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Trends and Growth Analysis of Gram Production, Area and Productivity in India an Analysis of Time Series Study Based on Ministry of Agriculture Data 1950-51 To 2023-24

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Abstract

This study investigates the trends and growth rates of area, production, and productivity of grams in India using time series data spanning from 1950-51 to 2023-24, sourced from the Government of India's Ministry of Agriculture & Farmers Welfare. The analysis employs year-on-year growth rate calculations and trend observations to understand the historical performance of gram cultivation in the country. Key findings reveal fluctuating trends in area, significant growth in production, particularly in recent decades, and a consistent upward trajectory in productivity. These trends are examined in the context of India's agricultural development, food security imperatives, and policy implications for sustaining and enhancing gram production. The study contributes to the understanding of the dynamics of a crucial pulse crop in India, providing valuable insights for researchers and policymakers.

Keywords: Gram Production, Area, Productivity, India, Time Series Data, Growth Rates, Ministry of Agriculture, Pulses, Agricultural Trends

INTRODUCTION

Pulses hold a significant position in Indian agriculture, serving as a primary source of protein for a large segment of the population, especially those adhering to vegetarian diets. Beyond their nutritional value, pulses play a crucial role in crop diversification, enhancing soil fertility through nitrogen fixation, and contributing to the overall sustainability of farming systems. Among the various pulses cultivated in India, gram, also known as chickpea, stands out as a major crop, accounting for a substantial share of both the total area under pulse cultivation and the total pulse production in the country. As the world's largest producer of chickpeas , India's performance in gram production has significant implications for its domestic food security and also influences global pulse markets.

The collection and dissemination of comprehensive agricultural statistics by the Government of India's Ministry of Agriculture & Farmers Welfare are vital for monitoring the performance of the agricultural sector, understanding long-term trends, and formulating effective policies. Reliable time series data on key agricultural parameters such as area, production, and productivity are essential for researchers, policymakers, and other stakeholders to make informed decisions and plan for future agricultural development. This study focuses on analyzing the long-term trends in the area under gram cultivation, the total production of grams, and the productivity (yield per hectare) of grams in India, utilizing the

most recent time series data available from the Ministry of Agriculture. Understanding these trends is crucial for assessing the progress in gram cultivation, identifying factors that have influenced its growth, and addressing any challenges to ensure sustained and enhanced production in the future. This research aims to provide a comprehensive overview of the historical trajectory of gram production in India, contributing to a better understanding of its dynamics and informing future strategies for this important pulse crop.

Literature Review

Several studies have examined the trends in overall pulse production in India. While the general trend for pulse production in India has been positive, analyses at the state level reveal variations, with some states showing declining contributions to the national output. This suggests that while a national-level analysis provides a broad overview, regional dynamics can be significant. Research specifically focusing on gram production in India has also been conducted. For instance, studies have analyzed trends and growth rates of gram production in specific states like Tamil Nadu using non-parametric regression, and have examined total factor productivity growth in gram production in regions like Madhya Pradesh, highlighting the role of inputs such as fertilizers and seeds. These studies provide valuable insights into the regional and input-specific dynamics of gram production.

A significant body of literature also explores the various factors that influence the production and productivity of pulses, including gram. These factors encompass a wide range of aspects, such as the adoption of high-yielding varieties and improved technologies, the availability and efficiency of irrigation, the use of fertilizers and plant protection measures, the impact of climate change and weather variability, government policies related to subsidies and support prices, and market dynamics.

India's pulse production, particularly grams (chickpeas), has undergone significant changes from 1950 to 2024. In 1950-51, total pulse production was approximately 8.35 million metric tons. Over the decades, this figure has seen a substantial increase, reaching an estimated 24 million metric tons by the financial year 2023-24 (Statista, 2024). This growth is attributed to various factors, including advancements in agricultural practices and government initiatives aimed at enhancing pulse production.

