Chapter - 3

RESEARCH DESIGN

Research design deals with the introduction, statement of the problem, objectives of the study, hypotheses of the study and the methodology adopted for the study. The methodology comprises of nature of the study, period of the study, data required for the preparation of the thesis and the sources, various statistical tools adopted for the analysis of data etc.

3.1 Introduction

Agriculture is a key sector occupying an important position in the Indian economy. The agriculture sector constitutes around 17 percentage of India’s Gross Domestic Product (GDP). The effective contribution of agriculture to the national economy is far greater on account of its backward and forward linkage with other sectors. The Govt. policy has been to protect and promote the agriculture sector through procurement and administered price mechanism. However, in view of reduced direct support to agriculture under the agreement on agriculture with the World Trade Organization (WTO), there is a policy shift towards market oriented approach. In recent years, a major theme of economic liberalisation and reforms in agriculture sector is improvement in the functioning of product markets. It is increasingly felt that efficient product markets serve to further the interests of agriculture sector.

Historically, the Government has intervened at every stage of the marketing of major agricultural commodities. Minimum support prices were announced for 21 commodities and every activity of marketing such as transportation, storage, credit supply and international trading of these commodities was regulated. Government intervention accelerated with the implementation of the Agreement on Agriculture under the World Trade Organization (WTO). Prices of agricultural commodities are determined increasingly by market forces; hence fluctuating demand and supply of agricultural commodities is expected to result in high price risk for agri-business.

In a competitive market, price behaviour of a commodity is determined mainly by
demand supply. A disequilibrium movement in demand and supply results in price
volatility. In the case of agricultural commodities such as rubber, pepper and
cardamom supply variability is high as production in a geographical area is affected
by natural factors such as weather, pests and diseases. To help manage price risk, the
commodity derivatives play a significant role.

A key aspect of the process of strengthening agricultural markets is the question of
obtaining efficient derivative market for commodities. If derivative markets function
adequately, some of the policy goals regarding price volatility of agricultural
commodities can be addressed in a market oriented manner. The National
Agriculture Policy (2000) has articulated this reasoning well and the ban on futures
trading was lifted for all commodities in April 2003. Domestic entities facing price
risk abroad are permitted to utilize foreign derivative markets to address their price
risk management need.

A peculiar institutional feature of commodity markets in India is that there is no
large nationwide market for any commodity. Instead, there are multiple, isolated,
independent, regional markets for many commodities. An apt description of
commodity markets in India is that they are highly fragmented. As a result,
commodity futures markets in India too are dispersed with separate trading
communities in different regions.

Futures trading help in hedging the price risk and in price discovery. Futures trading
are recommended as a suitable system to reduce abnormal price fluctuations.
International experts feel that the real price can be determined only in an open
system of trade like futures trading. In a closed, spot/cash purchase system, the
consumer cannot enter into a rubber contract for their future requirements, as no
trader would take the risk of predicting the future price on his own.

In futures trading, as the view and expectations of many participants are reflected, a
fair price discovery is possible. Through the on-line commodity exchanges, the
producers, traders and processors, exporters and importers get an on-line platform
for price risk management. It also provides them an opportunity to hedge their
positions as per their views on the prices of the respective commodity.
Farmers of primary commodities in developing countries like India, face substantial income risk due to price fluctuations. Apart from the price-support schemes from the Government, a number of alternative market based techniques like storing of harvested output during a low price period and selling it during high price period are used. A relatively new technique is to hedge price risks on futures exchanges.

In futures trading, any trader across the country, who has varied interests and equal access to live market information, negotiate on a single electronic platform. Price discovery occurs in the course of trading, wherein all orders and bids are entered into a single electronic book. A computer screen based trading system, with anonymity of the counterparty is used. Since the two parties to the transaction trade anonymously, the exchange provides a guarantee that the contract will be honoured and thus eliminates counterparty risk.

The commodity futures market in India has tremendous potential to grow. The removal of restrictions on commodity futures trading, the setting up of automated demutualised multi-commodity exchanges and the rise in trading volume, with a collective daily turnover of around Rs.4,000 crores, amply demonstrates the market’s potential.

Futures trade assumes significance in a volatile ready market and price risk management because of the price discovery. The price discovery is the process of determining the price of a commodity, based on supply and demand factors. The expectations theory hypothesizes that the current futures price is a consensus forecast of the value of the (spot) price in the future. For example, today’s 180 day pepper futures rate is a market forecast of the ready rate that will exist in 180 days. The efficient market ensures that the average difference between today’s futures rate (with n day maturity) and the subsequent ready rate n days later was zero. The difference, if any, represents both the futures rate’s forecasting error and the opportunity for gain (or loss) from open positions in the market. The efficiency of the futures market is usually examined by testing the unbiasedness of futures rate as a predictor of the future ready rate.

