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Economics of Seed Spices in Gujarat: Analyzing Parity of Cost, Price, and Income

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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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ABSTRACT

This study analyzes the cost, price, and income parity in three major seed spices cultivated in Gujarat by examining indices of average input prices, Farm Harvest Prices, cost of production, and gross income to evaluate the profitability and challenges faced by farmers. The secondary data on input cost, cost of production and gross income were collected for the period of eleven years from 2011-12 to 2021-22 from the reports of "The Scheme for Farm Cost Studies of Important Crops in Gujarat State" and "The Scheme for Creating a Permanent Machinery for studying Cost of

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Cultivation/ Production of Principal crops grown in Gujarat state, further analysis of parity indices were estimated by taking 2011-12 as base year. The results indicate that for cumin crop, input prices grew significantly, while farm harvest prices exhibited a non-significant increase. Parity indices between Farm Harvest Prices and input prices remained below 100, indicating that farm harvest prices did not cover rising input costs. However, in years like 2016-17, 2018-19, and 2021-22, the farm harvest price and gross income were favorable, indicating profitability for farmers. In fennel, input prices and production costs showed significant growth, while farm harvest prices and gross income had minimal increases. Parity indices suggested that farm harvest prices were insufficient to cover rising costs in most years, though 2012-13 and 2021-22 were favorable for farmers in terms of both price and income. Coriander, with significant growth in input prices, showed a slight increase in farm harvest prices and a decrease in production costs. Parity indices indicated that the farm harvest price consistently exceeded input prices and the cost of production, ensuring favorable profitability and encouraging investment in coriander cultivation. Overall, the findings underscore the need for policy interventions to stabilize farm harvest prices and control input cost inflation, ensuring sustained profitability for farmers growing seed spices.

Keywords: Parity indices; cost; price and income; cumin; coriander and fennel.

1. INTRODUCTION

India, renowned as the "Land of Spices," dominates global spice production and consumption, cultivating spices across 4.138 million hectares and producing 9.754 million tonnes in 2019-20 (Anonymous, 2020[a]). Spices form a vital part of India's economy, accounts over 10% to total agricultural exports, with 1.193 million tonnes exported. (Anonymous, 2020[b]) Despite this, over 87% of the production is consumed domestically, reflecting their essential role in Indian cuisine and diverse applications. Among the various spices, seed spices like cumin, coriander, fennel and other seed spices hold prominence, occupying 55.85% of the total spice cultivation area and contributing 22.73% of total production of a country. (Anonymous, 2020[a]). Within India, Gujarat and Rajasthan stands out as a leading producer of seed spices, earning title as the "Seed Spices Hub." In 2019-20, the state cultivated spices on 0.699 million hectares, producing 1.009 million tonnes (Anonymous, 2020[a]), driven by favorable climatic conditions and the dedication of its farming community. Gujarat's pivotal role underscores its significance in supporting India's spice economy and meeting global demand for high-quality seed spices.Despite the increasing demand for these spices in domestic and international markets, the profitability for farmers is often undermined due to disparities in cost, price, and income. Addressing this parity issue is essential to ensure the sustainability and economic viability of seed spice cultivation.

The importance of parity between input costs and output prices has been well summerized in previous studies. Rising input costs adversely impacted the profitability of cereal growers, necessitating policy interventions to maintain parity (Shindage et al*.,* 2009). While terms of trade improved for certain crops like bajra and cotton in Gujarat, wheat farmers faced unfavorable parity indices (Devi and Zala, 2015). Similarly, cotton growers in Vidarbha struggled with unfavorable output-input price parity during specific years, highlighting the need for stabilizing mechanisms (Thakare and Shende, 2017). Fluctuations in input and output price parity for tur in Maharashtra were reported to affect growers' profitability, emphasizing the importance of addressing policy measures with market realities (Kale, et al*.*, 2021). These studies collectively indicate the critical need for assessing and addressing parity in agricultural pricing to support farmers' livelihoods. Therefore, efforts was made to achieve objective of evaluate the parity between cost, prices, and income of major seed spices in India, providing insights into trends and identifying gaps that need immediate attention. By addressing these issues, the research will contribute to formulating strategies for equitable pricing and sustainable production of seed spices (Anonymous 2022).

