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Temporal and Spatial Production Price Behaviour of Marketed Rapeseed-mustard in Rajasthan

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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

The present study has been carried out with the objectives of examining growth performance of area and production of rapeseed-mustard along with behavioural change in price and arrivals of rapeseed-mustard in major districts of Rajasthan. The study period from 2010-11 to 2019-20 was selected for growth analysis and January, 2011 to December, 2020 selected for study of price and arrivals of rapeseed-mustard. The results shown that production of rapeseed-mustard was increased at positive rate and area at negative in Alwar and Sawai Madhopur districts. In case of Bharatpur, the area and production of rapeseed-mustard was reported positive growth rate. The instability in annual arrivals of rapeseed-mustard was recorded very high in KUMS, Alwar and

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KUMS, Dig as compared to KUMS, Nagar and KUMS, Sawai Madhopur. In case of prices, the variability in all selected Krishi Upaj Mandi Samities were record in mid-range.

Highlights:

- Highest arrivals instability was reported in Krishi Upaj Mandi Samiti, Alwar
- The production of rapeseed-mustard was showed positive growth rate in Rajasthan.

Keywords: Growth rate; price analysis; seasonal arrivals; instability.

1. INTRODUCTION

Oilseeds are principal crop in the dietary system of Indian people.Therefore, it would not be surprising to say that India is largest importer of edible oil in the world, followed by China, and Europian Union countries Bannor and Mathur [1]. The total oilseed production of India in 2018-19 was 32.25 million metric tonnes. The states Madhya Pradesh, Rajasthan and Maharashtra were contributed about 27.87, 21.47 and 14.84 per cent production of the country. [2]. Among the oil seeds producing states, Rajasthan state held second position in the economy. Rajasthan state produced 234 lakh tonnes oilseeds from 123 lakh hectare area under rapeseed-mustard (*Brassica juncea*)), soybean (*Glycine max*), groundnut (*Arachis hypogaea*), sesame (Sesamum indicum), castor (*Ricinus communis*) and tarameera (*Eruca sativa*) crops. Among these oilseeds, Rajasthan state has prime position in production of rapeseed-mustard followed by sesame and soybean Bairwa*et al.*[3]. Mustard is a rabi season cash crop in Rajasthan. It cultivated throughout the state since less requirement of irrigation and inter-culture operational activities. The rapeseed-mustard is mostly cultivated in Alwar, Dholpur, Bharatpur, Jaipur Sawai Madhopur, Sriganganagr, Jhunjhunu and Sikar districts of Rajasthan. As per balanced diet parameter for a vegetarian people, the per capita/day requirement of oils & fats is 35 gram (Shukl*et al.,* 1982). The economic advantages of mustard include; the oil and its seeds are used as a condiment in the preparing of pickles and cooking vegetables and curries; the mustard oilcake is used in cattle feed; the young leaves are famous for green vegetable termed as "*Sarson ka Saag*"; and other than thesemustard oil is having medicinal and industrial uses. However, farmers are not making extra efforts to produce mustard in the Rajasthan if the Krishi Upaj Mandi Samities are not efficient to offer economic price. The correlation method of price analysis was also criticised by Bannor[4] on the views that a high degree correlation between two or more markets does not mean that these are well integrated in the sense of competitive network of traders and spatial price difference are not exceeding to transport cost. The present study was planned to estimate the growth performance of area and production of rapeseed-mustard in major districts of Rajasthan along with behavioural change in price and arrivals of rapeseed-mustard in selected Krishi Upaj Mandi Samities of the state.

2. MATERIALS AND METHODS

The present study is solely depended on secondary time series data of the area, production, market arrivals and prices of mustard in Rajasthan. Based on availability of continuous time series data, the study period was selected from 2010-11 to 2019-20 for area and production while January, 2011 to December, 2020 (120 months) for market arrivals and prices performance of mustard in Rajasthan. Based on maximum arrivals of mustard in Krishi Upaj Mandi Samiti and availability of time series data, five major markets namely KUMS, Deeg (Bharatpur), KUMS, Nagar (Bharatpur) KUMS, Alwar and KUMS, Sawai Madhopur were selected in Rajasthan. Daily market information on arrivals and prices of mustard in selected KUMS were collected from authorized website of AGMARK and converted into month-wise arrivals and prices of the crop. This study is restricted to Alwar, Bharatpur and Sawai Madhopur districts of Rajasthan since; they are collectively contributed about 28 per cent production of the state.

