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Price behaviour of pearl millet in Gujarat

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Abstract

The study on price behaviour of pearl millet was performed within the boundary of Gujarat state for the duration of ten years i.e. (2009-2019). In order to study inter-year variability, intra-year variability and trends in pearl millet price, secondary data on yearly index numbers of wholesale prices in Gujarat state Pearl millet was compiled for the period from year 2009 - 2019. Coefficient of variation was calculated to measure the variability in yearly and monthly prices. To estimate trend, the linear and quadratic models were used. The measurement of coefficient of variations in yearly prices of pearl millet revealed the ranged from 19.93 per cent to 22.42 per cent. The result of linear model concluded that the regression coefficient of all markets was more significant. Co-efficient of multiple determination (R^2) was more than 65 per cent for markets pearl millet except one market which showed above 60 per cent.

Keywords: variation, trend, price, fluctuation

Introduction

Agriculture is the largest sector for economic activities and occupies an important role in the economic development of the country by giving raw material and food, capital for country's development as well as employment for the population and providing surplus for the development of national economy. In an agriculture-based country like India, prices of farm products have a wide range of variation than prices of industrial goods. They have weighty effect on the growth and stability. The price fluctuation affects both the farming and non-farming population. Cereals are grown in more than 200 countries. Highest area for cereal production was contributed by China (1.33%) followed by US (1.28%), India (0.69%), Russia (0.57%), Brazil (0.29%). Similarly, contribution to total production of cereals by china (2.09%), US (1.49%), India (1.06%), Russia (0.44%), Brazil (0.4%). Pearl millet (*Pennisetum glaucum*) is a cereal cultivated for food, feed and forages particularly grown in African and Asian countries. They are small seeded cereals and forage grasses. They are used for both man and domestic cattle. They have drought resistant property. Pearl millet is rich in iron and calcium content. It is considered as the ancient food grain. It has panicle type of inflorescence and undergoes cross pollination because of protogynous condition. Being nonglutinous, millets are also safe for people suffering from gluten allergy and celiac disease. The changes in price over years in long run is termed as trend in arrivals and trend in prices. Trend in arrival is for development in technology of production, infrastructure and supply of input and trend in prices is affected by increase in population, supply of money and increase in purchasing power. The study of trend helps us to conclude the direction of range in arrival and prices in different markets.

Objectives

1. To examine the variability in price of pearl millet.
2. To measure the trend and rate of increase in price pearl millet.

Methodology

The study on price behaviour of pearl millet is performed within the boundary of Gujarat state. The monthly data on prices of pearl millet from 2009 to 2019 were collected from different market Committees or agricultural websites. The three largest markets were selected on the basis of highest arrivals.

Variability in prices

First of all, coefficient of variation was calculated to measure the instability in yearly and monthly prices.

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$$CV \% = \frac{SD}{Mean} * 100$$

Where,

CV% = Coefficient of variation

SD=Standard Deviation = (Variance)^{1/2}

$$Variance = \frac{\sum_{i=1}^n (x_i - \bar{x}_i)^2}{n-1}$$

Instability index

Cuddy Dell Valle Index (CDI) is used to overcome this limitation of C.V. Because if the time series data exhibit trend behaviour than variation measured by CV can be overestimated. As against that Cuddy Della Valle index attempts detrends the C.V. by using coefficient of determination (R²). Hence C.V. adjusts with R² to detrend the production series.

$$Cuddy-Della Valle index = C.V. * (1 - R^2)^{0.5}$$

Where C.V. = Coefficient of Variation i.e. $CV \% = \frac{SD}{Mean} * 100$

SD = Standard Deviation = (Variance)^{1/2}

$$Variance = \frac{\sum_{i=1}^n (x_i - \bar{x}_i)^2}{n-1}$$

R² = ESS/TSS i.e., ratio of explained variation to total variation.

ESS = Variation explained by explanatory variable.

TSS = Total Variation.

Different range of instability are as follows

- Low instability = between 0 to 15
- Median instability = greater than 15 and lower than 30
- High instability = greater than 30

Trend in yearly prices

The trend in annual prices were analysed with the help of following models.

Linear and quadratic model

$$P_t = \beta_0 + \beta_1 T + U \dots\dots\dots (model 1)$$

$$P_t = \beta_0 + \beta_1 T + \beta_2 T^2 + U \dots\dots\dots (model 2)$$

Model 1 is for linear calculation and model 2 for quadratic calculation.

P_t = yearly index number of wholesale prices

T = Time (1,2,3...10)

U = Disturbance term with usual assumption

β₀, β₁, β₂ = parameters to be estimated

Result and Discussion

Variability in pearl millet prices.

To study the variability in pearl millet prices, there are two concepts i.e., inter-year variability and intra-variability. The fluctuation in prices occurs differently in both way, intra-year and inter-year variability.