To reduce the violent fluctuations in price and to stabilize the prices, artificial means like regulated market and buffer stocking can be used. But the regulations of the
World Trade Organization restrict the Government regarding control over trade. In such situations, international bodies under the U.N. recommend futures trading as a panacea to protect the poor farmers from the vagaries of price fluctuations. India, being an agrarian economy, is subjected to the vagaries of rain and therefore not only the production of farm products is affected, but the spot prices and future prices are adversely affected. Introduction of futures markets in agricultural commodities is expected to provide the farmers with an indicator of future prices, which would help them to make production decisions as well as to lock the spot prices for future deliveries.

The problems and prospects of the agriculture sector and commodities derivative market can be analysed from the following viewpoints.

(i) What is the significance of the plantation and spices sector in our agriculture dominated country?

(ii) What is the present status of the commodity derivatives market in India?

(iii) Has derivative markets help price discovery and risk management?

3.2 Statement of the problem

In India the forward trading of commodities was started from 1875, and it was reintroduced in 2003 after a long period of ban. Now there are six national level multi commodity exchanges and they are trading 113 commodities in India. After the reintroduction of futures trading there is a substantial growth in the commodities market. There is a positive relation between the size of the derivatives market and the involvement of participation in the market. A stable and relevant market attracts a high participation from people. The structure of Indian commodity market is a three tier regulating system. They are Department of Economic Affairs (DEA), Forward Markets Commission (FMC) and National level Multi Commodity Exchanges. Now the FMC is merged with Securities Exchange Board of India (SEBI).

There are various organised and unorganised exchanges in India dealing futures trading in commodities. At present India has six national exchanges and these are facing various problems in their working. Some of the problems are, low awareness
of futures markets among participants, high transaction costs, few and widely dispersed delivery centers, high settlement costs, unreliability of warehouse receipts, mismatch between the grade specified in the futures contract and what is available in the market for delivery etc.

Price discovery is a fundamental function of the derivatives market and also one of the core objectives of national level commodity exchanges. Price discovery means there is a long term relationship between the spot and futures prices of commodities. If the spot and futures prices are cointegrated it can be concluded that the prices are determined by demand and supply and viceversa. There were too many studies in the agricultural sector, gold, bullion and energy about the aspect of price discovery. However, there are no studies related to the plantation sector.

Hedging is one of the main functions provided by futures market and also the reason for the existence of futures markets. There are different views on the effectiveness of commodity derivatives for hedging. Hedging is the process of eliminating the risk by holding an offset position in the other market. Here the risk in the spot market can be reduced by a counter action in the futures market. The studies in this field covers the stock market, agricultural commodities, crude oil and gold etc. However, there are no studies relating to the plantation sector.

The market structure and price mechanism of the cardamom, pepper and rubber are entirely different. The effectiveness of futures in price discovery and hedging may vary accordingly. These three commodities have remarkable influence in the international market.

In this context it becomes necessary to conduct a study on the commodity derivatives market in India.

3.2 Objectives of the study

1. To study the growth and structure of commodity derivatives market in India.
2. To study the operation of the derivatives exchanges and identify the problems in their working.
3. To analyse the extent to which the commodity futures markets help price discovery.
4. To study the hedging performance of commodity futures.
5. To study the commodity wise difference of price discovery and hedging in cardamom, pepper and rubber.

3.3 Hypotheses of the study

1. The growth and structure of the commodity derivatives markets is determined by the involvement of the participants.
2. The derivative exchanges increased the growth of the commodity derivatives market.
3. There is a positive relation between the spot and future prices of plantation commodities, that is, it reveals the presence of price discovery.
4. The changes in future prices of commodities affects in spot price correspondingly.
5. The effectiveness of the futures differs with reference to different commodities namely cardamom, pepper and rubber.

3.4 Methodology of the study

The methodology of study includes the nature of the study, period of the study data required sources of data, tools adopted for the collection of data, statistical tools applied for the analysis of data etc.

3.4.1 Nature of the study

The study is descriptive and analytical in nature. It is descriptive with regard to the structure and working of the exchanges. Here the fact finding investigation is done and makes an analysis and interpretation of the existing conditions. The descriptive study helps to identify the relationship between current and non manipulated variables. The outcome of a descriptive study is the formulation of a policy in solving a problem. It is also analytical in nature. The study uses the prices of spot and near month futures, volume and value of trade, and GDP are analysed by using numerical data.
3.4.2 Period of the study

The period of the study covers twelve years from January 2003 to December 2014.

3.4.3 Data Required

i. Closing price of Ribbed Smoked Sheets (RSS4) Futures for the period March 2003 to December 2014.

ii. Closing price of Pepper (PMG1) Futures for the period April 2004 to 15th March 2014.

iii. Closing price of Cardamom (7mm) Futures for the period February 2006 to December 2014.


vii. Data relating to the value of commodity derivatives and futures market.

viii. Data relating to futures prices and volume.

ix. Profile of the six multi commodity exchange- National Multi Commodity Exchange of India Ltd (NMCE), National Commodity and Derivatives Exchange (NCDEx), Multi commodity exchange of India Ltd (MCx), Indian Commodity Exchange (ICEX), Ace Derivatives and Commodity Exchange, and Universal Commodity Exchange Limited (UCX).

x. Data relating to the area, production, export and import of Rubber, pepper and Cardamom.

xi. The GDP of India from 2002-03 to 2014.