2.1 Analytical Tools

The exponential growth model was used to analyse the growth rate of area, production, arrivals and prices of mustard in Rajasthan. The model is expressed as below:

$$Y = ab^t$$

Where; Y is area/production/monthly arrivals/prices,
a is constant,
b is coefficient and
t is time period

Compound Annual Growth rate is computed as

CAGR (%) = (Antilog of *b*-1) x 100

Further, this study also concentrated on seasonal behaviour of arrivals and price in selected Krishi Upaj Mandi Samities. According to multiplicative model of seasonal index, seasonal component *viz.,* trend, seasonal, cyclical and irregular.

$$P = T \times S \times C \times I$$

Where;

P price of mustard in i^{th} market, T = Trend component, S = Seasonal component, C = Cyclical component and I = Irregular component.

The growth performance of arrivals and prices of mustard in selected markets were computed as below:

$$Y = ab^t$$

Where;

Y= monthly arrivals/prices, a = constant, b = trend coefficient and t = time period

CAGR (%)= (Antilog of b-1) $\times$ 100

This study particularly focused on the seasonal component by eliminating trend, cyclical and irregular components from time series data. The seasonal price index was computed by central moving average formula as given below:

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

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

Where; CMA = Central Moving Average, P = Nominal price, n = number of periods
CMA eradicates irregular variations and emphasises systematic movements of variable series. This method replaces the observed value in the data series by the arithmetic mean of that value and a given number of the observations taken just before and after it. Consequently, the central moving average has the similar trend as the prices. The seasonal index can be computed by following formula as:

$$SI = \frac{TCSI}{TCI} = SEi = \left(\frac{Pi}{CMAi}\right) \times 100$$

SI includes seasonal variation in addition to error term (E).

3. RESULTS AND DISCUSSION

3.1 Cultivation of Mustard in Rajasthan

Mustard cultivation in Rajasthan state concentrated in all districts. However, Bharatpur, Alwar and Sawai Madhopur districts jointly contributed about 28 per cent share in the state production (Anonymous, 2019-20). Since 2010-11, the production of mustard in Alwar, Bharatpur and Sawai Madhopur districts were shown increasing trend at the growth rate of 3.89, 3.34 and 3.28 per cent per annum, respectively.

However, at the same time, area under mustard cultivation was declined in Alwar and Sawai Madhopur districts at the compound annual growth rate of -0.24 and -2.45 per cent per annum, respectively. In case of Bharatpur district, mustard cultivated area was expanded at the rate of 0.74 per cent per annum. It was confined from the results that mustard production could be increased due to varietal development and good package of practices recommended by the central research institutes and state agricultural universities according to climate and weather conditions of the state. At the same time area under mustard crop might be declined due to expansion in area of its competing crops as wheat and gram which are more economic to farmers. [5] reported similar growth pattern in area and production of cumin in Rajasthan during 1991-92 to 2018-19 period.

3.2 Arrivals Behaviour of Mustard

Based on arrivals quantity, Deeg, Nagar, Alwar and Sawai Madhopur are largest market in Rajasthan. During study period more than ¼ of the state production was contributed by these markets. It could be seen from the figure that Sawai Madhopur and Alwar markets were highly preferred markets for selling throughout the study period. It could be analyzed from the table-2 that mustard arrivals in the selected markets especially in Deeg was declined due to reduction of production in this district. In latest five years, Alwar is preferred than other markets as higher produce is arriving in this markets. It could be pointed out from the table that preference for this market among mustard growers was increasing throughout the year. On the basis of arrivals, it would not be wrong to say that Alwar is a mustard city because it has marked several

heights of mustard arrivals. Many oilseeds giant like Indian Tobacco Company, Hindustan Liver limited, and large size exporters & processors buy its raw material from Alwar, makes this market special Grade-A mustard oil markets of the nation. During this period, arrivals recorded highest growth in Alwar followed by Sawai Madhopur, Deeg and Nagar. At the same time, negative growth rate was recorded in Deeg market indicates aberration of produce from Deeg to Alwar and Sawai Madhopur. Over the year highest variation as presented by CV was pointed out in Alwar market. Relatively smaller degree of inter-year variation was found out in Deeg market. Meena *et al.* [6] reported similar behaviour of arrivals in coriander crop during 2008-2019 in Rajasthan.

