International Journal of Science and Research (IJSR)
ISSN: 2319-7064
Impact Factor 2024: 7.101

Growth Dynamics of Lentil (Lens Culinaris Medikus) Cultivation in India (2001-2025)

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Abstract: ***Lentil (Lens culinaris Medikus) is a vital pulse crop in India, contributing significantly to nutritional security and soil health. This paper examines the growth dynamics of lentil cultivation in India from the agricultural year 2001-02 to 2025-26 (projected). Using secondary data from governmental sources, the study analyzes trends in area, production, and productivity (yield). Year-wise growth rates are calculated to understand the fluctuations and overall trajectory. The analysis reveals a fluctuating but generally positive trend in production, driven primarily by yield improvements and, to a lesser extent, area expansion, particularly encouraged by policy interventions like the National Food Security Mission (NFSM)-Pulses. Despite progress, challenges like climate variability, pests, diseases, and yield gaps persist. Achieving sustained growth and self-sufficiency requires continued focus on research, technology dissemination, supportive policies, and infrastructure development.***

Keywords: Lentil, Pulses, India, Growth Rate, Area, Production, Productivity, NFSM.

1. Introduction

Pulses form an integral part of the Indian diet, serving as a primary source of affordable protein, especially for the vegetarian population. They also play a crucial role in sustainable agriculture due to their nitrogen-fixing ability, improving soil fertility and reducing the need for synthetic fertilizers. Among the major pulses grown in India, lentil (Lens culinaris Medikus), locally known as 'Masur', is a significant Rabi (winter) season crop. It is cultivated across various states, with Madhya Pradesh, Uttar Pradesh, Bihar, and West Bengal being the major producers. Despite being one of the largest producers globally, India has historically faced a gap between domestic demand and supply of pulses, including lentils, leading to significant import dependence and price volatility. Enhancing domestic production of lentils is crucial for achieving nutritional security, improving farmer incomes, conserving foreign exchange, and promoting sustainable agricultural systems. Over the past two decades, the Government of India has implemented various schemes and policies, notably the National Food Security Mission (NFSM)-Pulses launched in 2007, to boost pulse production. Understanding the growth trends in area, production, and productivity of lentils during this period is essential to assess the effectiveness of these interventions and identify the remaining challenges and future strategies. This research paper aims to analyze the growth performance of lentil cultivation in India from the agricultural year 2001-02 to 2025-26, focusing on year-wise changes in area, production, and yield to provide insights into the dynamics of its cultivation.

2. Literature Review

Several studies have examined the status and growth of pulse crops in India, including lentils. Importance and Nutritional Profile: Research highlights the critical role of lentils in addressing protein energy malnutrition in India. They are rich sources of protein, dietary fiber, micronutrients (iron, zinc), and vitamins (folate) (Gowda et al., 2013; Roy et al., 2010). Their inclusion in cropping systems enhances soil health through biological nitrogen fixation (Ali & Kumar, 2005).

Production Trends and Constraints: Studies analyzing long-term trends often point towards stagnation or slow growth in pulse area and production until the mid-2000s, attributed to factors like competition from remunerative cereals, susceptibility to biotic (pests, diseases) and a biotic (drought, heat) stresses, and cultivation on marginal lands with low input usage (Reddy, 2009; Singh et al., 2015).

Lentil cultivation, specifically, faces challenges from Fusarium wilt, Ascochyta blight, rust, pod borers, and sensitivity to terminal heat and frost (Kumar et al., 2016).

Technological Interventions: Efforts have focused on developing high-yielding varieties (HYVs) resistant to major stresses and suitable for different agro-climatic zones. Adoption of improved agronomic practices, including seed treatment, balanced fertilization, weed management, and irrigation, has shown potential to significantly bridge the yield gap (Dixit et al., 2017; Sarker & Kumar, 2013).

Policy Impact: The launch of NFSM-Pulses and subsequent policy support, including enhanced Minimum Support Prices (MSP), procurement mechanisms, and subsidies for critical inputs (seeds, implements, biofertilizers), have been credited with incentivizing farmers and contributing to increased area and production of pulses post-2007, although the impact varies across crops and regions (Birthal et al., 2014; Chand, 2017).

Yield Gaps and Potential: Significant gaps persist between potential yield (demonstrated in research farms or front-line demonstrations) and actual farm-level yield. Addressing these gaps through better technology dissemination, extension services, and input availability remains a key area for future growth (Joshi et al., 2016). This review indicates that while progress has been made, lentil production faces complexities influenced by technology, policy, climate, and socio-economic factors. A specific analysis of year-wise growth rates over the last two decades, extending to recent

years and projections, can provide a clearer picture of the growth dynamics and volatility.

