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Statistical Analysis of Price Behaviour of Pearl Millet in Rajasthan

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Abstract: A study was undertaken by collecting monthly wholesale prices of pearl millet in Rajasthan to assess trends in the price behavior. This study was based on the secondary data on prices and arrivals of pearl millet in selected Agricultural Produce Market Committees (APMCs), of Rajasthan for the period of 11 years i.e., from 2010-11 up to 2020-21. The analysis revealed that there were irregular fluctuation but an overall increasing trend in the prices of pearl millet was recorded in the all selected *mandies*. Yearly trend in price of pearl millet in all selected *mandies*, showed no visible cyclical movement. It was evident from the results that the irregular fluctuations did not exhibit any definite periodicity in their recurrence. There was similarity in seasonality of prices in Alwar and Barmer *mandies* but the difference and variation in prices of pearl millet over months were much more in Jaipur mandi. It was observed that pearl millet arrival pattern was almost similar in all selected *mandies* which was higher just after harvesting and lower there-after. Looking to IPR and ASPV, there was much variability in prices in Barmer *mandi* while coefficient of variation was highest in Jaipur *mandi*.

Key words: Prices and arrivals, seasonal, trend, cyclical, irregular, IPR, ASPV.

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Agriculture plays a very important role in economy and is thus considered to be the backbone of economic system especially in developing countries as large population in these countries depends on agriculture directly or indirectly (like processing, marketing, and distribution). It also provides the employment opportunities to huge percentage of the inhabitants. Agriculture plays a vital role in India's economy also. 54.6% of the total workforce in India is engaged in agriculture and allied sector activities (Anonymous, 2011). The share of agriculture in GDP has increased to 19.9% in 2020-21 from 17.8% in 2019-20. According to the estimate, the share of the agriculture and allied sector in total GVA has improved to 20.2% in 2020-21 and 18.8% in 2021-22 (Anonymous, 2021a).

Total cereals production during 2020-21 was estimated at 279.87 mt which was 5.39 mt higher than the average production of last five years (274.48 mt). Production of coarse

cereals was also 3.4 mt higher in 2020-21 than their production of 47.75 mt during 2019-20 (Anonymous, 2021b).

Agricultural marketing plays a significant role in the movement of commodities from the producer to the consumer and in stabilizing the prices. Agricultural marketing plays an important role not only in stimulating production and consumption, but also in accelerating the pace of economic development. In general, prices for agricultural products are highly unstable compared to non-agricultural products. This price instability is directly linked to the biological nature of agricultural production. Agriculture in our country is a monsoon dependent biological industry, thus uncertainty in supply side is natural and consequently fluctuations in prices. The wide fluctuation affect the farmer's capacity of making sustained efforts for increasing production which is often considered as the greatest obstacle in the way of agricultural development (Benke, 2016).

Price fluctuations adversely affect the earnings of farmers and have a dominant impact on farmers' decision making, their resource allocation behavior and status of their welfare (Adegeye and Dittoh, 1985; Abdissa and Dereje, 2001; Grega, 2002). The high instability of agricultural prices resulting from these factors could generate risks and uncertainties in the activity, blocking a more suitable allocation of resources. This proposition justifies the interventions in agricultural markets to stabilize prices, benefiting both the sector and the rest of society. The seasonal nature of agricultural production itself leads to price fluctuations. Seasonal variations also influence monthly price changes, as some crops can only be harvested once or twice a year, and for some of them, the possibility of storage is also impractical. Hence price fluctuation in agricultural commodities is a common phenomenon due to their seasonal nature of production, wide ecological imbalances compared to other crops and seasonal demand for agricultural commodities (Thakare *et al.*, 2017). Hence, looking to the above facts the present study was carried out to study the price behavior of pearl millet in Rajasthan.

Materials and Methods

The study was purposively confined to the state of Rajasthan. Secondary data in respect of arrivals in different markets and monthly prices of pearl millet for the period of eleven years from 2010-11 to 2020-21 were collected from Directorate of Economics and Statistics, Government of Rajasthan, Jaipur and Mandi offices of selected *mandies* and AGMARKNET (https://agmarknet.gov.in) to study the relationship between prices and arrivals.

