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GROWTH AND DECOMPOSITION ANALYSIS OF CORIANDER CROP IN GUJARAT, INDIA

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ABSTRACT

This paper explores the trend in area, production and productivity of coriander in Gujarat. This study analysed the growth and instability of coriander in Gujarat from 2002-03 to 2021-22 using CAGR and the Cuddy-Della Valle index. The period was divided into period-I (2002-03 to 2011-12), period-II (2012-13 to 2021-22), and the overall period. Results indicated a significant increase in area and production in period-II compared to period-I. The overall growth rates in area, production and yield were 10.41, 12.12, and 1.55 per cent per annum, respectively. The magnitude of instability in the area of coriander crop was higher as compared to production and yield. Decomposition analysis highlighted the major role of the area effect (114.67%) in coriander production growth, while yield and interaction effects were negative throughout the study period.

Key words : Coriander, Compound growth rate, Instability index, Decomposition analysis.

Introduction

India is the foremost country in the production, consumption and export of spices; hence, it is popularly known as the Spice Basket or Land of Spices. Spices are a crucial group of agricultural commodities essential in the culinary arts. Among all the spices, seed spices constitute a major portion. Worldwide, coriander (*Coriandrum sativum* L.) is farmed as a seed spice crop. Coriander is a member of the "Apiaceae" family. It is grown as a field crop for its seeds commonly known as "Dhania" which has a fragrant odor and aromatic test (Painkara *et al*., 2024). In India, coriander, also known as cilantro, Chinese parsley, or Arab parsley, is grown for its leaves and seeds. Coriander seed is used in cakes, breads and other baked goods. Coriander has many health benefits, including the ability to treat conditions including skin irritation, excessive cholesterol, diarrhea, mouth ulcers, anemia, indigestion, menstruation disorders, smallpox, conjunctivitis, skin disorders, and blood sugar abnormalities. It also has positive effects on eye health. (Kumar and Kumar, 2017).

India is the top producer, consumer, and exporter of coriander, holding around 67.57 percent of the global market share in 2021 (Anonymous, 2022). The major coriander growing states are Madhya Pradesh, Gujarat, Rajasthan, Assam, Odisha and West Bengal. Gujarat is particularly significant, ranking second in both the area dedicated to coriander cultivation and the volume of production. During the 2022–23 season, Gujarat allocated 2.17 lakh hectares to coriander farming, resulting in a production of 3.13 lakh metric tons (Anonymous, 2023).

Materials and Methods

The secondary time series data for the last twenty years (2002 to 2022) on area, production and yield of coriander were collected from various issues of the Directorate of Agriculture, Agriculture, Farmers Welfare & Co-operation Department, Government of Gujarat and other official sources. The time series data of area, production and yield of coriander crop has been taken for 20 years from 2002-03 to 2021-22. The study period (2002-03 to 2021-22) was divided into three periods, i.e., period-I (2002-03 to 2011-12), period-II (2012-13 to 2021-22) and overall period (2002-03 to 2021-22). Two different analyses had been carried out in the study, *viz*. (a) compound annual growth rates in area, production and yield and (b) decomposition analysis.

Compound Growth Rate

The growth rate can be defined as the rate of change per unit time (Mohan and Sunny, 1993). It is used to measure the past performance of the economic variables given and describe the trends in those variables over a period of time. The normal statistical procedure to obtain a measure of the growth dynamics of crops over a period is to postulate a hypothetical function that would adequately describe the series of economic variables over a period of time and estimate their parameters.

The compound growth rates in area, production and yield of the coriander crop were worked out using the exponential function.

$$Y_t = a\, b^t\, ut \quad (1)$$

Where,

Y_t = area/production/yield of coriander in district in year 't',

a = intercept;

b = regression coefficient,

t = time element which takes the value 1, 2, 3...n,

u_t = error term

By taking logarithms of both the sides, the equation takes the form

$$\text{Log } Yt = \text{Log } a + t \log b \quad (2)$$

The value of log b in equation (2) was computed using the formula,

$$Log\ b = \frac{\left(\Sigma t\ Log\ Y - \left(\Sigma t . \Sigma\ Log\ Y / N\right)\right)}{\Sigma t^2 - \left(\frac{\Sigma t^2}{N}\right)} \quad (3)$$

Where,

N = Number of years.

Subsequently, the compound growth rate (%) was computed by using the formulation.

