International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(2): 1513-1516

Received: 12-01-2019
Accepted: 15-02-2019

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Spatial and temporal variations in arrivals and prices of maize in selected markets of Karnataka

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Abstract
Maize (*Zea mays*) is one of the important cereal crops of the world and gaining lot of importance in animal feed industry has been chosen made to know the spatial and temporal variation in major maize markets *viz.* Davanagere, Haveri and Hassan of the state. The data on monthly arrivals and prices of maize were collected from the records of chosen APMC's, krishimaratavahini and agmarknet and were analysed through EVIEWS7 and MINITAB18 software. Results of the study revealed seasonality in maize arrivals in all the selected markets. Arrivals were peak after the harvest of *Kharif* crop (October to December) and *rabi* crop (January to March) consequently, seasonal indices of maize price were higher during the months of April to September due to lower arrivals. Findings of the co-integration analysis used to assess the spatial integration of prices revealed that major markets for maize in Karnataka *viz.*, Davanagere, Hassan and Haveri exhibited bidirectional influence on each other with respect to prices. Attempts were also made to know the maize price integration with markets in neighbouring states, *viz.*, Nizamabad (Telangana) and Udumalpet (Tamil Nadu) leading maize markets in south India. Results revealed that Nizamabad market exhibited unidirectional influence on prices of Davanagere and Hassan Markets, whereas, Udumalpet (Tamil Nadu) market prices have bidirectional influence on Haveri and unidirectional influence on Hassan market. However, prices for maize in Udumalpet and Nizamabad markets have not shown any integration with each other.

Keywords: Temporal variations, arrivals, maize

Introduction
Maize (*Zea mays*) is one of the important cereal crops of the world. It is a rich source of carbohydrate, starch, fiber and protein for humans and animal dietary requirements. It also serves as a basic raw material in the production of starch, oil and protein, alcoholic beverages, food sweeteners and fuel which is cheaper than other cereals. It is also a versatile crop, grown across a range of Agro Ecological Zones in India. Global area and production of maize was 186 million ha and 1075.2 million MT, respectively during 2016-17. Even though India being the fifth largest producer of maize in the world but contributes for about four per cent of the global production, since USA and China together accounts for more than 75 per cent of the global production. Although, maize is grown throughout the year, about 90 per cent of the India's production comes from *kharif* crop.

The variations in market arrivals and prices can be of two types, *viz.,* Temporal fluctuations observed over time, which is the result of complex mixture of changes associated with different components of time series *viz.* trend, cyclical, seasonal and irregular variations and Spatial fluctuations which are over space and are outcome of differences in place and seasonal production, transportation bottlenecks, *etc*. These factors would lead to changes in the cropping pattern and the income of the farmers.

The seasonal variations are a regularly recurring pattern within a year, which could be seen in the arrivals and prices of farm produce due to the seasonal and perishable nature of farm production coupled with farmers' urgent cash needs and poor produce holding capacity. In other words, the seasonal variations are mainly attributable to climatic factors and biological growth processes of plants. Hence, due to seasonality in production, and hence seasonal arrivals lead to seasonal variations in prices. Normally the prices of farm produce prevail at lower level immediately after harvest time and then show increasing trend as season progresses, reaching their peak during off season or just prior to the next harvest. The studies on seasonal variations provide important information to the producer to plan for sale of

produce and consumer to plan their purchases, beside help Government to operate its procurement and buffer stock for PDS policy measures at the appropriate time.

The trends in arrivals of a commodity over the years are the results of the associated developmental production technology, supply of inputs and infrastructure, while trends in prices are associated with size of population, money supply, purchasing power and price level (inflation or deflation) in the economy. Studies on trends enable to indicate the direction of change in arrivals and prices across markets (spatial price variations). The spatial price refers to price differences prevailing in spatially separated markets at a given time. In perfect competitive market, the price differences for a commodity across the markets do not exceed the cost of transportation and nominal profit. The efficiency of marketing largely depends on the degree to which wholesale prices of a commodity across markets are integrated. Since, the inter-relation between the price movements across the markets depends upon the nature and extent of competition. An analysis of such inter-relationships helps us in understanding the efficiency of the marketing systems. For the present study on market dynamics, Maize (*Zea mays*) was chosen for indepth analysis.