3.3 Seasonality Arrivals of Mustard

Generally, mustard crop is cultivated in rabi season during second fortnight of October and after maturity harvesting starts from late February. Arrivals of new produce begin from February to May. During 2011-2020 periods, year wise arrivals of mustard were presented in figure-2. It was revealed from the figure that in most of the years larger arrivals could be pointed out from March to May since mustard harvested onward late February. It could be observed from the figure-1 that the height of peak in arrivals was reported in 2-3 months after harvesting of mustard due to lack of storage facilities with farmers. [6] reported similar price behaviour of coriander in selected markets of Rajasthan during 2008-2019.

For the present study, the year wise arrivals of mustard in selected markets were shown in table-2. It could be pointed out from the table that highest arrivals of mustard was recorded for Alwar (155243 tonnes) followed by Deeg (20975 tonnes) and Sawai Madhopur (20227 tonnes). Simultaneously, highest and significant growth rate was also found for Alwar grain mandi. To minimize the overdue burdens, mostly farmers sold their mustard produce immediate after harvesting of the crop. The arrivals of mustard could be declined due to impulsion of sale the farm produce to landlords or large traders of locality. Because farmers borrowed money from landlord or village traders whenever they have need in farm operational activities.

Monthly average arrivals of mustard over the period are presented in figure-3. It was revealed from the figure that seasonally arrivals of mustard were concentrated in the months of March, April and May is clearly visible. The average month wise arrivals in selected markets during March, April and May were 8904, 11443 and 8362 metric tonnes, respectively. Further, the lowest arrivals was 1260 tonnes in January followed by December and February 1268 and 1282 tonnes, respectively. This type of arrivals pattern reported lower holding capacity of mustard cultivators in Rajasthan.

Seasonal wise arrivals and percentage share of mustard in each year (2011-2020) was reported in table 3. It was revealed from the table that 56.4 per cent of average annual arrivals were sold in peak season i.e. March-May followed by post peak season (June-August) 19.6 per cent. During peak season, the highest arrivals of mustard might be due to lumber of loan amount, lower holding capacity or distress sale by the growers to abide with prior financial commitments. Lowest arrivals about 8 per cent was recorded in pre-harvest season (December to February). During crop season (September-November), the arrivals were relatively higher than pre-harvest period because during these months, the market prevailing price was slightly higher than the harvest season. Further, it could be compulsion for growers to vacate storage structure for produces of next season crops.

3.4 Seasonal Arrivals Indices

Seasonal index was measured using most popular 12 month central moving average method to calculate the seasonal variation in index terms. The seasonal arrival indices for all selected markets were presented in table-4. It was observed from the table that seasonal index for mustard arrivals was varied from 14.76 per cent in August to 411.89 per cent in March in Sawai Madhopur markets with highest coefficient of average seasonal arrival variation (186.16%). In Sawai Madhopur 86.16 per cent greater arrivals than average were pointed out in the month of April whereas 85.24 per cent shorter than average was arrived in August. In Alwar maximum arrivals of 175.02 per cent higher than standard was computed in April and 74.31 per cent shorter than standard was depicted in January month. The smallest variation in maximum and minimum seasonal index was measured in Nagar market indicates relatively uniform arrivals indicated by lowest coefficient variation. In terms of arrivals quantity, it could be implied from this table that larger size markets i.e. Sawai Madhopur and Alwar bumped into high extent of seasonality than smaller size markets namely Deeg and Nagar.

3.5 Price Analysis

The pricing nature of agricultural commodities is more sensitive with seasonality than industrial goods. It plays an important responsibility in the overall farm economy of the nation and thus obtains extensive concern of policy makers. The descriptive statistical measures of monthly price in these markets were depicted in Table-5. It could be analyzed from the Table that during study period, the mustard prices fluctuated from Rs. 2292/quintal to Rs. 5722/quintal in the selected markets. The maximum price was reported Deeg (5722 quintal^{-1}) followed by Alwar (5635 quintal^{-1}), Sawai Madhopur whereas minimum price was recorded for Alwar (2292 quintal^{-1}).

