



# Trends and Market Integration of *Kharif* Sorghum in Beed District of Maharashtra

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## Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

## Article Information

DOI: 10.9734/AJAEES/2022/v40i121817

## Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://www.sdiarticle5.com/review-history/96030>

Original Research Article

Received: 26/10/2022  
Accepted: 29/12/2022  
Published: 30/12/2022

## ABSTRACT

Sorghum cultivation has declined over the period of time farmer's turned to production high lucrative cereals such as rice, wheat, corn, pulses and competitive crops like oilseeds and cotton. The District Statistic Board of Beed has reported that the cultivation area for *Kharif* Sorghum in the year 2020 to 2021 were 7194 hectares and 481 kg per hectare respectively. The time series data of sorghum arrivals and prices were collected from APMCs Beed, Dharur and Parli during the period 2001-2020 to study the growth and market integration of selected markets. The trends and annual compound growth rate in arrivals and prices of *Kharif* Sorghum was calculated by using linear and exponential form respectively where as Market integration was worked out by estimating Bivariate correlation analysis. The present study reported that Beed market has positive annual growth rate,

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while in Dharur and Parli markets has negatively significant annual growth rate in Kharif Sorghum arrivals. Beed, Dharur and Parli markets showed positive and non-significant growth rate in prices of *Kharif* Sorghum. The said study also revealed that there was strong association of sorghum prices among the selected markets.

**Keywords:** Trends; market integration; *Kharif* sorghum; arrivals and prices.

## 1. INTRODUCTION

The Indian agricultural sector, which is a major workforce employer, has witnessed a buoyant growth in the past few decades and no doubt Green revolution in India has played a major role in improve the agricultural production sector. According to the Economic Survey of 2021 to 22, India has observed a growth of 3.6 per cent in the year 2020 to 2021 and 3.9 per cent in year 2021 to 2022 in the Gross Value Added (GVA) of the country. As per Fourth Advance Approximation for the period 2020 to 2021, total food grain production in the country is estimated at a record 308.65 million tonnes which is 11.15 million tonnes higher than that during 2019 to 2020 [1-4]. The production of rice, wheat and coarse cereals has increased at compound annual growth rates (CAGR) of 2.7, 2.9 and 4.8 per cent respectively during last six years i.e. 2015-16 to 2020-21.

Sorghum cultivation has declined over the period of time farmer's turning to production of high lucrative cereals such as rice, wheat, corn, pulses and competitive crops like oilseeds and cotton [5-9]. In Kharif cultivation, the high constraints are the lack of better dual purpose variety seeds and hybrids available at reasonable prices and at the appropriate times along with grain mould susceptibility during extended monsoon years at grain maturity and stem-borer vulnerable in dry weather conditions [10,11].

According to Economic Survey of Maharashtra, sorghum was widely produced which were 381000 million tonnes in the year 2020 to 2021 and will be again in the period 2021 to 2022. One of the major sorghum-producing states in India is Maharashtra. In 2020 to 2021, it was grown over an area of 379000 hectares. A study of trend in arrivals and prices assumes special significance in developing economy like India as it can provide fair price to the producers and a long run marketing system would strengthen all corporate activities with an integrated strategy to satisfy the end users.

## Objectives:

1. To study trends in arrival and prices of *Kharif* Sorghum
2. To analyze the market integration of *Kharif* Sorghum markets in Beed district.

## 2. METHODOLOGY

The study was based on secondary data. The time series data of arrivals and prices were collected from APMCs in Beed district i.e. Beed, Dharur and Parli markets during study period 2001 to 2020 i.e. 20 years and in the year 2020 from January to December month wise i.e. 1 year. The selected market was based on the quantity of arrivals and prices of *Kharif* sorghum of Beed district of Maharashtra state. The trends in arrivals and prices of *Kharif* Sorghum determine by using functional form given below.

$$M = a + bt \quad \text{Equation 1}$$

$$P = c + dt \quad \text{Equation 2}$$

Where,

- M = Monthly market arrival of *Kharif* Sorghum in quintals  
 P = Price of *Kharif* Sorghum in rupees per quintals.  
 a and c = intercepts  
 t = Time variable in years  
 b = Regression coefficient (rate of change in monthly market arrivals for a unit change in time (dm/dt))  
 d = Regression coefficient (rate of change in monthly market prices for a unit change in time (dp/dt))

The annual compound growth rate of arrivals and prices of *Kharif* Sorghum was worked out by using an exponential form as below.