Pearl millet was selected for this study as its area and production is maximum in Rajasthan. *Mandies* of Alwar and Barmer were selected on the basis of rank in production of pearl millet in Rajasthan and of Jaipur was selected as it houses biggest grain *mandies* and thus could be useful for the comparative purpose.

Analysis of price behavior of pearl millet

Decomposition of prices was done to study the variations in monthly prices of pearl millet for the period of eleven years. A time series is a complex mixture of four components namely, Trend (T), Cyclical (C), Irregular (I) and Seasonal (S) variations. These four types of movements are frequently found either separately or in combination in a time series. The relationship among these components is assumed to be additive or multiplicative, but the multiplicative model is the most commonly used method in economic analysis, which was used for the study and it can be presented as under (Acharya and Agarwal, 1992):

$P_t = T_t \times C_t \times S_t \times I_t$ (in monthly price series)

$P_t = T_t \times C_t \times I_t$ (in yearly price series)

where, P_t = time series data on prices of selected agricultural commodities (Rs./qt.); S_t = seasonal fluctuation at time t; T_t = trend value at time t; C_t = cyclic fluctuation at time t; I_t = irregular fluctuation at time t.

Analysis of trend in prices

Over a long period of time, time series is very likely to show a tendency to increase or decrease over time. The factors responsible for such changes in time series are mainly the growth of population, change in the taste of people, technological advances in the field, etc.

Analysis of linear component: For examining the trend in prices, linear function was estimated by using the Ordinary Least Squares (OLS) method.

Linear function: $P_t = \alpha + \beta T_t + U_t$

where, P_t= Index number of prices of selected agricultural commodity in t^{th} year; T_t = Serial number assigned to the t^{th} year; U_t = Random disturbance term with usual OLS assumptions; α, β and are regression coefficients to be estimated.

Analysis of cyclical component: Cyclical movements are fluctuations which differ from periodic movements. Cyclical movements have longer duration than a year and are periodicity of several years as in business cycles. The cyclical component under multiplicative hypothesis in the yearly price series was worked out by Symbolically:

$$\frac{P_t}{\hat{P}_t} \times 100 = \frac{T_t \times C_t \times I_t}{T_t} \times 100 = (C_t \times I_t)\, 100$$

where, P_t = Original price or index number of price; $\hat{P}_t$ = estimated trend value and T_t, C_t and I_t are trend, cyclical and irregular components.

Analysis of irregular component: Here the effects could be completely unpredictable, changing in a random manner. A given observation is affected by episodic and accidental factors. The irregular component in an annual series of prices does not have a definite pattern. It was estimated as residual component by using the estimates of trend and cyclical components.

The index of irregular component can be computed by the following:

$$I_t = \frac{C_t \times I_t}{C_t} \times 100$$

Analysis of seasonal component: For Seasonal analysis ratio to moving average method is used to substantiate the objective. The logical reasoning behind this method follows from the fact that 12 months moving average can be considered to represent the influence of cycle and trend C×T.

Intra-year price variation: The following approaches will be used to precisely measure the intra-year price variation.

Intra year price rise: The difference between the lowest and highest price within a year was measured by calculating the following per cent coefficient:

$$IPR = \frac{HSPI - LSPI}{LSPI} \times 100$$

where, IPR = Intra-year price rise (expressed in per cent terms); HSPI = Highest seasonal price index; LSPI = Lowest seasonal price index

Since this measure is affected by the lowest coefficient, another measure called the coefficient of average seasonal price variation (ASPV) will also be computed.

