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Analysing the Compound Annual Growth Rate (CGR) of G.I. tagged Saffron, Area, Production, and Productivity in Pulwama District, Jammu and Kashmir, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

This study analyzes the Compound Annual Growth Rate (CAGR) of saffron cultivation in Pulwama District, Jammu and Kashmir, from 1997 to 2021, focusing on area, production, and productivity. The findings show significant fluctuations across five periods. Period I (1997-2001) experienced notable declines in area, production, and productivity by 15.24%, 60.19%, and 15.35%, respectively. Period II (2002-2006) saw a slight recovery, with area and production increasing by 1.53% and 3.17%, while productivity decreased by 5.50%. Period III (2007-2011) marked substantial improvement, with area, production, and productivity rising by 7.17%, 15.29%, and 13.66%. Period IV (2012-2016) had minor declines in area by 0.75%, and more significant drops in production and productivity by 6.80% and 10.93%. Period V (2017-2020) showed modest growth in area by 1.96%, and significant increases in production by 22.32% and productivity by 19.62%. Overall, from 1997 to 2021, the area decreased slightly by 1.058%, production declined by 4.66%, but productivity improved by 2.076%. These trends can help policymakers enhance the sustainability and profitability of saffron production in the region.

Keywords: CAGR; saffron; area; production; productivity.

1. INTRODUCTION

Saffron, derived from the Arabic word "Zafaran" which originates from the Persian word "Zarparan" meaning "flowers of golden petals," holds its secrets in the dried red stigmas that contain significant amounts of three glycosylated apocarotenoids - crocin, picrocrocin, and safranal. These compounds, along with over 150 other volatile and aromatic compounds, contribute to the distinctive color, bitter taste, and aroma of saffron. This spice is widely used as a flavoring and coloring agent in food, as well as an essential component in the dye, perfumery, and flavoring industries. Saffron also boasts numerous biological properties such as anticancer, antimutagenic, and antioxidant effects. Consequently, saffron commands the highest price among spices globally, varying depending on the country of origin. While saffron production is predominantly concentrated in countries with low labor costs like Iran and Azerbaijan, it is also cultivated in nations such as Greece, Switzerland, Spain, Argentina, and the USA. Moreover, newer regions like China and Japan are increasingly adopting saffron cultivation [1-3]. Saffron, known as "red gold," is a highly valued agricultural product, particularly in Iran, which dominates the global market with a 90% share in both production and export. The cultivation of saffron is labor-intensive, requiring around 200 man-days per hectare, with even greater labor demands in processing and marketing. Despite its comparative advantage in production, as indicated by DRC and SCB indices, the marketing dynamics reveal a significant disparity, where producers earn less than 65% of the final consumer price. Given that over 70% of household income in saffron-producing regions is derived from this crop, there is a compelling need for a regional marketing board alongside an agricultural exchange market [4-6]. This would enhance coordination in production, marketing, and export, ensuring Iran maintains its dominant market position Ahmadi, et al. [4]. Kashmir stands out as one of the primary saffron-producing regions worldwide. Nestled in the Karewas of Kashmir and Bhaderwah in the Jammu Division, saffron serves as a significant cash crop, offering employment opportunities to approximately 5% of the rural workforce in the Kashmir Valley. Known as "Kum Kum" and "Kesar" in Sanskrit, and "Koung" in the Kashmiri language, this precious "golden" spice is believed to have originated from the Takshak Spring in Zewan village, located around 11 km from Srinagar, before spreading to neighboring areas. Kashmir ranks as the second-largest contributor of saffron to the global market. The cultivation of saffron in the Pampore Karewa of Kashmir dates back to ancient times. 1. Pampore, located at 34° 1‟ N, 74° 56‟ E, is the primary center for saffron cultivation in Kashmir's

Tehsil. The area has an average elevation of 1574 meters (AMSL). Saffron cultivation is prominent in villages such as Khunmoh, Zewan, Balhama, Sampora, Ladhoo, Chandhara, Woyan, Khrew, Shar Konibal, Dussu, Namblabal, Kadlabal, Hatiwara, Samboora, and Lethpora. While the cultivation of saffron initially began in this region, it has since expanded to neighboring districts such as Srinagar, Ganderbal, Budgam, Shopian, Anantnag, Bhaderwah, and Kulgam. However, Pampore remains the main hub for saffron cultivation in the Pulwama district.