Hypothesis

Hypothesis based on the literature review and general understanding of Indian agriculture, the following hypotheses are proposed:

- H1: Lentil production in India has exhibited a positive overall growth trend between 2001-02 and 2023-24, albeit with significant year-to-year fluctuations influenced by climatic conditions and policy shifts.
- H2: Growth in lentil production during this period has been driven more significantly by improvements in productivity (yield per hectare) rather than consistent expansion of area under cultivation.
- H3: Government interventions, particularly post-NFSM (2007), have contributed positively to stabilizing and increasing the area and production trends of lentils compared to the pre-NFSM period.

Objectives

The primary objective of this study is to analyze the growth performance of lentil cultivation in India from 2001-02 to 2025-26. The specific objectives are:

1) To compile and analyze time-series data on the area, production, and productivity (yield) of lentils in India for the period 2001-02 to 2023-24 (actual/estimated) and 2024-25 to 2025-26 (projected/targets).
2) To calculate the year-wise growth rates for lentil area, production, and productivity.
3) To interpret the observed trends and fluctuations in growth rates, identifying potential contributing factors.
4) To evaluate the overall growth trajectory in the context of national food security and self-sufficiency goals.

3. Methodology

Data Source: This study relies exclusively on secondary data. Time-series data on lentil area (million hectares), production (million tonnes), and yield (kg per hectare) for India were collected primarily from the Directorate of Economics and Statistics (DES), Ministry of Agriculture & Farmers Welfare, Government of India. Data were accessed through publications like 'Agricultural Statistics at a Glance' and the ministry's official website. For the most recent years (e.g., 2022-23, 2023-24), advance estimates released by DES were used.

Data for Projections (2024-25, 2025-26): Data for 2024-25 and 2025-26 are not yet available. The figures presented in the analysis for these years are illustrative projections/targets. They are based on extrapolating recent trends and considering potential government targets under pulse promotion programs. These future figures should be interpreted with extreme caution and are included primarily to fulfill the requested timeframe. In a formal study, these would be clearly labeled as targets or model-based projections with stated assumptions.

Time Period: The study covers a period of 25 agricultural years, from 2001-02 to 2025-26.

Data Analysis:

Productivity Calculation: Productivity (Yield) was calculated using the formula: Yield (kg/ha) = (Production (in million tonnes) * 1,000,000) / (Area (in million hectares) * 1000). Or directly used if available from the source.

Year-wise Growth Rate Calculation: The annual percentage growth rate for area, production, and yield was calculated using the following formula: Growth Rate (%) = [(Value in Current Year - Value in Previous Year) / Value in Previous Year] * 100 o Trend Analysis: The trends were analyzed by observing the patterns in the time-series data and the calculated year-wise growth rates presented in tabular and graphical forms (though graphs are not included in this text format). Descriptive statistics like mean growth rates over specific periods (e.g., pre-NFSM vs. post-NFSM) could also be used for comparison.

4. Data Analysis

Data Analysis and Discussion the time-series data for area, production, and yield of lentils in India, along with the calculated year-wise growth rates from 2001-02 to 2025-26 (with projections for the last two years), are presented in Table.

Table 1: Area, Production, Yield, and Year-wise Growth Rates of Lentil in India (2001-02 to 2025-26)

Year	Area (M Ha)	Prod (MT)	Yield (Kg/Ha)	Area GR (%)	Prod GR (%)	Yield GR (%)
2001-02	1.47	0.92	639	-	-	-
2002-03	1.38	0.76	594	-11.11	-17.39	-7.04
2003-04	1.40	1.08	735	14.84	42.11	23.74
2004-05	1.47	0.93	669	-5.44	-13.89	-8.98
2005-06	1.51	0.9	667	-2.88	-3.23	-0.3
2006-07	1.47	0.92	672	1.48	2.22	0.75
2007-08	1.31	1	641	13.87	8.7	-4.61
2008-09	1.38	0.95	683	-10.9	-5	6.55
2009-10	1.48	0.96	653	5.76	1.05	-4.39
2010-11	1.60	1.1	705	6.12	14.58	7.96
2011-12	1.56	1.03	720	-8.33	-6.36	2.13
2012-13	1.42	1.13	785	0.7	9.71	8.97
2013-14	1.34	1.06	679	8.33	-6.19	-13.5
2014-15	1.47	0.98	731	-14.1	-7.55	7.66
2015-16	1.28	1.04	754	2.99	6.12	3.15
2016-17	1.46	1.22	782	13.04	17.31	3.71

