PATTERN OF PRICES AND MARKET INTEGRATION OF MAJOR PULSE CROPS IN GUJARAT

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Abstract: The study has analyzed price and arrivals pattern and market integration of major pulse crops i.e. gram and tur in Gujarat state. The secondary data on monthly wholesale prices and arrivals were collected from the website of agmarknet.gov.in of selected regulated markets for last ten years (2007 to 2016). The study has indicated that the inter-year price analysis shows upward trend of annual price indices and there was a significant increase in the price of gram and tur in all the selected markets with positive and statistically significant compound growth rate during the study period. The intra-year price analysis revealed that the general pattern of seasonal variations in prices were found with increased the prices in off season and decreased in main season all most in all the selected markets in both the crops. The pattern of arrivals shows that the quantity of arrival was more in off season in the selected markets. This may be due to that the stockiest released their stocks with the commencement of new season. The results of market integration exposed that there was positive and significant correlation was found for each market pairs that means the wholesale prices of gram and tur was integrated in all the selected markets. Thus, it can be inferred from the above results that the prices increased in one market, it leads to increase the prices in other markets.

Keywords: Gram, Tur, Price behavior, Wholesale prices, Arrivals, Seasonal price indices, Market integration

INTRODUCTION

Pulses are key source of protein for the rural poor and urban peoples of the country as well as for the vegetarians which comprise major population of the country. These pulses mainly include chickpea, pigeonpea, lentil, mungbean, urdbean and fieldpea. Pulses enrich the soil fertility by fixing atmospheric nitrogen in the root nodules and improve the soil structure. The split grains of pulses called *dal* are excellent source of high-quality protein, essential amino and fatty acids, fibers, minerals and vitamins. India is the largest producer as well as consumer of pulses, and is the largest importer in the world (Singh *et. al.,* 2015). This is because the demand for pulses far outweighs their domestic production. Even a liberal import of pulses has not been able to supplement the widening gap between their demand and supply. The skyrocketing prices of pulses since 2008 can be attributed to almost stagnated production leading to a decline in per capita availability. The yields of pulses are often subjected to moderate to severe losses due to recurrent drought situation under rainfed due to low or erratic rainfall. Presently about 24 to 25 million hectares of land is under pulses producing about 19 million tons annually. Even though about 2-3 million tons need to be imported every year to meet the demand. The yield (around 780 kg a hectare) of pulses is less than the global average and the per capita availability (www.iipr.res.in). The results from household consumption surveys indicate decline in the consumption of pulses leading to increase in malnutrition and decline in protein intake, about 15.2 % of people in India are undernourished (Shalendra *et al*., 2013). Even though India is the largest producer, consumer and importer of the pulses in the world the backdrop of wide mismatch between demand and supply, large scale imports, it is necessary to look at the price movement of pulses. The prices of pulses have shown an upward trend in most of the period in the recent years.

Gujarat state is categorized as one of the minor pulse producing state in India (Srivastava, *et al*., 2010). In recent time, state is in limelight as agriculture has recorded fastest growth *i.e.* 9.6 per cent during the year 2000 to 2010 among all Indian state. (Gulati *et al.,* 2009). In India, total pulse area and production irrespective of Twelfth Plan was 252.43 lakh hectares and 187.00 lakh tonnes respectively. Out of the total area and production Gujarat have only 2.85 and 3.47 per cent of area and production, respectively, but in case of productivity of pulses Gujarat have 5th rank (902 kg per ha). However, 2nd and 3rd rank for productivity of pigeon pea and chickpea, respectively (DAC&FW, 2016). Looking to the productivity scenario of pulses, Gujarat has great potential and scope to expand the area and meet the gap between demand and supply with enormous extent. Therefore, this study was proposed to glance inter and intra year price movement of major pulses in Gujarat.