Fig. 6 presented year wise monthly average price of mustard in selected study period. It could be observed from the figure that every year mustard price was increased slightly March month onward, price shows recovery and attained its peak level during sowing time of the crop. However, this higher price could not sustain upto harvesting period. The recovery of prices in these markets was jumped from Rs.3615 in March to Rs. 5614 in November. Kumar et al. [7] reported similar findings in price behaviour of tomato in selected metropolitan markets of India.

During the study period price was augmented with a maximum compound annual growth rate 2.87 per cent per annum in Alwar Krishi Upaj Mandi, Alwar whereas least CAGR (2.33%) was recorded in KUMS, Nagar-Bharatpur (Table-6). During entire study period, the larger arrivals of mustard in Alwar market was influenced by maximum growth rate in mustard price in the Alwar market. The price variation in monthly modal price was computed by coefficient of variation that was varied from 13.22 to 14.62 per cent. The price instability in mustard was about one third to the monthly arrivals variation. The instability in arrivals of mustard was more than prices in selected markets of Rajasthan. It may be due to distress sale and overdue burden of farmers.

Fig. 7 represented average monthly price of mustard in Rajasthan. it can be observed from the figure that highest price of Rs. 4007 per quintal recorded in December followed by November (Rs. 3991/quintal) against least price in the month March (Rs. 3331/quintal). The price of mustard was gradually increased from March to December. Further, it was declined in month of January to March. The modal price in December was almost 16 per cent larger than March month. Therefore, it could be observed from the figure that mustard growers might be get better price during sowing season of the crop if they develop better storage facilities.

General tendency of time series data is to increase or decrease over the year or month. To understand the secular trend pattern of price, average annual price of mustard in selected markets of Rajasthan were presented in Fig. 8. It was revealed from the figure that annual prices of mustard were showing rising trend over the year during study period. During this decade, the mustard price in grain mandi, Sawai Madhopur was just doubled from Rs. 2580 per quintal in 2011 to Rs. 4554 per quintal in2020. Similar trend patterns were also recorded in grain mandi, Alwar, Nagar and Deeg.

Table1. Area and production of mustard in Studied Area (Area: Ha and Production: Tonnes)

Year	Alwar		Bharatpur		Sawai Madhopur	
	Area	**Production**	**Area**	**Production**	**Area**	**Production**
2010-11	252730	426074	202688	322089	151680	221217
2011-12	264822	339114	208018	340983	171164	165325
2012-13	245516	383065	231278	377518	181313	237691
2013-14	238293	350841	211103	307524	184269	192454
2014-15	230660	318464	196515	273312	185007	228402
2015-16	234421	340282	203222	309039	168457	157184
2016-17	229719	446945	201585	390284	162944	270576
2017-18	229013	468873	200016	384758	99497	170886
2018-19	250197	534464	218330	485598	158916	300838
2019-20	265693	492851	245203	403110	149969	280592
CAGR(%)	-0.24^{NS}	3.89**	0.74^{NS}	3.34^{NS}	-2.45^{NS}	3.28^{NS}
	(0.060)	(0.147)	(0.071)	(0.143)	(0.175)	(0.223)

Source: Author's own compilation and computation.Figures in the parentheses are standard error of Exponential Model; Note:-**Significance @5 per cent and ^{NS}Non-significance