The study of area production and productivity of saffron in Jammu and Kashmir is of critical importance due to the region's unique agro-climatic conditions that make it the primary saffron-producing area in India [7-9]. Understanding these parameters is essential for optimizing cultivation practices, enhancing yield, and ensuring the sustainability of saffron farming. Scientific insights into the area under cultivation, production volumes, and productivity rates can inform targeted interventions to address challenges such as soil degradation, water scarcity, and disease management. Additionally, this research contributes to the development of policies aimed at supporting saffron farmers, boosting local economies, and preserving the cultural heritage associated with saffron cultivation in Jammu and Kashmir.

2. METHODOLOGY

2.1 Study Area

The present study focuses on the Union Territory of Jammu and Kashmir. This region is renowned for its saffron cultivation, making it an ideal location to analyse saffron production growth rates. The study was conducted in the Pulwama Districts in the Union Territory of Jammu and Kashmir purposively as this district have the higher number of Saffron cultivators in the UT of J&K.

2.2 Data Collection

Secondary data was primarily used for this study. Data on saffron production from 1997 to 2021 was collected from various reliable sources including journals, periodicals, and government websites. To ensure data consistency and accuracy, multiple sources were cross verified.

2.3 Area, Production and Productivity of Saffron in J&K

Data on saffron cultivation from 1997 to 2021 assumes additional importance as additional importance while assessing the impact of Geographical Information (GI) tagging for Kashmiri saffron in 2020. GI tag is an acknowledgment that a product has certain characteristics, it's traditional ways of making it, or it enjoys some prestige gained because of geographical origin. This condition is crucial to preserve the authenticity of the product and maximize its sales. Prior to GI tagging, data showed that saffron production and seed production were changing, with greater challenges in the early 2000s, where production declined but seed production gained significant growth since 2011, indicating the start of a revival of saffron farming practices The year 2020, when saffron gets its GI tag, coincides with a dramatic increase in production and processing. By 2020, production rose to 15.12 metric tonnes and crop yield to 4.07 kg per hectare. This trend continued in 2021, where production reached a peak of 18.05 MT and yield increased to 4.86 kg per hectare. GI tagging likely played an important role in this resurgence. This has not only given the saffron farmers confidence to ensure the authenticity of the product is protected, but may also open up new market opportunities and increase the demand for Kashmiri saffron both domestically and internationally. The GI tag also highlights the uniqueness and quality of Kashmiri saffron, which can promote good agricultural practices, leading to significant increases in yields post-2020.

2.4 Data Analysis

The compound annual growth rate (CGR) was employed to measure the growth rate of saffron production during the specified periods. CGR provides a standardized measure of the growth rate over a specific period, making it suitable for comparing growth rates across different time frames.

2.5 Compound Annual Growth Rate (CAGR)

In the present study, compound growth rates in area, production, productivity, export and import quantities of pepper were estimated by using the exponential growth function of the form,

