tools have significantly enhanced productivity. Demonstration programs conducted by Krishi Vigyan Kendras (KVKs) and agricultural universities have played a pivotal role in popularizing these technologies. However, small and marginal farmers often

face financial constraints and limited technical knowledge, which slow down technology adoption.

The economic environment and market factors strongly influence farmers' decision to cultivate mustard. Minimum Support Price (MSP) announced by the government provides income security and encourages area expansion under mustard cultivation. Stable market demand for edible oil, increasing population and growing health awareness regarding mustard oil further strengthen market prospects. However, price fluctuations, market intermediaries, transportation costs and lack of storage facilities reduce farmers' bargaining power. Digital platforms like e-NAM have attempted to improve market transparency, but uneven awareness and infrastructure gaps limit their effectiveness. Government policies and institutional support also play a crucial role. Schemes such as the National Mission on Oilseeds and Oil Palm (NMOOP), Pradhan Mantri Fasal Bima Yojana (PMFBY), soil health card scheme and agricultural credit facilities provide financial and technical support to mustard growers. Subsidies on seeds, fertilizers and irrigation equipment encourage modernization. However, delayed implementation, bureaucratic hurdles and limited outreach reduce the impact of these initiatives at the grassroots level. Labour availability and cost is another influencing factor. Mustard cultivation requires labor for land preparation, sowing, weeding and harvesting. Migration of rural youth to urban areas has led to labor shortages and increased wages, raising production costs. Mechanization such as seed drills and harvesters helps address this challenge, but small farmers often lack access to such equipment. Pest and disease management significantly affects mustard productivity. Aphids, white rust and Alternaria blight are major threats to the crop. Integrated pest management practices including biological control, resistant varieties and judicious use of pesticides are essential for minimizing crop losses. Lack of timely advisory services and overuse of chemicals often worsen pest resistance and environmental damage.

Socio-economic characteristics of farmers such as education, landholding size, risk-bearing capacity and access to credit also influence mustard cultivation decisions. Educated farmers are more likely to adopt improved practices, while larger landholders benefit from economies of scale. Small and marginal farmers often struggle due to limited capital, fragmented land and inadequate market access. Climate change and environmental sustainability are emerging determinants. Rising temperatures, changing rainfall patterns

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and extreme weather events are increasingly affecting mustard yield stability. Sustainable practices such as crop rotation, conservation agriculture, organic farming and efficient water management are essential to mitigate climate risks and maintain long-term productivity. Finally, research, extension and knowledge dissemination significantly shape mustard cultivation outcomes. Agricultural universities, KVKs and extension agencies play a key role in transferring scientific knowledge to farmers. Field demonstrations, farmer training programs and mobile advisory services enhance awareness. However, limited extension staff and weak farmer-scientist linkages restrict outreach effectiveness.

Table 1: Area, production and average yield per hectare of Mustard Crop in Uttar Pardesh

(Area in 000 ha.)

(Production in 000 Tonne)

(Yield in Kg. per ha.)

Year / District	Area (A) ('000 ha)	Production (P) ('000 tons)	Yield (Y) (kg/ha)
1966–67	215	92	428
1970–71	142.5	101	709
1980–81	318.4	201	631
1990–91	489.2	702	1,435
2000–01	425.7	612	1,437
2010–11	532.6	1,004	1,885
2018–19	621.3	1,318.40	
2019–20	654.2	1,182.70	
2020–21	632.8	1,246.50	
Agra	18.4	39.6	
Aligarh	65.2	142.5	
Mathura	92.7	205.4	
Meerut	21.3	47.8	
Bulandshahr	34.5	76.2	
Firozabad	15.7	31.4	
Etah	28.6	59.9	
Mainpuri	19.4	38.6	
Hathras	11.2	24.3	
Baghpat	8.9	19.6	