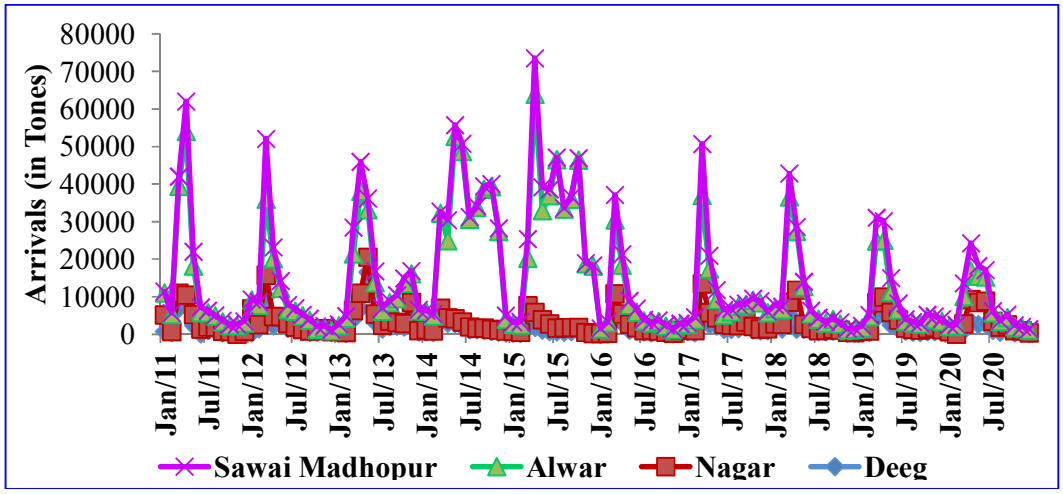

Fig. 1. Market wise monthly arrivals quantity of Mustard (in Tonnes)

Table2. Annual arrivals of Mustard (in Tonnes)

Year & Market	Deeg	Nagar	Alwar	Sawai Madhopur
2011	23006	17732	115375	18271
2012	22837	22469	65988	26134
2013	47685	18801	107155	26194
2014	19070	10974	534772	15818
2015	12526	17301	419273	26121
2016	13711	12777	57318	13315
2017	21674	20443	78445	24705
2018	15953	20122	76398	12909
2019	19047	19725	57358	20435
2020	14243	26579	40345	18367
Average	20975	18692	155243	20227
CAGR (%)	-4.37	2.26	-6.95	-1.90
CV (%)	48.29	23.93	111.59	26.23

Source: Author's own compilation and computation

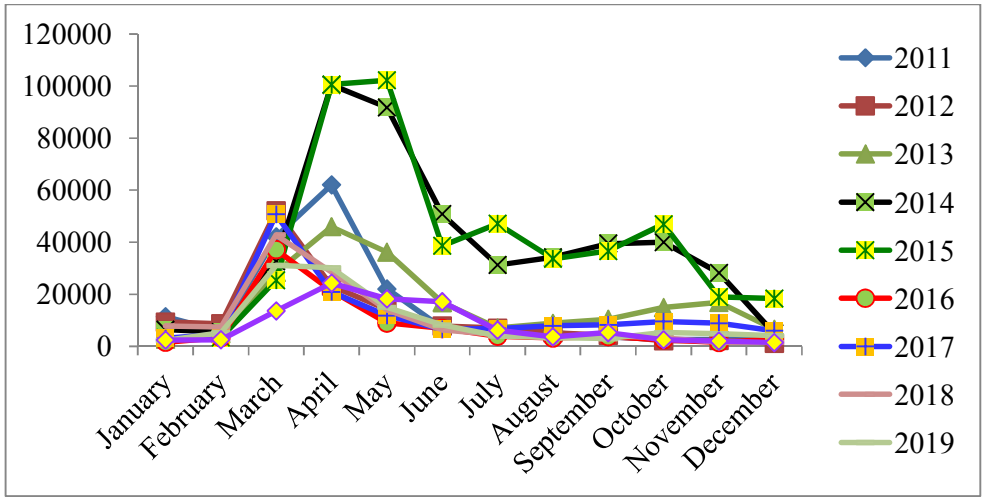

Fig. 2. Year wise Monthly Arrivals of Mustard in Rajasthan (in tonnes)

