Current Journal of Applied Science and Technology

38(6): 1-15, 2019; Article no.CJAST.54470
ISSN: 2457-1024
(Past name: British Journal of Applied Science & Technology, Past ISSN: 2231-0843, NLM ID: 101664541)

Enhanced Welfare through Market Integration: A Study of Growth, Variation and Price Integration of Chickpea

L. Wahlang[1], M. K. Sekhon[1] and Sunny Kumar[1*]

[1]Department of Economics and Sociology, Punjab Agricultural University, Ludhiana, Punjab, India.

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/CJAST/2019/v38i630470
Editor(s):
(1) Dr. Orlando Manuel da Costa Gomes, Professor of Economics, Lisbon Accounting and Business School (ISCAL), Lisbon Polytechnic Institute, Portugal.
Reviewers:
(1) Ismail Ukav, Adıyaman University, Turkey.
(2) Nurhidayatullaili Muhd Julkapli, Nanotechnology & Catalysis Research Centre (NANOCAT), Malaysia.
Complete Peer review History: http://www.sdiarticle4.com/review-history/54470

Original Research Article

Received 24 November 2019
Accepted 27 January 2020
Published 03 February 2020

ABSTRACT

Chickpea is the most important pulse in India. The present study is based on secondary data, worked out trends in production, seasonal variation and integration among major markets of India. Advance Econometrics analysis like Granger Causality test, Johansen Co-integration test and Vector Error Correction model were employed to examine the integration of markets. The trend in area and production shows fluctuations in major producing states except in Uttar Pradesh. In all the major producing states of chickpea, contribution of area was higher in production. The production trend improves in case of Madhya Pradesh whereas decreased in Rajasthan and Uttar Pradesh. Seasonality in arrivals has impacted the monthly retail price in all the selected markets. Out of six selected markets, five markets were having a long run price relationship. However, market integration has not yet reached an optimal level because all markets were not spatially integrated with one another in all the cases. The short run results indicated that chickpea's markets were not well integrated. This could be due to poor market intelligence and unfavorable location of the markets. The policy intervention calls for strengthening market intelligent wing in all markets along with the establishing of online marketing system through computerization and networking. Strengthening of market infrastructure including transportation and communication facilities are the need of time in order to fully integrate the market prices. Concentration of marketing during the lean seasons helps reducing the impact of seasonality.

**Corresponding author: E-mail: sunnykumar@pau.edu;*

Keywords: Chickpea; seasonality; farm harvest price; retail price; co-integration and ECM.

1. INTRODUCTION

Chickpea is one of the earliest cultivated legumes and one of the most important pulse. Around 80 per cent of the chickpea produced worldwide is of Desi type and the rest is of Kabuli variety. Chickpea contain exceptional levels of iron, vitamin B-6 and magnesium. India is the highest producer contributing about 69 per cent of area and about 67 per cent of production to the world. Chickpea contributed about 45 per cent in production and about 35 per cent in area to the total pulses in India during triennium ending 2017-18.

The production of chickpea in India during TE 1952-53 was 37.48 lakh tonnes from an area of 72.18 lakh hectares. The production has almost doubled to 79.72 lakh tonnes while the area has slightly increased to 88.59 lakh hectares during TE 2015-16.The productivity of chickpea have not significantly increased when compared with competing crop like wheat over the decades. The yield was recorded at 519 kg/ha during TE 1952-53 and has slightly increased to 896 kg/ha during TE 2015-16. Accumulated evidences (Kelley and Rao, 1994; [1,2,3] indicated that unreliability in yield was due to poor adoption of agronomic packages as pulses were mostly grown in rain-fed condition and marginal land.

Besides, fertilizer used for production of pulses did not result in payoff as the fertilizer and moisture interaction was sub-optimal [4]. Poor performance of yield and inefficient market structure of pulses has resulted into stagnant growth in production at national level. In the major producing states of chickpea, the area expansion was the major source in production [5]. Slow growth in production of chickpea and other pulses was also witnessed through declined per capita availability. Rising income of the middle class has pushed demand for pulses. However, due to lack of supply has created the demand and supply gap which entailed the rising price of chickpea and other pulses.

Spatial price behavior in regional markets is important indicator of the market performance. Integrated markets refer to the situation in which prices of differentiated products do not behave independently [6]. Spatial market integration "is the smooth transmission of price signals and information across spatially separated markets" [7] or is the "measure of the extent to which demand and supply in one location are transmitted to another" [8]. If two markets are integrated, they will experience identical price shocks/changes [9].

It is assumed that price changes in one market will be fully transmitted to the other markets. In case of those markets which are not integrated inaccurate price information are conveyed that might distort marketing decisions and contribute to inefficient product movements. Accurate market information is vital and found to have positive benefits to both farmers and traders. Violent fluctuation in prices is a matter of concern among consumers, farmers and policy makers. These prices not only bring equilibrium between demand and supply but also affect the inter-sectoral distribution of income and rate of capital formation in farm sector. The studies on integration help in planning and developing the system for efficient marketing. In this paper an attempt has been made to examine the trends and variation in growth and the existence of integration among selected markets of chickpea in India.

2. MATERIALS AND METHODS

This study was carried out in Chickpea's major producing states of India namely Madhya Pradesh, Maharashtra, Rajasthan, Karnataka, Andhra Pradesh and Uttar Pradesh. Together, they accounted for more than 80 per cent of area and production of chickpea in the country. Based on the availability and consistency of data, one major market was taken from each selected state. The selected markets were Kurnool, Nasik, Banaglore, Bhopal, Lucknow and Delhi. This study was based on secondary data collected from www.Indiaagristat.com, www.agmarknet.gov. in and Agricultural Prices in India. Time series data on area, production and yield of chickpea were collected for the period 1950-51 to 2015-16. Monthly chickpea's retail prices were collected for the period 2008 to 2016. To study the general direction of movement of prices over time, trend analysis was carried out. The trend in prices is generally explained in straight line and hence linear trend method was used. In price analysis objective should not be to find the best fit functional form but to identify the straight line trend by suitably subdividing the series (Acharya and Agarwal, 1994). The trends (per year contribution) in various prices of chickpea were computed using the formula:

$$Y = a + bt$$

Where, Y = MSP/FHP/Wholesale price/Arrivals
a = Constant
t = Time variable
b = Regression Coefficient

Price Relationships: To examine the relationship between the minimum support price and farm harvest prices of chickpea in different markets, linear trend was chosen for the analysis, based on the value of R^2, significance level and economic interpretation of the coefficients

$$Y = a + bt$$

Where, Y = retail price
a = Constant
b = Coefficient,
t= time period

Seasonality exists in all agricultural commodities. To compute the seasonality of arrivals and retail prices of chickpea, the method of Ratio to Moving Average was employed. This method provides an index to quantify the degree of the seasonal variation in a time series.