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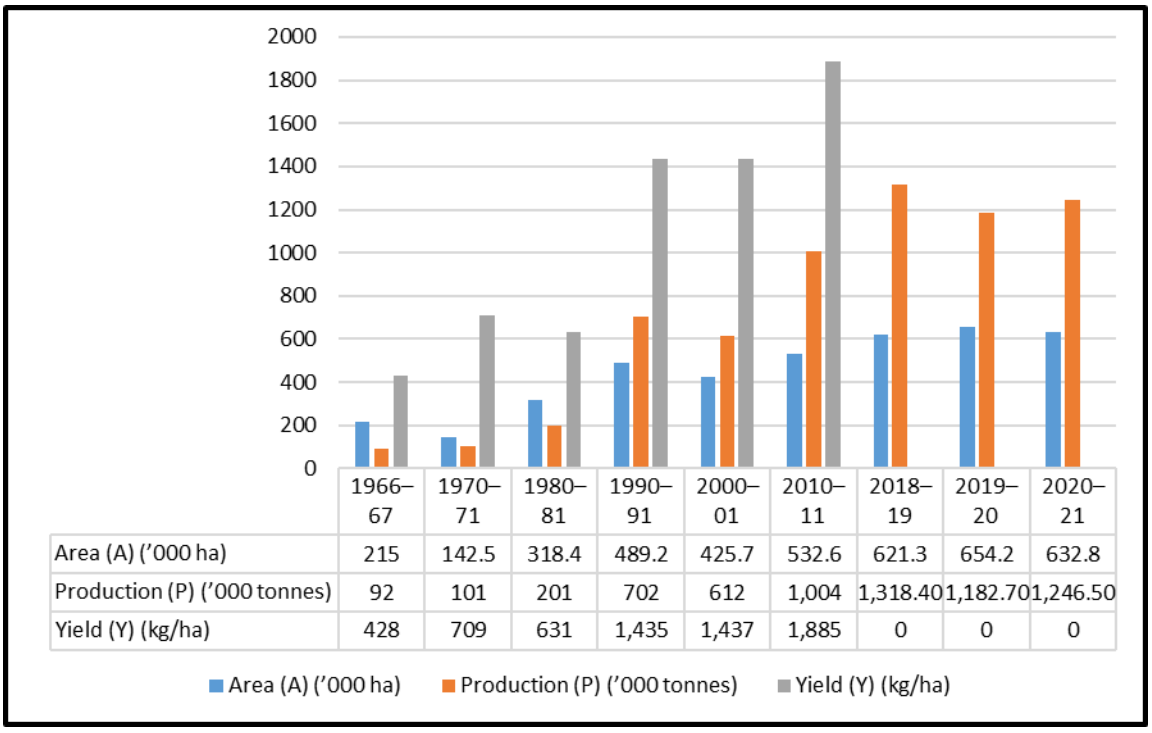
Muzaffarnagar	27.8	61.5	
Saharanpur	6.5	13.2	
Gautam Buddha Nagar	3.4	7.1	
Hapur	12.6	26.8	
Shamli	5.9	12.5	
Bijnor	22.3	48.9	
Moradabad	7.8	16.4	
Rampur	9.5	20.1	
Bareilly	14.2	29.8	
Shahjahanpur	18.7	40.3	
Pilibhit	6.3	13.5	
Sambhal	10.4	22.9	

Source: Statistical Abstract of Uttar Pradesh 2020-2021

Figure 1: Area, production and average yield per hectare of Mustard Crop in Uttar Pradesh



	1966–67	1970–71	1980–81	1990–91	2000–01	2010–11	2018–19	2019–20	2020–21
Area (A) ('000 ha)	215	142.5	318.4	489.2	425.7	532.6	621.3	654.2	632.8
Production (P) ('000 tonnes)	92	101	201	702	612	1,004	1,318.40	1,182.70	1,246.50
Yield (Y) (kg/ha)	428	709	631	1,435	1,437	1,885	0	0	0

Source: Based on Table 1

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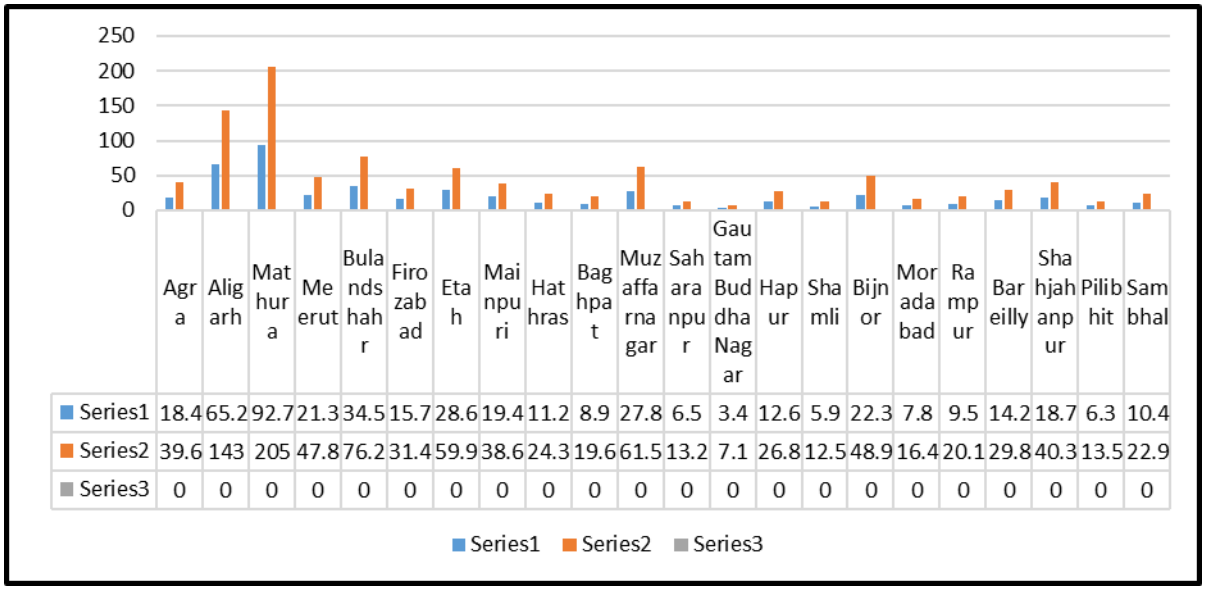
Figure 2: Area, production and average yield per hectare of Mustard Crop in District of Uttar Pardesh