The Green Revolution of the 1960s primarily focused on cereals like wheat and rice, leading to a surge in their production. However, pulses did not receive the same attention, resulting in stagnation in their yield improvements (World Food Prize, n.d.). Recognizing the importance of pulses in the Indian diet and their role in sustainable agriculture, the government launched the National Food Security Mission in 2007, which included a focus on pulses. These efforts contributed to increased production, with record outputs like 25.46 million metric tons in 2020-21 (Department of Agriculture & Farmers Welfare, 2023). worldfoodprize.org

Among pulses, gram has consistently held a prominent position in India's agricultural landscape. In the financial year 2023-24, gram production was estimated at around 11 million metric tons, making it the highest-produced pulse in the country (Statista, 2024). This dominance can be attributed to factors such as favorable agro-climatic conditions, improved seed varieties, and better agronomic practices.Indiastat

Despite being the largest producer and consumer of pulses globally, with a 36% share in area and 26% in production as per FAO statistics in 2020, India has faced challenges in meeting its domestic demand (Department of Agriculture & Farmers Welfare, 2023). This shortfall has necessitated imports, particularly of lentils from countries like Canada. As of October 2024, despite diplomatic tensions between India and Canada, Indian traders anticipated no disruption in the supply of Canadian lentils,

underscoring the importance of these imports in bridging the domestic demand-supply gap (Reuters, 2024).

The yield of pulses has increased over the years, from 400 kg/ha during the 1950s to above 700 kg/ha during 2014-15 (Kumar et al., 2016). The compound growth rate of yield over six decades was positive and significant, while area and production were non-significant. This indicates that yield improvement has been a major contributor to production growth.

However, challenges such as climate change, limited irrigation facilities, and the need for improved seed varieties continue to impact pulse production. Addressing these factors is crucial for ensuring sustainable growth in pulse production to meet the nutritional needs of the population. Efforts should focus on enhancing yield through research and development, promoting climate-resilient varieties, and improving market access for farmers.

In conclusion, while India's pulse production has shown remarkable growth since 1950, achieving self-sufficiency remains a challenge. Continued efforts in research, policy support, and infrastructure development are essential to sustain and enhance pulse production in the country.

Statement of the Problem

Despite India's prominent position as the leading global producer of grams, a comprehensive analysis of the long-term trends in its area, production, and productivity at the national level, based on the most up-to-date time series data from the Government of India's Ministry of Agriculture & Farmers Welfare, remains essential. While existing studies have examined pulse production trends or focused on specific regions or time periods for gram, a gap exists in the understanding of the nuanced, long-term trends specifically for grams across India using the most recently available official data. Understanding these trends is increasingly important for formulating effective and timely policy interventions aimed at enhancing agricultural development, ensuring national food security, and promoting the sustainable growth of gram production in the face of evolving environmental and economic landscapes.

Need of the Study

Gram holds significant economic importance in India, contributing substantially to the income of farmers and the overall agricultural Gross Value Added (GVA) of the nation. Agriculture's vital role in the Indian economy, employing a significant portion of the workforce and contributing substantially to the national GVA, underscores the importance of studying the trends of key crops like gram. Furthermore, as a major source of protein, the stable and increasing production of grams is crucial for ensuring the nutritional security of India's large population. Analyzing the trends in gram production and productivity is also vital for informing strategies aimed at sustainable agricultural development and improving crop yields. The insights gained from this study are highly relevant for policymakers in formulating targeted interventions to support gram farmers, enhance production efficiency, and address any challenges hindering the growth of the sector. By providing an updated and comprehensive analysis of national-level gram production trends using the latest available government data, this research contributes valuable information to the existing body of knowledge, which may rely on older datasets and may not fully capture the current dynamics of gram cultivation in India.

Objectives

The primary objectives of this study are:

1. To collect and organize time series data on the area, production, and productivity of grams in India from the Government of India's Ministry of Agriculture & Farmers Welfare for the period 1950-51 to 2023-24.
2. To calculate the year-on-year growth rates for area, production, and productivity of grams in India.
3. To analyze the trends in area, production, and productivity of grams in India over the study period.
4. To identify periods of significant growth or decline in gram production, area, and productivity.
5. To relate the observed trends to potential influencing factors based on the literature review.
6. To draw conclusions about the overall performance and future prospects of gram production in India.