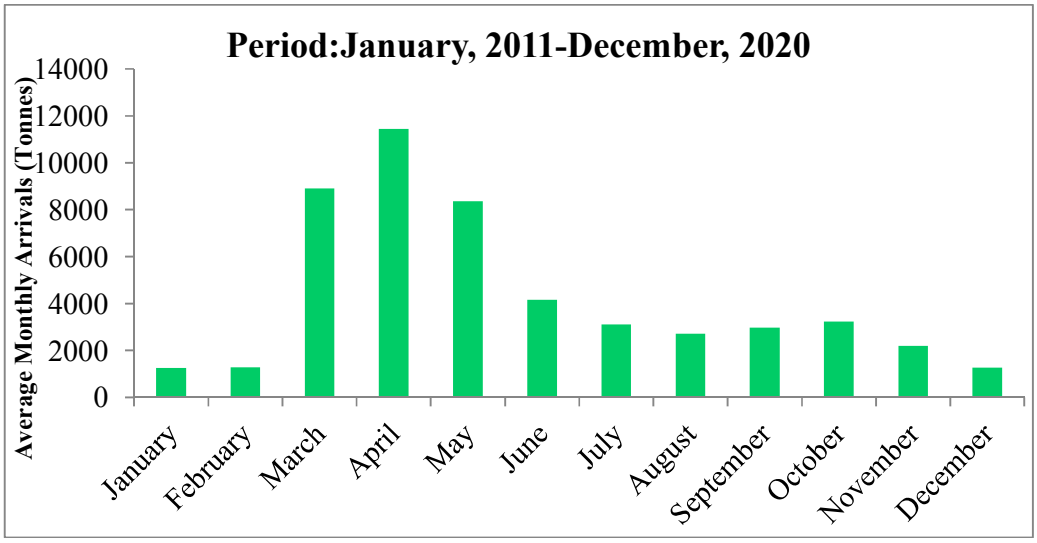

Fig. 3. Average Monthly Arrivals of Mustard (in Tonnes)

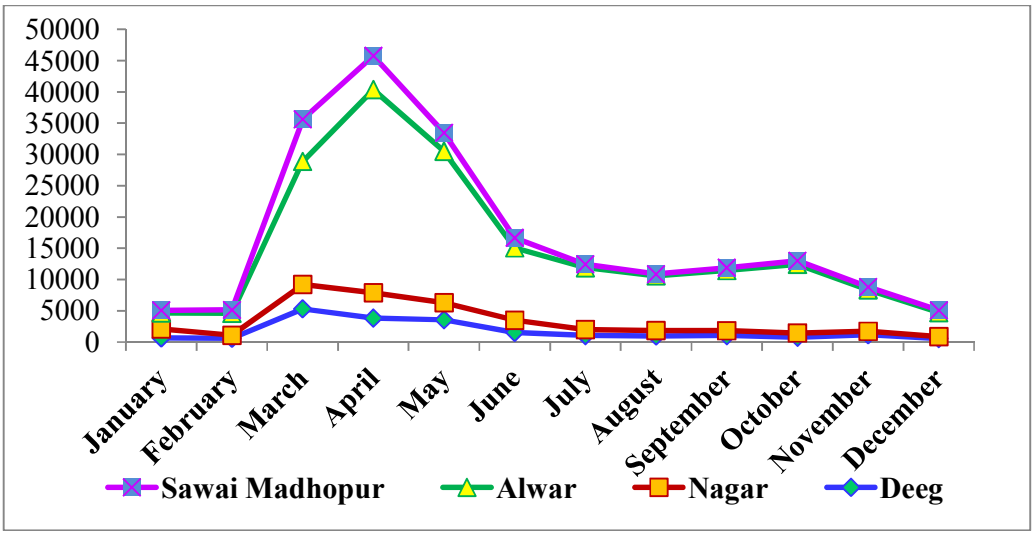

Fig. 4. Market wise Average Monthly Arrivals of Mustard (in Tonnes)

Table3. Season wise Arrivals and per cent share of Mustard (in Tonnes)

Year	March-May	June-August	Sept.-Nov.	Dec-Feb.	Total
2011	126162(72.35)	18686(10.72)	8934(5.12)	20602(11.81)	174384
2012	89562(65.17)	20053(14.59)	8624(6.28)	19187(13.96)	137426
2013	110610(55.35)	32761(16.39)	42243(21.14)	14221(7.12)	199835
2014	224876(48.27)	116289(24.96)	107805(23.14)	16865(3.62)	465835
2015	228159(48.01)	119467(25.14)	102561(21.58)	25034(5.27)	475221
2016	67492(69.49)	14020(14.44)	7752(7.98)	7859(8.09)	97123
2017	83505(57.48)	21319(14.68)	26734(18.40)	13707(9.44)	145265
2018	85495(68.19)	14154(11.29)	8931(7.12)	16800(13.40)	125380
2019	76267(65.43)	15594(13.38)	13005(11.16)	11698(10.04)	116564
2020	56199(56.46)	27037(27.16)	9843(9.89)	6456(6.49)	99535

Source: Author's own compilation and computation

Table4.Seasonal index of mustard arrivals in major markets (Jan., 2011-Dec., 2020)