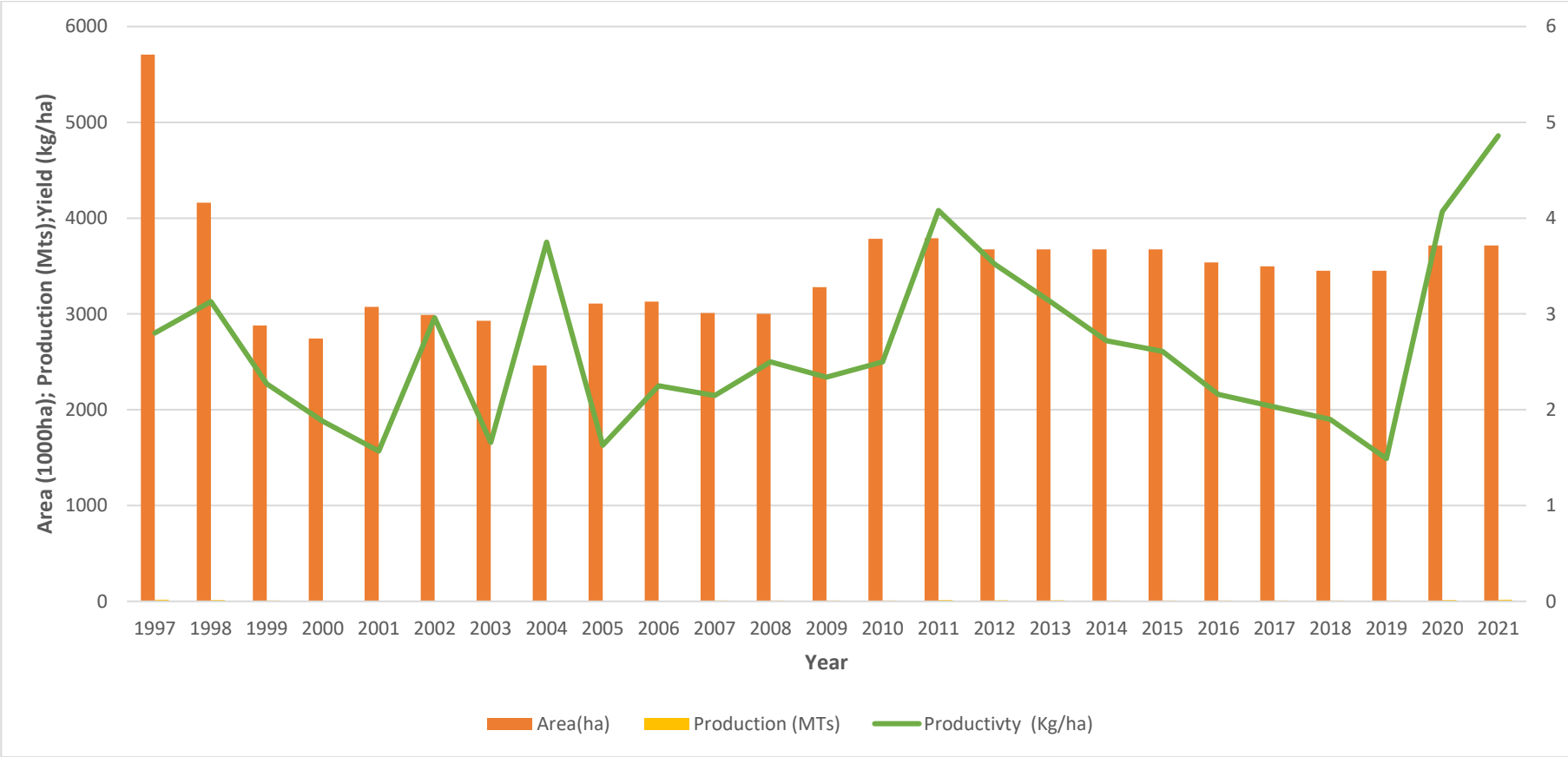

Fig. 1. Year wise status of saffron in Jammu and Kashmir

The collected data was categorized into five distinct periods for analysis:
Period I: 1997-2001
Period II: 2002-2006
Period III: 2007-2011
Period IV: 2012-2016
Period V: 2017-2021

$$Y = AB^t$$

Where,
Y = dependent variable to be estimated (area, production, productivity)
A = intercept
B = regression coefficient
t = time variable

The equation was estimated after transforming as follows

$$\log Y = a + bt$$

where,
a=Log A
b=Log B

Then, the per cent compound growth rate (G) was calculated using the relationship

CGR = [(antilog of b)-1] x 100

3. RESULTS AND DISCUSSION

The Table 1 represents the Compound Growth Rate (CGR) analysis for saffron in Jammu and Kashmir across different periods, focusing on three key parameters: Area, Production, and Productivity. Each parameter's growth rate is given as a percentage change over the respective period.

During Period I (1997-2001) the area under saffron cultivation decreased significantly by 15.24% during this period. Saffron production also saw a sharp decline of 60.19%, which aligns closely with the decrease in the area. Productivity experienced a dramatic decrease of 15.35%, indicating that not only did the cultivated area and overall production decrease, but the efficiency of production (yield per unit area) also fell significantly. In Period II (2002-2006) there was a slight recovery in the area under saffron cultivation, which grew by 1.53%. Despite the marginal increase in area, production continued to incline by 3.17%, suggesting other adverse factors affecting production. Productivity showed a small improvement of 5.50%, indicating a slight decrease in yield per unit area, even though overall production was up. Period III (2007-2011) saw a more substantial increase in the area under cultivation, growing by 7.17%. Production increased significantly by 15.29%, which is higher than the increase in the area, suggesting improved productivity. Productivity rose by 13.66%, indicating notable improvements in yield per unit area. The area under saffron cultivation in Period IV (2012-2016) slightly decreased by 0.75%. Production saw a more significant decline of 6.80%, reflecting issues beyond just the reduction in the area. Productivity decreased by 10.93%, showing a drop in yield per unit area. During Period V (2017-2020) the area under cultivation grew slightly by 1.96%. There was a substantial increase in production by 22.32%, which is much higher than the increase in the area, indicating improved productivity. Productivity increased significantly by 19.62%, showing major improvements in yield per unit area.