2. METHODOLOGY

2.1 Selection of Crops

The present study was carried out for three major seed spice crops grown in Gujarat state *viz.,* cumin, coriander and fennel which was selected based on the highest triennium average of area. (Table1)

Table 1. Triannium averages of area and production of spices in Gujarat state (2018-19 to 2020-21)

Crop	Area (ha)	Share in area (%)	Production (MT)	Share in production (%)
Cumin	439662.67	67.24	425313.67	40.90
Coriander	85844.00	13.13	130887.00	12.59
Fennel	52552.67	8.04	108314.67	10.41
Suwa	13625.33	2.08	17967.67	1.73
Garlic	12665.00	1.94	98590.67	9.48
Chilli-Dry	11521.33	1.76	22280.00	2.14
Other	38007.33	5.81	236528.33	22.75
Total	653878.33	100.00	1039882.01	100.00

(Source: Directorate of Agriculture, Department of Agriculture, Farmers' Welfare and Cooperation, GoG, Gujarat)

2.2 Data Collection

To achieve the objective of parity indices, the study was relied on the time series data on cost of cultivation and input-output prices of selected seed spice crops. The data collected from the reports of "The Scheme for Farm Cost Studies of Important Crops in Gujarat State" and "The Scheme for Creating a Permanent Machinery for studying Cost of Cultivation/ Production of Principal crops grown in Gujarat state" for the period eleven years from 2011-12 to 2021-22. Further, both of above mentioned schemes follow the cost concepts prescribed by the Commission for Agricultural Costs and Prices (CACP), ensuring standardized cost measurements for analysis.

2.3 Analytical Tools

2.3.1 Parity indices

The simple index numbers of input-output prices and income was computed by considering 2011-12 as base year, the parity between input costs and output prices of selected crops were judged by using the computed indices.

The parity indices between output prices of selected crops and inputs as a whole were obtained for each crop separately by using the following formula (Patel *et. al* 1997):

$$RPIjt = \frac{FHPI_{jt}}{AIP_{jt}} x100$$

Where,

RPIjt = Parity index between prices of inputs and output of j^{th}crop in t^{th} year
FHPIjt = Index of farm harvest prices for j^{th} crop in t^{th} year and
AIPjt = Index of average inputs prices of j^{th} crop in t^{th} year

The parity indices between output prices and per quintal cost of cultivation of selected crops were worked out as under,

$$RCIjt = \frac{FHPI_{jt}}{CPI_{jt}} x100$$

Where,

RCIjt = Parity index between output prices and per quintal cost of production of j^{th}crop in t^{th} year
FHPIjt = Index of farm harvest prices for j^{th} crop in t^{th} year and
CPIjt = Index of per quintal cost of Production j^{th} crop in t^{th} year

Parity indices of gross income from crops (RGII) and per quintal cost of production (CP) was worked out by dividing the gross income index (GII) for the particular crop by per quintal cost of production.

$$RGIIjt = \frac{GII_{jt}}{CPI_{jt}} x100$$

Where,

RGIIjt = Parity index between gross income and per quintal cost of j^{th}crop in t^{th}year
GIIjt = Gross income index of j^{th}crop in t^{th} year and
CPIjt = Index of per quintal cost of production for j^{th} crop in t^{th} year

3. RESULTS AND DISCUSSION

The allocation of resources by the farmers are dependent upon prices of inputs, farm harvest

prices, cost of production and gross income from the crops and it is essential to examine the changes in these for the production of major seed spices and these changes were judged by working out the average price indices of all inputs for the period from 2011-12 to 2021-22 at constant prices. The cost-price relationship of different commodities affects the relative profitability and economic incentives to produce. Using constant indices for price parity estimation is a valid approach, especially if the goal is to assess the parity between farm harvest prices and input prices or production costs over time while adjusting for inflation or price changes. This allows for a more accurate comparison of prices and costs across different time periods, as it accounts for changes in the price level. The price indices have been worked out to know the fluctuations in prices of the inputs during the period from 2011-12 to 2021-22.