Methodology

The study was conducted using the secondary data on arrivals and prices of maize in three major markets in Karnataka *viz.* Davanagere, Hassan and Haveri. The seasonal indices were computed to study the temporal variation in maize prices and arrivals. For which the time series information on maize prices were gathered from the registers kept up in the chosen APMCs. These business sectors keep up information on daily basis, month to month and yearly basis. For the study of temporal and seasonal fluctuations in arrivals and prices of maize, monthly secondary data were collected from the selected markets for a period of 10 years period from 2007-08 to 2016-17.

The seasonal variation in prices and arrivals, twelve months ratio to moving average method was used. In the first step, 12 months moving total were generated. These totals were divided by 12 to compute 12 months moving average. Then a series of centered moving averages were worked out. In the next step, original values were expressed as a percentage of corresponding centered moving averages. Further, the irregular component in the series was removed. Afterwards, these percentages were arranged in terms of monthly averages. Then the average index for each month was computed. Finally these monthly average indices were adjusted in such a way that their sum becomes 1200. This can be done by working out a correction factor and multiplying the average for each month by this correction factor. The correction factor (K) used was K [K=1200/S]. Where, K is correction factor and S is sum of averages indices for 12 months; multiply K with the percentage of moving average for each month to obtain the seasonal indices.

Co-integration: in EVIEWS

When a time series model is estimated, the first thing to make sure is that either all time series variables in the model are stationary or they are co-integrated, which means that they are integrated of the same order and errors are stationary, in which case the model defines a long run equilibrium relationship among the co-integrated variables. Therefore, a co-integration test generally takes two steps. The first step is to conduct a unit root test on each variable to find the order of integration. If all variables are integrated of the same order, the second step is to estimate the model, also called a "co-integrating equation," and test whether the residual of the model is stationary. The purpose of this exercise is to implement the co-integration test in EVIEWS and also estimate the error correction model.

On the basis of the availability of modal price data on maize in major markets of Karnataka [Davanagere, Haveri, and Hassan] and neighbouring states [Nizamabad market from Telangana State and Udumalpet market from Tamilnadu State] were chosen for detailed analysis of market integration and data were analysed by the EVIEWS7 and MINITAB18 softwares.

Results and Discussion

When a time series model is estimated, the first thing to make sure is that either all time series variables in the model are stationary or they are co-integrated, which means that they are integrated of the same order and errors are stationary, in which case the model defines a long run equilibrium relationship among the co-integrated variables. Therefore, a co-integration test generally takes two steps.

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Seasonal variations in arrivals and prices of maize in selected markets

In order to ascertain the seasonal variation in maize arrivals and prices in the selected markets, the seasonal indices for arrivals and prices were calculated using 10 years moving average method. The results on seasonal indices of monthly arrivals and prices of maize in the selected markets are presented in Table 1.

Table 1: Seasonal indices of maize in selected markets of Karnataka

Month	Davanagere		Hassan		Haveri	
	Arrivals	Prices	Arrivals	Prices	Arrivals	Prices
January	181.06	92.42	142.52	82.19	260.59	89.38
February	191.96	93.28	167.66	87.47	224.21	87.30
March	143.43	92.70	183.85	94.08	177.49	93.39
April	96.77	95.25	36.50	101.28	170.04	97.81
May	71.08	97.75	14.82	100.54	9.67	97.47
June	26.22	104.56	5.78	105.24	32.89	102.03
July	21.94	105.49	2.33	106.64	15.06	106.59
August	17.83	109.37	3.13	105.45	13.11	109.32
September	13.40	107.57	6.25	101.48	2.98	104.59
October	57.60	98.56	70.19	103.95	9.66	98.66
November	183.95	99.94	256.45	105.86	62.99	106.11
December	194.77	103.11	310.52	105.83	221.32	107.36

The seasonal indices of maize prices in selected markets revealed that prices were low during the months of January to May and October to November in Davangere and Haveri markets. This was attributable to higher maize arrivals to the market due to sale of produce immediately after the harvest by the respondents to meet their financial requirements coupled with the issue of non-availability of sufficient warehousing facilities at nearby areas in the study area. Whereas, Hassan market showed low price indices during January to March months, this is because of consistent demand from neighbouring markets as well as Tamil Nadu.