The saffron crop has changed drastically from 1997-2021. The total area used for saffron has decreased slightly with a percentage of only 1.058%. Saffron production however, has decreased more drastically with this crop accounting for 4.66% decline in production between 1993-2010 as compared to 2000-2020 figures that show a 3% increase. However, since then there has been an improvement in productivity by 2.076% referring to yield per unit area of land which was once unheard-of before now due to advances in cultivation techniques as well as climate change and evolving market demands This can aid policymakers in devising ways to enhance saffron production sustainability and profitability while addressing these trends.

Table 1. Compound Growth Rate (CGR) analysis for saffron in Jammu and Kashmir across different periods

	AREA	PRODUCTION	PRODUCTIVITY
PERIOD I 1997-2001	-15.24	-60.19	-15.35
PERIOD II 2002-2006	1.53	3.17	-5.50
PERIOD III 2007-2011	7.17	15.29	13.66
PERIOD IV 2012-2016	-0.75	-6.80	-10.93
PERIOD V 2017-2020	1.96	22.32	19.62
Overall 1997-2021	-1.058	-4.66	2.076

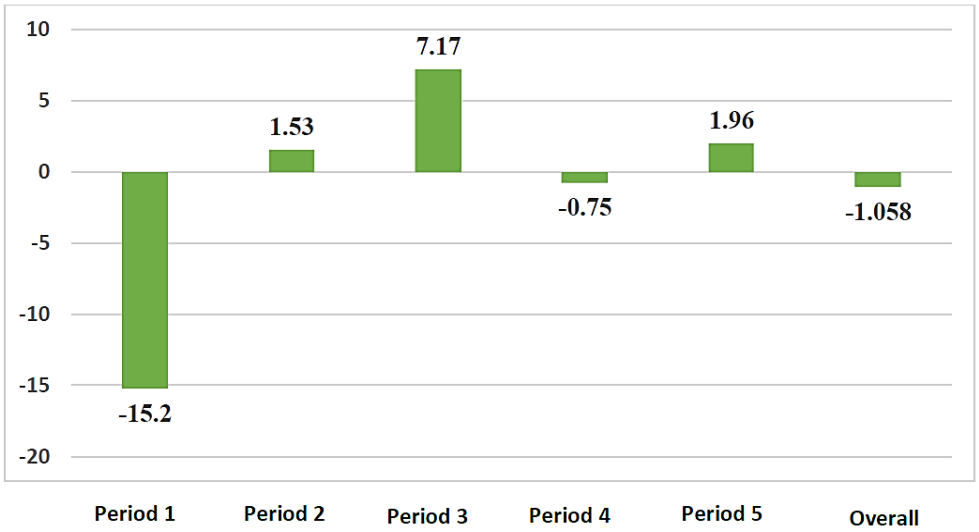

Fig. 2. Compound growth rate of area of saffron in Jammu and Kashmir

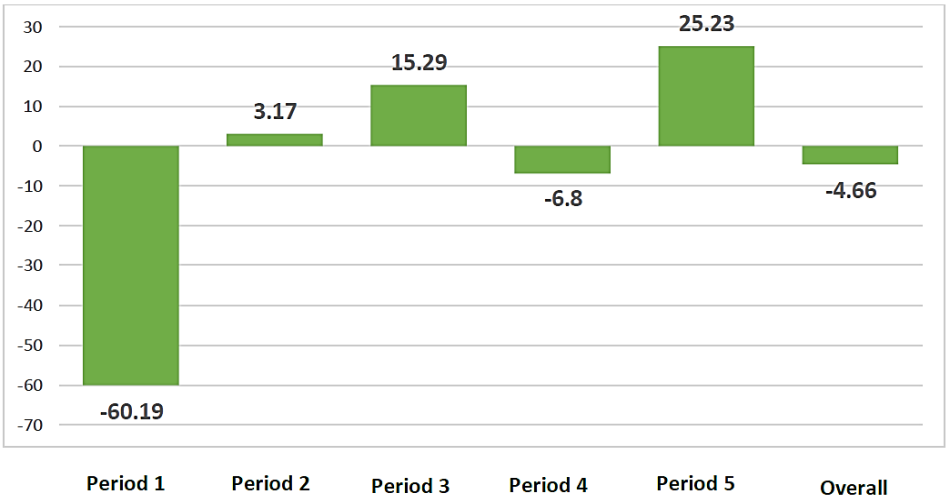

Fig. 3. Compound growth rate of production of saffron in Jammu and Kashmir

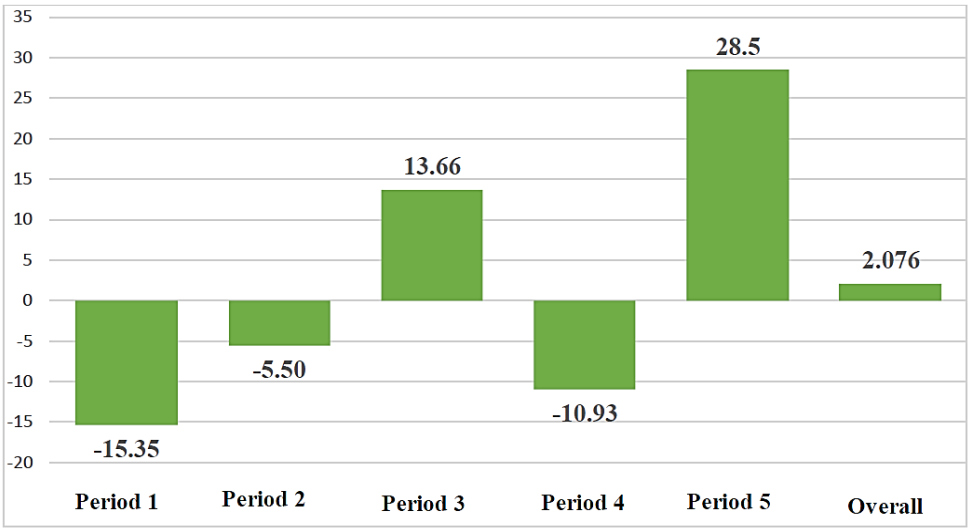

Fig. 4. Compound growth rate of productivity of saffron in Jammu and Kashmir

4. SUMMARY AND CONCLUSION

The Compound Growth Rate (CGR) analysis of saffron cultivation in Jammu and Kashmir over five distinct periods reveal significant insights into the dynamics of saffron production. During Period I (1997-2001), there was a drastic reduction in the area under cultivation, production, and productivity, with a 60.19% decline in productivity indicating severe underlying issues such as poor agronomic practices, adverse climatic conditions, or disease outbreaks. This led to a reduction in both the cultivated area and overall production as farmers likely abandoned or reduced saffron cultivation. In Period II (2002-2006), a