

Market arrivals and price behaviour of coriander seeds in Rajasthan, India

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Abstract

Present study was undertaken to study seasonality in arrivals and prices of coriander seeds in Rajasthan, a second largest coriander producer in India, using monthly data from January, 2008 to June, 2019. The results of the study depicted the typical seasonal pattern in coriander arrivals. seasonality index shows more than two hundred percent arrivals during peak months i.e. from February to April. Almost 50 to 60 per cent of annual productions arrives in markets during March, April and May months. The variation in prices was comparatively lower than arrivals. Following the law of demand, lowest index in prices was measured in February and highest was seen in November. Seasonal Index for prices varies between 88 to 111 per cent. The coefficient of variation was measured high in arrivals than prices. The prices has shown increasing trend till 2014 but started declining in later years resulted in decreasing supply in the studied market in recent years. There was inverse relationship between arrivals and prices in five out of six studied markets. Findings of this study highlights lower prices during peak arrival seasons adversely affects the income of coriander growers in the states, consequently coriander acreage in the state is shrinking. Therefore it is recommend that coriander seed should be covered under price policy support for adherence to ceiling and floor price so that further decline in area under this crop can be arrested.

Key words : Arrivals, coriander seed, price, Rajasthan

Introduction

Coriander (*Coriandrum sativum* L.) is a major seed spice crop grown in the country under 5.44 lakh ha with national production of 7.21 lakh tonnes during 2017-18. It is mainly grown in Madhya Pradesh (2.79 lakh ha), Rajasthan (0.98 lakh ha) and Gujarat (0.75 lakh ha) states. Rajasthan (1.30 lakh tonnes) is the second largest coriander producing state in the country, next only to Madhya Pradesh (3.91 lakh tonnes), contributing eighteen percent to national area and production both during 2017-18 (Spice board, 2019-20). In Rajasthan, its cultivation mainly concentrated in Baran, Kota and Jhalawad districts, jointly contributing more than ninety percent to the states area and production both (Table 1). Continuously declining acreage under this crop is point to ponder. Prices play a crucial role in area allocation to a crop (Kumar *et al.*, 2012; Singh *et al.*, 2016; Meena *et al.*, 2018). Continuous decreasing prices since 2014 till 2018 may be a main reason for its shrinking area in the state as well as country. More than this, low prices during peak seasons further jeopardises the farmers income. Prices of agricultural commodity generally exhibited seasonal movements are tangled to the annual nature of the crop (Flaskerud & Johnson 1993). The seasonal nature of field crops made total supply to the

market in short period of time leads to lowest prices near harvest and the highest prices near the end of the marketing year. Prices follow an upward trend, staying on-track with the pattern of forward price bids initially laid down at harvest (Welch, 2011). For most of the field crops, seasonality occurs over a period of 12 month. Seasonal analysis helps to identify the timing of a season s high and low and to estimate difference between the high and low price which are very helpful to take various decisions by farmers and other stakeholders in supply chain.

Data base and methodology

The present study is based on the prices and arrivals of coriander seeds in major APMC markets in Rajasthan. Six markets namely, Atru, Baran, Bhawanimandi, Itawa, Kota and Ramganjmandi were selected based on maximum arrivals of coriander seeds in the state. The information on arrivals and prices in above markets from January, 2008 to June, 2019 (138 months) are considered in the study. The daily basis data were collected from Agmarknet website were smoothed to monthly basis.

Analysis of data :

According to multiplicative model price series can be decomposed into four component i.e. Trend, Cyclical, Seasonal and Irregular components.

$$P = T * C * S * E$$

Where; P is price, T is Trend component, C is Cyclical component, S is Seasonal component and E is Random component.

To study trends in arrivals and prices, compound growth rates of arrivals and prices of coriander seeds in study markets was worked out as below

$$Y = ab^t$$

Where; Y is monthly arrivals/prices, a is constant, b is trend co-efficient and t is time period

Annual compound growth rate (CGR) is calculated as

$$\text{CGR (\%)} = (\text{Antilog of } b-1) \times 100$$

This study focused on the seasonal component by removing other components (viz; trend, cyclical and random) from price series. To estimate the seasonal price index, central moving average (CMA) was estimated using the following formula

$$\text{CMA}_t = \sum \frac{P_i}{n}$$

$$i = \frac{t-1}{2(n-1)}$$

Where: CMA = Central Moving Average, P = Nominal price, n= number of periods

CMA eliminates random variations and emphasizes systematic movements of variables series. This technique substitutes the observed value in the time series by the average of that value and a given number of the observations taken immediately before and after it. Consequently, the CMA has the same trend as the price, show cyclical fluctuations appearing in the original series. The CMA represents the trend and cyclical components of the original series, and eliminates seasonality and randomness (Bashir, 2003).

The formula for seasonal index (SI) can then be written as

$$\text{SI} = \text{TCSE}_i / \text{TC}_i = \text{SE}_i = (P_i / \text{CMA}_i) * 100$$

SI includes seasonal fluctuation in addition to randomness (E). The SI is already deflated as it is calculated by dividing nominal price series (the original price) by another nominal series (for details see Abba, 2009).

Results and discussion

Cultivation of coriander in study area

Coriander cultivation in Rajasthan mainly concentrated in *Hadoti* region comprised of Kota, Baran, Bundi and Jhalawad districts. During study period, Kota, Baran and Jhalawad districts jointly contributes 93 to 96 per cent share to states total area and production. Since 2008-09 the coriander acreage in the state shown decreasing trend

at compound growth of -2.2 per cent per annum. After 2011-12 its area and production reduced to less than half in Baran district; the second largest coriander growing district of Rajasthan. In same period, production decreased at more than double rate (-4.9%) indicates increasing vulnerability of this crop in main coriander growing belts of the state (Table 1). The productivity of coriander reduced drastically from 700 to 574 kg/ha during the year 2013-14 and 2014-15, respectively due to continuous increase in severity of seed and soil borne stem gall disease in popular cultivated varieties like RCr-436 and CS-6 in the last four years. (Singh *et al.*, 2016 and Malhotra *et al.*, 2016). The severe attack of stem gall in these districts coupled with decreasing market price for this crops (Fig. 5) since 2013-14 havocted the coriander growers resulting continuously falling acreage and production of this crop in study area. Shrinking coriander acreage needs attention of the researcher and policymakers at central and state levels.