Average seasonal price variation: The average seasonal price variation (ASPV) will be calculated as

$$ASPV = \frac{HSPI - LSPI}{(HSPI+LSPI)/2} \times 100$$

Results and Discussion

Trend, Cyclical and irregular components in yearly prices of pearl millet

The estimates of linear trend in wholesale prices of pearl millet for the selected *mandies* of the Rajasthan have been presented in the Table 1, which indicates that the regression coefficient β associated with the time element (T) was positive and highly significant at 1% level for all the three selected *mandies*. Results revealed that there was an increasing trend in the prices of pearl millet in the Jaipur mandi, Alwar *mandi and* Barmer mandi. The value of regression coefficient for time was estimated to be the highest for Barmer *mandi* (6.76) followed by Jaipur *mandi* (5.89) and Alwar *mandi* (6.29). The estimates of the coefficient of determination (R^2), as a measure the goodness of fit of the regression line, indicated that the time element alone explained 57.00% to 70.00% variation in the wholesale prices of pearl millet in the selected *mandies* during the study period. Similar trends were recorded by Verma (2017) for coriander in Rajasthan.

Yearly price of pearl millet in Jaipur *mandi* exhibited two cycles, which consisted of 3 years (2011-12 to 2014-15 and 2014-15 to 2017-18)

Table 1. Estimates of linear trend equations for yearly prices of pearl millet in selected mandies of Rajasthan during 2010-11 to 2020-21

Mandies	Intercept (α)	Slope Coefficient (β)	Coefficient of determination (R^2)
Jaipur	125.42	6.29**	0.70
Alwar	126.10	5.89**	0.57
Barmer	128.66	6.76**	0.67

Note - ** denotes significant at 1% level of significance

Table 2. Components of time series in yearly prices of pearl millet in Jaipur mandi during 2010-11 to 2020-21

Year	Components of time series		
	Trend	Cyclical	Irregular
2010-11	94.00	-	-
2011-12	100.28	96.93	93.09
2012-13	106.57	107.70	108.57
2013-14	112.85	106.65	100.05
2014-15	119.14	100.97	95.34
2015-16	125.42	101.84	102.78
2016-17	131.71	97.78	104.06
2017-18	137.99	93.90	88.34
2018-19	144.28	102.65	105.17
2019-20	150.56	105.30	106.11
2020-21	156.85	-	-

Table 3. Components of time series in yearly prices of pearl millet in Alwar mandi during 2010-11 to 2020-21

Year	Components of time series		
	Trend	Cyclical	Irregular
2010-11	96.63	-	-
2011-12	102.52	95.01	93.78
2012-13	108.41	106.82	108.07
2013-14	114.31	106.35	100.89
2014-15	120.20	101.95	93.53
2015-16	126.10	104.63	104.94
2016-17	131.99	100.40	103.17
2017-18	137.88	96.39	87.82
2018-19	143.78	105.76	106.55
2019-20	149.67	105.05	107.58
2020-21	155.57	-	-

which was not clearly cyclical (Table 2; Fig. 1). Similar cyclical movement was observed in Alwar *mandi* as well as in Barmer *mandi* (Tables 3 & 4; Fig. 2 & 3). It is evident from the results that the irregular fluctuations did not exhibit any definite periodicity in their recurrence. Satheesh *et al.* (2012) also reported high irregular variations of cardamom prices during the period from 1995 to 2012.

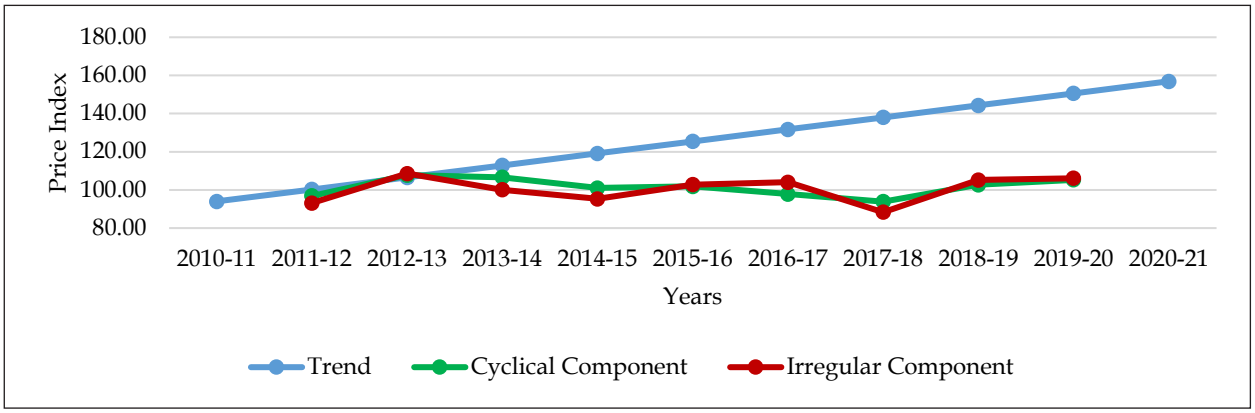

Fig. 1. Components of time series in prices of pearl millet in Jaipur mandi.