(i) Correlation analysis

Correlation coefficient is a measure of degree of linear association between two variables. Karl-Pearson's correlation coefficient was used to investigate the association of chickpea prices in different markets. Correlation coefficient(r) between two market price series X and Y

$$r(X,Y) = \frac{\mathrm{Cov}(X\,Y)}{\sqrt{\mathrm{Var}(x).\mathrm{Var}(y)}}$$

Where, X and Y denotes the prices series for two different markets.

If two prices move perfectly in the same direction, the correlation coefficient will equal to one and the price series will move in parallel to each other. However, there are problems within this method that high level of correlation by no means indicates the integration of markets. Thus, the correlation coefficient can only serve as an indicator of likelihood of market integration. Advanced statistical methods were used to work out the integration among different markets.

Markets are considered to be integrated when long term equilibrium occurs between them. However, price series prerequisite to be stationary to create such relationship. A stationary time series is one whose statistical properties like mean and variance are all constant over a period of time. In the absence of stationarity, the estimated relationship may be counterfeit without any significant implication. The relationship is projected to hold good when price series are found stationary at the same level of differencing. The price-series of chickpea in different markets were first checked for stationarity by using Augmented Dickey-Fuller (ADF) unit root test of the following form.

$$\Delta Y_t = \alpha + \beta\, Y_{t-1} + \sum_{i=1}^{m} a_i \Delta Y_{t-i} + \varepsilon_t$$

Where, Y_t = retail price of chickpea in a given market at time t

$$\Delta Y_t = Y_t - Y_{t-1,}$$

α= intercept/constant,
ϵ_t = pure white noise error term

m = optimal lag value which is selected on the basis of Schwartz Information Criterion (SIC). Now, Null hypothesis (H_0), β = 0 Series has a unit root (non-stationary series). Alternative hypothesis (H_1), β < 0 Series has no unit root (stationary series) Accepting the null hypothesis that is 'β = 0' indicating that time series is non-stationary or the series has a unit root problem. Denial of null hypothesis and acceptances of the alternative hypothesis that is 'β< 0' indicating that the time series is stationary and free from the consequences of unit root.

2.1 Co-integration Test

After confirmation of stationarity in the entire price series at same order of differences, the co-integration of markets were tested by Johansen maximum-likelihood techniques. In this present context the long run price relationship between the markets were employed by conducting Johansen co integration test [10]. This test is generally based on the maximum likelihood ratio test statistics which is used to examine the number of co integrating vectors present. The trace statistic along with the Maximum-eigen-value-statistic is primarily used with a null hypothesis (H_0): There is at most 'r' co integrating vectors present and an alternative hypothesis (H_1): There is at most 'r+1' co integrating vectors present. The calculated values from the tests will denote the number of integrating vectors actually present and thereby the extent of co-movement of prices can be

easily measured. The co integration test implies that when the number of co integrating vectors is increased it will give rise to increasing strength and stability of price linkages. The Eigen values represent the strength of the correlation between the first difference and the error correction.

2.2 Granger Causality Test

Granger's causality technique was used to reveal the causal relationship between the prices series in selected chickpea markets. The presence as well as the causality direction of long-run market price relationship can be evaluated by using the Granger causality test directed within vector auto regressive (VAR) model. It is a probabilistic account of causality using empirical data sets to find the patterns of causality. An autoregressive distributed lag (ADL) model for the Granger-causality test had been specified as below:

$$X_t = \sum_{i=1}^{n} a_i\, Y_{t-i} + \sum_{j=1}^{n} \beta_j X_{t-j} + u_t$$

$$Y_t = \sum_{i=1}^{n} \lambda_i\, Y_{t-i} + \sum_{j=1}^{n} \delta_j\, X_{t-j} + u_t$$

Where, t = the time period,
u_t = the error terms and X and Y are the prices series of different markets.

To test the pattern of causality between two variables F-test was used with null hypothesis (H_0): The lagged X_t does not granger cause Y_t and alternative hypothesis (H_1): The lagged X_t granger cause Y_t. Here F statistic must be used in combination with the p value when deciding about the significance of the results. If p value is less than the alpha level, individual p values are studied to find out which of the individual variables are statistically significant.

2.3 Error Correction Method (ECM)

If a collection of non-stationary series are integrated of order one i.e. I(1) and the series are found to be co-integrated i.e. the series are having a long run equilibrium relationships, then it is proceeded to perform Vector Error Correction Model (VECM) technique. In doing so it enables to examine the short run and the long run dynamic of the co-integrated series. The term 'error correction' narrates the fact that the last period deviation (the error) from long run equilibrium influences the short run dynamics of the dependent variable. Thus the coefficient of the 'error correction term' is the speed adjustment, because it measures the speed at which the dependent variable (price of chickpea) returns to equilibrium after the changes in the independent variable (the time period considered).

The advantage of the Error Correction Methodology (ECM) is that it incorporates variables both at their level and their first differences. In doing so, ECM captures short-run disequilibrium situations as well as long-run equilibrium adjustments between the prices series. ECM can incorporate such short-run and long run changes in price movements. A comprehensive ECM formulation estimates both short-run and long-run transmission of chickpea prices in different market was considered by first taking the autoregressive distributed lag equation as following:-

The cointegrating equation is given by:

$$Y_t = \beta_0 + \beta_1 X_t + U_t$$

Then, we get $U_t = Y_t - \beta_0 - \beta_1 X_t$

Now, $\Delta Y_t = \beta_0 + \beta_1 \Delta X_t + \beta_2 U_{t-1} + \epsilon_t$

Where, $\Delta Y_t = Y_t - Y_{t-1}$

ϵ_t is the random term and
$U_{t-1} = Y_{t-1} - \beta_0 - \beta_1 X_{t-1}$ is the error correction term.