Arrivals pattern of coriander seeds

Based on quantity of arrivals Atru, Baran, Itawa, Ramganjmandi, Kota and Bhawanimandi are the largest markets in study area. During study years half to two third of the state production was found to land in these markets. Only 40 per cent of Baran district production arrived in Atru and Baran markets; 13 per cent of Jhalawad district production arrived in Bhawanimandi markets whereas 270 per cent of Kota districts production arrivel in Itawa, Ramganjmandi and Kota markets. This indicates inter-district movements from nearby districts. From Figure 1 it can be seen that Kota and Ramganjmandi are most preferred markets throughout the study period.

From table 2 it is quite visible that coriander arrivals in the study markets especially in Kota is declining after 2012 because of decreasing production in study area. Highest arrival of 31902 tonnes in a single month was recorded in Kota market during March, 2012 followed by Ramgandmandi during May, 2010 (29226 tonnes). In last three years, Ramganjmandi is preferred over Kota as more produce is arriving in this market indicates increasing preference for this market among coriander growers since 2017 (Table 2). Ramganjmandi is also known as coriander city because it has marked several records in coriander seed arrivals. It manifested with highest single day arrivals of 4890 tonnes as well as highest average daily arrivals of 1532 tonnes during May 2010. Many spices giant like MDH and big exporters buys its raw material from Ramganjmandi, makes this market special Grade-A coriander markets of the country. During study period arrivals recorded highest growth in Kota followed by

Table 1. Area (in ha) and production (in tonnes) of coriander in study area

| Year | Baran | | Jhalawar | | Kota | | Rajasthan | |
|---------|-------|--------|----------|--------|-------|-------|-----------|--------|
| | Area | Prod. | Area | Prod. | Area | Prod. | Area | Prod. |
| 2008-09 | 90683 | 110647 | 96940 | 92187 | 49135 | 63055 | 250520 | 280310 |
| 2009-10 | 77423 | 100236 | 97940 | 107542 | 50589 | 67495 | 232140 | 281080 |
| 2010-11 | 59979 | 86179 | 85795 | 69683 | 45452 | 57307 | 187890 | 218900 |
| 2011-12 | 85432 | 115321 | 117368 | 123037 | 57744 | 83371 | 260000 | 311000 |
| 2012-13 | 45890 | 66071 | 72186 | 66872 | 36704 | 50367 | 250000 | 300000 |
| 2013-14 | 52713 | 30254 | 76130 | 50602 | 48524 | 32354 | 182730 | 117080 |
| 2014-15 | 64815 | 60824 | 106697 | 92010 | 67954 | 42023 | 249310 | 198760 |
| 2015-16 | 44953 | 63645 | 98356 | 89650 | 54890 | 58231 | 212730 | 227200 |
| 2016-17 | 39372 | 61678 | 91636 | 80099 | 39687 | 52281 | 181710 | 206960 |
| CGR (%) | -8.45 | -9.12 | -0.35 | -2.37 | 0.03 | -4.49 | -2.20 | -4.91 |

Source: Compiled from crop production statistics, Govt. Of Rajasthan

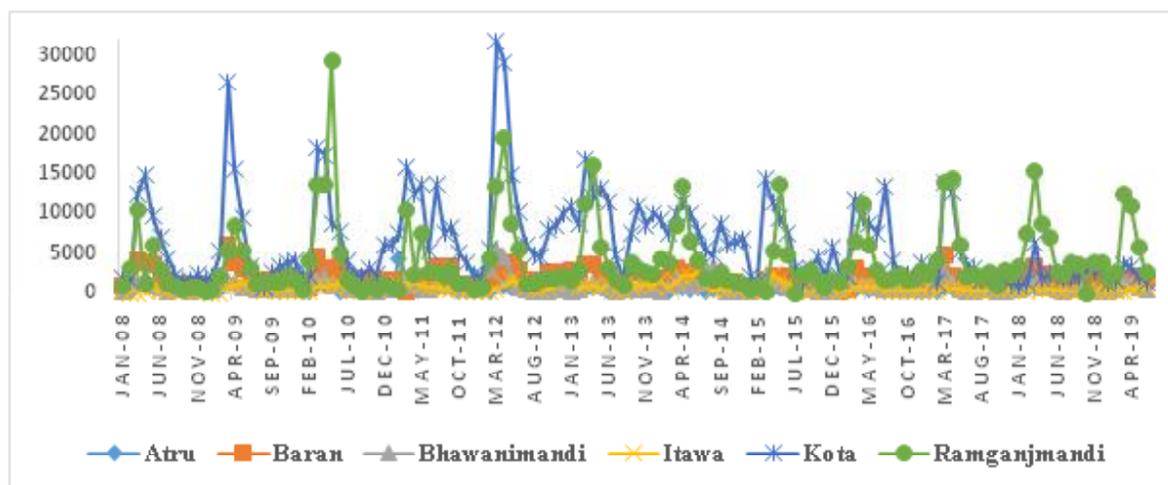


Fig. 1. Market-wise monthly arrivals of coriander seeds (in tonnes)

Ramganjmandi market. On the other hand negative growth was observed in Atru, Baran, Bhawanimandi and Itawa markets indicates diversion of produce from above markets to Kota and Ramganjmandi over the period of time. Highest year to year variation as represented by coefficient of variation was seen in Kota market. Comparatively lower degree of inter year variation was measured in Ramganjmandi market.

Seasonality in arrivals of coriander seeds

In Rajasthan, coriander for seed purpose is generally sown during second fortnight of October and harvesting starts from late February with peak in months of March. Arrivals from new season produce start from February. Figure 2

shows yearwise arrivals from 2008 to 2018. In most of the years maximum arrivals could be seen in month of March followed by April, May and June except 2010 and 2015.

Figure 3 clearly depicts the seasonality in the arrivals of coriander seeds during the study period. In this graph high degree of arrival concentration in the months of March, April and May is quite visible. The average monthly arrivals in studied markets during March, April, May and June were 5370.34, 4872.65, 3813.27 and 2313.51 tonnes respectively. The lowest arrival 1125.79 tonnes was recorded in August followed by January 1263.69 tonnes. This pattern shows low holding capacity of the coriander