3.1 Cumin

Cumin (*Cuminum cyminum* L.) is a key spice crop in India, widely recognized for its distinctive aroma and warm, earthy flavor. India stands as the largest producer and exporter of cumin globally (Singh and Tiwari, 2020), with Gujarat and Rajasthan being the primary states for its cultivation. In Gujarat, cumin holds a dominant position among spices, accounting for 67.24% of the total spice cultivation area and contributing 40.90% to the state's total spice production during the period 2018-19 to 2020-21. (Table 1) The state's favorable climatic conditions and advanced agricultural practices have made it a hub for cumin farming, playing a significant role in the spice economy.

3.1.1 Indices of input-output prices, cost and income of cumin

The economic trends in cumin cultivation, including indices of average input prices, farm harvest prices, cost of production, and gross income, are given in Table 2, providing insights into its financial viability from 2011-12 to 2021-22. From the results obtained (Table 2), it can be concluded that the indices of average input prices of cumin were increased at positive and significant growth rate of 1.72 per cent per annum. The indices of farm harvest price were also increased at positive growth rate of 1.05 per cent, but found non-significant. Whereas, cost of production indices were found decreased at a negative growth rate of -0.61 per cent. Indices of gross income increased at a positive and non-significant growth rate of 1.41 per cent during the study period of 2011-12 to 2021-22.

3.1.2 Parity indices of cumin

To examine the impact of changes in input prices on profitability of cumin production, parity indices between farm harvest prices to average input prices, farm harvest prices to per quintal cost of production and gross income to per quintal cost of production were worked out at constant prices and presented in Table 3.

From the Table 3 it was observed that, the parity indices between FHP and average input prices of cumin were less than 100 during the ten year period *i.e.,* 2012-13 to 2021-22*,* which indicates relatively lower increase in FHP of cumin as compared to rise in the prices of inputs used by the farmers in its production. Similar results were found by Shendage et al*.,* 2009 for cereal crops and Kale et al*.,* 2021 for tur crop.

Table 2. Indices of average input prices, farm harvest prices, cost of production and gross income from 2011-12 to 2021-22 of cumin (Base year 2011-12) in Gujarat state

Year	Average input price(indices)	Farm harvest price (indices)	Cost of production (indices)	Gross income (indices)
2011-12	100.00	100.00	100.00	100.00
2012-13	102.96	91.03	94.23	87.68
2013-14	115.15	69.94	90.13	74.51
2014-15	105.67	94.31	97.42	93.28
2015-16	117.65	103.12	106.03	101.86
2016-17	120.73	114.19	100.23	118.07
2017-18	122.08	103.30	107.02	102.32
2018-19	105.61	103.09	93.73	103.51
2019-20	130.40	83.05	85.81	92.43
2020-21	119.39	88.72	88.37	94.88
2021-22	119.19	111.66	95.99	107.56
CAGR (%)	1.72**	1.05 ^{NS}	-0.61 ^{NS}	1.41^{NS}

****, ** and * indicate 1%, 5% and 10% levels of significance, respectively and NS-non-significant*

Table 3. Parity indices between FHP to input prices, FHP to cost of production and income to cost of production of cumin (at constant prices) in Gujarat state

Year	FHP / Input prices	FHP / Cost	Income / Cost
2011-12	100.00	100.00	100.00
2012-13	88.41	96.60	93.05
2013-14	60.74	77.60	82.67
2014-15	89.25	96.80	95.75
2015-16	87.65	97.26	96.06
2016-17	94.58	113.93	117.80
2017-18	84.62	96.53	95.61
2018-19	97.61	109.98	110.43
2019-20	63.69	96.79	107.72
2020-21	74.32	100.40	107.37
2021-22	93.68	116.33	112.06

In case of parity indices of FHP to per quintal cost of production of cumin was found more than 100 for year 2016-17, 2018-19, 2020-21 to 2021-22. Therefore, it can be concluded that the FHP of cumin in these years were in favour of farmers. In the remaining years, ratio was not favorable to cumin growers *i.e.,* less than 100 indicate that increase in FHP was less than its cost of production. Further, Looking to the parity between gross income to the per quintal cost of production of cumin, the indices were found more than 100 in year 2016-17 and continuously from 2018-19 to 2021-22. This could be attributed to the increase in the farm harvest price and may be also due to increase in the productivity of cumin in these years (Anonymous 2011-12).