Inter-year variability

The coefficients of variation in yearly prices of pearl millet for period under study has been shown In TABLE 1

It could be seen from the results that the variability in the entire period under study was ranged from 19.93 per cent to 22.42 per cent. It concluded that there was a moderate fluctuation in yearly prices of pearl millet under study in Gujarat. Which can be due to fluctuation in production that affected the supply.

Table 1: Coefficients of variation in yearly prices of pearl millet in Gujarat during 2009-2019.

Crops	Markets	Coefficients of variation (%)
Pearl millet	Banaskantha	22.42
	Sabarkantha	21.24
	Gandhinagar	19.93

The trend diagram of yearly index number of wholesale prices has been drawn for pearl millet for the period from 2009 to 2019, and the trend diagram is shown in figure 1.

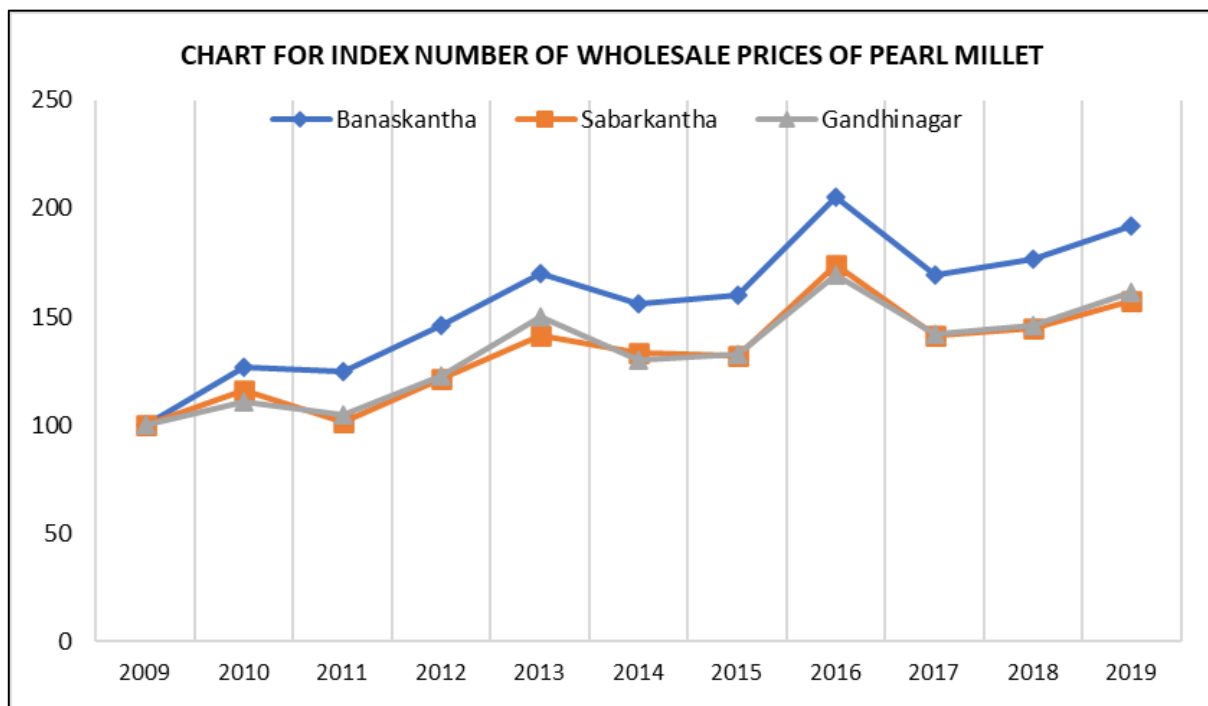


Fig 1: Index numbers of wholesale prices of Pearl millet in Banaskantha, Sabarkantha and Gandhinagar.

Instability index

Time series data gives trend behaviour but under such condition variation measured by C.V. can be overestimated. To overcome this condition of C.V. under trend behaviour, yearly price index was measured during the period of 2009 to 2019 and the result is presented in table 2. it was observed that index is classified into low, medium and high level of index, however pearl millet did not showed medium and high instability index, so it is not presented here. It was concluded from the analysis that pearl millet showed low stability index in respective markets.

Table 2: Price instability index in pearl millet in Gujarat during 2009-2019.

Range of instability Index	Markets	Crops	Instability index
Low instability	Banaskantha	Pearl millet	10.75
	Sabarkantha	Pearl millet	11.94
	Gandhinagar	Pearl millet	10.71

Intra-year variability

The rate of flow of stocks in to the market reveals the intra-year fluctuations in prices of agricultural commodities. Coefficients of variation in monthly prices within each year were calculated for Pearl millet 2009-2019 to estimate the intra-year variability of pearl millet.