Table 2. Annual arrival of coriander seeds (in tonnes)

| Year | Atru | Baran | B'mandi | R'mandi | Itawa | Kota |
|----------|----------|----------|----------|----------|----------|-----------|
| 2008 | 5583.70 | 21972.40 | 7814.60 | 28464.60 | 1773.20 | 60891.00 |
| 2009 | 7104.40 | 26970.00 | 8984.00 | 33535.20 | 5486.90 | 78753.20 |
| 2010 | 6040.00 | 23651.20 | 9336.50 | 70783.60 | 6543.90 | 76157.50 |
| 2011 | 10403.20 | 17425.40 | 9882.40 | 34073.40 | 7867.70 | 101237.90 |
| 2012 | 5300.80 | 27754.00 | 18512.20 | 61959.90 | 9080.50 | 135898.60 |
| 2013 | 4446.10 | 27132.00 | 7349.00 | 55060.60 | 9422.60 | 116672.30 |
| 2014 | 5160.20 | 21004.00 | 15723.90 | 50755.50 | 14013.20 | 94119.20 |
| 2015 | 3292.10 | 13872.50 | 8243.40 | 34211.13 | 7538.40 | 66159.30 |
| 2016 | 2939.30 | 14165.60 | 7608.10 | 43039.60 | 4718.20 | 69541.60 |
| 2017 | 3076.40 | 19875.50 | 8164.10 | 56065.40 | 4467.70 | 51756.90 |
| 2018 | 8693.20 | 22218.20 | 6713.10 | 62056.50 | 3657.30 | 30569.30 |
| 2019 | 5398.90 | 9386.80 | 4353.80 | 36301.30 | 2145.80 | 13077.70 |
| Average | 5639.95 | 21458.25 | 9848.30 | 48182.31 | 6779.05 | 80159.71 |
| CGR (%) | -0.12 | -0.18 | -0.32 | 0.40 | -0.50 | 0.43 |
| C.V. (%) | 98.68 | 58.22 | 101.41 | 88.46 | 84.95 | 110.49 |

Note: Year 2019 considered January to June arrival only. CGR and CV measure the growth and variation in annual total arrivals.

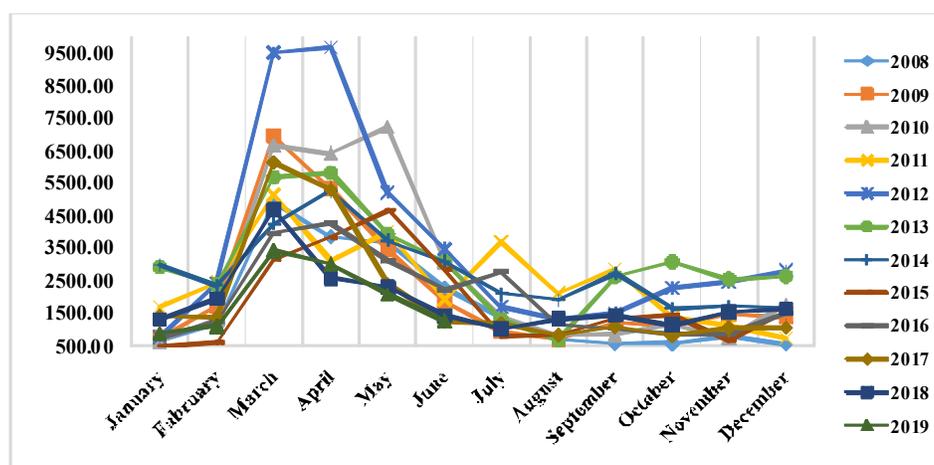


Fig. 2. Year wise monthly arrivals of coriander seeds (in tonnes)

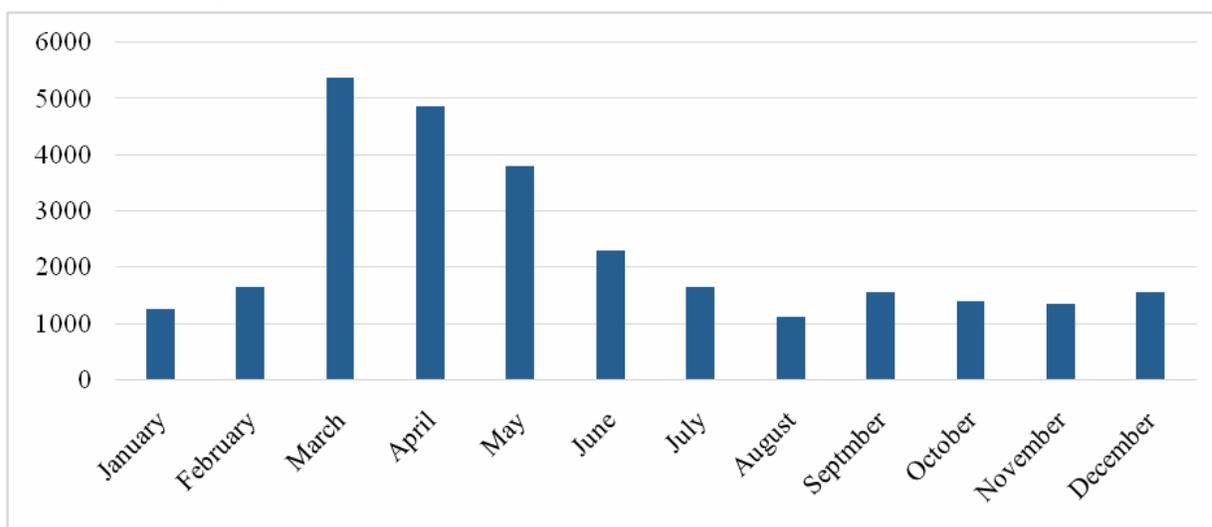


Fig. 3. Average monthly arrivals of coriander seeds (in tonnes)

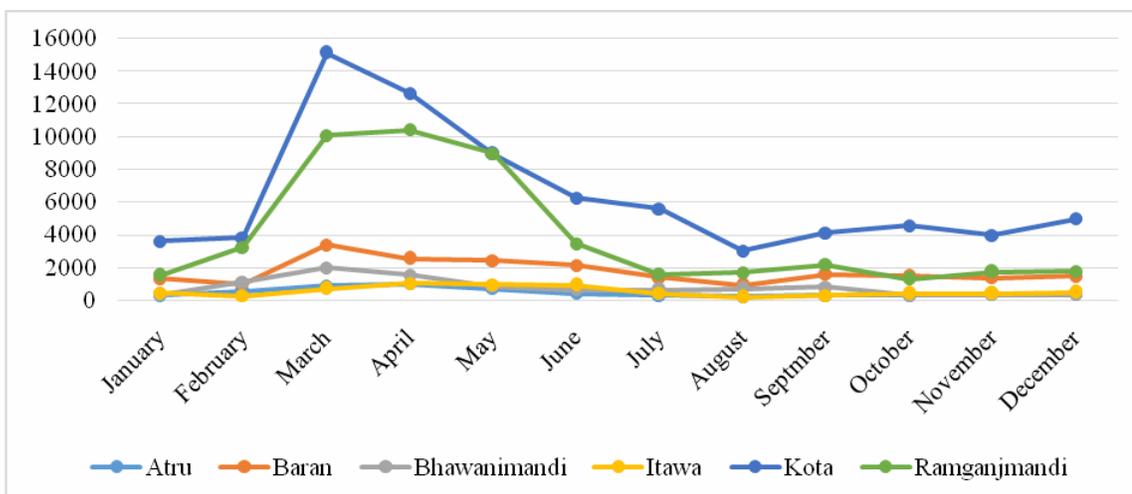


Fig. 4. Market-wise average monthly arrivals (tonnes) of coriander seeds

growers. From Figure 1 it can be seen that the height of peaks has lowered since 2013 because of decreasing production and due to storage of produce for distribution of sale over the year by the farmers.