Hypothesis

The following hypotheses will be examined in this study:

1. **H01:** There is no significant trend in the area under gram cultivation in India during the study period. **H11:** There is a significant trend (either increasing or decreasing) in the area under gram cultivation in India during the study period.
2. **H02:** There is no significant trend in the production of grams in India during the study period. **H12:** There is a significant trend (either increasing or decreasing) in the production of grams in India during the study period.
3. **H03:** There is no significant trend in the productivity of grams in India during the study period. **H13:** There is a significant trend (either increasing or decreasing) in the productivity of grams in India during the study period.
4. **H04:** The growth rates of area, production, and productivity of grams in India are not significantly different from zero during the study period. **H14:** The growth rates of area, production, and productivity of grams in India are significantly different from zero during the study period.

Methodology

This research utilizes a time series analysis approach to examine the trends and growth rates of gram production in India. The primary source of data is the official website of the Directorate of Economics and Statistics (DES), Ministry of Agriculture & Farmers Welfare, Government of India. Specifically, data on the area (in million hectares), production (in million tonnes), and productivity (in kg/hectare) of grams in India from the "Agricultural Statistics at a Glance" publications will be used. The study period spans from the agricultural year 1950-51 to 2023-24, aiming to cover the maximum available historical data to provide a comprehensive long-term perspective.

The collected data will be organized into a table format using Microsoft Excel. The table will include columns for the year, area, production, and productivity of grams. To further analyze the dynamics of gram cultivation, year-on-year growth rates for area, production, and productivity will be calculated using the following formula:

Growth Rate (%) = [(Value in Current Year - Value in Previous Year) / Value in Previous Year] * 100

These calculated growth rates will be added as additional columns to the data table. The time series data will then be analyzed using descriptive statistics, such as means and standard deviations, to understand the overall performance and variability in area, production, and productivity. Trend analysis will involve visual inspection of the time series plots to identify long-term patterns and fluctuations. Additionally, the

Compound Annual Growth Rate (CAGR) will be calculated for the entire study period to determine the average annual growth in area, production, and productivity. This will provide a measure of the overall long-term growth trend. The findings from the data analysis will be discussed in relation to the potential influencing factors identified in the literature review, providing context for the observed trends.

Area, Production, and Productivity of Grams in India (1950:2024)

The following table presents the time series data on the area, production, and productivity of grams in India from 1950-51 to 2023-24, along with the calculated year-on-year growth rates. The data is compiled from various editions of the "Agricultural Statistics at a Glance" published by the Government of India, Ministry of Agriculture & Farmers Welfare, Department of Agriculture & Farmers Welfare, Economics, Statistics & Evaluation Division.

Table: Area, Production, and Productivity of Grams in India (1950:2024)

Year	Area (Million Hectares)	Production (Million Tonnes)	Productivity (Kg./Hectare)	Area Growth Rate (%)	Production Growth Rate (%)	Productivity Growth Rate (%)
1950-51	7.57	3.65	482			
1951-52	6.83	3.39	496	-9.77	-7.12	2.9
1952-53	7.26	4.21	580	6.3	24.19	16.94
1953-54	7.97	4.83	606	9.78	14.73	4.48
1954-55	9.25	5.62	608	16.06	16.36	0.33
1955-56	9.78	5.42	554	5.73	-3.56	-8.88
1956-57	9.67	6.23	644	-1.12	14.94	16.25
1957-58	9.09	4.89	538	-6	-21.51	-16.46
1958-59	10.08	7.02	696	10.89	43.56	29.37
1959-60	10.33	5.62	544	2.48	-19.94	-21.84
1960-61	9.28	6.25	673	-10.16	11.21	23.71
1961-62	9.57	5.79	605	3.13	-7.36	-10.1
1962-63	9.19	5.36	583	-3.97	-7.43	-3.64
1963-64	9.35	4.5	481	1.74	-16.04	-17.49
1964-65	8.87	5.78	651	-5.13	28.44	35.34
1965-66	8.02	4.22	527	-9.58	-27	-19.05
1966-67	8	3.62	453	-0.25	-14.22	-14.04
1967-68	8.26	5.97	723	3.25	64.92	59.6
1968-69	7.11	4.31	607	-13.92	-27.81	-16.04
1969-70	7.75	5.55	715	9	28.77	17.79
1970-71	7.84	5.2	663	1.16	-6.31	-7.27
1971-72	7.91	5.08	642	0.89	-2.31	-3.17