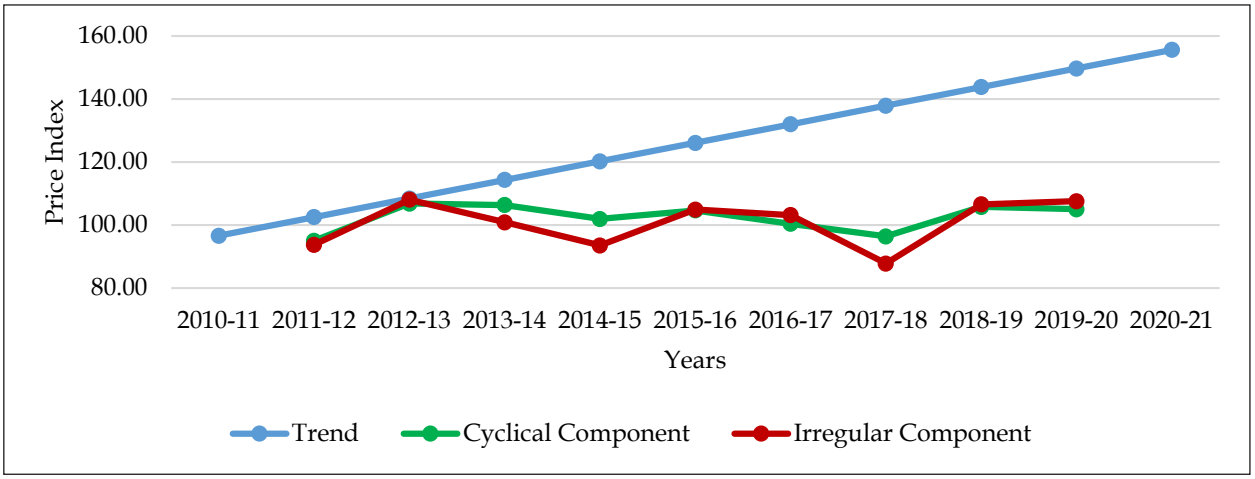

Fig. 2. Components of time series in prices of pearl millet in Alwar mandi

Table 4. Components of time series in yearly prices of pearl millet in Barmer mandi during 2010-11 to 2020-21

Year	Components of time series		
	Trend	Cyclical	Irregular
2010-11	94.85	-	-
2011-12	101.61	95.94	93.38
2012-13	108.37	103.95	107.48
2013-14	115.14	102.71	100.05
2014-15	121.90	99.92	93.66
2015-16	128.66	103.60	105.94
2016-17	135.42	100.61	100.71
2017-18	142.19	98.57	91.34
2018-19	148.95	107.19	105.32
2019-20	155.71	105.04	107.52
2020-21	162.48	-	-

Seasonal indices in monthly prices and arrivals of pearl millet

The estimated results of seasonal indices of monthly prices of pearl millet are presented in tables 5 & 6 and Fig. 4, 5 & 6. The results clearly indicate the existence of seasonality in prices of pearl millet in the Jaipur *mandi*. The tables also shows that pearl millet price indices in Jaipur *mandi* were the lowest (94.86) for month of September and highest for the month of August (105.58). Pearl millet price indices in Alwar *mandi* continued to increase from 94.98 in the month of September (lowest seasonal price index) to the month August (102.38) which was the highest seasonal price index of pearl millet in Alwar *mandi*. In Barmer *mandi*, the price fluctuations varied from 92.91 (October) to 105.29 (July) during the study period.