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METHODOLOGY

To achieve the stipulated objective of the study the secondary and time series data for last thirty years (1986-87 to 2015-16) on area, production and productivity of gram and tur were collected from various issues of Directorate of Agriculture, Agriculture & Cooperation Department, Government of Gujarat. The secondary data on monthly wholesale prices and arrivals were collected from the website of agmarknet.gov.in of selected regulated markets for last ten years (2007 to 2016). The CGR and Instability Index were calculated by using the following methods.

The CGR was calculated by fitting the exponential function given below:

$Y = a\ b^t$ (1)

Where, Y= area/production/yield/annual index number of wholesale prices

a = constant

b= regression co-efficient

t= time variable

Thus, natural log on both the sides of eq (1) was taken to convert it in to linear form.

$\text{Log } Y = \log a + t \log b$ (2) and,

CGR (%) was work out using following formula:

CGR (%) = (antilog of b-1) x 100

The simple co-efficient of variation (CV) often contains the trend component and thus over estimates the level of instability in time series data characterized by long-term trends. To overcome this problem, the Cuddy Della Valle Index was used to correct the CV. Cuddy and Della Valle (1978) and Della Valle (1979).

Instability Index (II) = CV x $\sqrt{(1-R^2)}$

Where, CV = co-efficient of variation and

R^2 = co-efficient of determination from a time trend regression adjusted by the number of degrees of freedom.

The significant CGRs were classified in two groups *i.e.* negative and positive CGR.

Inter-year Price Behaviour

The Inter-year price behavior was studied by using the following methods given below;

To examine the general behavior of wholesale prices the year to year price behavior was ascertained by examining the prices of the crops over the period. The general price behavior of wholesale prices was studied through their price indices.

Annual price index was calculated by the following formula:

$I_t = P_t/P_0$ x 100

Where,

I_t = price index for year t,

P_t = price in period t,

P_0 = price in the base year (triennium ending 2007-2009)

To know the trend and rate of increase or decrease in annual wholesale prices the Compound Growth Rate (CGR) was calculated by using the exponential model as given in equation (1) and (2).

Intra-year Price Behaviour

The intra-year price behavior was studied by calculating the seasonal price indices of monthly wholesale prices in selected markets.

Seasonal Price Indices

To know the seasonal pattern of wholesale prices of gram and tur the following multiplicative model of time series analysis was used (Acharya and Agarwal, 1994).

O = T x C x S x I

Where,

O = Monthly wholesale prices,

T = Trend value,

S = Seasonal variations, and

I = Irregular variations.

The seasonal index numbers were constructed by using the twelve months moving average method. To remove the effects of trend (T) and cyclical variations (C), twelve months moving average were calculated and centered. Further, ratios of original price indices to centered moving average were calculated to obtain the combine effect of S x I. In order to eliminate the effect of irregular component (I), these ratios were averaged and finally adjusted seasonal indices (S) were obtained.

Market Integration

Market integration shows the extent to which prices in different markets move together (Barret, 2001). It is considered as pre-condition for effective marketing reforms to take place. The high degree of market integration indicates the competitiveness of the markets. The well-integrated market provides the ways for the farmers to specialize according to comparative advantage. Market integration also plays a vital role in determining pattern and pace of diversification towards the high value crops (Sidhu *et al.,* 2010).

To study the market integration three regulated markets on the basis of quantity of arrivals were selected. All the relevant data have been collected from website of agmarknet.gov.in. The monthly wholesale prices (for the period 2007-2016) data for selected markets was compiled and analyzed by using Pearson's correlation coefficient to assess the relationship between two markets.

The following formula has been used to calculate the correlation coefficient between the markets;

$$ r = \frac{n \sum XY - (\sum X)(\sum Y)}{\sqrt{n \sum X^2 - (\sum X)^2}\ \sqrt{n \sum Y^2 - (\sum Y)^2}} $$

Where,

r = correlation coefficient;

n = number of observations;

X = monthly average prices of selected crop (Rs/qt) in one market;

Y = monthly average prices of selected crop (Rs/qt) in another market.