The factor β_2 measures the rate of change/adjustment of the short-run aberrations to the long run equilibrium. To capture the rate of adjustment, Vector Error Correction Model (VECM) has been used. This method allows the testing of co integration as a system of equations in one step. Other benefit of this method is that we do not need to bring over an error term from one step into the rest. Besides, this method does not need the prior assumption of endogenity or erogeneity of the variables.

3. RESULTS AND DISCUSSION

The area, production and yield of chickpea in India have not significantly improved (Annexure-I) when compared to its competing crop wheat. The higher CAGR in chickpea area was observed during decade of 1950's and 2000's (4.51% and 4.32%) whereas in yield had never found CAGR more than 2 per cent in all the decades 1950 to 2015-16. Over the decades, the slow increase in production was due to various constraints in yield. Accumulated evidences indicated that unreliability in yield was due to poor adoption of agronomic packages as pulses

were mostly grown in rain-fed condition, susceptible to diseases and pests, weather aberration and lack of genetic breakthrough, minimal adoption of high yielding varieties led to very little use of fertilizer due to rained cultivation. Fertilizer used for production of pulses did not result in payoff as the fertilizer and moisture interaction was sub-optimal [4]. Poor performance of yield of pulses has resulted into stagnant growth in production. Area and production of chickpea in India had seen positive, negative and fluctuating rate during 1950-51 to 2015-16. On the basis of growth rate in production of chickpea, states were divided into three categories: a) States with fluctuating growth rate in production, b) States with decreasing growth in production of chickpea and c)States with improving growth in production.

a) States with fluctuating growth rate

Maharashtra, Andhra Pradesh and Karnataka states comes in this category. The growth in area and production of chickpea in Maharashtra during the first decade was negligible and negative in the second decade (Table 1). However, from the year 1970 to 2010, the growth rate in area and production was substantial. The decline in yield during the period 2010-11 to 2015-16 has resulted into negative growth rate in production despite the significant growth in area. This was because of deficient rainfall that led to late sowing in major producing regions like Nashik and Jalgaon; besides, persisting moisture stress in the regions affected the yield of chickpea (Chana Survey, 2016).

Andhra Pradesh shared more than ten per cent growth in area and production to the country during 1990s and 2000's. Negative growth in area, yield and production of chickpea in the state was recorded in the later period. The impact of Technology Mission on Oilseeds and Pulses (1996) and National Food Security Mission - Pulses (2007) have seen phenomenon growth rate in area and production during 1990 to 2010. In the triennium ending 2015-16, Karnataka contributed about 9 per cent of area and about 12 per cent of production of chickpea to the country. The growth rate in area and production during the first decade was negative. However, increase in area and production was significant from 1970 onwards. Phenomenal growth in area was recorded during the period from 1980 to 2016. This was partly due to the impact of Technology Mission on Oilseeds and Pulses (1996) and National Food Security Mission - Pulses (2007).

b) States with decreasing growth rate

Rajasthan being one of the major chickpea producing state in the country have witnessed high fluctuation causes decrease in area and production over the decades. The growth rate in area and production was impressive during 1950-51 to 1959-60 (Table 2). The impact of Technology Mission on Oilseeds and Pulses (1996) vividly seen on the improvement in area and production during 2000-01 to 2009-10. However, the yield of chickpea in Rajasthan has been disappointed with low productivity over the years. The area of chickpea in Uttar Pradesh have witnessed a decreasing trend over the decades because of the consequences of Green Revolution where famers preferred high yielding varieties of wheat and shifted the area from chickpea cultivation to wheat cultivation. The decrease in area has resulted into lower production. The area of chickpea in Uttar Pradesh in 1950-51 was 34.39 lakh hectares, production was 14.54 lakh tonnes and yield was 596 kg/ha. The area and production have decreased to 2.68 lakh hectares and production decreased to 1.64 lakh tonnes during 2015-16.

c) States with improving growth

Madhya Pradesh is the largest producer of chickpea in the country contributed about 34 per cent of area and 40 per cent of production during TE 2015-16. For six decades, the production had increased to 33.64 lakh tonnes during the year 2015-16 from an area of 30.17 lakh hectares (Table 3). There was fluctuation in area and production of chickpea during 1960s because of multiple drought years. The area and yield have seen negative growth during this period. However, the area and production have recorded phenomenon growth from 1970, particularly during 2000-01 to 2009-10. Technology Mission on Oilseeds and Pulses (1996) and National Food Security Mission – Pulses (2007) were the main impact on the phenomenon growth rate.

To achieve the sustainable growth in chickpea production the focus of planning should be diverted towards improving productivity in states like Maharashtra, Andhra Pradesh and Karnataka, where the growth is improving over time and find out the factors which are responsible for slow growth of chickpea in other states. The study confirmed the negative growth rate of area and production in most of the states. However, in Madhya Pradesh production had

Table 1. Decade wise CGR of area, production and yield of chickpea in states of India, 1950-51 to 2015-16

Period	Maharashtra			Andhra Pradesh			Karnataka		
	A	P	Y	A	P	Y	A	P	Y
1950-51 to 1959-60	0.62	1.11	0.45	-2.64**	-4.10***	-1.43	-0.71*	-1.19	-0.42
1960-61 to 1969-70	-0.57	-2.85*	-0.38*	-2.03**	-3.82***	-2.10**	3.95**	9.15***	4.96***
1970-71 to 1979-80	3.68*	7.91*	4.18	-1.93	-2.55	-0.58	0.97	3.83	3.27
1980-81 to 1989-90	4.45***	8.61**	3.96	0.57	3.82	3.67	6.13***	3.02	-2.81**
1990-91 to 1999-00	5.76***	7.08**	1.25	10.13***	10.03**	-0.08	5.99**	11.56**	5.29**
2000-01 to 2009-10	8.24***	12.56***	5.25***	12.49***	15.51***	2.69*	8.23***	8.87***	0.31
2010-11 to 2015-16	4.13	-0.29	-6.84*	-6.73*	-4.93	0.47	7.12*	4.29	-2.64
1950-51 to 2015-16	0.38***	0.69***	0.33***	0.33*	0.91**	0.55***	0.45***	0.75***	0.27***