Table 5. Seasonal indices of monthly prices of pearl millet in the selected mandies of Rajasthan during 2010-11 to 2020-21

Months	Jaipur	Alwar	Barmer
January	99.78	101.29	100.34
February	99.56	100.71	99.15
March	103.57	101.45	101.66
April	101.76	102.23	101.09
May	102.23	102.07	101.61
June	99.09	98.84	103.50
July	97.52	100.24	105.29
August	105.58	102.38	104.31
September	94.86	94.98	92.91
October	96.27	95.15	91.82
November	98.71	99.32	97.46
December	101.08	101.35	100.85
Total	1200	1200	1200

Table 6. Seasonal indices of monthly arrivals of pearl millet in the selected mandies of Rajasthan (2010-11 to 2020-21)

Months	Jaipur	Alwar	Barmer
January	76.33	51.77	128.70
February	65.87	39.19	87.39
March	63.80	28.20	85.54
April	29.78	23.37	69.33
May	27.13	16.76	32.50
June	17.06	10.11	8.17
July	18.20	10.24	13.06
August	21.88	9.09	24.31
September	112.23	180.90	39.12
October	431.76	508.91	354.07
November	213.22	214.54	203.30
December	122.74	106.92	154.59
Total	1200	1200	1200

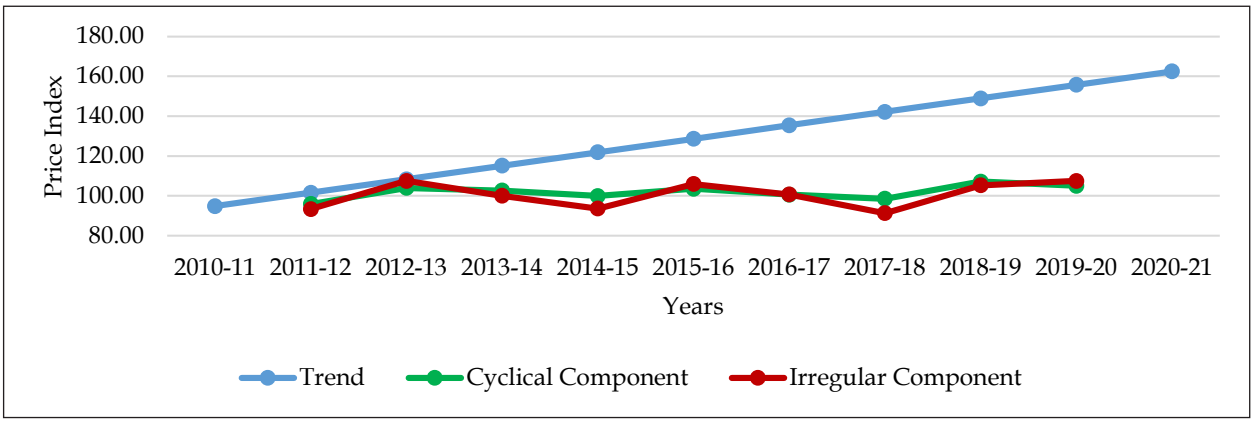

Fig. 3. Components of time series in prices of pearl millet in Barmer mandi.