The value of correlation coefficient (r) was varies from -1 to +1. The positive value indicates that there is a positive relationship among the markets that means increase the prices in one market leads to increase in prices of other market. Degree of relationship is strong when the value is closer to ±1. If the value is exactly ±1, it indicates perfect relationship either positive or negative depending on the sign of the value.

RESULTS AND DISCUSSION

Table 1 represents the results of Compound Growth Rate (CGRs) and Instability Index (II) of area, production and yield of gram and tur in Gujarat.

It is evident from the table that the growth rate of area, production and yield of gram was found positive and statistically significant and in case of tur the growth rate of area was found negatively significant. This showed that the area of gram has risen significantly in last thirty years but the area of tur was decreased significantly, whereas, the growth rate of yield was found positive and significant in both the crops. This indicated the increasing trend of yield over the years. Further, the result shows that the variability in production and area was found more as compare to yield in gram and in case of tur area was more stagnant as compared to production and yield.

Table 1. Compound Growth Rate (CGR) and Instability Index (II) of Area, Production and Yield

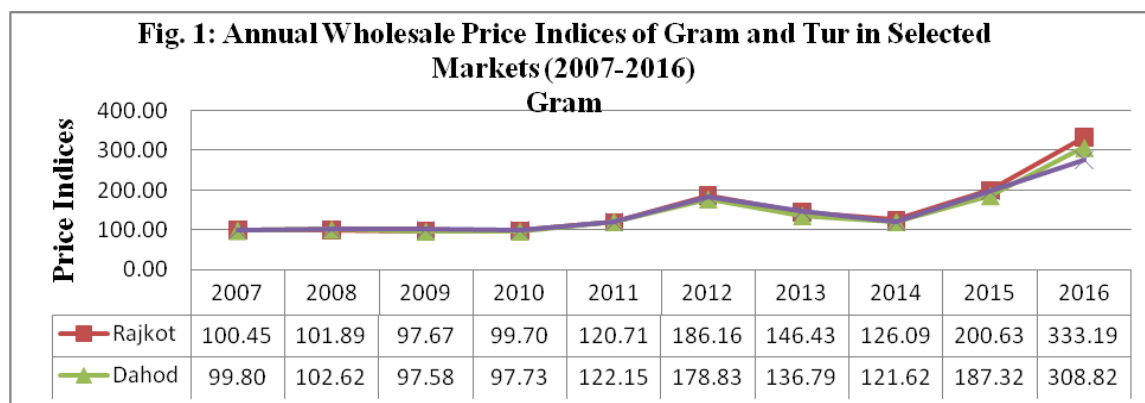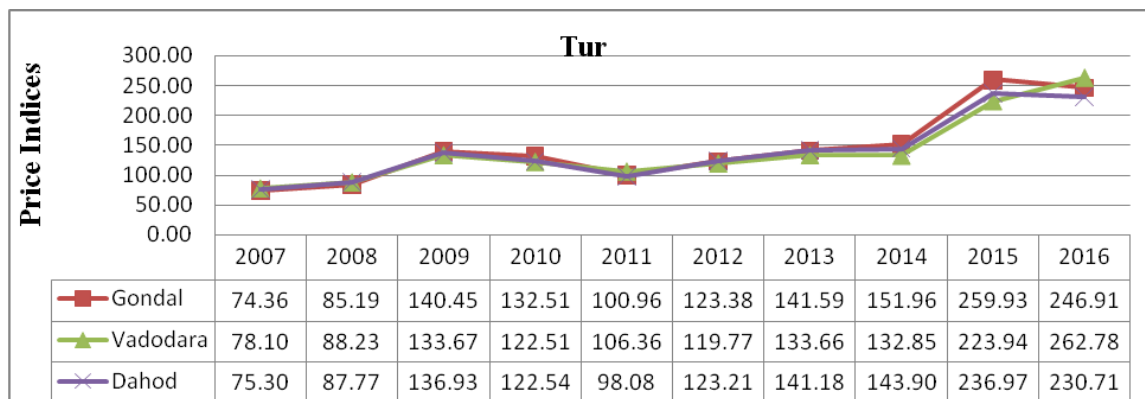| Particular	Gram		Tur	
	CGR	II	CGR	II
Area	3.64**	40.91	-2.04**	10.97
Production	6.35**	53.37	0.20	26.42
Yield	2.55**	24.00	2.29**	21.40