Table 3 presents the season wise arrivals and percent share to total annual arrivals in study markets from 2008 to 2019. It reveals that on average throughout study period 53 percent of total annual arrivals comes in the market during peak season (March, April and May) followed by post peak season (18%; June, July, Aug.). Highest arrivals

in peak season may be due to distress sale by the farmers to abide with prior financial commitments or low holding capacity of the farmers. Least arrivals of 13% was seen in the months of Sept., October and November (crop season). From December to February (pre harvest season) the arrivals was comparatively higher (16%) may be because of storage constraints with farmers as they have to vacate storage structure for next crop although prices prevailed during these months was also found low. Seasonal Index (SI) was measured using most widely

Table 3. Season wise arrival economic and percent share to total annual arrivals

| Year | March, April, May | June, July, Aug. | Sept., Oct., Nov. | Dec., Jan., Feb. | Total |
|------|-------------------|------------------|-------------------|------------------|----------|
| 2008 | 12419.83 (58.91) | 4371.22 (20.73) | 1958.77 (9.29) | 2333.43 (11.07) | 21083.25 |
| 2009 | 15705.12 (58.59) | 3469.95 (12.94) | 3775.28 (14.08) | 3855.27 (14.38) | 26805.62 |
| 2010 | 20292.83 (63.25) | 5328.25 (16.61) | 2718.23 (8.47) | 3746.13 (11.68) | 32085.45 |
| 2011 | 12261.82 (40.67) | 7710.53 (25.58) | 5336.93 (17.70) | 4839.05 (16.05) | 30148.33 |
| 2012 | 24401.10 (56.64) | 6461.40 (15.00) | 6248.88 (14.50) | 5972.95 (13.86) | 43084.33 |
| 2013 | 15431.93 (42.07) | 5072.70 (13.83) | 8258.18 (22.51) | 7917.62 (21.59) | 36680.43 |
| 2014 | 13235.58 (39.55) | 7120.05 (21.28) | 6102.92 (18.24) | 7004.12 (20.93) | 33462.67 |
| 2015 | 11655.31 (52.46) | 4475.10 (20.14) | 3467.72 (15.61) | 2621.35 (11.80) | 22219.47 |
| 2016 | 11353.98 (47.97) | 6140.47 (25.94) | 2732.52 (11.54) | 3441.77 (14.54) | 23668.73 |
| 2017 | 13851.88 (57.96) | 3269.42 (13.68) | 2958.68 (12.38) | 3821.02 (15.99) | 23901.00 |
| 2018 | 9542.90 (42.76) | 3770.65 (16.90) | 4112.80 (18.43) | 4891.58 (21.92) | 22317.93 |
| 2019 | 8522.88 (72.37) | 1258.43 (10.69) | N.A. | 1996.07 (16.95) | 11777.38 |

Note: Figure in parenthesis represents percent share to total annual arrivals; NA represents data not available.

used Central Moving Average Method to assess the seasonal variation in terms of an index. It is an average that can be used to compare an actual observation relative to what it would be if there were no seasonal variations. A seasonal index of a month's arrival would indicate that month had more or less than the average monthly arrivals. During study period SI for coriander seed arrivals varied

from 32 per cent in January to 307 per cent in April in Ramganjmandi market as resulted in highest coefficient of variation in arrivals in this market. In Ramganjmandi 207 percent higher arrivals than average were recorded in the month of April whereas 68 per cent lower than average was measured in January. In Kota highest arrivals of 166 percent more than average was measured in March and

60 less than average was recorded in January month. Least difference in highest and lowest SI was measured in Baran market indicates comparatively uniform arrivals indicated by lowest CV (Table 4). From the below table it could be implied that bigger markets in term of arrivals i.e. Kota and Ramganjmandi encountered high degree of seasonality than smaller markets.

To measure variation within a year, intrayear coefficient of variation was calculated. During the study year, based on average of all study markets highest intrayear variation

was measured in year 2008 (94%) and lowest was found in year 2017 (48%). In Baran market this variation was lowest (52%) and in Ramganjmandi within year variation was highest (98%). Kota had lower intrayear variation (68.13%) compared to Bhawanimandi (77%), Itawa (68%) and Atru (72%) markets. It can be inferred that although Ramganjmandi is highest price fetching market for coriander seed (Table 6) but farmers join Kota most frequently as indicated by lower degree of intrayear coefficient of variation than Ramganjmandi market.

Table 4. Seasonal Index for coriander seed arrivals in major markets

| Month | Atru | Baran | B'mandi | Itawa | Kota | R'mandi |
|-------------------------|--------|--------|---------|--------|--------|---------|
| January | 60.39 | 72.11 | 51.87 | 73.13 | 39.82 | 32.14 |
| February | 52.46 | 61.72 | 150.29 | 38.81 | 57.53 | 83.71 |
| March | 190.80 | 210.19 | 244.70 | 161.81 | 266.37 | 242.18 |
| April | 250.56 | 145.99 | 206.05 | 177.67 | 178.97 | 307.49 |
| May | 180.09 | 141.19 | 130.16 | 179.36 | 146.54 | 177.49 |
| June | 96.48 | 120.88 | 90.45 | 187.76 | 103.98 | 89.77 |
| July | 67.22 | 70.30 | 49.80 | 79.46 | 75.43 | 45.74 |
| August | 43.47 | 47.63 | 61.96 | 34.23 | 41.23 | 41.51 |
| September | 71.82 | 79.66 | 83.95 | 53.00 | 59.55 | 58.87 |
| October | 53.87 | 88.33 | 41.33 | 67.57 | 71.32 | 34.25 |
| November | 57.09 | 77.60 | 43.91 | 64.43 | 66.48 | 40.59 |
| December | 75.76 | 84.38 | 45.54 | 82.78 | 92.79 | 46.25 |
| Maximum | 250.56 | 210.19 | 244.70 | 187.76 | 266.37 | 307.49 |
| Minimum | 43.47 | 47.63 | 41.33 | 34.23 | 39.82 | 32.14 |
| H. Index - L. Index | 207.09 | 162.56 | 203.37 | 153.53 | 226.56 | 275.36 |
| Coeff. of av. variation | 140.86 | 126.10 | 142.20 | 138.32 | 147.98 | 162.15 |

