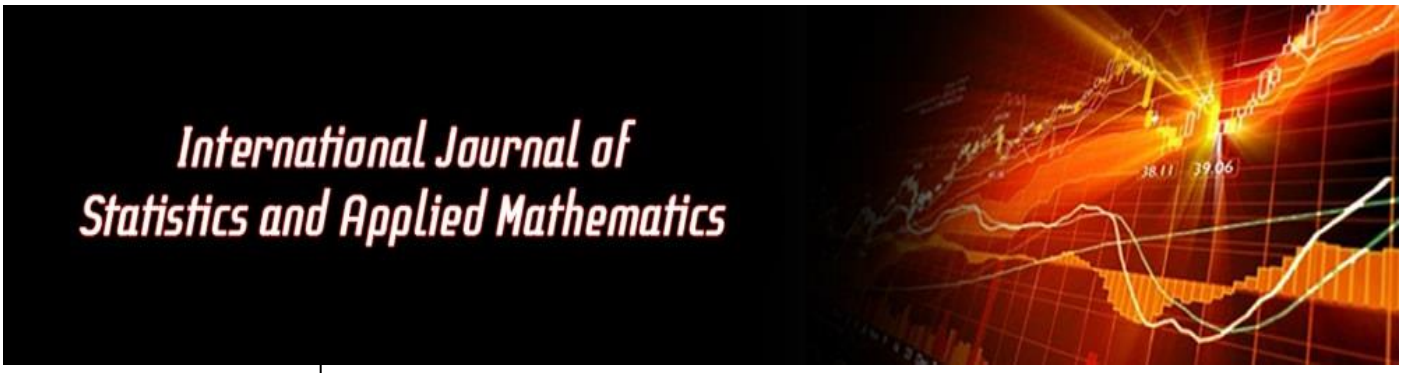

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Current status and post-Covid effect on floriculture sector in Haryana

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Abstract
The floriculture sector, integral to both ecosystems and economies, faced significant challenges during the COVID-19 pandemic, particularly in Haryana, India. Flowers, beyond their ecological role in pollination, hold cultural and emotional value and are a part of a global multi-billion-dollar market. India, with a notable floriculture industry, experienced a decrease in flower crop cultivation from 323 thousand hectares in 2019 to 283 thousand hectares in 2021 due to the pandemic. This study focuses on the impact of COVID-19 on flower crop cultivation in Haryana, analyzing data from 2004 to 2023. The analysis utilized compound annual growth rates (CAGR), coefficient of variation (CV), and the Cuddy-Della Valle Index (CDVI) to assess changes in the area and production of loose and cut flowers. Results indicated a significant decline in the area under flower cultivation and loose flower production during the pandemic, with a decrease of 64.82 per cent and 64.71 per cent respectively, compared to the base year. Conversely, cut flower production increased by 44.28 per cent despite high fluctuations and a negative CAGR (-6.70%). The study revealed heightened instability in the sector during the COVID-19 period (2019-23), with CV and CDVI values indicating high variability across all parameters, particularly in cut flower production, which exhibited a 50.33 per cent fluctuation. The pandemic's impact was evident in the sharp decline in domestic flower demand, disrupted supply chains, and reduced market prices, leading to a shift in cultivation preferences towards cut flowers due to their longer shelf life. The study underscores the need for strategic policies to stabilize and enhance the floriculture sector post-pandemic, focusing on reducing instability and promoting growth in flower crop cultivation in Haryana.

Keywords: Flower, growth rate, instability, cuddy-dellavalle index

1. Introduction
Flowers play a crucial role in ecosystems, aiding in the pollination process which is essential for the production of fruits and seeds. Beyond their biological importance, flowers have profound cultural and emotional significance. They are used to express emotions, commemorate events, and enhance the aesthetic appeal of spaces. From the roses symbolizing love and passion to lilies representing purity and renewal, flowers carry deep meanings in different cultures and traditions. In 2023–24, India's floriculture production area was 285 thousand hectares, producing 2,284 thousand tonnes of loose flowers and 947 thousand tonnes of cut flowers, according to the National Horticulture Database published by the National Horticulture Board (Source: Ministry of Agriculture and Farmers Welfare, 2nd Advance Estimates, 2023–24). Currently, several states engage in commercial flower cultivation; Tamil Nadu (21%), Karnataka (16%), Madhya Pradesh (14%), and West Bengal (12%) are the top states that do so, outperforming other states that produce flowers, such as Mizoram, Gujarat, Andhra Pradesh, Odisha, Jharkhand, Haryana, Assam, and Chhattisgarh. The Indian floriculture industry comprises a variety of flowers such as Roses, Tuberoses, Gladioli, Anthuriums, Carnations, and Marigolds, among others. Cultivation is carried out in both open farm conditions and state-of-the-art polyhouses and greenhouses.