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

Market integration of agricultural products gained importance in developing countries due to potential application to develop the national economy. Market integration analysis examines

how different markets over space are related. Efficient market integration enhances supply security, reduce price risks, prevent food shortage, reduce market entry barriers and support the effectiveness of macro-level economic policies. Market integration was worked out by estimating Bivariate correlation coefficient (r) between price changes in different selected market (Acharya and Agarwal-1994).

$$r_{p_1p_2} = \frac{COV (P_1, P_2)}{dp_1, dp_2}$$

Where,

r = Simple correlation coefficient  
 Cov (p<sub>1</sub>, p<sub>2</sub>) = Co-variation between p<sub>1</sub> and p<sub>2</sub>  
 P<sub>1</sub> = Price of the commodity in first market  
 P<sub>2</sub> = Price of the commodity in second market  
 dp<sub>1</sub> = Standard deviation of prices in first market  
 dp<sub>2</sub> = Standard deviation prices in second market

Student 't' was used to test significance of 'r' which is given as,

$$t \text{ test} = r \frac{\sqrt{n-k}}{\sqrt{1-r^2}}$$

Where,

r = correlation coefficient,  
 n = number of observation  
 k = number of parameter

### 2.1 Standard Deviation

Standard deviation is one of the measures of dispersion. This measure of dispersion was estimated by squaring the deviation of each observation from the mean, adding the squares and dividing it by the total number of observation (n) and extracting the square root.

$$\text{Standard deviation} = \sqrt{\frac{\sum_{i=1}^n (X_i - \bar{X})^2}{n-1}}$$

Where,

X<sub>i</sub> = arrivals/prices  
 $\bar{X}$  = Mean of arrivals/prices i= 1,2,3.....n  
 N = number of years/months

### 2.2 Coefficient of Variation

Coefficient of variation is defined as the "Percentage variation in the mean as the standard deviation being stated as the total variation in the mean". The coefficient of variation of each market was worked out by comparing the variability present in market arrivals and prices.

$$CV = \frac{SD}{\text{Mean}} \times 100$$

Where,

SD = Standard deviation  
 Mean = Arithmetic mean  
 CV = Coefficient of variation

## 3. RESULTS AND DISCUSSION

### 3.1 Trends of Arrivals and Prices of Kharif Sorghum

The trend analysis of annual arrivals and prices of *Kharif Sorghum* in selected APMC's was presented in Table 1. It reveals that, Beed APMC showed positive trend in arrivals, whereas, Dharur and Parli market showed negative trends. The trends values of arrivals are 497.65, -1161.03 and -1818.53 for Beed, Dharur and Parli APMC markets, respectively. The trend of annual prices of *Kharif Sorghum* in Beed, Dharur and Parli markets were positive which are having trend values of prices in Beed 111.27, Dharur 97.43 and Parli 88.36 markets, respectively. Simillar results was observed by Navasare et.al [12] in their study.

### 3.2 Compound Growth Rate of Arrivals and Prices of Kharif Sorghum

The Compound growth rate was determined for the annual arrivals and prices of *Kharif Sorghum* by using exponential type of equation depilated in Table 2.

The Beed APMC showed positive compound growth rate significant at 5 per cent level of significance. *Kharif Sorghum* was inadequate at the time of study period in Dharur and Parli markets, which exhibit negatively significant compound growth rate significant at 1 per cent level of significance. Beed, Dharur and Parli has reported compound growth rates of 7.061, -11.82, and -5.469, respectively. Beed, Dharur, and Parli. Values of R<sup>2</sup> for APMC's were 0.189, 0.682, and 0.433, respectively. In the study period, it was vived that the APMCs for the Beed, Dharur and Parli markets revealed positive compound growth rates, which were significant at 1 per cent level of significance. In comparison to Beed and Parli markets, the annual compound growth rate of arrivals of *Kharif Sorghum* was highest in the Dharur market (11.05) during the study period. The R<sup>2</sup> values were 0.878, 0.961,

and 0.913 for the markets Beed, Dharur and Parli respectively.