Table 5. Intrayear coefficient of variation (%) in arrivals of coriander seeds in study markets

| Year | Atru | Baran | Bhawanimandi | Itawa | Kota | Ramganjmandi |
|------|--------|-------|--------------|--------|--------|--------------|
| 2008 | 96.46 | 68.31 | 72.71 | 111.72 | 89.25 | 123.81 |
| 2009 | 63.68 | 62.55 | 56.46 | 85.22 | 109.92 | 81.70 |
| 2010 | 73.98 | 57.24 | 72.10 | 60.95 | 88.08 | 143.32 |
| 2011 | 129.28 | 66.65 | 56.02 | 59.11 | 49.82 | 103.68 |
| 2012 | 72.51 | 45.61 | 115.58 | 63.89 | 81.06 | 109.06 |
| 2013 | 61.79 | 37.76 | 64.19 | 47.02 | 38.71 | 94.26 |
| 2014 | 47.84 | 41.63 | 87.66 | 63.33 | 25.13 | 82.10 |
| 2015 | 67.58 | 52.52 | 85.86 | 108.74 | 74.25 | 127.94 |
| 2016 | 92.15 | 69.66 | 64.99 | 77.35 | 69.59 | 78.11 |
| 2017 | 85.11 | 60.32 | 102.82 | 48.50 | 97.05 | 94.19 |
| 2018 | 38.73 | 34.48 | 76.59 | 43.69 | 51.75 | 74.15 |
| 2019 | 36.31 | 25.87 | 69.09 | 45.21 | 42.94 | 68.73 |

Price analysis

Agricultural prices play a significant role in the overall farm economy of the country and thus receive considerable concern of policymakers. Understanding the time-series properties of agricultural prices is a prerequisite to analyzing risk management and forecasting problems (Tomek, 1994). During study period, coriander seed prices varied from ₹ 2203 to 9656 per quintal in studied markets. Highest average price was recorded in Ramganjmandi followed by Kota whereas lowest prices prevailed in Bhawanimandi (table 6). Figure 5 and 6 presents monthly average and annual average price of coriander seed in study period. It can be seen that prices starts falling continuously since August, 08 till June, 2010 and prevails low till end of 2010. From January, 2011 onwards, prices shows recovery and attained its highest level throughout study period to ₹ 9659 a quintal in November 2014 in Itawa and ₹ 9494 per quintal in Ramganjmandi during December, 2014 (Fig. 4). This tempo of higher prices could not sustain for longer period and started declining from 2015 to 2017 continuously (Fig. 5). Between 2015 and 2017 per quintal price of coriander seeds decreased by three to four thousand. As result per quintal price decreased to less than half to ₹ 4000 a quintal in March, 2017 and prevails low till November, 2018. Recovery in prices since October, 2018 was seen with a jump of ₹ 3000 per quintal as a results unit prices moved to more than seven

thousand a quintal by June, 2019. From figure below we can observe that there is almost six year price cycle from peak to peak in coriander seed prices in the studied markets. It can be inferred that during study period prices has almost doubled from ₹ 3500 to 7000 a quintal in twelve years period showing decreasing trend from 2008 to 2010 and increasing trend from 2010 to 2014 again decreasing trend from 2015 to 2017 and upward trend from 2018 to 2019 involving various upward and downward movements in between.

During the study period prices increased with a highest compound growth of 0.39 per cent per annum in Ramganjmandi market whereas least growth (0.28%) was measured in Itawa market. The highest growth in prices in Ramganjmandi market may be the main reason for increasing arrivals in this market during recent years. The coefficient of variation in the monthly modal prices varied from 33 to 36 per cent. Variation in modal prices was almost one third to the monthly arrivals. Intra year variation in prices was measured to compare and measure within year fluctuation in prices during study years. The average percent variation in a year was measured from 11 to 12 percent. It was highest in Ramganjmandi (12.04%) and low in Kota (11.42%) only higher than Bhawanimandi. It shows that although prices were higher in Ramganjmandi but within year variation was also high in this market represents lower stability within a year (table 7).

Table 6. Descriptive statistics of monthly prices of coriander seed (₹ Quintal⁻¹) from January 2008 to June 2019

| Particulars | Atru | Baran | B'mandi | Itawa | Kota | R'mandi |
|-------------|---------|---------|---------|---------|---------|---------|
| Mean | 5089.82 | 5113.21 | 4866.10 | 4871.57 | 5128.10 | 5242.19 |
| Minimum | 2325.00 | 2202.63 | 2232.90 | 2244.52 | 2305.96 | 2360.17 |
| Maximum | 9399.17 | 9466.20 | 8408.84 | 9656.16 | 9486.96 | 9494.96 |
| C.V. (%) | 34.06 | 36.22 | 32.69 | 36.66 | 35.03 | 35.51 |