3.2 Coriander

Coriander (*Coriandrum sativum* L.) is an important spice crop widely cultivated for its aromatic seeds and leaves, which are used extensively in culinary and medicinal applications. In Gujarat, coriander ranks as the second most cultivated spice, contributing 13.13% of the total spice area and 12.59% of the state's spice production during 2018-19 to 2020-21 (Table 1). Its adaptability to semi-arid regions and its high demand in domestic and export markets make coriander a valuable crop in Gujarat's agriculture.

3.2.1 Indices of average input prices, cost and income of coriander

Table 4 represents the price indices of inputs used in coriander production, farm harvest prices, cost of production and gross income indices from 2011-12 to 2021-22 of coriander in Gujarat state at constant prices (Base year, 2011-12).

The average input price indices were increased at the positive and significant growth rate of 1.08 per cent per annum over the study period. The farm harvest price as well as gross income

Table 4. Indices of average input prices, farm harvest prices, cost of production and gross income from 2011-12 to 2021-22 of coriander (Base year 2011-12) in Gujarat state

Year	Average input prices (indices)	Farm harvest price (indices)	Cost of production (indices)	Gross income (indices)
2011-12	100.00	100.00	100.00	100.00
2012-13	107.29	171.21	144.80	115.23
2013-14	108.77	199.86	101.73	186.42
2014-15	118.98	186.46	97.18	169.88
2015-16	129.27	186.60	116.32	166.73
2016-17	116.78	160.67	94.13	153.97
2017-18	116.43	125.42	108.25	120.10
2018-19	115.71	145.85	100.16	143.88
2019-20	114.46	135.50	93.69	140.66
2020-21	117.05	149.30	98.98	155.68
2021-22	118.24	201.03	111.82	173.13
CAGR (%)	1.08*	0.81 ^{NS}	-1.10 ^{NS}	2.25 ^{NS}

****, ** and * indicate 1%, 5% and 10% levels of significance, respectively and NS-non-significant*

indices of coriander were showed positive but non-significant growth rate of 0.81 per cent and 2.25 per cent per annum, respectively. While indices of per quintal cost of production of coriander was decreased at a rate of -1.10 per cent over the study period.

3.2.2 Parity indices of coriander

To analyse the impact of changes in input prices on profitability of coriander production, parity indices between farm harvest prices to average input prices, farm harvest prices to cost of production as well as gross income to cost of production were worked out at constant prices from 2011-12 to 2021-22 and results obtained given in Table 5.

It was clearly seen from the results that farm harvest price to input price ratio was found greater than 100 during whole study years. This clearly implies that prices received for coriander was increased higher than the increase of price paid for inputs. Further, parity between farm harvest price to per quintal cost of production of coriander were also found favourable *i.e.,* greater than 100 during the study period indicated that farm harvest prices received was increased relatively higher than the increase in per quintal cost of production of coriander. The parity indices between gross income to per quintal cost of production of coriander were found more than 100 during the whole study period except 2012-13. This indicates that gross income increased at a higher rate as compared to per quintal cost of production of coriander reflecting the increased profitability of coriander farmers relative to production expenses which ultimately, providing incentives for farmers to continued investment and expansion in coriander cultivation in the state.

3.3 Fennel

Fennel (*Foeniculum vulgare* Mill.) is a versatile spice and medicinal plant valued for its sweet and aromatic seeds, which are used in culinary, pharmaceutical, and industrial applications. Ranking as the third most cultivated spice in Gujarat, fennel accounted for 8.04% of the total spice area and contributed 10.41% to the state's spice production during 2018-19 to 2020-21 (Table 1). The crop thrives in Gujarat's agro-climatic conditions, making it an integral part of the state's spice production.

3.3.1 Indices of input-output prices, cost and income of fennel

Indices of average input prices, farm harvest prices, cost of production, and gross income received from fennel in Gujarat state from 2011-12 to 2021-22 at constant prices is represented in Table 6.

It is observed from the Table that average input price indices and per quintal cost of production of fennel increased at a high positive and significant growth of 2.01 and 5.78 per cent per annum, respectively. While farm harvest price indices and gross income indices were grown at meager positive and non-significant growth of 0.56 and 0.41 per cent, respectively.