slight recovery in the cultivation area was observed; however, production continued to decline, suggesting that the adverse factors persisted, even though there was a minor improvement in productivity. This slight increase in productivity hints at marginal improvements in cultivation techniques or better crop management practices. Period III (2007-2011) marked a substantial recovery, with significant increases in the area, production, and productivity. This suggests the implementation of better agricultural practices, the introduction of high-yield saffron varieties, and favourable climatic conditions. The higher growth in production and productivity compared to the area indicates enhancements in cultivation efficiency and management. Conversely, in Period IV (2012-2016), a slight decline in the area and productivity, coupled with a more considerable decline in production, points to potential setbacks such as market fluctuations, climatic variability, or issues related to soil fertility and pest management. The sharper decline in production compared to the area suggests inefficiencies or challenges in maintaining the previous productivity gains. Finally, Period V (2017-2020) shows a strong recovery phase with modest growth in the area and significant increases in production and productivity. This period likely benefited from sustained improvements in cultivation practices, technological advancements, better pest and disease management, and supportive government policies. The substantial rise in productivity during this period indicates effective use of resources and optimized farming techniques. Overall, the analysis indicates that saffron cultivation in Jammu and Kashmir has experienced significant fluctuations due to various factors affecting area, production, and productivity. Sustaining and enhancing saffron production requires a focus on consistent and advanced agronomic practices, climate-resilient strategies, and supportive policies.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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