CHAPTER III

METHODOLOGY

The present study was carried out for Market Co-integration between Gondal and Rajkot APMCs. The time series data on arrival and prices of groundnut, sesame and garlic were collected from Gondal and Rajkot APMCs. Primary data on problems was collected by personal interview with the Farmer.

3.1 AREA OF STUDY

3.2 SAMPLE SIZE

3.3 METHODS OF DATA COLLECTION

3.4 STATISTICAL ANALYSIS

3.1 AREA OF STUDY

Gondal is a city and a municipality in the Rajkot district of the Indian state of Gujarat. Total Population of Gondal City as per last census (2011) was 113,000 approximately. Gondal is located at 21.97 degree North (Latitude) and 70.8 degree to East (Longitude). The largest factors in the economy of Gondal are oil mills and marketing yards. Gondal is the largest producer of ground nut oil in Gujarat, with 300–500 oil mills. The marketing yard is one of the biggest in the Saurashtra region and the second largest in Gujarat, after Unjha. Because of that, major arrival of groundnut crop in Saurashtra region is observed in Gondal APMC. So, APMC market of Gondal was selected purposively. Major crops grown in the Gondal area are cotton, groundnut, wheat, chilly, cumin, coriander, garlic, sesame and some pulses. The monthly data on market prices and arrivals of groundnut, sesame and garlic was collected for the period 2001 to 2015.

Gondal APMC was established in 1951. It is a successful example of this initiative and is one of the biggest markets in Gujarat for vegetables and regulated commodities, catering to approximately 6000 to 10,000 plus buyers who visit daily for trading in the market. Balubhai Patel was the first chairman of Gondal APMC. Gondal APMC runs as a primary market under regulated market. In 2014-2015, the market arrival was 37, 63,720 quintal with a yearly turnover of 13.39 rs. Crores. Gondal APMC cover 83 village of Saurashtra region. It is consider as a richest APMC in Gujarat.
3.2 SAMPLE SIZE

A total 100 farmers which were sold their product in Gondal APMC for the find out the problems faced by farmers towards service provided by APMC like as storage facility, loading and unloading service, price, labours, auction facility and grading system of goods. The facilities like residency for stay and food at minimum cost to the farmers are also provided. Year of study period 2001 to 2015.

3.3 METHODS OF DATA COLLECTION

The data was collected from both primary sources and secondary sources. Primary data was collected by using structured questionnaires. Secondary data from the reliable sources such as records and reports from the APMC market of Gondal and Rajkot, Government websites like agmarknet portal and annual reports etc. was also used for the completion of the research study.

3.4 STATISTICAL ANALYSIS

3.4.1 Growth rate, trend and instability in price

**Compound growth rate CGR**

The present study utilizes the time series data (2001 to 2015) on price and arrival of groundnut, sesame and garlic were collected from the reliable sources such as records and reports from the APMC market of Gondal and Rajkot, Government websites like agmarknet portal and annual reports. The exponential function \( Y = ab^t \) was fitted to the data to compute the compound growth rates. Methodology adopted by Sitarambabu et al. (2014)

\[
\text{Compound growth rate (r)} = (\text{antilog b -1}) \times 100
\]

**Trend in yearly prices**

The movement of price over the period would be positive as well as negative. The trend in annual prices was analyzed with the help of following models. Therefore, to know changes in price over the period, trend in yearly prices was analyzed. The trend in annual prices was analyzed with the help of following models. Methodology adopted by Pawar and Misal (2004)
Methodology

**Linear and Quadratic models**

Following two models is employed.

\[
P_t = \beta_0 + \beta_1 T + U \quad \text{(Model 1)}
\]

\[
P_t = \beta_0 + \beta_1 T + \beta_2 T^2 + U \quad \text{(Model 2)}
\]

Where,

\[P_t = \text{yearly index numbers of average prices}\]

\[T = \text{Time (1, 2, 3 \ldots 15)}\]

\[U = \text{Disturbance term with usual assumptions, and, } \beta_0, \beta_1, \beta_2 \text{ are parameters to be estimated.}\]

Adjusted coefficients of multiple determination \((R^2)\) was worked out using the following formula for above models for all the groundnut, sesame and garlic market under study,

\[
R^2 = 1 - \frac{(1 - R^2)(T-1)}{T-K-1}
\]

Where,

\[R^2 = \text{Adjusted coefficients of multiple determination.}\]

\[T = \text{Number of observations.}\]

\[K = \text{Number of independent variables.}\]

The measurement of instability in time series data requires an explicit assumption of what constitutes the acceptable and unacceptable components. A systematic component which can be predicted does not constitute instability and hence, it should be eliminated from the data. The remaining unpredictable component represents the variability. In this study the instability in price and arrival of groundnut, sesame and garlic crops are measured in relative terms by the Cuddy-Della Valle index which is used in recent years by a number of researchers as a measure of variability in time series data. The simple coefficient of variation over estimates the level of variability in time-series data characterized by long-term trends whereas the Cuddy-Della Valle index corrects the coefficient of variation. The instability index \((IX)\), is given by the expression. Methodology adopted by Sitarambabu *et al.* (2014)
IX = CV \( (1 - R^2)^{1/2} \)

Where, CV = Coefficient of variation (in percent)

\( R^2 = \) Coefficient of determination from a time trend regression adjusted by the number of degrees of freedom.