The economic impact of flowers is also noteworthy. The floriculture industry, which includes the cultivation and sale of flowers and ornamental plants, is a multi-billion-dollar global market. India's total export of floriculture was ₹717.83 crores (USD 86.63 Million) in 2023-24. The major importing countries were the U.S.A, Netherlands,

United Arab Emirates, U.K, and Canada. There are more than 300 export-oriented units in India, with over 50% based in Karnataka, Andhra Pradesh, and Tamil Nadu. With technical collaborations from foreign companies, the Indian floriculture industry is poised to increase its share in global trade. In recent decades, the global floriculture sector has significantly grown, reaching $42,200 million in export revenue. This sector creates employment opportunities, improves the livelihood and well-being of farmers, and reduces poverty and inequality due to its high export potential and profitability from relatively lower capital investment.

The coronavirus infection known as SARS-CoV-2, resulting in COVID-19 disease had a devastating impact on the world in 2020–21. Various measures have been taken by nations in response to the pandemic, including the implementation of full or partial lockdowns. Similar to previous pandemics, human activity and the world economy have suffered greatly as a result of these mandatory quarantine measures. The COVID-19 pandemic has had far-reaching impacts across various sectors worldwide, and the agricultural sector in Haryana, India, is no exception. The pandemic has caused a tumultuous period in the floriculture sector of Haryana, a state renowned for its varied agricultural output.

The impressive growth of the floriculture sector was seriously impeded by the worldwide COVID-19 pandemic due to supply chain disruptions. The area under flower crop cultivation in India experienced a decline from 323 thousand ha in 2019 to 283 thousand ha in 2021. This decrease in cultivation area may be attributed to various factors such as transport restrictions during the pandemic significantly affected the flower supply chain. Other factors such as maintaining social distancing from consumers during lockdowns, sudden job losses, fear of infection from flowers, limited opening hours of flower markets, and the lack of online sales during lockdowns have all contributed to a prompt reduction in market demand. Consequently, the demand in the flower market decreased by almost 50% instantly.

Consistency in the area devoted to any commodity plays a crucial role in increasing its production. With this background, the study has assessed the after effects of COVID-19 on the flower crop in Haryana. The findings of the study could help in identifying the differential impact of COVID-19 on the area and production of flower crops and in formulating suitable policies to enhance the area under cultivation.

2. Materials and Methodology

The study pertains to the state of Haryana, India. It is based on secondary data, with time series data on the area and production of flower crops collected over 20 years, from 2004 to 2023. This data was sourced from the Horticulture Department, Government of Haryana website (hortharyana.gov.in/en)to analyze the variability in the area and production of flower crops.

a. Compound Annual Growth Rate

Compound annual growth rates (CAGR) were calculated to study the changes in the area and production of flower crops over a period. The compound annual growth rate was determined by fitting the following equation to the time series data on area and production:

$Y_t=Y_0\ (1+r)^t$

Taking log on both sides

$LnY_t=LnY_0+tLn\ (1+r)$

$LnY_t= a+bt$

Where, $a=LnY_0$

$b=Ln\ (1+r)$

Y_t= area/ production
Y_0= constant
t= time period in years and
b= regression coefficient
% compound growth rate= (Anti log b-1) × 100 (Jamanal and Sadaqath, 2017) [5]

b. Coefficient of variation

To estimate the variability in the area and production of flower crops for the study period, the coefficient of variation (CV) was used. The coefficient of variation is defined as the ratio of the standard deviation (SD) to the mean, providing a measure of relative variability (Ankush *et al*., 2024) [1].

$$CV(\%) = \frac{SD}{Mean} \times 100$$

c. Measure of Instability

There are several techniques available to measure the index of instability. In this study, the instability in the area and production of flower crops was measured in relative terms by using the Cuddy-Della Valle index. This index has been increasingly used by researchers in recent years to measure variability in time series data.