3.3.2 Parity indices of fennel

The price indices of inputs used in production, farm harvest price, cost of production and income received from fennel at constant prices from 2011-12 to 2021-22 is given in Table 7. The results implies that the parity indices between farm harvest prices and average input prices of fennel were less than 100 during study period

Table 5. Parity indices between FHP to input prices, FHP to cost of production and income to cost of production of coriander (at constant prices) in Gujarat state

Year	FHP / Input prices	FHP / Cost	Income / Cost
2011-12	100.00	100.00	100.00
2012-13	159.58	118.24	79.58
2013-14	183.75	196.46	183.25
2014-15	156.71	191.86	174.81
2015-16	144.35	160.42	143.34
2016-17	137.59	170.69	163.58
2017-18	107.72	115.86	110.94
2018-19	126.04	145.62	143.66
2019-20	118.38	144.63	150.14
2020-21	127.56	150.83	157.28
2021-22	170.02	179.78	154.83

Table 6. Indices of average input prices, farm harvest prices, cost of production and gross income from 2011-12 to 2021-22 of fennel (Base year 2011-12) in Gujarat state

Year	Average input price (indices)	Farm harvest price (indices)	Cost of production (indices)	Gross income (indices)
2011-12	100.00	100.00	100.00	100.00
2012-13	104.08	112.72	101.44	127.80
2013-14	116.54	93.22	112.64	107.82
2014-15	112.85	109.68	104.21	126.04
2015-16	132.07	92.25	172.13	87.56
2016-17	133.20	86.77	174.44	84.22
2017-18	138.31	86.60	132.80	109.37
2018-19	125.96	79.34	157.75	89.42
2019-20	129.08	113.00	188.92	103.78
2020-21	126.84	94.75	186.09	91.52
2021-22	117.98	133.49	138.76	160.63
CAGR (%)	2.01**	0.56 ^{NS}	5.78***	0.41 ^{NS}

****, ** and * indicate 1%, 5% and 10% levels of significance, respectively and NS-non-significant*

Table 7. Parity indices between FHP to input prices, FHP to cost of production and income to cost of production of fennel (at constant prices) in Gujarat state

Year	FHP / Input prices	FHP / Cost	Income / Cost
2011-12	100.00	100.00	100.00
2012-13	108.30	111.12	125.99
2013-14	79.99	82.76	95.72
2014-15	97.19	105.25	120.95
2015-16	69.84	53.59	50.87
2016-17	65.14	49.74	48.28
2017-18	62.61	65.21	82.36
2018-19	62.99	50.29	56.69
2019-20	87.54	59.82	54.94
2020-21	74.70	50.92	49.18
2021-22	113.15	96.20	115.76

except 2012-13 and 2021-22 years indicated that level of farm harvest prices of fennel was not sufficient to cover the increased prices of inputs during most of the study years except 2012-13 and 2021-22. The parity indices of farm harvest price to per quintal cost of production of fennel was found favorable only during the years 2012-13 (111.12) and 2014-15 (105.25), while in the remaining years, ratio was not in favour of fennel farmers *i.e.,* it was less than 100, so it was concluded that increase in the farm harvest price was less than cost of production of fennel in those years.

The parity indices of gross income to per quintal cost of production for fennel were less than 100 for most of the years under study except 2012-13, 2015-16 and 2021-22 indicated in these years, the per quintal cost of production was increased at higher rate as compared to gross returns from fennel and thereby adversely affecting the level of profitability. These results were found in agreement with the Shindage et al*.,* 2009 they also found that increase in input prices affect profitability of cereal crops.

4. CONCLUSION AND RECOMMENDATIONS

The parity analysis of major seed spices viz., cumin, coriander and fennel in Gujarat highlights differences in the economic conditions faced by farmers. For cumin, parity indices between farm harvest prices (FHP) and input prices were below 100 for most years, suggesting that the rise in input costs exceeded the increase in farm harvest prices, leading to reduced profitability for farmers during those years. However, during

year 2016-17 and 2021-22 favorable parity was recorded. Meanwhile fennel growers faced challenges as input prices and production costs grew significantly, and increase in farm harvest prices did not enough to cover them, resulting in negative parity for several years, especially from 2015-16 to 2020-21. In contrast, coriander experienced positive parity throughout the study period, as farm harvest prices and gross income grew more than input prices and cost of production, ensuring greater profitability for coriander farmers. Overall, the findings of the present investigation underscore the need for targeted policy support to improve profitability for cumin and fennel growers, while also promoting the continued success of coriander farming.

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 this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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