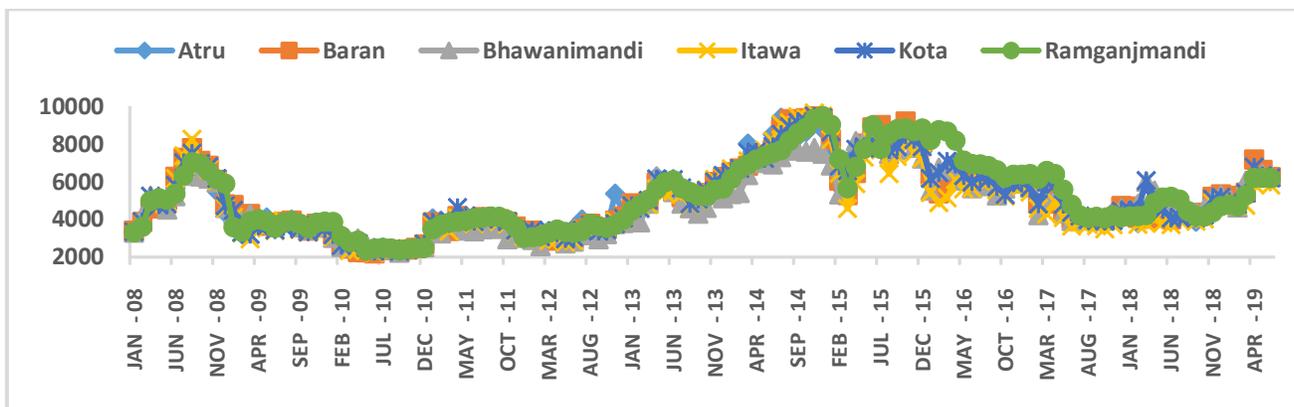


Fig. 5. Market-wise monthly average prices (₹ Quintal⁻¹) of coriander seeds

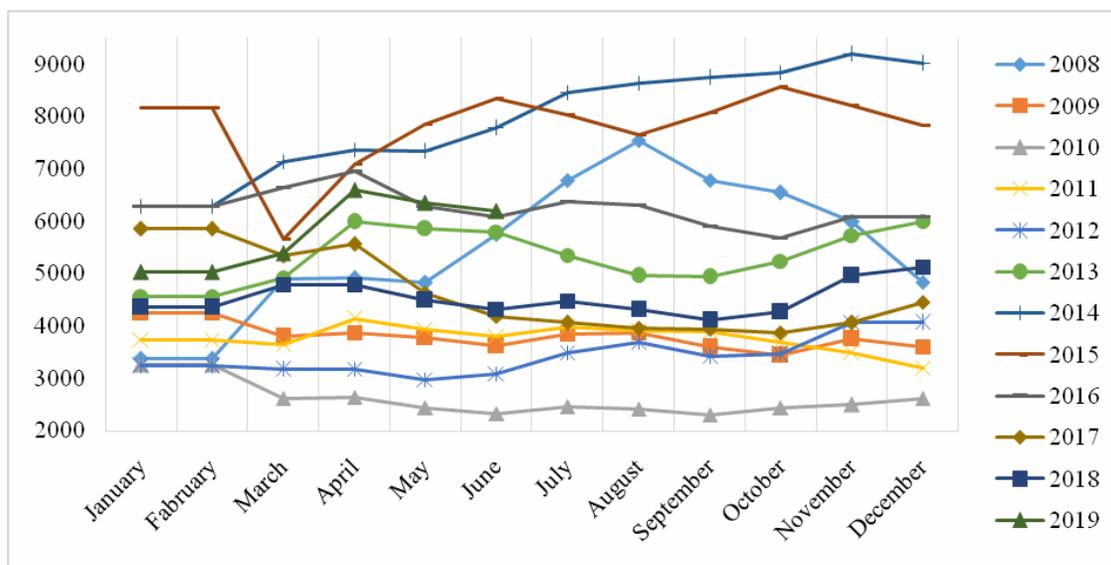


Fig. 6. Year wise monthly average prices (₹ Quintal⁻¹) of coriander seeds

Table 7. Average annual price of coriander seeds (₹ Quintal⁻¹) with intra-year coefficient of variation (%)

| Year | Atru | Baran | B'mandi | Itawa | Kota | R'mandi |
|----------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| 2008 | 5298.27 (22.75) | 5661.22 (24.18) | 5327.20 (18.97) | 5659.50 (25.00) | 5589.76 (22.79) | 5533.09 (20.78) |
| 2009 | 3846.78 (7.35) | 3895.55 (9.12) | 3841.10 (6.43) | 3545.29 (8.37) | 3602.72 (8.64) | 3761.68 (5.04) |
| 2010 | 2560.04 (8.97) | 2471.28 (10.22) | 2598.18 (8.83) | 2491.44 (8.49) | 2564.44 (9.21) | 2686.73 (15.64) |
| 2011 | 3879.31 (6.95) | 3798.26 (6.78) | 3401.82 (7.31) | 3732.68 (7.91) | 3933.15 (8.30) | 3829.98 (8.28) |
| 2012 | 3675.42 (16.83) | 3389.59 (12.24) | 3160.80 (11.82) | 3316.32 (12.19) | 3421.83 (8.79) | 3475.01 (7.62) |
| 2013 | 5355.12 (12.21) | 5409.90 (8.59) | 4931.42 (14.06) | 5326.02 (9.44) | 5519.21 (11.07) | 5402.26 (8.35) |
| 2014 | 8140.03 (11.39) | 8172.06 (14.01) | 6975.58 (11.70) | 8330.29 (13.25) | 8179.27 (12.49) | 7832.27 (13.02) |
| 2015 | 7564.39 (11.72) | 7888.38 (15.16) | 7460.60 (11.87) | 7099.28 (14.66) | 7783.25 (7.23) | 8075.24 (12.60) |
| 2016 | 6195.56 (6.35) | 6170.62 (5.00) | 6004.46 (7.84) | 5615.81 (6.56) | 6201.45 (7.45) | 7274.80 (12.15) |
| 2017 | 4607.78 (13.43) | 4533.80 (14.21) | 4411.13 (12.97) | 4149.62 (13.74) | 4663.39 (15.98) | 5065.95 (20.24) |
| 2018 | 4447.36 (9.75) | 4421.44 (9.49) | 4936.94 (9.50) | 4083.24 (9.68) | 4639.02 (12.38) | 4566.25 (8.72) |
| 2019 | 5925.64 (13.35) | 5979.55 (12.74) | 5821.83 (11.87) | 5347.09 (10.52) | 5751.36 (12.74) | 5563.89 (12.02) |
| Avg. | 5089.82 | 5113.21 | 4866.09 | 4871.57 | 5128.10 | 5242.19 |
| CGR (%) | 0.36 | 0.35 | 0.38 | 0.28 | 0.37 | 0.39 |
| C.V. (%) | 33.94 | 36.09 | 32.57 | 36.53 | 34.90 | 35.38 |

Note: CGR and CV measure the growth and variation in annual prices. Figure in parenthesis represents intra-year coefficient of variation (%)

Due to seasonality in production, consumption and expensive storage, prices of agricultural commodities follows a seasonal pattern. Agricultural commodity prices are generally lower during the harvesting season due to adequate supply and high during the end of the marketing season due to inadequate availability of the crop (Tiwari, *et al.*, 2017). This pattern normally repeats itself year after year. Monthly price data of an agricultural commodity measure the seasonal pattern in its prices. Seasonality is expressed as 12 indexes that represent the ratio of the each month price to the average annual price. Seasonal Index in coriander seed prices was measured to check the per cent change in particular month over annual average. Results in table 8 shows that during study years price ranges from 111 to 88 percent i.e. at most 11 percent above average and 12 percent below average. The highest price index was almost 111 percent in April against a low of 88 per cent in February in Bhawanimandi market. In

coriander seeds average high price index for the six studied markets was 107 percent and average low price index was 91.23 percent. On average, the difference between high and low price index among the above markets was 15 percent. In Kota where a high arrival lands, a high of 104 percent in November and a low of 92 per cent in October observed wherein Ramganjmandi a high of 106 percent in April and low of 95 percent in October was seen. In month of March when maximum produce arrived in markets the SI for price was measured less than 100 percent in Atru, Baran and Itawa markets and above than 100 in Bhawanimandi, Kota and Ramganjmandi markets. It concludes that if coriander farmers want to sale their produce in peak harvest season should move to Bhawanimandi, Kota and Ramganjmandi markets and should stay away from Baran and Itawa markets. The variation in coriander seeds prices was comparatively lower than paddy where it varied from 160 to 60 percent (Nasurudeen *et al.* 2007).