Note: CGR denotes Compound Growth Rate, A=Area, P=Production and Y=Yield

Table 2. Decade wise CGR of area, production and yield of chickpeas in Rajasthan and Uttar Pradesh, 1950-51 to 2015-16

Period	States with decreasing growth rate						States with improving growth		
	Rajasthan			Uttar Pradesh			Madhya Pradesh		
	A	P	Y	A	P	Y	A	P	Y
1950-51 to 1959-60	16.68***	22.81***	5.45**	-0.59	0.88	-0.39	1.98***	5.61**	3.57*
1960-61 to 1969-70	-3.53**	-2.52	1.06	-1.67***	0.72***	0.95***	0.74*	-0.79	-1.73*
1970-71 to 1979-80	1.21	3.42	2.17	-2.75***	-5.23**	-0.70**	2.24**	-0.61	-2.77*
1980-81 to 1989-90	-5.29*	-6.96*	-2.48*	-1.46**	-1.88*	-0.42	1.05*	2.09*	1.02*
1990-91 to 1999-00	3.12	6.11*	1.98*	-4.01***	-3.84***	0.19	1.58**	4.38***	2.75***
2000-01 to 2009-10	5.64*	4.88	-0.97	-5.13***	-6.19***	-1.12	2.61**	4.47*	1.82
2010-11 to 2015-16	-8.63*	-5.05	-0.78	-10.59*	-20.61**	-12.31**	-0.96*	1.91	3.39*
1950-51 to 2015-16	0.14*	0.35**	0.16**	-0.57***	-0.44***	0.13**	0.28***	0.55***	0.27***

shown promising escalation in the recent years as compared to area which remained relatively stagnant.

3.1 Variability in Prices

Prices permeate and exert a controlling force on the entire economy. Prices in general are volatile. Prices of commodities never move in same direction or with the same speed. Fig. 1 depicted the relationship between the minimum support price and farm harvest price of chickpea in the selected markets. The farm harvest price was higher than the minimum support price of chickpea in all the major producing states except in Karnataka during 2005-06 and in Maharashtra during 2011-12. However, when the production surged, during 2013-14 and 2014-16, the farm harvest price in all the major producing states fell. So there was a vivid pattern of price hikes in chickpea. These fluctuations in prices of chickpea created uncertainty in the minds of producer. Although sometimes chickpea's price was high but there is no price assurance in the market.

This might be true as, unlike other crops through minimum support price is declared to chickpea; the procurement market by the govt is not well established. Thus, chickpea market is largely driven by the market forces and not regulated by government price policy.

Farmers preferred wheat cultivation because of its higher productivity and assurance of price. It was noted that the net profit from pulses was lower than from other competing crops [5]. Relative low yield performance of chickpea and other pulses was so low that even higher prices could not make them profitable to compete with rice and wheat crops [11]. Since wheat is a staple food, much more concentration in terms of inputs and management practices was emphasis on wheat as compare to chickpea.

Seasonality exists in all agricultural commodities. It revealed the pattern of seasonality in arrivals and price of chickpea exhibited in all the selected markets [12]. It was noted that all the selected markets followed a similar pattern of movement of the retail prices of chickpea throughout the year as shown in Table 3. The retail prices of chickpea fall in post-harvest months due to large quantity arrivals. The price rises during the lean period due to less availability of chickpea in the markets. Hence, the seasonal arrivals of chickpea in India also impacted the retail prices. Various studies also confirmed the existence of seasonality in various agricultural commodities [13,14,15,16,17].

The study confirmed the vivid pattern of retail price hikes in these markets. Ever rising demand provided its weak supply keeps pulses inflation elevated. Weather related shocks further added to the problem. On the other side, rapid increasing population, rising per capita income and changing food habits of the consumers are reasons for the rise in demand for pulses.

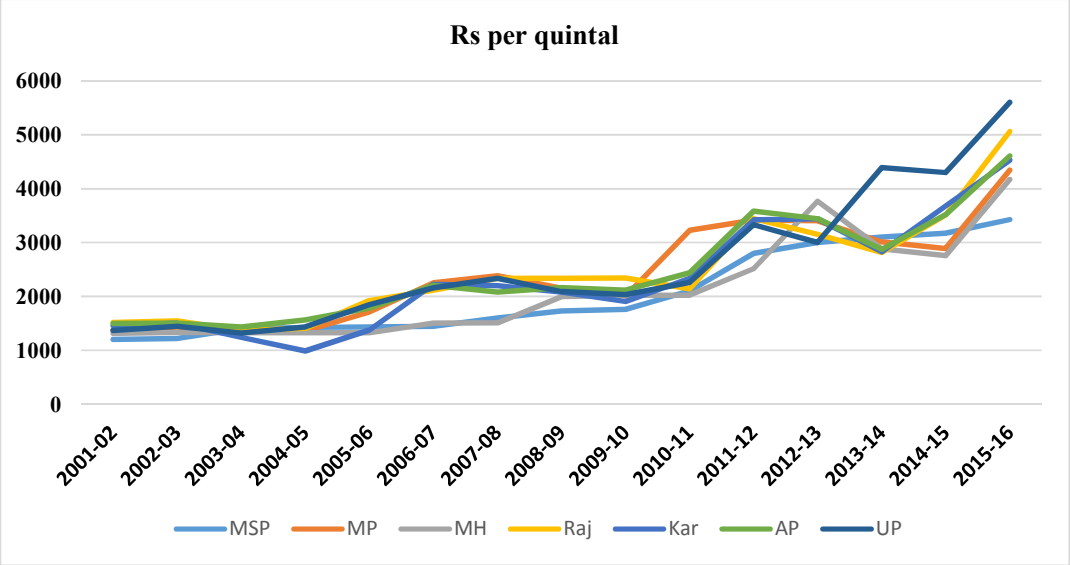

Fig. 1. MSP versus farm harvest price of chickpea in the selected states

Table 3. Seasonal indices of retail price of chickpea in selected markets, 2006 to 2016