Source: Based on Table 1

Table 1 The above table presents a comprehensive picture of the trends in area, production and yield of mustard cultivation in Uttar Pradesh over a long period, along with district-wise distribution. The temporal data from 1966–67 to 2020–21 clearly indicates a significant expansion in the area under mustard cultivation, reflecting the growing importance of this crop in the state's agricultural system. In 1966–67, mustard occupied 215 thousand hectares with a production of 92 thousand tonnes and a yield of 428 kg per hectare. Although there was a decline in area during 1970–71, productivity improved substantially, indicating early adoption of improved agronomic practices. By 1980–81, both area and production increased markedly, showing renewed farmer interest in mustard cultivation. A major transformation is visible from 1990–91 onwards, when production rose sharply to 702 thousand tonnes, accompanied by a significant increase in yield to 1,435 kg per hectare. This improvement can be attributed to the introduction of high-yielding varieties, better irrigation facilities, balanced fertilizer use and improved pest management practices. The trend continued in the subsequent decades, with 2010–11 recording the highest yield of 1,885 kg per hectare, reflecting technological advancement and effective extension services. During 2018–19 to 2020–21, both area and production remained consistently high, indicating the stabilization of mustard cultivation as a major rabi crop in the state. The district-wise data further highlights spatial variations in mustard

cultivation across Uttar Pradesh. Western districts such as Mathura, Aligarh and Bulandshahr emerge as major mustard-producing regions, with Mathura alone contributing 92.7 thousand hectares and 205.4 thousand tonnes of production. These districts benefit from favorable agro-climatic conditions, assured irrigation and better market access. Aligarh and Bulandshahr also show substantial area and production, confirming their importance in the state's mustard belt. Districts like Meerut, Etah, Mainpuri and Muzaffarnagar contribute moderately, indicating diversified cropping patterns. On the other hand, districts such as Gautam Buddha Nagar, Shamli, Saharanpur and Pilibhit show comparatively lower area and production, which may be due to higher urbanization, dominance of sugarcane and wheat crops and limited land availability. The presence of mustard in almost all districts, even with varying intensity, reflects its adaptability and economic significance. Overall, the table demonstrates that mustard cultivation in Uttar Pradesh has witnessed remarkable growth over time, supported by technological progress, policy support and farmer acceptance. This steady advancement aligns with the objective of enhancing productivity and ensuring sustainable agricultural development in the state.

Conclusion

The study of mustard cultivation in Uttar Pradesh over the last five decades reveals a remarkable transformation in agricultural practices, resulting in substantial improvement in yield and production efficiency. Although fluctuations in the area under cultivation have been observed, a steady rise in overall production and productivity is evident. This progress can be largely attributed to the adoption of advanced agricultural technologies, dissemination of high-yielding seed varieties and supportive government policies. However, the research also brings out significant inter-district disparities in growth patterns, highlighting the need for region-specific strategies to tackle local agro-climatic and socio-economic challenges. To sustain and further accelerate the growth of mustard cultivation, the study emphasizes the importance of innovative farming techniques, climate-resilient agricultural practices and strengthened extension services. By adopting a holistic development approach that integrates traditional farming knowledge with modern scientific innovations, Uttar Pradesh can further enhance its position as a major mustard-producing state. Such efforts will not only contribute to higher farm incomes but also strengthen national food security and promote sustainable agricultural development in the country.

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