Table 8. Seasonal Index (in %) for coriander seed prices in major markets

| Month | Atru | Baran | Bhawanimandi | Itawa | Kota | Ramganjmandi |
|-----------|--------|--------|--------------|--------|--------|--------------|
| January | 99.35 | 103.42 | 96.41 | 102.89 | 103.36 | 100.58 |
| February | 88.81 | 93.03 | 87.73 | 93.18 | 92.51 | 100.88 |
| March | 95.79 | 94.62 | 106.78 | 90.51 | 103.92 | 101.18 |
| April | 104.39 | 99.67 | 110.61 | 100.00 | 103.99 | 105.67 |
| May | 100.33 | 95.59 | 101.71 | 96.51 | 99.51 | 101.14 |
| June | 99.79 | 96.35 | 96.40 | 97.16 | 96.18 | 98.88 |
| July | 106.12 | 101.61 | 102.39 | 107.68 | 102.80 | 98.51 |
| August | 100.38 | 106.12 | 103.26 | 104.01 | 103.15 | 102.94 |
| September | 99.32 | 101.65 | 93.85 | 100.19 | 97.25 | 98.79 |
| October | 96.29 | 100.17 | 93.55 | 95.92 | 91.86 | 95.46 |
| November | 106.09 | 104.53 | 104.22 | 106.96 | 104.04 | 99.80 |
| December | 103.36 | 103.24 | 103.10 | 104.99 | 101.42 | 96.20 |
| Maximum | 106.12 | 106.12 | 110.61 | 107.68 | 104.04 | 105.67 |
| Minimum | 88.81 | 93.03 | 87.73 | 90.51 | 91.86 | 95.46 |
| C.V. (%) | 17.76 | 13.14 | 23.08 | 17.32 | 12.43 | 10.15 |

From the Figure 7 it can be seen that highest prices of ₹ 5276 quintal⁻¹ prevailed in the month of November followed by April (₹ 5259 quintal⁻¹) against lowest in the month of February (₹ 4523 quintal⁻¹). Prices in the six months namely, February, March, May, June, September and October was recorded lower than average annual prices wherein other six months i.e. January, April, July, August, November and December were higher than average annual prices. The modal prices in November were found 15 per cent higher than February month. We

can observe that prices starts declining from November and remains low till February, tends to increase from March.

Trend and correlation in average annual arrivals and prices of coriander seeds

Figure 8 & 9 presents the trend in annual arrivals and prices respectively in the studied markets. Trend is the general tendency of a series to increase or decrease over a period. In order to understand the secular trend of arrivals and prices of coriander seeds the linear equations for different studied markets were estimated using OLS

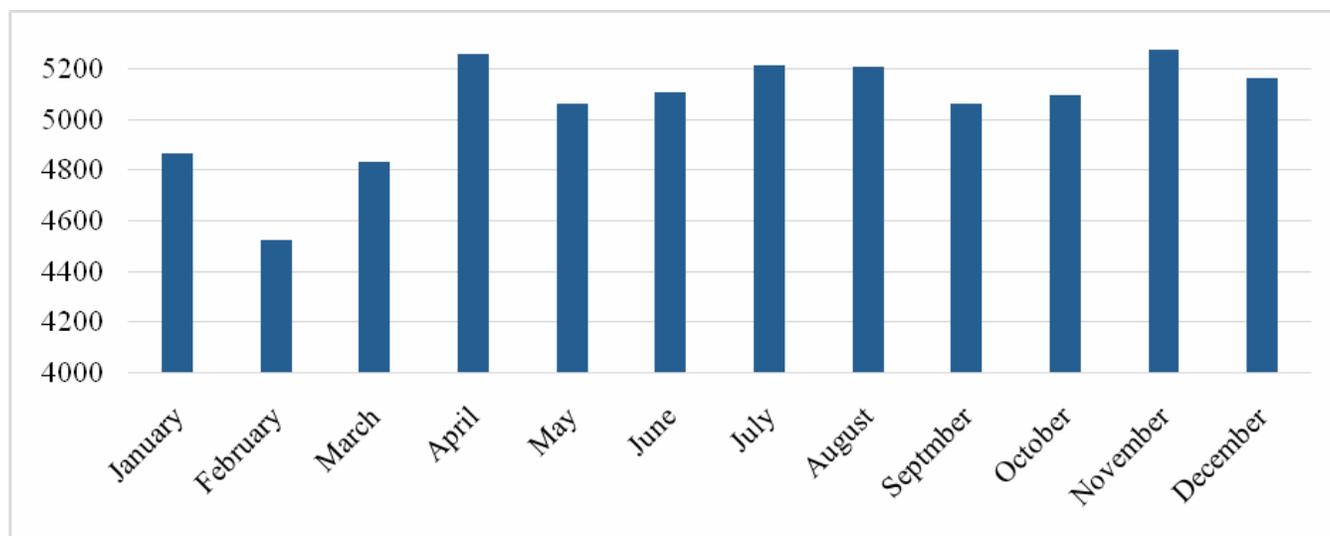


Fig. 7. Average prices (₹ Quintal⁻¹) of coriander seed throughout study years

regression for the study years. At five percent level of significance, there was significant increase in modal prices in all the studied markets over the study years (Table 9). Keeping other things constant, highest yearly increase in quintal⁻¹ price of ₹ 202 was estimated in Ramganjmandi market, followed by Bhawanimandi (₹ 196 a quintal) and Kota (₹ 185 a quintal) markets. Wherein Atru least increase in unit prices was seen. In arrivals of coriander seed, there was increasing trend in Ramganjmandi market throughout study years. Highest increase in unit prices per year may be the main reason for such increasing arrivals in Ramganjmandi over the period, surpassing the Kota (the largest among studied market) since year 2017. Rest of the markets, other than Ramganjmandi observed negative trend in arrivals over the years. Significant decrease in arrivals measuring 950 quintals per years in Baran and 5317 quintals in Kota markets was estimated.