** Significant at 1% level of probability

Inter-Year Price Behaviour
The inter and intra-year price fluctuations of pulses over the period of time influenced the general price index to a greater extent. The uncertainty in prices affects the farmer's income and production of crops also.
The annual wholesale price indices of gram and tur during the period 2007-2016 (with base year triennium end 2007-09 =100) were presented in Fig. 1. It can be seen from the figure that the upward trend of annual prices with few exceptions was found in all the selected markets with similar pattern in both the crops. The annual price indices of gram was highest in last two years in all the markets that means the prices of gram was increased in the year 2015 and 2016 as compared to past years. While in case of tur in Gondal and Dahod market the price indices was highest in the year 2015, whereas, in Vadodara the highest prices was recorded in the year 2016.
The estimates of compound annual growth rate of wholesale price of gram and tur were depicted in Table 2. The results disclosed that the compound rate of increase in prices of gram and tur in all the selected markets were statistically significant. This clearly indicates that the price of gram and tur in all the selected markets was significantly increased during last decade.

Fig. 1: Annual Wholesale Price Indices of Gram and Tur in Selected Markets (2007-2016)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Rajkot	100.45	101.89	97.67	99.70	120.71	186.16	146.43	126.09	200.63	333.19
Dahod	99.80	102.62	97.58	97.73	122.15	178.83	136.79	121.62	187.32	308.82

Tur	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Gondal	74.36	85.19	140.45	132.51	100.96	123.38	141.59	151.96	259.93	246.91
Vadodara	78.10	88.23	133.67	122.51	106.36	119.77	133.66	132.85	223.94	262.78
Dahod	75.30	87.77	136.93	122.54	98.08	123.21	141.18	143.90	236.97	230.71

Table 2. Estimates of Compound Growth Rate of Wholesale Price Indices of Gram and Tur in Selected Markets (2007-2016).

Gram					
Markets	**Intercept (a)**	**Estimates of Coefficient (b)**	**Compound Growth Rate (CGR) in %**	**R^2**	**Adjusted R^2**
Rajkot	1.88	0.05	11.79**	0.71	0.67
Dahod	1.89	0.04	10.76**	0.68	0.63
Jetpur	1.89	0.04	10.56**	0.71	0.67
Tur					
Gondal	1.85	0.05	12.47**	0.77	0.74
Vadodara	1.88	0.06	14.36*	0.32	0.23
Dahod	1.86	0.05	11.48**	0.78	0.75