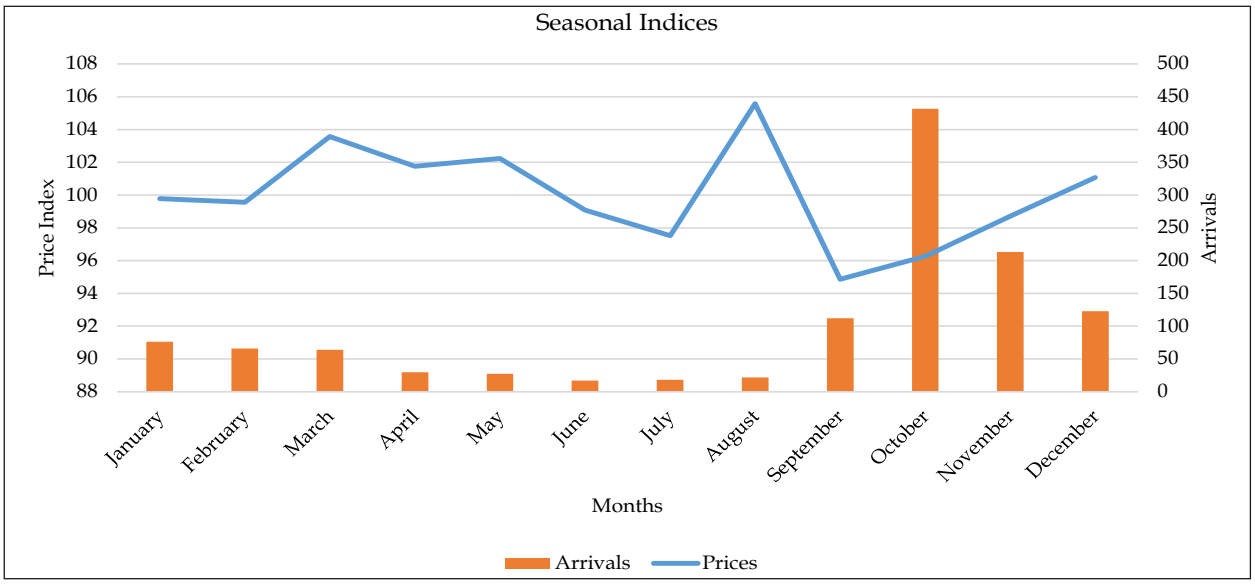

Fig. 4. Seasonal indices of monthly prices and arrivals of pearl millet in Jaipur mandi in Rajasthan during 2010-11 to 2020-21.

The results indicated that the pearl millet arrival indices in Jaipur and Barmer *mandies* were lowest for month of June and in August the *Mandies* of Alwar. In all *mandies* the arrivals peaked in October.

Extent of seasonal price variation in selected mandies of pearl millet in Rajasthan

The extent of seasonal price variation was determined by using different measures of intra year price variations. The three methods used to measure intra year price variations were the intra-year price rise (IPR), coefficient of average seasonal price variation (ASPV) and the coefficient of variation (CV).

The results of intra year price rise (Table 7) revealed that the extent of intra year price rise (IPR) varied from as low as 7.79% in Alwar *mandi* to as high as 14.66% in Bamer *mandi*. The extent of average seasonal price variation (ASPV) varied from as low as 1.87% in Alwar *mandi* to as high as 3.42% in Bamer *mandi*. The results of coefficient of average seasonal price variation were in tune with that of the coefficient of variation (C.V.). The coefficient of