### 3.3 Market Integration

Market integration is the relationship among the spatially separated markets. APMC's difference in the extent of integration and therefore, there may be a variation in their degree of efficiency [13-17]. The extent by which price of a commodity move together over a period of time in different markets located at varied distances from each other is an indicator of market integration for the commodity. The relationships between two or more APMC's, which are spatially integrated and indicated by APMC integration. Spatial integration is one of the most important indicators of effective function of APMC. According to the Table 3 of the bivariate correlation analysis of the prices of *Kharif* sorghum in the Beed, Dharur, and Parli markets, there were very high degree of association of prices between these three markets, with Beed, Dharur and Parli each having a Correlation Coefficient of 0.95, 0.93, and 0.95, respectively. This association was highly significant at the 1 per cent level of significance. These results are in line with the results of Devi G., and Parmar P. [18] , Bannor R. K. and Mathur S., [19] and Nayak *et.al.* [20] in their study regarding market integration. Due to their proximity, the Beed,

Dharur, and Parli market places have a high degree of connectivity with one another. As a result, the price signal spread readily between market places.

The annual price of *Kharif* Sorghum in Beed, Dharur, and Parli APMC is presented in Table 4 along with descriptive information spanning twenty years. Descriptive statistics demonstrate the fundamental components and characteristics of the data being examined. It offers a succinct review of the factors considered as well as the observations that have been noted. When combined with simple graphical analysis, it also serves as the foundation for virtual study of quantitative data. The conclusion was based on descriptive statistical price data for *Kharif* Sorghum in the markets of Beed, Dharur, and Parli. 20 observations in all (from 2001 to 2020) were used for the market analysis. The average cost of *Kharif* Sorghum per quintal in various geographically distinct markets ranged from Rs.1440.66 to Rs.1048.85. The findings showed that, in comparison to Dharur and Parli APMC's, Beed had the highest mean price per quintal. Beed market has the highest standard deviation (738.71), followed by Dharur (661.34) and Parli (649.81), in that order. Market prices are unstable, and the coefficient of variation seems to range from higher to lower in some market places.

**Table 1. Marketwise trends of arrivals and prices of *Kharif* Sorghum**

Variables	Arrivals			Prices		
	Beed	Dharur	Parli	Beed	Dharur	Parli
A	15699.07	22947.21	53056.61	211.55	-12.05	52.51
B	497.65	-1161.03	-1818.53	111.27	97.43	88.36
R <sup>2</sup>	0.047	0.543	0.416	0.879	0.905	0.802
T	0.948	-4.625	-3.587	11.45	13.10	8.548

**Table 2. Marketwise compound growth rate of arrivals and prices of *Kharif* Sorghum**

Variables	Arrivals			Prices		
	Beed	Dharur	Parli	Beed	Dharur	Parli
A	8.933	10.24	10.90	6.089	5.637	5.707
B	0.068	-0.125	-0.056	0.094	0.104	0.096
R <sup>2</sup>	0.189	0.682	0.433	0.878	0.961	0.913
T	2.049	-6.215	-3.714	11.42	21.23	13.77
CGR (%)	7.061	-11.82*	-5.469*	9.902*	11.05*	10.15*

\*Significant at the 5 per cent level.

**Table 3. Market Integration prices of *Kharif* Sorghum**

Market	Beed	Dharur	Parali
Beed	1	0.95**	0.93**
Dharur		1	0.95**
Parali			1

\*\*Significant at 1 per cent level

**Table 4. Descriptive statistics of price data for *Kharif* Sorghum markets**

Markets	Mean (Rs.)	SD	N
Beed	1440.66	738.71	20
Dharur	1076.00	661.34	20
Parli	1048.85	649.81	20

#### 4. CONCLUSIONS

Analysis of the annually growth rate of arrivals of *Kharif* Sorghum in Beed market recorded positive and non-significant, While in Dharur and Parli markets recorded negatively significant. Beed, Dharur and Parli markets showed positive and non-significant growth rate in prices of *Kharif* Sorghum. There is strong degree of association in prices between markets.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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