*significant at 5 per cent and ** Significant at 1 per cent probability level

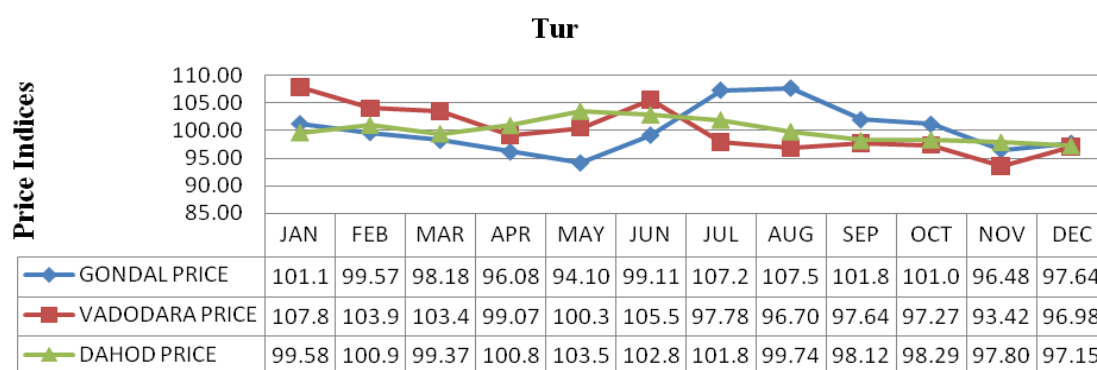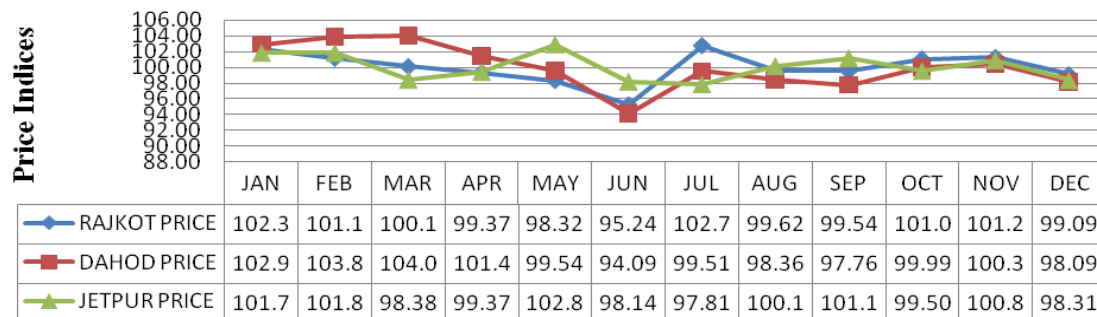**Intra-Year Price Behaviour**