Month	Selected markets					
	Kurnool	Nasik	Bangalore	Bhopal	Lucknow	Delhi
January	98.90	105.02	97.97	101.01	100.43	95.06
February	96.90	98.76	97.21	100.37	97.90	95.79
March	94.99	102.41	97.91	99.26	95.86	94.19
April	94.97	100.23	99.64	96.38	94.38	95.14
May	99.85	97.79	95.98	100.13	94.81	96.01
June	97.49	95.48	93.55	96.11	99.48	98.64
July	103.47	96.85	101.47	100.92	101.28	102.58
August	103.04	100.96	102.47	101.97	103.45	101.94
September	103.76	102.21	101.37	100.67	104.47	103.58
October	104.32	100.37	105.94	101.09	110.30	103.29
November	102.64	100.97	103.75	102.32	107.60	108.22
December	99.65	98.99	102.76	99.76	89.80	105.57

Table 4. Estimates of retail prices in selected markets, 2008 to 2016

Market	Intercept	Coefficient	R^2	t-value
Kurnool	1722.2	550.5 t	0.658	3.67***
Nasik	2009.6	627.9 t	0.623	3.40**
Bangalore	1353.4	635.2 t	0.679	3.85***
Bhopal	1704.3	446.4 t	0.534	2.83**
Lucknow	1897.6	524.9 t	0.677	3.82***
Delhi	3051.7	212.2 t	0.524	2.77**

**** and ** significant at 1 and 5 per cent level of significance*

3.2 Trend of Retail Prices in Selected Markets

There was an increasing trend in retail prices of chickpea in all the selected markets at national level. Three markets namely Nasik, Bhopal and Delhi are found to be significant at 5 per cent level and the other three markets namely Kurnool, Bangalore and Lucknow are found to be significant at 1 per cent level as shown in Table 4. The annual increase in retail prices of chickpea was found highest in Bangalore market with an increment of Rs 635 per quintal per annum followed by Nasik market with an increment of Rs 627 per quintal and then followed by Kurnool market with an increment of Rs 550 per quintal. The annual increase is found lowest in Delhi and Bhopal markets with an annual increment of Rs 212 and Rs 446 per quintal respectively.

3.3 Integration of Chickpea's Retail Markets in India

In order to find integration among chickpea retail market correlation was worked out. The correlation coefficient in all the paired markets ranged from 0.70 to 0.97. This indicates that the retail prices of chickpea in selected markets were highly correlated. Further, the highest correlated markets were between Kurnol-Lucknow markets which were associated of the order 0.97. The lowest correlated wholesale markets were between Banglore-Delhi markets which were associated of the order 0.70 (Annexure-II). However, there are problems within this method that high level of correlation by no means indicates the integration of markets. Thus, the correlation coefficient can only serve as an indicator of likelihood of market integration. Advanced methods of econometrics were used to work out the integration of retail markets.

3.4 Results of Augmented Dickey-Fuller Test (ADF)

The Augmented Dickey-Fuller (ADF) based unit root test procedure was employed to check whether the retail price series of chickpea in the selected markets at national level are stationary at their level or at their first difference (Annexure III). In all the selected retail markets, the Augmented Dickey Fuller test values at level are smaller than the critical value at 0.01 level of significance. Therefore, the null hypothesis is accepted which denotes the presence of a unit root problem.

In other words, the retail prices series in all the selected markets are non-stationary at level. However, at their first difference, the values of Augmented Dickey Fuller test in all the selected markets are greater than the critical value. Hence, the null hypothesis is rejected which denotes the absence of a unit root problem or the series of retail prices are stationary at their first differences. As a result, the stationary prices series are free from spurious relationships.

(i) Johansen Co-integration Test

Once it is confirmed that all of the price series are stationary at same order of differences, the co-integration of markets were tested by Johansen maximum-likelihood techniques. Based on the Johansen multiple co-integration procedure, the integration among the selected chickpea's retail markets in India was analyzed using E-Views. Unrestricted co-integration rank tests (Trace statistic and Eigen values) were recorded in Table 5. It is evident from the table that four retail markets are found to be co-integrated at 5 per cent level of significance. Thus the test discovered that out of six selected markets; at least four markets are having a long run relationship.

3.5 Direction of Relationship in Retail Prices

The results of the causal relationships between the retail prices of chickpea from the selected markets at national level are presented in Table 6. The postulated null hypothesis for the Granger Causality test is that the retail price series in one particular markets does not cause or influence the retail prices in another market. Null hypothesis is accepted when the probability is greater than 0.05. However, when the probability is less than 0.05, the null hypothesis is rejected. The direction of causality between retail markets are displayed in Table 7. Among the selected retail markets of chickpea in India; Delhi market caused bidirectional price transmission with Nasik market and caused unidirectional price transmission with Bangalore market. However, Delhi market did not cause price transmission with Lucknow, Bhopal and Kurnool markets. In other words, the retail prices in Delhi market are influenced or impacted by the retail prices in Nasik markets and vice versa. The retail prices in Delhi market influence the retail prices in Bangalore market but not the other way around. Retail prices in Delhi market did not influence the retail prices in Lucknow, Bhopal and Kurnool markets.

It is observed from the table that Bangalore market is the most connected and highly influential retail market among the selected markets as it is having bidirectional price transmission with three other markets namely Bhopal, Nasik and Lucknow markets. Even though Bangalore markets did not Granger cause Kurnool and Delhi markets. The retail prices in Bhopal market are influenced by the retail prices in Bangalore and Lucknow markets and vice versa. Retail prices in Bhopal market had a one way influenced in the retail prices in Kurnool, Nasik and Delhi markets.

Further, Lucknow market caused bidirectional price transmission with Bangalore and Bhopal markets but caused unidirectional price transmission with Delhi, Nasik and Kurnool markets. The least connected and less influential retail market is Kurnool market as it influenced in one way direction with only two markets and did not influence the retail prices in other three markets.