Cuddy-Della Valle Index

The simple coefficient of variation tends to overestimate the level of variability in time-series data characterized by long-term trends. In contrast, the Cuddy-Della Valle index corrects the coefficient of variation. The instability index CDVI is given by the expression:

$$CDVI = CV \times \sqrt{(1 - AdR^2)}$$

Where,
CV = coefficient of variation (in percent)
AdR^2 = coefficient of determination from a time trend regression adjusted by the number of degrees of freedom (Vilhekar *et al.*, 2022) [8].

The ranges of CDVI are given as follows

- Low instability = 0 to 15
- Medium instability = 15 to 30
- High instability = 30 and above

3. Results and Discussion

The results of the study was presented and discussed in two sections i.e. overall impact and COVID-19 impact on area and production of flower crops.

3.1 Growth rate

The growth rate of flower crops in Haryana was analyzed by using the compound annual growth rate (CAGR). The time series data on area and production of flower crops in Haryana were analyzed and presented in Table 1.

Table 1: Growth of area and production of flower crops in Haryana during the period (2004–2023)

Particulars	Area (000 ha)	Loose flower production (000 MT)	Cut flower production (00,000 Sticks)
Base year (TE 2004)	4.81	55.58	508.00
Current year (TE 2023)	1.69	19.61	733.00
Absolute change	-3.12	-35.97	225.00
Relative change (%)	-64.82	-64.71	44.28
Mean	4.96	49.63	789.69
Standard deviation	1.77	18.55	397.43
Coefficient of variation (%)	35.61	37.37	50.33
Compound annual growth rate (%)	-5.77	-4.34	-6.70

It could be observed from the data that the area under flower crops decreased by 64.82 per cent in the current year (1.69 thousand ha) compared to the base year (4.81 thousand ha), with a fluctuation of 35.61 per cent. The area showed a significant decrease, with the compound growth rate decelerating by 5.77 per cent per year during the period from 2004 to 2023. In comparison to the base year of 55.58 thousand MT, the output of loose flower in Haryana was found to have declined by 64.71 per cent in the current year (19.61 thousand MT), with a fluctuation of 37.37 per cent, and demonstrated a compound growth rate of -4.34 per cent each year. Conversely, the production of cut flowers climbed by 44.28 per cent (508.0 to 733.0 lakh sticks) annually, with a 50.33 per cent volatility and a compound growth rate of -6.70 per cent per year.

3.2 Measure of Instability

An instability analysis on the area and production of flowers over a twenty-year period was conducted. Instability measures, including the coefficient of variation and the Cuddy-Della Valle index, were determined and are presented in Table 2.

Table 2: Measure of instability in area and production of flower in Haryana

Sr. No.	Measure of Instability	Coefficient of variation	Cuddy-Della Valle Index
1.	Area	35.61	26.81
2.	Loose flower production	37.37	33.76
3.	Cut flower production	50.33	42.14

Fluctuations in agriculture are often measured using the simple coefficient of variation (CV), but this method can include a trend component, leading to an overestimation of instability in time series data characterized by long-term trends. To address this issue, the study utilized the Cuddy-Della Valle Index, which adjusts the coefficient of variation to provide a more accurate measure of instability. The estimated Cuddy-Della Valle instability indices for Haryana revealed higher instability in the production of both loose flowers (33.76%) and cut flowers (42.14%), followed by the area under cultivation (26.81%). The results from the coefficient of variation (CV) were also similar to those obtained using the Cuddy-Della Valle index. The values of the Cuddy-Della Valle (CDV) index (%) for the area under cultivation, loose flower production and cut flower production all fall within the high variation range, indicating significant instability over the period 2004–2023.