Compound growth rate(r) = [(Antilog of log b) -1] × 100

Student 't' test was used to determine the significance of the growth rates obtained for which the following formulation was employed

t = Log b/SE (Log b)

$$SE\left(Log\ b\right) = \sqrt{\frac{\Sigma\left(Y - \bar{Y}\right)^2 - Log\ b * \left(\Sigma\left(Y - t\right) - \Sigma\left(t\right) * \bar{t}\right)}{\left(N - 2\right)\Sigma\left(t - \bar{t}\right)^2}} \quad (4)$$

Where,

N = number of observations

(N-2) = degrees of freedom

The calculated 't' values, from equation (6), were compared with the table 't' values and the significance was tested for different significant probability levels.

Instability

To measure the instability index, Cuddy-Della Valle (1978) index was used.

$$Ix = CV\sqrt{\left(1 - \bar{R}^2\right)} \quad (5)$$

$$CV(\%) = S/\bar{X} * 100$$

Where,

Ix = Instability index,

CV = Coefficient of variance,

$\bar{R}^2$ = Adjusted coefficient of multiple determination,

$\bar{X}$ = Mean value,

S = Standard deviation

Decomposition analysis

To measure the relative contribution of area, yield to the total output change for the major crops, the decomposition analysis model as given by Minhas and Vaidhyanathan (1965). Sharma and Subramanyam (1984) redeveloped the model and several research workers (Kalamkar, 2003) used this model and studied growth performance of crops in the state. The method state that if A_0, P_0 and Y_0, respectively, are area, production and yield in base year and A_n, P_n and Y_n are values of the respective variables in the n^{th} year item.

$$P_0 = A_0 \times Y_0$$

$$P_n = A_n\, Y_n \quad (6)$$

Where,

A_0 and A_n = Area

Y_0 and Y_n = Yield

n = Year

$$P_n - P_0 = \Delta P$$

$$A_n - A_0 = \Delta A$$

$$Y_n - Y_0 = \Delta Y \quad (7)$$

From equations (6) and (7), we can write

$$P_0 + \Delta P = (A_0 + A)\,(Y_0 + \Delta Y)$$

Hence,

$$P = \frac{A_0 \Delta Y \times 100}{\Delta P} + \frac{Y_0 \Delta A \times 100}{\Delta P} + \frac{\Delta Y \Delta A \times 100}{\Delta P} \quad (8)$$

Production = Yield effect + area effect + interaction effect

Thus, the total change in production can be decomposed into three components *viz*., yield effect, area effect and the interaction effect due to change in yield and area.

Results and Discussion

Compound Growth Rate and Instability

The compound growth rate (CGRs) and Instability Index (II) of coriander in Gujarat were presented in Table 1. In the case of the area, the growth rate (1.37%) in period I increased to 14.97 per cent in period II at the 10 per cent level of significance. During the entire study period, the growth rate in area was found positively non-significant. The growth rate in production was found to be 8.04 per cent in period I increased to 11.04 per cent in period II at the 10 per cent level of significance. During the entire study period, the growth rate in production was found positively non-significant. In the case of yield, the growth rate was decreased in period II over a period I at the 1 per cent level of significance. During the entire study period, the growth rate in yield was found positive and significant. It can be concluded that area and production of coriander were increased significantly in period II over period I, but yield was decreased significantly in period II over period, whereas at the overall period yield was increased positively significant (Fig. 1).

The instability in area, production and yield of the coriander crop was found to decrease in period II compared to period I. During the entire study period, the highest Instability Index (II) was found for area (399.81) followed by production (384.68) and yield (27.50). It can be concluded that the yield of the coriander crop was found to be more stable than area and production in both periods I and II. Boyal *et al.* (2015) and Jinjala *et al.* (2020) conducted similar types of studies on growth and instability in the area, production and productivity of fenugreek and onion, respectively (Fig. 2).

Decomposition analysis

To determine how area, yield and their interaction are responsible for the growth of coriander production in Gujarat from 2002-03 to 2021-22, decomposition analysis was carried out. Growth in coriander production was decomposed into three factors, *viz*., area effect, yield effect and interaction effect. The contribution of area, yield and their interaction to the change in production of coriander over the years are presented in Table 2 and Fig. 3.

During Period I, it was evident that the increase in

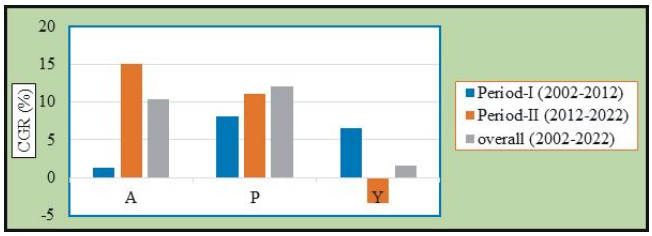

Fig. 1 : CGR of area, production and yield coriander in Gujarat.