Month	Deeg	Nagar	Alwar	Sawai Madhopur
January	30.87	38.79	25.69	20.75
February	26.95	25.78	62.07	34.61
March	385.89	274.53	241.05	411.89
April	194.42	272.65	275.02	339.58
May	151.47	162.61	160.28	148.14
June	93.47	147.37	83.31	90.25
July	67.58	67.93	60.03	39.25
August	58.94	51	59.33	14.76
September	60.18	45.72	62.44	21.04
October	55.07	57.09	92.55	36.12
November	37.1	29.17	45.98	24.6
December	38.07	27.38	32.25	19.02
CV	103.39	92.54	81.81	135.23
Minimum	26.95	25.78	25.69	14.76
Maximum	385.89	274.53	275.02	411.89
Coeff. of Average seasonal arrival variation	173.89	165.66	165.83	186.16

Source: Author's own compilation and computation

Table5. Descriptive Statistics of Monthly Prices of Mustard (Period: January, 2011-December, 2020)(Rs/Quintal)

Particulars	Deeg	Nagar	Alwar	Sawai Madhopur
Mean	3724.5	3676.9	3680.8	3612.5
Minimum	2401.0	2364.0	2292.0	2349.0
Maximum	5722.0	5510.0	5635.0	5594.0
CV	16.1	15.4	16.3	16.2

Source: Author's own compilation and computation

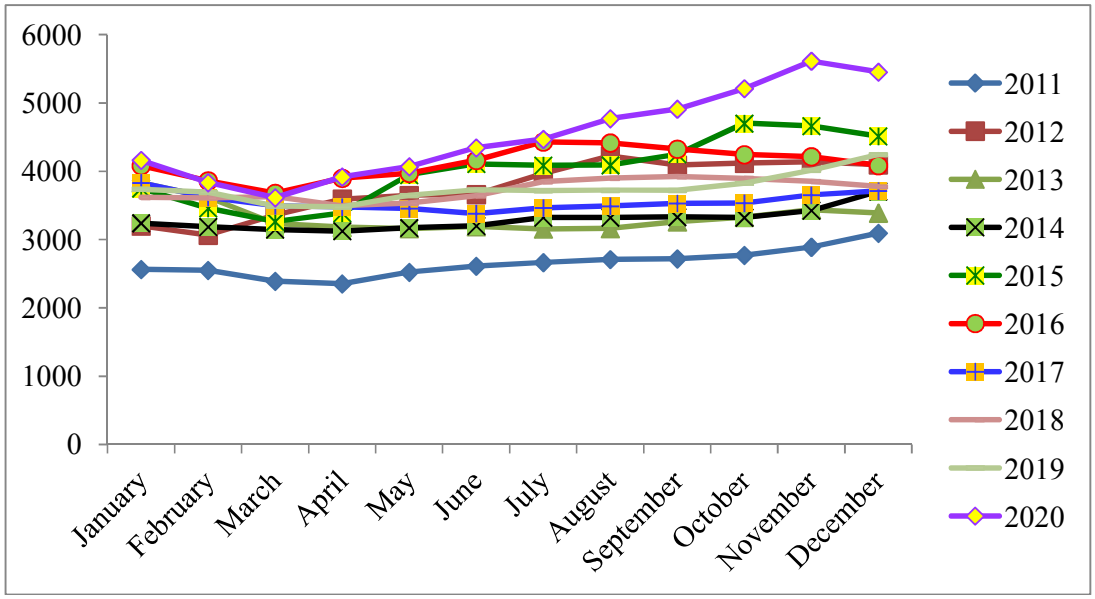

Fig. 6. Year wise Monthly Average Prices of Mustard (Rs/Quintal)

Table6. Market wise Average Annual Prices of Mustard (Rs/Quintal)

Year/Market	Deeg	Nagar	Alwar	Sawai Madhopur
2011	2714	2707	2616	2580
2012	3843	3796	3741	3672
2013	3365	3389	3283	3281
2014	3323	3289	3307	3249
2015	4024	4000	4065	3987
2016	4186	4166	4129	3978
2017	3615	3606	3543	3453
2018	3759	3711	3786	3652
2019	3805	3663	3824	3718
2020	4611	4444	4516	4554
Mean	3724	3677	3681	3612
CAGR (%)	2.60	2.33	2.81	2.77
CV (%)	13.96	13.22	14.41	14.62