Davangere being major markets for maize exhibiting considerable seasonal variations in prices. Maize can be grown in all the seasons although *kharif* and *rabi late rabi* are the major seasons. Thus, higher maize arrivals created glut during peak seasons and resulted in lower price realization as revealed by lower seasonal indices for maize. On the other hand maize price indices were found to be higher during off season, i.e., from April to September months. This is due to low market arrivals during these months. However, during December, all the three maize markets selected for the study have exhibited higher indices for both arrivals and prices. Thus, seasonality in maize arrivals was observed in all the selected markets. Arrivals were peak after the harvest of *kharif* crop (October to December) and *rabi* crop (January to March). Consequently, seasonal indices for maize arrivals were higher during the months of January to March and November to December. The seasonal behavioral pattern of arrivals and prices for maize are represented in Fig.1.

It is very interesting to note that even with higher seasonal indices for maize arrivals in Hassan and Davanagere markets during the month of December (310.52 and 194.77) seasonal price indices for maize were found to be also higher. This could be attributable to participation of more number of traders and existence of more competition among the traders in Hassan and Davanagere markets for purchases. This may be attributable to procurement of maize may be to meet industrial and feed demand. Similarly in the case of Haveri market positive association was noticed between maize arrivals and prices during the month of December and prices prevailed in the market was found to be higher inspite of higher arrivals to the market. However, during rest of the months of the year, inverse relationship was observed between arrivals and prices of maize in all the study markets.

Spatial variations in arrivals and prices of maize and market integration

The prices of agricultural commodities not only vary with the season of production but also being influenced by prices in other markets and the way in which market allows for entry and exit of traders, flow of market information and the degree of integration of markets which forms the other components of market structure for a commodity. Hence in the present study efforts were also made to study the influence of prices in major markets of neighbouring states *viz.*, Nizamabad market of Tealangana state and Udumalpet market of Tamil Nadu state.

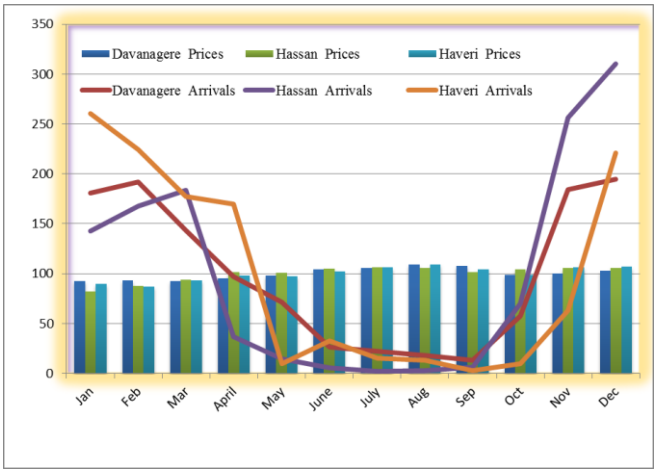


Fig 1: Seasonal indices of prices and arrivals of maize in selected markets

The results of Granger causality test to study the cointegration of maize markets of Karnataka with other major markets in neighbouring states are represented in Table-2. It could be observed from the results that Granger causality test was used for daily prices of eight markets pairs for identifying market integration. Davanagere market exhibited bidirectional influence on maize prices of Udumalpet, Hassan and Haveri markets. While, the Nizamabad market prices have unidirectional influence on Davanagere and Hassan markets. Udumalpet market prices had unidirectional influence on prices in Hassan market. However, the maize prices in Udumalpet and Nizamabad markets did not show any relation with each other indicating the maize prices in these markets are not dependent on each other. Thus, Davanagere, Hassan and Haveri markets for maize in Karnataka are integrated and also influenced by the prices in other major markets of neighbouring state markets *viz.*, Udumalpet (TN) and Nizamabad (TS) of south India.