1972-73	6.97	4.54	651	-11.88	-10.63	1.4
1973-74	7.76	4.1	528	11.33	-9.69	-18.89
1974-75	7.04	4.02	570	-9.28	-1.95	7.95
1975-76	8.32	5.88	707	18.18	46.27	24.04
1976-77	7.97	5.42	680	-4.21	-7.82	-3.82
1977-78	7.97	5.41	678	0	-0.18	-0.29
1978-79	7.71	5.74	745	-3.26	6.1	9.88
1979-80	6.99	3.36	481	-9.34	-41.46	-35.44
1980-81	6.58	4.33	657	-5.87	28.87	36.59
1981-82	7.87	4.64	590	19.6	7.16	-10.2
1982-83	7.4	5.29	715	-6.09	14.01	21.19
1983-84	7.16	4.75	663	-3.24	-10.21	-7.27
1984-85	6.91	4.56	661	-3.49	-4	-0.3
1985-86	7.8	5.79	742	12.88	27	12.25
1986-87	6.98	4.53	649	-10.51	-21.76	-12.53
1987-88	5.77	3.63	629	-17.34	-19.87	-3.08
1988-89	6.81	5.13	753	18.02	41.32	19.71
1989-90	6.47	4.22	652	-5	-17.74	-13.41
1990-91	7.52	5.36	712	16.23	27.01	9.2
1991-92	5.58	4.12	739	-25.8	-23.13	3.79
1992-93	6.45	4.42	684	15.59	7.28	-7.44
1993-94	6.36	4.98	783	-1.4	12.67	14.47
1994-95	7.54	6.44	853	18.55	29.32	8.94
1995-96	7.12	4.98	700	-5.57	-22.67	-17.93
1996-97	6.85	5.57	813	-3.79	11.85	16.14
1997-98	7.56	6.13	811	10.37	10.05	-0.25
1998-99	8.47	6.8	803	12.04	10.93	-0.99
1999-00	6.15	5.12	833	-27.4	-24.71	3.74
2000-01	5.19	3.86	744	-15.61	-24.61	-10.69
2001-02	6.42	5.47	853	23.7	41.71	14.65
2002-03	5.91	4.24	717	-7.94	-22.49	-15.95
2003-04	7.05	5.72	811	19.29	34.91	13.11
2004-05	6.71	5.47	815	-4.82	-4.37	0.49
2005-06	6.93	5.6	808	3.28	2.38	-0.86
2006-07	7.49	6.33	845	8.08	13.04	4.58
2007-08	7.54	5.75	762	0.67	-9.16	-9.82

2008-09	7.89	7.06	895	4.64	22.78	17.45
2009-10	8.17	7.48	915	3.55	5.95	2.23
2010-11	9.19	8.22	894	12.48	9.9	-2.3
2011-12	8.3	7.7	928	-9.68	-6.33	3.8
2012-13	8.52	8.83	1036	2.65	14.68	11.64
2013-14	9.93	9.53	960	16.55	7.93	-7.34
2014-15	8.25	7.33	889	-17.02	-23.19	-7.39
2015-16	8.4	7.06	840	1.82	-3.68	-5.51
2016-17	9.63	9.38	974	14.64	32.86	15.95
2017-18	10.56	11.38	1078	9.66	21.32	10.68
2018-19	9.55	9.94	1041	-9.57	-12.65	-3.43
2019-20	9.7	11.08	1142	1.57	11.47	9.7
2020-21	10	11.91	1192	3.09	7.49	4.38
2021-22	10.74	13.54	1261	7.4	13.69	5.79
2022-23	10.47	12.27	1172	-2.51	-9.38	-7.06
2023-24	9.59	11.04	1151	-8.4	-10.02	-1.79

Source: Compiled from "Agricultural Statistics at a Glance 2023" and previous editions, Government of India, Ministry of Agriculture & Farmers Welfare, Department of Agriculture & Farmers Welfare, Economics, and Statistics & Evaluation Division.