3.3 COVID-19 impact on area and production of flower crop in Haryana

3.3.1 Growth rate over different intervals

After analyzing the growth rate of entire study period, we divide the whole study period into four intervals of 2004-08, 2009-13, 2014-18 and 2019-23 to find out the COVID-19 impact. The results are depicted in following table:

Table 3: Growth of area and production of flower crops in Haryana during different intervals

Interval	2004-08	2009-13	2014-18	2019-23
Area				
CV	8.49	1.86	5.16	36.27
CAGR	4.07	1.16	-1.48	-14.44
Loose flower production				
CV	27.50	3.54	10.73	39.42
CAGR	8.28	2.19	1.90	-10.91
Cut flower production				
CV	39.47	6.56	30.07	71.42
CAGR	18.92	3.53	-14.16	30.24

After analyzing the results in table 1, it is evident that all three variables—area, loose flower production, and cut flower production—exhibit very high fluctuations and a negative compound annual growth rate. However, this does not represent the true picture. By breaking the entire study period into different intervals of five years, the details and trends become clearer, providing a more accurate understanding of the situation. From Table 2, it can be observed that the highest fluctuations occurred during the COVID-19 interval (2019-23), with 36.27 percent in the area, 39.42 percent in loose flower production, and 71.42 percent in cut flower production. The compound annual growth rate (CAGR) was positive for all variables in the earlier intervals. However, during the COVID-19 interval (2019-23), there was a negative CAGR for the area and loose flower production, while cut flower production showed a positive CAGR. Conversely, cut flower production exhibited a negative CAGR during the 2014-18 interval.

3.3.2 Measure of Instability in different intervals

After analyzing the growth rate of entire study period, we divide the whole study period into two intervals of 2004-2018 and 2019-2023 to find out the COVID-19 impact. The results are depicted in following table:

Table 4: Measure of instability (CDVI) in area and production of flower in different intervals

Intervals	Area	Loose flower production	Cut flower production
Coefficient of variation (%)			
2004-18	8.03	17.72	34.34
2019-23	36.27	39.42	71.42
Cuddy-Della Valle Index (%)			
2004-18	7.77	15.12	34.08
2019-23	26.20	36.46	60.53

After analyzing the complete data, the results indicate instability across all variables. However, by breaking the data into two different intervals—pre-COVID (2004-18) and post-COVID (2019-23)—more accurate insights emerge. From

Table 4, it can be observed that during the pre-COVID interval, the Cuddy-Della Valle Index (CDVI) values indicated low instability for the area (7.77%), medium instability for loose flower production (15.12%), and high instability for cut flower production (34.08%). In contrast, during the post-COVID interval, all variables exhibited very high instability compared to their respective pre-COVID levels.

The primary reason for the high instability during COVID-19 interval in all variables and the negative compound annual growth rate of area and loose flower production was the COVID-19 pandemic, which severely impacted the floriculture sector, similar to other industries. The pandemic led to a drastic drop in domestic flower demand due to the closure of religious places, postponed weddings, deferred public and private sector events, and the absence of major social and religious functions, leaving farmers struggling to market their produce (Directorate of Floriculture Research-ICAR). On the other hand, cut flower production showed a positive compound annual growth rate during the 2019-23 interval. This was because farmers began to prefer cut flowers over loose flowers, primarily due to the longer shelf life of cut flowers (Gawade *et al*., 2017) [3]. The COVID-19 pandemic caused severe disruptions in the flower supply chain due to nationwide lockdowns, reduced market prices, and disrupted export facilities, potentially negatively impacting the welfare of developing countries (Mitra *et al*., 2022) [6]. However, the longer shelf life of cut flowers provided a partial solution to these supply chain issues, as it facilitated easier transportation and helped mitigate some of the challenges. The cut flower sector also experienced a small negative compound growth rate during the 2014-18 interval. This was attributed to a decrease in the area under cut flower cultivation, especially in protected cultivation areas, as farmers shifted to loose flower production, as per the data available from Horticulture department, Government of Haryana.

4. Conclusion

The overall analysis of the time series data for area, loose flower production, and cut flower production shows a negative compound annual growth rate when considering the entire period. However, dividing the data into four intervals reveals a more nuanced picture. Specifically, the 2019-23 interval, which coincides with the COVID-19 pandemic, is the only period that demonstrates a negative compound annual growth rate for area and loose flower production. In contrast, cut flower production showed a positive compound annual growth rate during this interval. In terms of instability, the 2019-23 interval also stands out, with all variables exhibiting significantly higher values of the coefficient of variation (CV) and the Cuddy-Della Valle Index (CDVI) compared to their respective levels in the pre-COVID intervals. This highlights the substantial impact of the pandemic on the floriculture sector, leading to greater instability and negative growth rates during this period.

Conflict of interest: Authors declare that there is no conflict of interest among them.

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