Table 2: Co-integration of major markets for maize in the study area

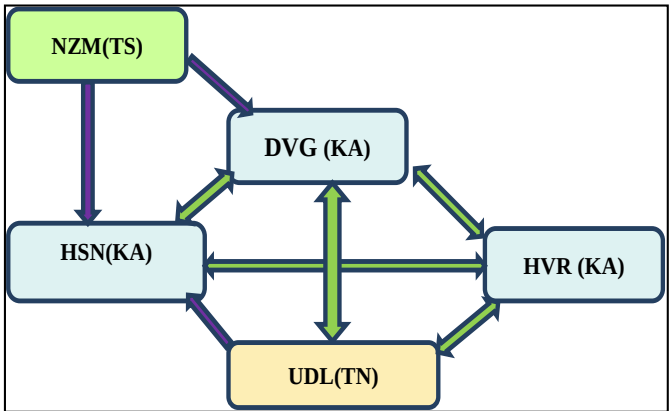
Sl. No.	Null Hypotheses	F-Statistic
1	HSN does not Granger Cause DVG	8.79**
2	DVG does not Granger Cause HSN	4.77**
3	HVR does not Granger Cause DVG	36.41**
4	DVG does not Granger Cause HVR	9.50**
5	NZM does not Granger Cause DVG	5.55**
6	DVG does not Granger Cause NZM	2.01^{NS}
7	UDL does not Granger Cause DVG	8.73**
8	DVG does not Granger Cause UDL	11.72**
9	HVR does not Granger Cause HSN	7.51**
10	HSN does not Granger Cause HVR	9.12**
11	NZM does not Granger Cause HSN	5.70**
12	HSN does not Granger Cause NZM	2.14 ^{NS}
13	UDL does not Granger Cause HSN	3.75 ^{NS}
14	HSN does not Granger Cause UDL	1.50 ^{NS}
15	NZM does not Granger Cause HVR	3.84 ^{NS}
16	HVR does not Granger Cause NZM	2.86 ^{NS}
17	UDL does not Granger Cause HVR	9.33**
18	HVR does not Granger Cause UDL	7.94**
19	UDL does not Granger Cause NZM	0.66 ^{NS}
20	NZM does not Granger Cause UDL	1.62 ^{NS}

Note: ** - Significant at one per cent probability level and NS - Non-significant

Thus results on co-integration analysis for major maize markets in Karnataka *viz.*, Davanagere, Hassan and Haveri exhibited bidirectional influence on each other. Similarly, Nizamabad (Telangana) market exhibited unidirectional influence on prices of Davanagere and Hassan Markets, whereas, Udumalpet (Tamil Nadu) market prices have bidirectional influence on Haveri and unidirectional influence on Hassan market. However, the other leading markets for maize *viz.*, Udumalpet and Nizamabad markets of Telangana state and Tamil Nadu state in south India were found to be not integrated with each other (Fig. 2).

This integration of maize prices of major markets in Karnataka with markets in other neighbouring state could be attributable to more of maize processing industries in Tamilnadu and Telangana States compared to Karnataka. Even though Karnataka is leading state in production of maize, but has relatively few maize based manufacturing industries. Only KMF feed unit is enjoying almost monopoly power in Karnataka, due to weak competition from private cattle feed manufacturing industries. Therefore, there lies greater scope for adoption of new processing technology for manufacturing value added products of maize and poultry

feed both in public and private sectors. This great scope for developing poultry feed and value added products of maize in Karnataka not only help create additional employment opportunities but also would help farmers to realise remunerative prices for maize through increased completion in the market.



Note: DVG-Davanagere, HSN-Hassan, HVR-Haveri, NZM-Nizamabad and UDL- Udumalpet.

Fig 2: Causal dependency of selected maize markets

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