The result showed in table 3 for intra-year variability said that that the prices of Pearl millet in Banaskantha markets explained intra year fluctuation ranging between 5.76 to 25.67 per cent. The lowest variability was observed in year 2010 and the highest variability was in year 2009. In case of Sabarkantha market intra year fluctuation ranged from 3.61 to 22.02 per cent. The lowest variability was observed in year 2011 and the highest variability was found in year 2010. In Gandhinagar market intra year fluctuation ranged from 3.65 to 20.45. the lowest variability was found in year 2011 and the highest variability was observed in year 2019. In all three markets year 2009 and 2010 showed high variability whereas, remaining years showed moderate fluctuations. Thus, on an average, the prices of Pearl millet showed moderate to high degree of intra year variability in all markets under the period

of study from year 2009-2019.

Table 3: Coefficient variation of monthly prices of pearl millet of Gujarat during 2009-2019. (percent)

Year	Pearl millet		
	Banaskantha	Sabar-kantha	Gandhi-Nagar
2009	25.67	9.59	12.16
2010	5.76	22.02	5.97
2011	8.4	3.61	3.65
2012	9.83	10.53	10.88
2013	7.73	5.85	10.2
2014	9.66	4.16	5.39
2015	7.6	8.94	8.75
2016	8.19	20.93	7.47
2017	15.8	8.09	11
2018	12.8	15.26	15.54
2019	17.53	18.75	20.45

Trends In Pearl Millet

To analyse the trend for yearly prices for Pearl millet, the below approaches were used.

1. Estimation of linear trend.
2. Estimation of quadratic trend.

Estimation of linear trend

Linear model was fitted for selected time period for research i.e., 2009-2019 with the help of yearly index number of wholesale prices for all selected pearl millet. The analysed results are presented in the table 4.

The result concluded that the regression coefficient of all markets was more significant. An accepted amount of variation in the prices could be explained with the help of linear trend. The increase in rate for Pearl millet in markets of Banaskantha, Sabarkantha and Gandhinagar was 8.21, 5.60 and 5.77 per cent respectively. Thus, overall Banaskantha market for Pearl millet showed highest rate of increase. Coefficient of multiple determination (R^2) was more than 65 per cent for markets of pearl millet except one market which showed above 60 per cent. Thus, it can be concluded that linear model results a major part of variations in prices of pearl millet during the selected period of study.

Table 4: Estimates of linear trend in yearly prices of pearl millet in Gujarat during 2009-2019. (Model 1) (n=11)

Crops	Markets	Intercept B_0	Coefficient For time β_1	R^2	Adjusted R^2
Pearl millet	Banaskantha	107.67	8.21	0.76	0.74
	Sabarkantha	99.25	5.60	0.68	0.64
	Gandhinagar	98.97	5.77	0.71	0.67

Estimation of quadratic trend

To analyse the important assumption of rate of increase being

constant in the selected period of time i.e., 2009 to 2019 quadratic model was used.

Table 5: Estimation of quadratic trend in yearly price of pearl millet in Gujarat during 2009-2019. (Model 2) (n=11)

Crops	Markets	Intercept β_0	Coefficient For time (T) β_1	Coefficient for $T^2 \beta_2$	R^2	Adjusted r^2
Pearl millet	Banaskantha	85.65	18.37 (5.95)	-0.84 (0.48)	0.83	0.79
	Sabarkantha	87.77	10.90 (5.62)	-0.44 (0.45)	0.71	0.64
	Gandhinagar	87.34	11.14 (5.40)	-0.44 (0.43)	0.74	0.68

The concluded result is presented in table 5 for the pearl millet markets. The results showed that the co-efficient of regression associated with the variable of time (β_1) were found to have all positive values in the markets of pearl millet. These coefficients were significant at 5 per cent. In the

same way, the coefficient of quadratic term i.e., T^2 was found to be negative in markets of pearl millet.

The co-efficient for multiple determination (R^2) observed to be in higher variation i.e., more than 70 per cent which was explained by quadratic trend. The values for R^2 were found

slightly higher than values observed in linear trend. Same as linear model adjusted co-efficient of multiple determination was also worked out to know the better fit.

The values of adjusted co-efficient of multiple determination in all markets of Pearl millet, for markets Banaskantha and Gandhinagar quadratic model fitted better and in Sabarkantha linear model fitted better.

Conclusion

The measurement of coefficient of variations in yearly prices of cereals revealed the ranged from 19.93 per cent to 22.42 per cent. Moderate fluctuation of year-to-year prices of pearl millet was observed under the study. The trend diagram of yearly index number of wholesale prices revealed continuous price fluctuation during the period under study. It was concluded from the analysis that pearl millet showed low stability index in their respective markets. On an average, the prices of Pearl millet moderate to high degree of intra year variability in all markets under the period of study from year 2009-2019. The result of linear model concluded that the regression coefficient of all markets was more significant. Co-efficient of multiple determination (R^2) was more than 65 per cent for markets of pearl millet except one market which showed above 60 per cent. Thus, it can be concluded that linear model results a major part of variations in prices of pearl millet during the selected period of study. The results of quadratic model showed that the co-efficient of regression associated with the variable of time (β_1) were found to have all positive values in the respective markets of selected pearl millet. These coefficients were significant at 5 per cent.

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