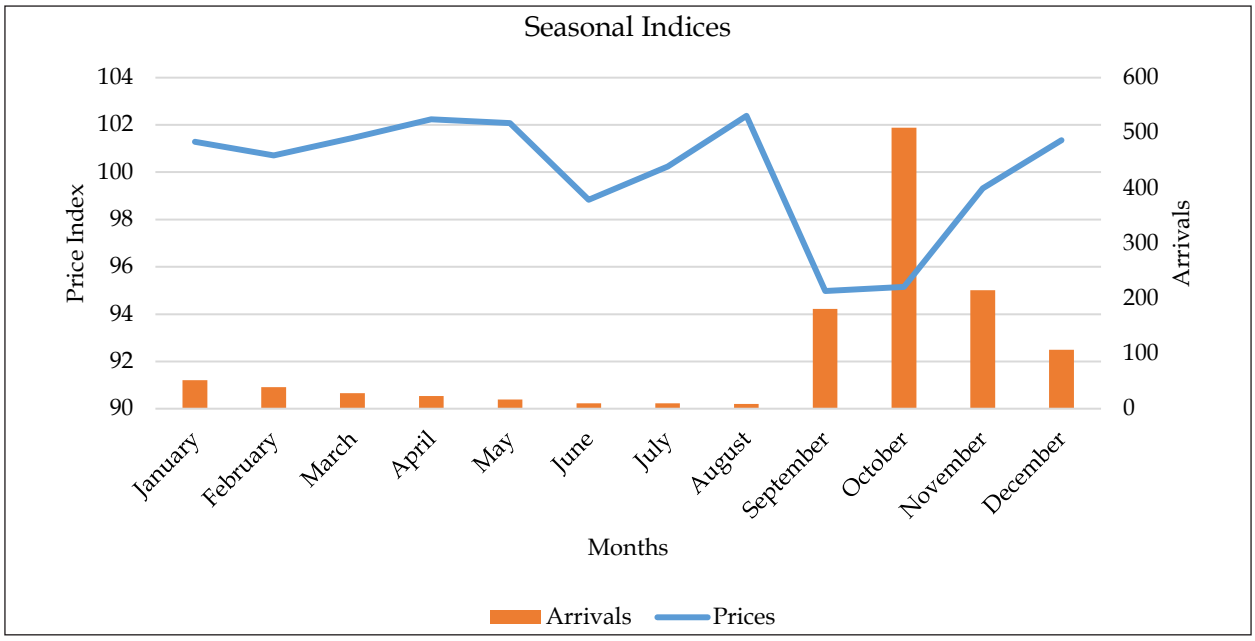

Fig. 5. Seasonal indices of monthly prices and arrivals of pearl millet in Alwar mandi in Rajasthan during 2010-11 to 2020-21.

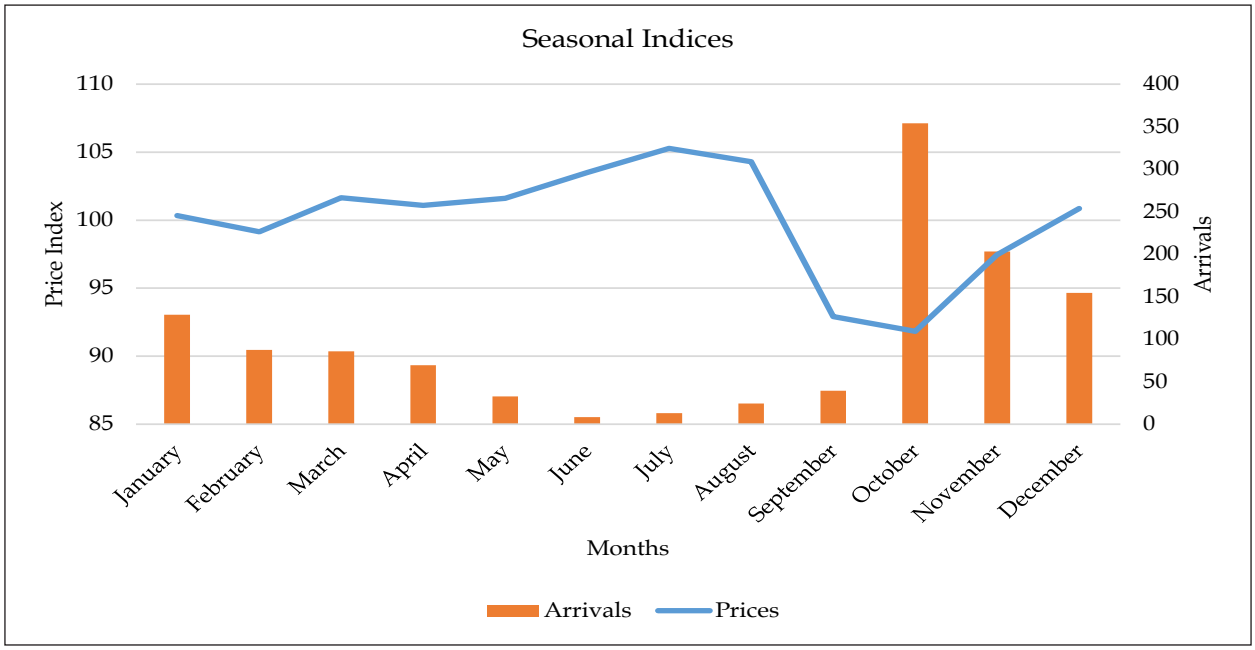

Fig. 6. Seasonal indices of monthly prices and arrivals of pearl millet in Barmer mandi in Rajasthan during 2010-11 to 2020-21.