Table 5. Results of Johansen Co-integration test in selected retail markets

Hypothesized No. of CE(s)	Eigen value	Trace Statistic	Critical Value	Prob.**
None *	0.414079	142.6291	95.75366	0.0000
At most 1 *	0.277653	86.49925	69.81889	0.0013
At most 2 *	0.189686	52.34811	47.85613	0.0178
At most 3 *	0.177052	30.26313	29.79707	0.0442
At most 4	0.077355	9.802652	15.49471	0.2962
At most 5	0.012765	1.348970	3.841466	0.2455

Note: Trace test indicates 4 co-integrating markets at 0.05 level
**Rejection of the hypothesis at 0.05 level*
***Mackinnon-Haug-Michelis (1999) p-values*
Price series: Kurnool, Bangalore, Bhopal, Nasik, Lucknow, Delhi
Lags interval (in first differences): 1 to 2

Table 6. Result of Granger Causality test in selected retail markets

Null hypothesis:	Observation	F-statistic	Probability
BANGALORE does not Granger Cause KURNOOL	106	1.22969	0.2967
KURNOOL does not Granger Cause BANGALORE		11.9287	2.E-05
BHOPAL does not Granger Cause KURNOOL	106	9.44336	0.0002
KURNOOL does not Granger Cause BHOPAL		0.28304	0.7541
NASIK does not Granger Cause KURNOOL	106	2.52968	0.0847
KURNOOL does not Granger Cause NASIK		5.74019	0.0044
LUCKNOW does not Granger Cause KURNOOL	106	6.91904	0.0015
KURNOOL does not Granger Cause LUCKNOW		2.69139	0.0726
DELHI does not Granger Cause KURNOOL	106	2.32768	0.1027
KURNOOL does not Granger Cause DELHI		5.12424	0.0076
BHOPAL does not Granger Cause BANGALORE	106	24.4739	2.E-09
BANGALORE does not Granger Cause BHOPAL		10.7499	6.E-05
NASIK does not Granger Cause BANGALORE	106	4.04059	0.0205
BANGALORE does not Granger Cause NASIK		5.51963	0.0053
LUCKNOW does not Granger Cause BANGALORE	106	10.5732	7.E-05
BANGALORE does not Granger Cause LUCKNOW		13.7810	5.E-06
DELHI does not Granger Cause BANGALORE	106	7.06139	0.0013
BANGALORE does not Granger Cause DELHI		0.44939	0.6393
NASIK does not Granger Cause BHOPAL	106	0.08133	0.9219
BHOPAL does not Granger Cause NASIK		9.09662	0.0002
LUCKNOW does not Granger Cause BHOPAL	106	3.15373	0.0469
BHOPAL does not Granger Cause LUCKNOW		17.0428	4.E-07
DELHI does not Granger Cause BHOPAL	106	0.53749	0.5859
BHOPAL does not Granger Cause DELHI		8.28470	0.0005
LUCKNOW does not Granger Cause NASIK	106	8.10550	0.0005
NASIK does not Granger Cause LUCKNOW		0.76852	0.4664
DELHI does not Granger Cause NASIK	106	4.56560	0.0126
NASIK does not Granger Cause DELHI		3.67146	0.0289
DELHI does not Granger Cause LUCKNOW	106	1.16258	0.3168
LUCKNOW does not Granger Cause DELHI		10.6736	6.E-05

Table 7. Direction of causality in selected retail markets

Kurnool	⟷	Bangalore, Nasik and Delhi
Kurnool	⟶ ✕	Bhopal and Lucknow
Lucknow	⟷	Bangalore and Bhopal
Lucknow	⟶	Delhi, Nasik and Kurnool
Bhopal	⟷	Bangalore and Lucknow
Bhopal	⟶	Kurnool, Nasik and Delhi
Nasik	⟷	Delhi and Bangalore
Nasik	⟶ ✕	Bhopal, Kurnool and Lucknow
Bangalore	⟷	Bhopal, Nasik and Lucknow
Bangalore	⟶ ✕	Kurnool and Delhi
Delhi	⟷	Nasik
Delhi	⟶	Bangalore
Delhi	⟶ ✕	Lcuknow, Bhopal and Kurnool

Note: ⟷ *Denotes bidirectional causality*

⟶ *Denotes unidirectional causality*

⟶ ✕ *Denotes no causality*

Table 8. Results of error correction in selected retail markets

Error correction	D(KUR)	D (BANG)	D(BHO)	D(NAS)	D(LUC)	D(DEL)
CointEq1	-0.005250 (0.01058) [-0.49606]	**0.186686** **(0.02771)** **[6.73812]**	-0.015734 (0.01112) [-1.41508]	0.019587 (0.01921) [1.01948]	0.019587 (0.01921) [1.01948]	-0.019093 (0.01126) [-1.69590]
D(KUR(-1))	-0.002909 (0.12905) [-0.02255]	-0.437232 (0.33781) [-1.29430]	-0.016691 (0.13557) [-0.12312]	0.073922 (0.23426) [0.31556]	0.072891 (0.14099) [0.51698]	0.085364 (0.13727) [0.62187]
D(KUR(-2))	0.161007 (0.12350) [1.30372]	-0.449302 (0.32329) [-1.38979]	**0.338764** **(0.12974)** **[2.61108]**	**-0.505011** **(0.22419)** **[-2.25262]**	0.248957 (0.13493) [1.84507]	**0.273502** **(0.13137)** **[2.08193]**
D(BANG(-1))	**-0.100717** **(0.03804)** **[-2.64775]**	-0.113521 (0.09958) [-1.14004]	**-0.162842** **(0.03996)** **[-4.07497]**	-0.115320 (0.06905) [-1.67003]	**-0.204030** **(0.04156)** **[-4.90925]**	**-0.130596** **(0.04046)** **[-3.22752]**
D(BANG(-2))	-0.032982 (0.03546) [-0.93008]	**0.257857** **(0.09283)** **[2.77778]**	**-0.092994** **(0.03725)** **[-2.49625]**	0.084303 (0.06437) [1.30960]	-0.032268 (0.03874) [-0.83285]	**0.091238** **(0.03772)** **[-2.41874]**
D(BHO(-1))	0.072050 (0.12613) [0.57123]	**0.983597** **(0.33018)** **[2.97899]**	0.066133 (0.13251) [0.49910]	0.258715 (0.22897) [1.12993]	**0.460450** **(0.13781)** **[3.34127]**	0.014819 (0.13417) [0.11045]
D(BHO(-2))	0.062931 (0.13299) [0.47320]	-0.146616 (0.34813) [-0.42115]	0.140341 (0.13971) [1.00451]	**0.673423** **(0.24142)** **[2.78947]**	0.250744 (0.14530) [1.72570]	0.098008 (0.14146) [0.69281]
D(NAS(-1))	0.098008 (0.14146) [0.69281]	0.264385 (0.14605) [1.81029]	0.078701 (0.05861) [1.34279]	0.060109 (0.10128) [0.59351]	0.098130 (0.06096) [1.60988]	0.059943 (0.05935) [1.01006]
D(NAS(-2))	-0.008621 (0.05770) [-0.14940]	**-0.475861** **(0.15105)** **[-3.15027]**	0.019270 (0.06062) [0.31787]	-0.116044 (0.10475) [-1.10781]	-0.093144 (0.06305) [-1.47742]	-0.032194 (0.06138) [-0.52449]
D(LUC(-1))	**0.268928** **(0.011563)** **[2.32575]**	**0.268928** **(0.11563)** **[2.32575]**	-0.085646 (0.12148) [-0.70505]	-0.088922 (0.20991) [-0.42363]	-0.055427 (0.12634) [-0.43873]	**0.345913** **(0.12300)** **[2.81230]**