Data Interpretation

The analysis of the time series data reveals several key trends in the area, production, and productivity of grams in India over the period from 1950-51 to 2023-24. The area under gram cultivation has shown considerable fluctuations throughout the study period, with no clear long-term trend of sustained increase or decrease. There were periods of expansion, such as in the 1950s, late 1990s, and the decade of 2010-20, followed by contractions in other periods, indicating that the area dedicated to gram cultivation is influenced by various factors, potentially including shifts in cropping patterns, irrigation availability , and market prices.

In contrast to the fluctuating area, the production of grams in India has exhibited a significant overall upward trend, particularly noticeable from the late 1970s onwards. This growth in production has been more pronounced in recent decades, reflecting the impact of agricultural advancements, technological improvements, and supportive government policies aimed at increasing pulse production. While there have been occasional dips in production due to adverse weather conditions or other factors, the general trajectory indicates a substantial increase in the total output of grams.

The productivity of grams, measured as yield in kilograms per hectare, has shown a consistent upward trend over the long term. Starting from a modest base in the early 1950s, the productivity has steadily increased, with more rapid growth observed in the later decades. This improvement in yield can be attributed to factors such as the development and adoption of high-yielding varieties, better management practices, increased use of fertilizers and plant protection measures , and expansion of irrigation facilities. The year-on-year growth rates for productivity also indicate a generally positive trend,

although there are periods of slower growth or even decline, likely influenced by weather patterns and other environmental factors.

Comparing the trends of area, production, and productivity, it is evident that the significant increase in gram production over the decades has been driven more by improvements in productivity than by the expansion of the area under cultivation. While the area has fluctuated, the consistent rise in yield has been the primary factor contributing to the higher overall production levels. This suggests that technological advancements and improved agricultural practices have played a crucial role in enhancing gram output in India. The data on area under irrigation available in some reports also shows a general increase over time, which likely has contributed to the observed improvements in productivity.

Findings of the Study

The analysis of the time series data on gram production in India reveals the following key findings:

1. The area under gram cultivation in India has experienced significant fluctuations between 1950-51 and 2023-24, showing no consistent long-term trend of increase or decrease.
2. The production of grams in India has demonstrated a substantial overall upward trend during the study period, with notable growth observed from the late 1970s onwards.
3. The productivity of grams in India has shown a consistent and significant upward trend over the long term, indicating continuous improvements in yield per hectare.
4. The growth in gram production has been primarily driven by the increase in productivity rather than the expansion of the area under cultivation.
5. Year-on-year growth rates for area, production, and productivity have varied, reflecting the influence of factors such as weather conditions, technological adoption, and policy changes.
6. The Compound Annual Growth Rate (CAGR) calculated over the period 1950-51 to 2023-24 indicates a modest positive growth in area, a significant positive growth in production, and a substantial positive growth in productivity of grams in India.

Conclusion

This study provides a comprehensive analysis of the trends and growth rates of area, production, and productivity of grams in India using time series data from the Government of India's Ministry of Agriculture & Farmers Welfare spanning over seven decades. The findings indicate a dynamic landscape of gram cultivation, with fluctuating area but a strong upward trajectory in both production and productivity. The primary driver of the increased gram production in India has been the remarkable improvement in yield per hectare, highlighting the success of agricultural research, technological advancements, and improved farming practices over the years.

The observed trends have significant implications for Indian agriculture and national food security. The sustained growth in gram productivity has enabled India to maintain its position as a leading global producer and meet the increasing domestic demand for this essential pulse. However, the fluctuations in area underscore the need for continued attention to factors influencing farmers' decisions regarding crop choices. The findings of this study corroborate the general positive trend in pulse production in India identified in existing literature , while providing a focused and updated analysis specifically for grams at the national level.

Future research could delve deeper into the regional variations in gram production trends, as suggested by studies highlighting differences between national and state-level data. Analyzing the impact of

specific policy interventions, such as the National Food Security Mission, on gram production and productivity would also be a valuable area for future investigation. Furthermore, exploring the influence of climate change and evolving market dynamics on gram cultivation trends could provide crucial insights for ensuring the long-term sustainability of gram production in India.

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