### 3.4.2 Seasonal variation

To analyse the seasonality in prices, there are many methods namely moving average method, link relative method, percentage to trend method were tried but moving average method gave stable, clear and definite seasonal variations and therefore this method was used. The relative seasonal fluctuations were calculated after eliminating the trends, cycle and irregular fluctuations with the help of following equation. Methodology adopted by Rao et al. (2014)

\[
\frac{T \times C \times S \times I}{T \times C} = \text{Adjusted specific seasonal index}
\]

Where, \( Y = \) original data on yearly groundnut/sesame/garlic market prices

\( T = \) trend component

\( S = \) Seasonal variations

\( C = \) Cyclical component

\( I = \) Irregular variations

In this method firstly the effect of trend and cyclical variations \((T \times C)\) were removed from time series to get adjusted specific seasonal indices. Thus,

\[
\frac{T \times C \times S \times I}{T \times C} \times 100 = \text{Adjusted specific seasonal index}
\]

Then the monthly averages of these adjusted specific indices were worked out to remove the irregular fluctuations and showing general pattern of seasonal variations alone. The monthly averages of all these months divided by average of monthly averages to estimate the seasonal indices. Similar methodology adopted by Rao et al. (2014)
Monthly average each month

Seasonal indices = \frac{\text{Average of monthly averages}}{\times 100}

3.4.3 Co-integration Analysis

The most widely used tests for unit roots are the Dickey-Fuller (DF) test and the Augmented Dickey-Fuller test (ADF). Both tests test the null hypothesis that the series has a unit root or in other words, it is not stationary. Similar methodology was adopted by Beag and Singla (2014).

\[ \Delta Y_t = \beta_t + \delta Y_{t-1} + U_t \]

Where, \( \Delta Y_t = (Y_t - Y_{t-1}) \); \( Y_t = \ln Y_t \)

The ADF test is run with the following equation,

\[ \Delta Y_t = \beta_t + \delta Y_{t-1} + \alpha_t + \sum_{i=1}^{\alpha} \Delta Y_{t-i} + \epsilon_t \]

Where, \( \Delta Y_t = (Y_t - Y_{t-1}) \); \( \Delta Y_{t-1} = (Y_{t-1} - Y_{t-2}) \)

\( Y_t = \text{Price} \) and \( Y_t = \text{Arrival} \)

The extent of integration was determined whether the prices of groundnut/sesame/garlic markets are in parity with the different markets. Co-integration between the prices of the major markets were evaluated by regressing the prices of groundnut/sesame/garlic in different markets. The basic relationship that is commonly used to test for the existence of market integration is

\[ P_{it} = \alpha_0 + \alpha_1 P_{jt} + \epsilon_t \]

Where, \( P_i \) and \( P_j \) = Price series of a specific commodity in two markets \( i \) and \( j \)

\( \epsilon_t = \text{Residual term} \)

Johansen (1988) has developed a multivariate system of equations approach, which allows for simultaneous adjustment of both or even more than two variables. Johansen’s approach is also widely used in many bivariate studies as it has some advantages to the single equation approach.
3.4.4 Granger causality test

In order to know the direction of causation between the markets, Granger causality test was employed. When co-integration relationship is present for two variables, a Granger causality test can be used to analysis the direction of this co-movement relationship. Granger causality tests come in pairs, testing weather variable $X_t$ Granger-causes variable $Y_t$ and vice versa. All permutations are possible viz., univariate Granger causality from $X_t$ to $Y_t$ or from $Y_t$ to $X_t$, bivariate causality or absence of causality. The Granger causality test analyses price and arrivals of groundnut, sesame and garlic. Similar methodology was adopted by Beag and Singla (2014).

\[ P \ln D_t = \sum_{i=1}^{m} \alpha_i P \ln D_{t-i} + \sum_{j=1}^{m} \beta_j P \ln A_{t-j} + \varepsilon_{1t} \quad \ldots \ldots \quad (1) \]

\[ P \ln A_t = \sum_{i=1}^{m} \gamma_i P \ln A_{t-i} + \sum_{j=1}^{m} \delta_j P \ln D_{t-j} + \varepsilon_{2t} \quad \ldots \ldots \quad (2) \]

Where, $D$ and $A$ are Gondal and Rajkot markets, $P$ in stands for price series in logarithm form and $t$ is the time trend variable. The subscript stands for the number of lags of both variables in the system. The null hypothesis in Equation (1), i.e. $H_0: \beta_1 = \beta_2 = \ldots = \beta_j = 0$ against the alternative, i.e., $H_1$: Not $H_0$, is that $P$ in $A_t$ does not Granger cause $P$ in $D_t$. Similarly, testing $H_0: \delta_1 = \delta_2 = \ldots = \delta_j = 0$ against $H_1$: Not $H_0$ in Equation (2).