This decrease in arrivals in spite of significant increase in annual prices was mainly due to decrease in coriander production in study area as result of shrinking area. A general trend is that the arrival in a market adversely affects the prices to a large extent. Hence, correlation coefficient was measured to examine the relationship between annual arrivals and annual prices during study period and the results of the analysis are presented in last coulomb of table 9. All other markets except Itawa showed negative correlation between arrivals and prices. Highest degree of inverse relationship was found in Baran market followed by Atru. Means these two markets are highly manipulated by commission agents and traders who refrains the farmers in getting good prices for their produce. In Kota there was least degree in negative correlation. Similar results were also found by Makama *et al.* (2016) in rice and by Verma *et al.* (2013) in cumin.

Table 9. Trend in annual price and arrivals of coriander seed and correlation between its price and arrivals

| Markets | Price trend | Arrivals trend | Correlation between price and arrivals |
|--------------|-----------------------|----------------------|--|
| Atru | 3927.52 + 84.17 *(t) | 6781.5 178.7 (t) | -0.48 |
| Baran | 3994.93 + 177.60* (t) | 26627.5 950*(t) | -0.50 |
| Bhawanimandi | 3634.31 + 195.63* (t) | 11674.9 315.5 (t) | -0.20 |
| Itawa | 4055.45 + 128.61* (t) | 7363.1 149.2 (t) | 0.34 |
| Kota | 3952.19 + 184.90* (t) | 109130.0 5317.0* (t) | -0.17 |
| Ramganjmandi | 3944.48 + 201.71* (t) | 42711.6 + 689.3 (t) | -0.38 |

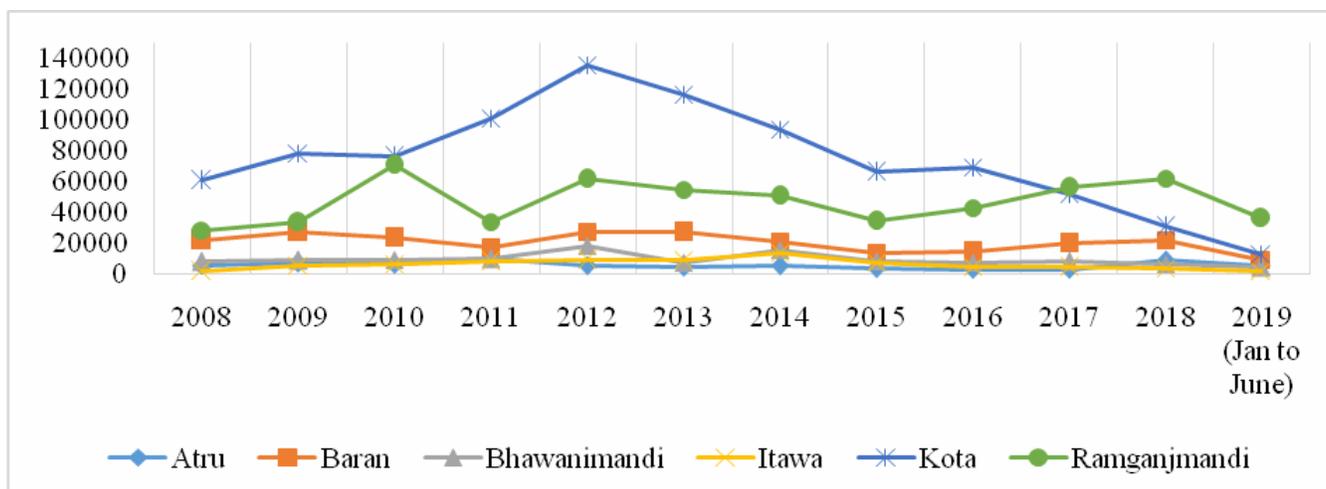


Fig. 8. Market-wise annual arrival of coriander seeds (in tonnes)

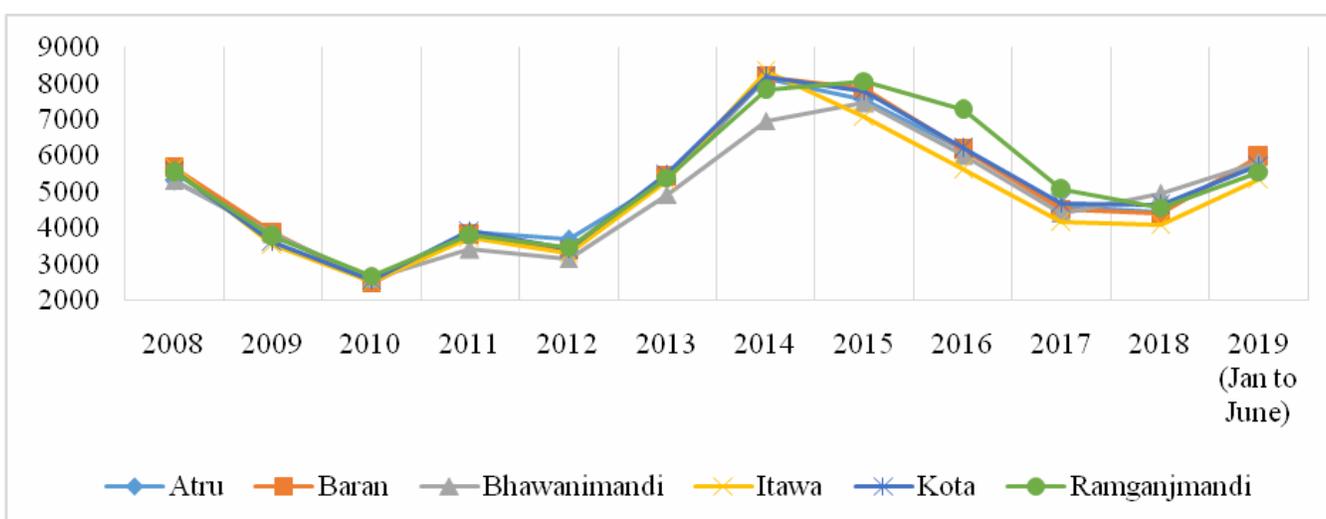


Fig. 9. Market-wise annual prices of coriander seeds (₹ quintal⁻¹)

Conclusions

From January, 2008 to June, 2019 prices of coriander seed shows various up and down movements. It increased from 2008 to 2014 later on shown decreasing trend till end of 2018 and again revived in 2019. The arrivals of this crop has increased from 126 thousand tonnes in 2008 to 258 thousand tonnes in 2012 but reduced sharply to 133 thousand tonnes in 2018. Decreasing prices coupled with various biotic and abiotic stresses leads to in area shrunk under this crop significantly results in arrivals in the study markets have decreased. There is high degree of seasonality in arrivals indicates low holding capacity of the farmers. Seasonality in prices was measured lower than arrivals. There was negative correlation between

arrivals and prices of coriander seed points out marketing inefficiencies. The revival in price during 2019 shows good sign for attracting more acreage under this crop in near future.

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