Error correction	D(KUR)	D (BANG)	D(BHO)	D(NAS)	D(LUC)	D(DEL)
D(LUC(-2))	-0.008666 (0.12647) [-0.06852]	**-0.915331** **(0.33107)** **[-2.76474]**	0.121147 (0.13286) [0.91181]	-0.258498 (0.22959) [-1.12593]	**-0.288388** **(0.13818)** **[-2.08704]**	-0.061308 (0.13453) [-0.45571]
D(DEL(-1))	0.081386 (0.10863) [0.74922]	-0.090258 (0.28436) [-0.31741]	-0.062863 (0.11412) [-0.55086]	0.071646 (0.19719) [0.36333]	0.117507 (0.11868) [0.99008]	**-0.293616** **(0.11555)** **[-2.54101]**
D(DEL(-2))	0.038282 (0.10443) [0.36657]	**-0.567704** **(0.27338)** **[2.07661]**	-0.011783 (0.10971) [-0.10740]	0.362948 (0.18958) [1.91450]	0.031691 (0.11410) [0.27775]	-0.105944 (0.11109) [-0.95369]
C	35.31966 (34.4200) [1.02614]	204.5918 (90.1032) [2.27064]	37.49517 (36.1598) [1.03693]	79.13303 (62.4831) [1.26647]	33.57843 (37.6064) [0.89289]	33.57843 (37.6064) [0.89289]
R-squared	0.289093	0.668332	0.668332	0.236847	0.453484	0.311774
F-statistics	2.846579	14.10542	3.288478	2.172469	5.808402	3.171071
Log likelihood	-750.1785	-851.2220	-755.3561	-812.7858	-759.4750	-756.6657
Schwarz SC	14.90964	16.83428	15.00826	16.10216	15.08672	15.03321

Note: KUR-Kurnool, BANG-Bangalore, BHO-Bhopal, NAS-Nasik, LUC-Lucknow and DEL-Delhi.
Standard error in ( ) and t-statistics in [ ]

Speed of adjustment to equilibrium in Prices: Since all the retail prices series in all the selected wholesale markets were non-stationary at level but were stationary at their first difference or integrated of the first order i.e. I(1) and according to Johansen Co integrating test, at least four retail markets were found to be co-integrated at 0.05 level of significance. Hence, the Vector Error Correction technique was employed for the retail price series of the selected markets. In doing so, it enabled to examine the short run as well as the long run dynamics of the co-integrated prices series. The coefficient is the speed adjustment as it gauges the speed at which the deviation in prices returns to equilibrium over time. Further, if the coefficient is negative or less than zero, it implies that the retail price series converge to long run equilibrium. However, if the coefficient is positive and zero, it implies that the retail prices series are not converging but diverge from the long run equilibrium. Being statistically significant, it implies that the lagged prices of its own market and the lagged prices of other markets influences the prices of the particular market.

According to Schwarz Information Criterion, the optimum number of lags was taken from one to two months. It is evident from the table that the retail prices in Bangalore market return to equilibrium in the long run through the dynamic adjustment correction and about 18 per cent of disequilibrium was adjusted within one month.

The retail price of chickpea in Kurnool market was influenced by one month lagged of the retail price of Bangalore and Lucknow markets at the extent of 10 and 26 per cent respectively (Table 8). Bangalore market was influenced not only by its own two months lagged retail price at the extent of 25 per cent but also by the prices lag in other markets also; one month lagged of Bhopal market, two months lagged of Nasik and Delhi markets in addition to one and two months lagged of the prices in Lucknow market were impacting the retail prices of chickpea in Bangalore market. The retail price of Bhopal market was influenced by two months lagged of Kurnool market at the extent of 33 per cent besides one and two months lagged of the retail the prices in Bangalore market at the extent of 16 and 9 per cent respectively. Furthermore, the retail price of chickpea in Nasik market was influenced by two months lagged of the prices in Kurnool and Bhopal markets at the extent of 50 and 67 per cent respectively. The retail prices in Delhi and Lucknow was influenced by the prices of their own lags in addition to the lags of other markets.

4. CONCLUSIONS AND POLICY IMPLICATIONS

At national level, chickpea production was falling due to shrinking in area till 1990. The trend reverse after the 1990s. However, the growth in production of chickpea had not been able to keep pace with the growth in population which has resulted into a huge demand-supply gap (Radhakrisna and Murthy, 1980). Chickpea production in Madhya Pradesh was increasing while in Uttar Pradesh and Rajasthan, it was decreasing over the decades. In some traditional area like Bihar, Punjab, Haryana and Uttar Pradesh; chickpea had been drastically substituted by wheat. This temporal shift in area of chickpea during the 1990s revealed that the crop had gradually shifted from the northern regions to southern regions of the country.

Despite the fact that farm harvest price was above the minimum support price in many of the years, the area and production of chickpea and other pulses have not significantly improved. Whatever the production increases, the area expansion was the major source, also supported by Joshi and Saxena [5]. The fact remains that infrastructure and other policy support for higher pulses production and procurement are lacking as compare to rice, wheat and commercial crops. Profitability is the key in deciding enterprise mix. It was noted that the net profit from pulses was lower than from other competing crops [5].