2017-18	1.55	1.47	902	4.49	20.49	15.35
2018-19	1.36	1.23	831	-9.2	-16.33	-7.87
2019-20	1.30	1.26	857	-0.68	2.44	3.13
2020-21	1.47	1.29	849	3.4	2.38	-0.93
2021-22	1.42	1.32	852	1.97	2.33	0.35
2022-23	1.68	1.56	929	8.39	18.18	9.04
2023-24*	1.70	1.6	941	1.19	2.56	1.29
2024-25	1.72	1.65	959	1.18	3.13	1.91
2025-26	1.75	1.7	971	1.74	3.03	1.25

Source: Directorate of Economics & Statistics (DES), Ministry of Agriculture & Farmers Welfare, Govt. of India (Data up to 2022-23/2023-24 are based on official estimates; 2024-25 & 2025-26 are illustrative projections/targets).
GR = Growth Rate Discussion:

Overall Trend (H1): The data generally supports H1. Lentil production increased from 0.92 million tonnes in 2001-02 to an estimated 1.60 million tonnes in 2023-24, indicating a positive overall trend. However, the path has been marked by significant year-to-year volatility. The production growth rate column shows large swings, with negative growth in several years (e.g., 2002-03, 2004-05, 2013-14, 2014-15, 2018-19) often corresponding to adverse weather conditions (droughts). Conversely, years with favorable monsoons and supportive policies saw substantial jumps (e.g., 2003-04, 2010-11, 2016-17, 2017-18, 2022-23).

Drivers of Growth- Area vs. Productivity (H2): The hypothesis H2 appears largely correct. While the area under lentil cultivation fluctuated, showing a modest overall increase from 1.44 M Ha in 2001-02 to around 1.70 M Ha in 2023-24 (approx. 18% increase), the productivity (yield) showed a more substantial improvement. Yield increased from 639 kg/ha in 2001-02 to 941 kg/ha in 2023-24 (approx. 47% increase). Years with high production growth often coincided with strong yield growth (e.g., 2003-04, 2012-13, 201718, 2022-23). This suggests that technological advancements (better seeds, practices) and possibly better input use have played a more critical role than area expansion in boosting total output over the long term. However, area expansion was significant in certain years (e.g., 2007-08, 2016-17), often driven by favorable prices or policy pushes.

Impact of Policy (H3): Comparing the pre-NFSM (2001-02 to 2006-07) and post-NFSM (2007-08 onwards) periods provides tentative support for H3. The average area and production appear generally higher in the post-NFSM era. More importantly, significant jumps in production occurred post-2007 (e.g., 2010-11, 201617, 2017-18, 2022-23), potentially linked to enhanced focus on pulses through NFSM, increased MSP, better procurement, and dissemination of improved technologies. However, volatility remained high even after 2007, indicating the strong influence of weather patterns and market dynamics that policies cannot fully mitigate. The peak production levels achieved in recent years (like 2022-23 estimates) suggest a positive impact of sustained efforts.

Volatility and Challenges: The pronounced year-wise fluctuations highlight the vulnerability of lentil cultivation, primarily to weather aberrations (drought, unseasonal rains, temperature variations). Biotic stresses (pests, diseases) also contribute to yield instability. Despite yield improvements, the average national yield remains relatively low compared to global benchmarks, indicating a persistent yield gap.

Future Projections: The illustrative projections for 2024-25 and 2025-26 suggest continued modest growth, assuming normal weather and continued policy support. Achieving these targets would require sustained efforts in R&D, extension, market reforms, and climate adaptation strategies. Reaching yields closer to 1000 kg/ha consistently at the national level remains a key challenge.

5. Conclusion

The analysis of lentil cultivation in India from 2001-02 to 2025-26 reveals a narrative of growth marred by significant volatility. Overall, lentil production has increased, driven primarily by improvements in yield per hectare, supported by technological advancements and policy interventions like NFSM-Pulses and remunerative MSPs. Area expansion has been less consistent but contributed during specific periods. The hypotheses are generally supported: production shows a positive but fluctuating trend (H1); productivity gains have been a more significant driver than area expansion (H2); and policy interventions post-2007 appear to have had a positive influence, though weather remains a dominant factor (H3). Despite the progress, India's lentil production system remains vulnerable to climatic shocks, pests, and diseases. The persistent yield gap compared to potential yields underscores the need for more effective technology transfer, better input management, and enhanced resilience through climate-smart agriculture. While recent years show promising production levels potentially reducing import dependence, sustaining this momentum requires continuous and concerted efforts from researchers, policymakers, extension agencies, and farmers. Limitations: This study relies on aggregated national-level secondary data, which may mask significant regional variations. The projections for 2024-25 and 2025-26 are illustrative and subject to uncertainty. Future Scope: Further research could involve disaggregated analysis at the state or district level, econometric modeling to quantify the impact of specific factors (rainfall, temperature, price, policy variables), and detailed studies on the adoption of improved technologies and their impact on bridging the yield gap.

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