The estimated monthly seasonal price indices of gram and tur in the selected markets are furnished in Fig. 2. It could be seen from the figure that the intra-year seasonal price indices of gram is all most stable in all the selected markets and it was highest in the month of July (102.79) and lowest in the month of June (95.24) in Rajkot. In case of Dahod market highest in March (104.04) and lowest in June (94.09), whereas, in Jetpur market reached its maximum level in the month of May (102.85) and minimum in July (97.81) month. It can be concluded that the price of gram was decreased in post-harvest season and increased in pre-harvesting period due to advancement of the season all most in all the three selected markets. Further, the results indicated that the intra-year seasonal price indices of tur were showing some ups and downs in all the selected markets. In Gondal market the highest indices was reached in the month of July, August (107.20, 107.56), respectively and lowest in May (94.10), whereas, in Vadodara the highest price indices was found in the month of January (107.83) and lowest in November (93.42). In case of Dahod market the seasonal indices was found highest in the month of May (103.50) and lowest in the month of December (97.15). Overall it can be concluded that the price of tur was increased in off season and decreased in peak season with the expectation of more arrival in the market.
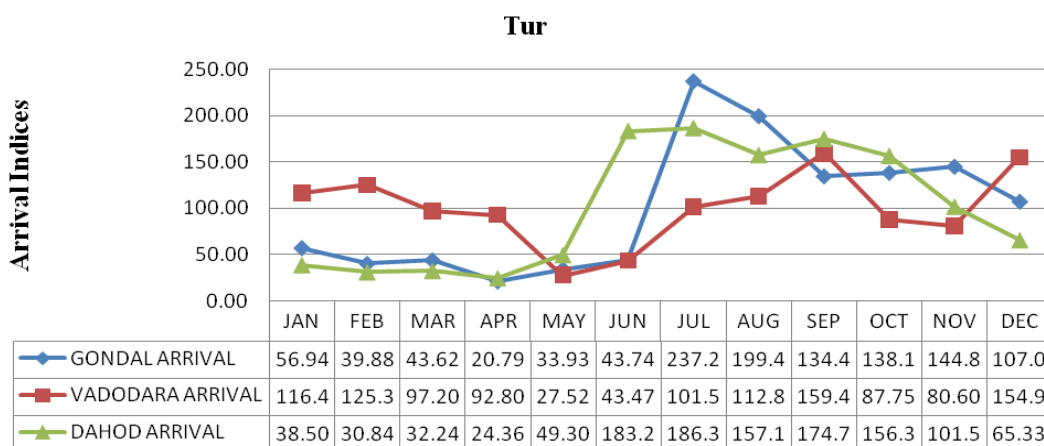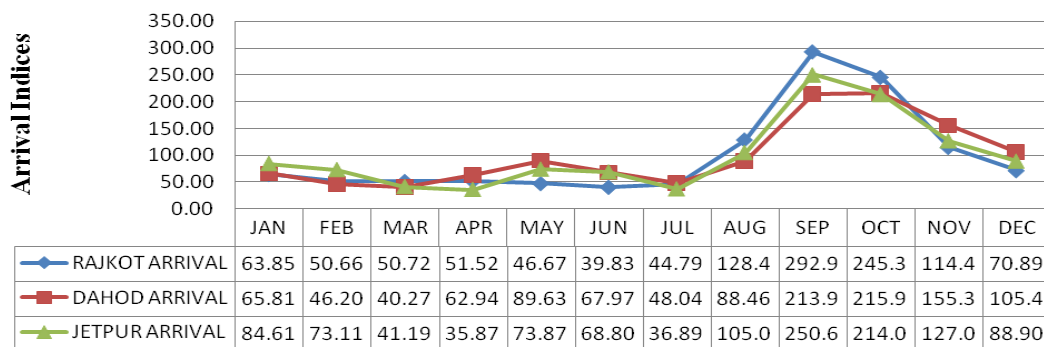
The Monthly patterns of arrivals of gram and tur in selected markets are shown in fig. 3. It is revealed from the figure that maximum arrival of gram in Rajkot market was found in the month of September (292.90) and minimum in the month of June (39.83). In Dahod market the maximum arrivals was found in the month of October (215.90) and minimum in the month of March (40.20), whereas, in case of Jetpur market the arrival reached at highest level in the month of September (250.60) and minimum level in the month of April (35.87). It can be concluded that arrival of gram in all the selected markets was increased in off season continuously from the month of July to October. This may be due to that the millers or traders purchase the commodity from the farmers at the time of harvesting and sale in the market in off season with the expectation of high prices in market in lean season.

Further, it could be seen from the figure that the arrival of tur in Gondal and Dahod market was recorded highest in the month of July (237.20, 186.37), respectively and lowest in the month of April (20.79, 24.36), respectively. Whereas, in Vadodara market the arrival pattern was slightly different from these two markets with highest arrival in the month of September (159.42) and lowest in the month of May (27.52). This may be due to that the stockiest purchased from the farmers in peak season and released the stock in off season with expectation of high prices.

Fig. 2: Seasonal Indices of Wholesale Price of Gram and Tur in Selected Markets (2007-2016)

Gram

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
RAJKOT PRICE	102.3	101.1	100.1	99.37	98.32	95.24	102.7	99.62	99.54	101.0	101.2	99.09
DAHOD PRICE	102.9	103.8	104.0	101.4	99.54	94.09	99.51	98.36	97.76	99.99	100.3	98.09
JETPUR PRICE	101.7	101.8	98.38	99.37	102.8	98.14	97.81	100.1	101.1	99.50	100.8	98.31

Tur

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
GONDAL PRICE	101.1	99.57	98.18	96.08	94.10	99.11	107.2	107.5	101.8	101.0	96.48	97.64
VADODARA PRICE	107.8	103.9	103.4	99.07	100.3	105.5	97.78	96.70	97.64	97.27	93.42	96.98
DAHOD PRICE	99.58	100.9	99.37	100.8	103.5	102.8	101.8	99.74	98.12	98.29	97.80	97.15