The existence of significant seasonality in arrivals and prices of chickpea offer an opportunity as well as a challenge to reduce its impact on farmers as well as consumers. This can be done by concentrating on markets during the lean periods. Development and adoption of early and late maturing chickpea varieties in addition to the strengthening and building sufficient scientific storage infrastructures would help in arrivals of chickpea to the markets throughout the year. The result of the study showed that there was integration among the selected markets of chickpea in India means they had a stable long run relationship. This was due to utilizing of technology like mobile phone and internet to communicate better and faster dispersal of the information between markets. However, market integration has not yet reached

an optimal level because all markets were not spatially integrated with one another in all the cases. The short run results indicated that chickpea's markets were not well integrated while long run relationship was evident, suggesting that markets did eventually move together in the long run. This could be due to poor market intelligence and unfavorable location of the markets. The policy intervention calls for strengthening market intelligent wing in all markets along with the establishing of online marketing system through computerization and networking. Development/strengthening of market infrastructure including transportation and communication facilities are the need of time in order to fully integrate the market prices.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Kerr MJ. Sustainable development of rain fed agriculture in India. EPTD Discussionpaper No. 20, International food policy research, Washington; 1996.
2. Narayan P, Kumar S. Constraints of growth in area production and productivity of pulses in India: An analytical approach to major pulses. Ind J of Agri Res. 2015; 49:114-24.
3. Ahlawat, Sharma P, Singh U. Production demand and Import of pulses in India. Ind J of Agron. 2016;61:S34-S44.
4. Rangaswamy P. Dry farming technology in India: A study of its profitability in selected areas. Agricole Publishing Academy, New Delhi; 1990.
5. Joshi PK, Saxena R. A profile of pulses production in India: facts, trends and opportunities. Ind Jn of Agri Econ. 2002;57:3.
6. Monke E, Petzel T. Market integration: An application of International trade in cotton, American J of Agril. Econ. 1984;66(4):401-487.
7. Golettie F, Raisuddin A, Farid N. Structural determinants of market integration: The case of rice market in Bangladesh, Developing Economics. 1995;33(2):185-202.
8. Negassa A, Meyers R, Maldhin EG. Analyzing the grain market efficiency in developing countries: Review of Existing Methods and Extensions to the Parity Bound Model, Market Trade and Institutions Division, Discussion Paper Mo. 63, International Food Policy Research Institute, Washington, D.C.; U.S.A; 2003.
9. Barret CB. Markets analysis methods: Are our enriched tool kits well suited to enlivened markets? American Journal of Agricultural Economics. 1996; 78:825-829.
10. Johansen S, Juselius K. Maximum likelihood estimation and inference on cointegration with applications to demand for money. Oxford Bulletin of Economics and Statistics. 1990;52:169-210.
11. Kaur M, Sekhon MK. Diversification of Punjab agriculture with pulses and oil seeds- A sensitivity analysis. Ind J Agri Econ. 2002;57:396.
12. Wahlang L. Price behavior and market integration of chickpea in India. unpublished M.Sc thesis submitted to Punjab Agricultural University, Ludhiana; 2018.
13. Asmatoddin M, Sapute TG, Maske VS. Arrival and price behavior of important pulse crops in Parbhani district. Intl J of Agri Sci. 2009;5:428-30.
14. Pandit A, Samal P, Mishra JR. An analysis of price behavior of rice in eastern Indian markets. Ind J Agril Mktg. 2012;26:102-14.
15. Kakde SJ, Khobarkar V, Khule GW. Performance of pulses in Akola District. PKV Res J. 2013;37:97-101.
16. Sharma S, Singh IP. Price behavior of soybean in Kota region of Rajasthan. Ind J Agril Mktg. 2013;27:7-22.
17. Mahalle SL, Shastri S, Kumar S. Behavioral study of market arrivals and prices of pigeon pea in Maharashtra. Ind J Econ Dev . 2014;10:86-94.

Annexure I. Area, production and yield of chickpea in India, 1950-51 to 2015-16

Period (TE)	Area (lakh hectare)	Production (lakh tonne)	Yield(kg/ha)
1952-53	72.19	37.49	519
1955-56	89.99	52.90	589
1958-59	96.15	60.48	626
1961-62	97.23	58.84	608
1964-65	91.39	52.14	572
1967-68	80.92	46.06	568
1970-71	75.66	50.18	662
1973-74	75.47	45.72	607
1976-77	77.79	51.06	652
1979-80	75.56	48.35	635
1982-83	72.84	47.53	654
1985-86	72.90	50.33	689
1988-89	64.54	44.29	684
1991-92	65.24	45.65	701
1994-95	67.85	52.78	773
1997-98	71.69	56.62	789
2000-01	66.00	52.58	793
2003-04	64.57	51.43	794
2006-07	70.45	58.01	823
2009-10	78.69	67.62	857
2012-13	86.69	82.52	953
2015-16	88.59	79.72	896

Annexure II. Pearson's correlation coefficient of chickpea's retail prices

Market	Kurnool	Bangalore	Bhopal	Nasik	Lucknow	Delhi
Kurnool	1.00					
Bangalore	0.836*	1.00				
Bhopal	0.953*	0.814*	1.00			
Nasik	0.882*	0.750*	0.816*	1.00		
Lucknow	0.974*	0.853*	0.965*	0.861*	1.00	
Delhi	0.879*	0.700*	0.871*	0.776*	0.886*	1.00

** Correlation is significant at 0.01 level (2-tailed)*

Annexure III. Results of stationarity test in selected retail markets

Markets	At level		At first difference		Critical value at 1%
	Test statistic	Stationarity	Test statistic	Stationary	
Kurnool	2.444	Non-stationary	-7.821*	Stationary	-3.494
Bangalore	0.271	-do-	-8.627*	-do-	
Bhopal	2.046	-do-	-3.889*	-do-	
Nasik	0.539	-do-	-9.620*	-do-	
Lucknow	0.349	-do-	-3.920*	-do-	
Delhi	-1.631	-do-	-11.355*	-do-	

*Note: * Reject null hypothesis at 0.01 level*
Null Hypothesis: Presence of a unit root in a series (a series is non-stationary)
Alternative hypothesis: Absence of a unit root in a series (a series is stationary)

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/54470