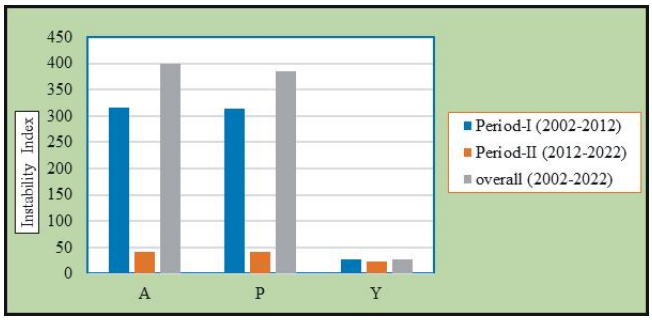

Fig. 2 : Instability of area, production and yield of Coriander in Gujarat.

Table 1 : Growth rates and instability in area, production and yield coriander in Gujarat (2002-03 to 2021-22).

Particulars		CGR (%)	Instability
Period-I (2002-03 to 2011-12)	A	1.37	316.30
	P	8.04	314.31
	Y	6.58***	26.98
Period-II (2012-13 to 2021-22)	A	14.97*	42.27
	P	11.04*	41.46
	Y	-3.42***	22.83
Overall (2002-03 to 2021-22)	A	10.41	399.81
	P	12.12	384.68
	Y	1.55***	27.50

Note: A, P & Y corresponds to Area, Production and yield, respectively.
*** indicates Significant at 1 per cent level, ** indicates Significant at 5 percent level and * indicates Significant at 10 per cent level.

coriander production was primarily driven by the expansion of cultivated area, accounting for 118.96 per cent of the total effect. This indicated that the expansion of land dedicated to coriander cultivation had the most significant positive impact on production. However, this period also showed a negative yield effect (-24.70%) and a minor positive effect from the interaction between area and yield (5.74%). Despite the negative yield effect, the substantial increase in cultivated area overshadowed this decline, resulting in overall production growth.

Moving to Period II, the dominance of the area effect continued, with an even higher contribution of 130.89 per

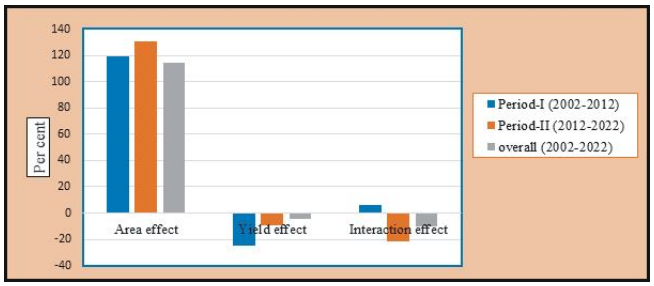

Fig. 3 : Decomposition analysis of coriander production in Gujarat.

Table 2 : Decomposition analysis of area, yield and their interaction towards increasing production of coriander in Gujarat (2002-03 to 2021-22).

Particulars		Per cent
Period-I (2002-03 to 2011-12)	Area effect	118.96
	Yield effect	-24.70
	Interaction effect	5.74
Period-II (2012-13 to 2021-22)	Area effect	130.89
	Yield effect	-9.45
	Interaction effect	-21.44
Overall (2002-03 to 2021-22)	Area effect	114.67
	Yield effect	-4.22
	Interaction effect	-10.45

cent. This suggested that the expansion of coriander cultivation continued to be the primary driver of production growth. However, both yield and interaction effects exhibited negative impacts, with the yield effect at -9.45 per cent and the interaction effect at -21.44 per cent.

Considering the entire study period, the analysis underscored the paramount importance of expanding the cultivated area for coriander production in Gujarat. The positive area effect, accounting for 114.67 per cent, highlighted the consistent role of land expansion in driving overall production growth. Despite the negative effects of yield and interaction, the overarching conclusion was that the expansion of cultivated area remains a pivotal factor in the sustained development of coriander production in Gujarat during the study period. Changela and Devi (2018) and Parmar and Devi (2021) conducted similar types of studies on decomposition analysis of major pulses and soyabean in Gujarat, respectively.

Conclusion

The results showed that the coriander crop in Gujarat has shown significant growth in both area and production over the study periods. This increase indicates improved resource utilization and production technologies. However, while the cultivation area and production have expanded, yield efficiency has faced challenges, underscoring the need for continued research to enhance yield performance. The magnitude of instability in the area of the coriander crop was higher as compared to production and y. Decomposition analysis concluded the growth of coriander production in Gujarat from 2002-03 to 2021-22 was primarily driven by the expansion of cultivated area. While yield and interaction effects were negative, the increase in land dedicated to coriander cultivation consistently played a crucial role in boosting overall production. This highlights the importance of expanding cultivation areas for the sustained development of coriander production in Gujarat.

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