Table 7. Intra year price rise in pearl millet in selected mandies of Rajasthan during 2010-11 to 2020-21

Mandies	Lowest Seasonal Price Index		Highest Seasonal Price Index		Magnitude of Variation (%)		
	Months	Seasonal Index	Months	Seasonal Index	IPR	ASPV	C.V.
Jaipur	Sep	94.86	Aug	105.58	11.31	2.68	2.74
Alwar	Sep	94.98	Aug	102.38	7.79	1.87	2.23
Barmer	Oct	91.82	Jul	105.29	14.66	3.42	2.41

IPR = Intra Year Price Rise; ASPV = Average Seasonal Price Variation; C.V. = Coefficient of Variation

variation for all the selected *mandies* including the state ranged from 2.23% to 2.74%. Looking to IPR and ASPV, there was much variability in prices in Barmer *mandi* while coefficient of variation was highest in Jaipur *mandi*.

Conclusion

The estimates of linear trend in wholesale prices of pearl millet of the Rajasthan indicated that the regression coefficient β associated with the time element (T) was positive and showed increasing trend during the study period. Yearly price of pearl millet in Jaipur, Alwar and Barmer *mandies* exhibited two somewhat cyclical trend, for the years (2011-12 to 2014-15 and 2014-15 to 2017-18). The irregular fluctuations did not exhibit any definite periodicity in their recurrence in most of the crops. Pearl millet price indices in selected *mandies* were higher in the months from June to August whereas, lower during the harvesting period i.e., from September to November as during these months arrivals are more. It was observed that pearl millet arrival indices in all selected *mandies* were lowest for month of June to August whereas, it was highest just after the harvesting (October to January). Looking to IPR and ASPV, there was much variability in prices in Barmer *mandi* while coefficient of variation was highest in Jaipur *mandi*.

These results indicate that there is a need of educating farmers to sale the produce at the correct time to take advantage of price variations. Farmers Producer Organizations can help them in aggregating, storing and selling the produce at right place and at right time.

References

Abdissa, G. and Dereje, B. 2001. Maize marketing in Ethiopia: A review. *Journal of Agricultural Economics* 5: 117-124.

Acharya, S.S. and Agarwal, N.L. 1992. *Agricultural Price Analysis and Policy*. Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi.

Adegeye, A.J. and Dittoh, J.S. 1985. *Essentials of Agricultural Economics.* Impact Publishers Ibadan. 251p.

Anonymous 2011. *Agriculture Census 2010-11.* Agriculture Census Division. Department of Agriculture, Corporation and Farmers Welfare, Ministry of Agriculture and Farmers Welfare, Government of India, Delhi, India.

Anonymous 2021a. *Rajasthan Agricultural Statistics at a Glance*. Directorate of Economics and Statistics, Department of Agriculture and Co-operation, Jaipur, Rajasthan.

Anonymous 2021b. *Annual Report, Economic Survey*. Department of Economics Affairs, Ministry of Finance, Government of India, Delhi, India.

Benke, S.R., Gholap, V.B. and Gade, P.V. 2016. An economic analysis of green gram arrivals and prices in Akola district (Akola APMC) of Maharashtra. *International Research Journal of Agricultural Economics and Statistics* 7(2): 198-202.

Grega, C. 2002. Price stabilization as factor of competiveness of agriculture. *Journal of Agricultural Economics* 48: 281-284.

Satheesh, B.K., Jayasree, K. and Silja, J. 2012. Price behaviour in small cardamom: An analysis. *Indian Journal of Arecanut, Spices and Medicinal Plants* 14: 9-15.

Thakare, H.P., Daundkar, K.S., Rathod, S.R., and Bondar, U.S. 2017. Changes and trends in arrival and prices of agricultural commodities in APMC Kolhapur market. *International Research Journal* of *Agricultural Economics and Statistics* 8(1): 26-30.

Verma, V.K. 2017. Use of ARIMA modeling in forecasting coriander prices for Rajasthan. *International Journal of Seed Spices* 6(2): 40-45.

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