Source: Author's own compilation and computation

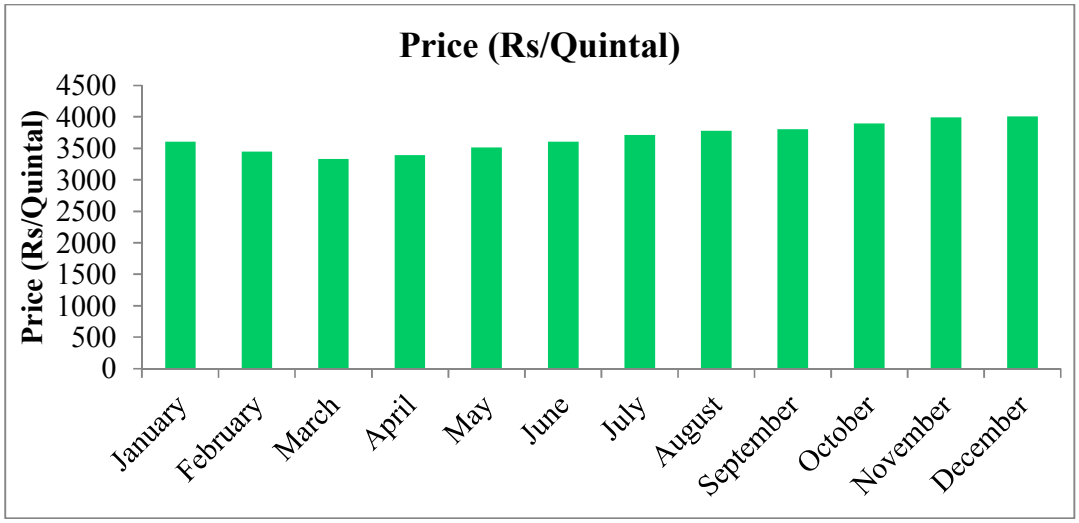

Fig. 7. Monthly Average Prices of Mustard (Rs/Quintal)

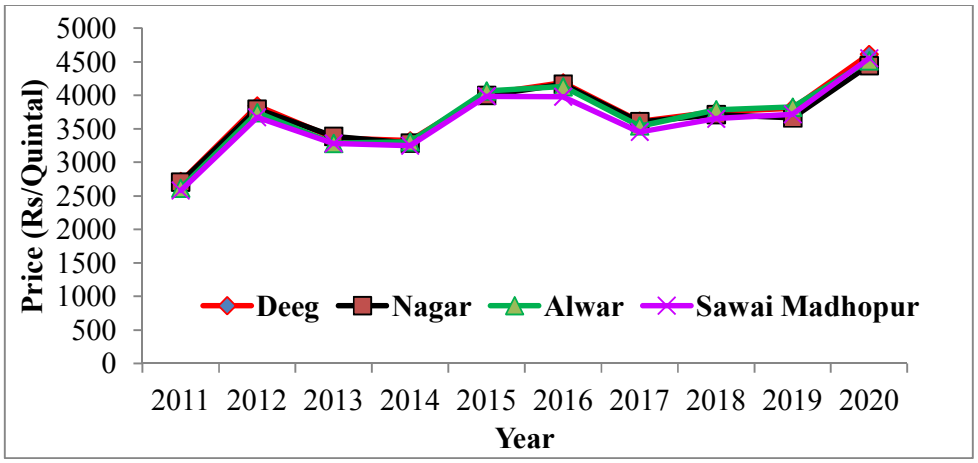

Fig. 8. Market wise Average Annual Prices of Mustard (Rs/Quintal)

4. CONCLUSION

It could be concluded from the above analysis that during study period (2010-11 to 2019-20) mustard production was augmented in Alwar, Bharatput and Sawai Madhopur districts wherein area in the meantime was declined in Alwar and Sawai Madhour districts of Rajasthan. It mean mustard production was mounted up might be due to favourable change in productivity and varietal development of mustard. During January, 2011 to December, 2020, the rapeseed-mustard price showed mixed up trend pattern in Rajasthan. it could be seen from the arrivals that larger size markets *viz.,* KUMS, Sawai Madhopur and KUMS, Alwar bumped into high extent of seasonality than smaller size KUMS, Deeg and KUMS, Nagar. The loan amount sanctioned in easy and adequate amount could reduce the dependency on landlord and village traders for money. Rural godown and warehouses provide loan upto 75 per cent of farmer's produce value. Therefore, rural godown and warehouses facilities should be available in the study area.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the institutes rather it was funded by personal efforts of the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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