Fig. 3: Monthly Pattern of Arrivals of Gram and Tur in Selected Markets (2007-2016)

Gram

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
RAJKOT ARRIVAL	63.85	50.66	50.72	51.52	46.67	39.83	44.79	128.4	292.9	245.3	114.4	70.89
DAHOD ARRIVAL	65.81	46.20	40.27	62.94	89.63	67.97	48.04	88.46	213.9	215.9	155.3	105.4
JETPUR ARRIVAL	84.61	73.11	41.19	35.87	73.87	68.80	36.89	105.0	250.6	214.0	127.0	88.90

Tur

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
GONDAL ARRIVAL	56.94	39.88	43.62	20.79	33.93	43.74	237.2	199.4	134.4	138.1	144.8	107.0
VADODARA ARRIVAL	116.4	125.3	97.20	92.80	27.52	43.47	101.5	112.8	159.4	87.75	80.60	154.9
DAHOD ARRIVAL	38.50	30.84	32.24	24.36	49.30	183.2	186.3	157.1	174.7	156.3	101.5	65.33

Market Integration

The correlation co-efficient of wholesale prices of gram and tur in different market pairs was calculated to determine the degree of market integration between two markets. The results are furnished in Table 3. The results indicated that, the value of correlation co-efficient between two market pairs of gram and tur like Rajkot-Dahod, Rajkot-Jetpur and Dahod-Jetpur and Gondal-Vadodara , Gondal-Dahod and Vadodara-Dahod, respectively was found positive and highly significan that means the wholesale prices of gram and tur was interlinked in all the selected regulated markets, if the prices increased in one market it leads to increased the prices in other markets, that is showing the positive correlation between the markets in terms of prices.

Table 3. Correlation Co-efficient of Wholesale Prices of Gram and Tur in Selected Market Pairs

Gram		
Sr. No.	**Market Pairs**	**Correlation Coefficient**
1.	Rajkot-Dahod	0.999^{**}
2.	Rajkot-Jetpur	0.990^{**}
3.	Dahod-Jetpur	0.989^{**}
Tur		
1.	Gondal-Vadodara	0.973^{**}
2.	Gondal-Dahod	0.998^{**}
3.	Vadodara-Dahod	0.976^{**}

** Significant at 1 per cent probability level

CONCLUSION

The findings revealed that the area and production of gram has risen significantly in last thirty years but the area of tur was decreased significantly. In case of yield the positive and significant growth rate was found for both the crops. This shows that the yield of both the pulse crops was increased significantly over the years in Gujarat. The results of instability index showed that the variability in production and area was found more as compare to yield.

The inter-year price analysis shows upward trend of annual price indices and there was a significant increase in the price of gram and tur in all the selected markets with positive and statistically significant compound growth rate during the study period. The intra-year price analysis revealed that the general pattern of seasonal variations in prices were found with increased the prices in off season and decreased in main season all most in all the selected markets. The pattern of arrivals of gram and tur shows that the quantity of arrival was more in off season in the selected markets. This may be due to that the stockiest released their stocks with the commencement of new season.

The results of market integration revealed that there was positive and significant correlation was found for each market pairs in both crops that indicated the wholesale prices of gram and tur was integrated in all the selected markets. Thus, it can be inferred from the above results that the prices increased in one market, it leads to increased the prices in other markets, and it showed the positive market integration among the markets in terms of prices.

POLICY IMPLICATIONS

Looking to the demand of pulse crops and significantly increasing the yield there is a need to increase the area of pulse crops with special reference to tur crop because the area of tur was decreased significantly over the years. The intra-year price analysis inferred that the general pattern of seasonal variations in prices was found with increase the prices in off season and decreased in main season in all the selected markets. So farmer should store the product when the prices are goes down and release in the market when prices are goes up. The results of market integration showed that the selected market pairs was integrated to each other in all the selected crops so it suggested that farmer should sale the product in regulated market instead of local market.

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