3.4.4 Data Sources

i. The daily closing spot and future price of rubber are collected from the website of National Multi Commodity Exchange.

ii. The daily closing spot and future price of pepper were collected from the website of National Commodity and Derivatives Exchange.
iii. The daily closing spot and *futures* price of cardamom had been collected directly from Multi Commodity Exchange of India ltd. Kochi.

iv. The volume and value of trade of various national and regional exchanges were collected from the web sites of Forward Markets Commission.

v. The information relating to the area and production of three commodities has been obtained from the Rubber Board Kottayam and Spices Board Kochi.

vi. The export and import of rubber, pepper and cardamom were collected from the Export Import data bank of Ministry of Commerce and Industry.

vii. The data relating to the GDP of India were obtained from the data bank of the World Bank.

3.4.5 Data collection tools

Data relating to future prices, spot prices and volume were collected from the informal discussions with senior executives of multi commodity exchange Cochin, Geojit BNB Pariba Kottayam, Rubber Board Kottayam, spices Board Cochin, Indian Pepper and spices Trade Association (IPSTA) Cochin, websites of various commodity exchanges and Director General of commercial intelligence and statistics Kolkata were conducted to collect primary and secondary data.

3.4.6 Data Analysis

The present study is based on the spot and *futures* prices of rubber, pepper and cardamom for a period of 12 years. These prices have been collected from the websites of three national level multi commodity exchanges namely NMCE, NCDEX and MCX. The daily closing values of spot and future prices of commodities have been taken into account. The total numbers of observations are 2639 in cardamom, 2968 in rubber and 3328 in case of rubber. The data were analysed with the help of econometrics techniques.

In order to reduce the highly fluctuations in the actual price of commodities it is better to compute the natural log of prices of commodities. The natural log prices of commodities were taken as the level form of data series. Before applying any econometrics analysis it becomes necessary to test the unit root of time series data.
Here the unit root is tested by using Augmented Dickey Fuller Test (ADF) and Philips Perron (PP) Test. These two basic econometrics tests were applied in two forms namely with trend and with trend and intercept level. The results indicate that there exists a unit root in the level form of data therefore it becomes non stationary series. So in order to eliminate the presence of unit root or for converting the non stationary series into stationary the return series of natural log were computed. So this is known as the first difference of data series. The return can be calculated as:

\[
\text{Return} = \ln\left( \frac{P_t}{P_{t-1}} \right)
\]

Where \( \ln \) = Natural Log
\( P_t \) = Price of today
\( P_{t-1} \) = Price of yesterday.

The return series if found to be stationary in two aspects namely with trend and with trend and intercept level.

The Johansen’s cointegration test can be applied to determine the existence of a long-run relationship between economic variables. From the statistical point of view, a long-term relationship means that the variables move together over time so that short-term relationship disturbances from the long-term trend will be corrected. The basic idea behind cointegration is that, if in the long run two or more series move closely together, even though the series themselves are trended, the difference between them is constant. It is possible to regard these series as a long-run equilibrium relationship, as the difference between them is stationary.

If the data series are to be cointegrated it is mandatory to apply the Granger causality test. This test explains about the fact that whether the future price causes the spot price or spot price causes the future price.

Ordinary Least Squares is the simplest model of the OLS regression, which is just a linear regression of change in spot prices on change in futures prices. In this method changes in spot price is regressed on the changes in futures price. The Minimum Variance Hedge Ratio has been suggested as slope coefficient of the OLS Regression. It is the ratio of covariance of (spot price, futures price) and variance of (futures prices). The R-square of this model indicates the hedging effectiveness. The OLS equation is given as:
\[ R_{St} = \alpha + H \times R_{Ft} + \epsilon_t \]

Where \( R_{St} \) = Return of spot at time \( t \),
\( \alpha \) = Constant
\( H \) = Hedge ratio
\( R_{Ft} \) = Return of future at time \( t \)
\( \epsilon_t \) = Error term

Vector Auto Regressive Model (VAR) test is applied on the time series data while using the econometrics applications. This test measures the relationship between two series, namely, the return of daily closing spot prices and futures prices. Here the return of spot and futures prices of cardamom, pepper and rubber were taken as the endogenous or dependent variable and return of futures prices of cardamom, pepper and rubber were taken as the exogenous or independent variable. While applying this test the estimation and conclusion are difficult because the dependent variables may influence on both sides of the equation that is left and right. This problem may lead to alternative non structural approaches to model the relationship among other variables.

The Vector auto Regression (VAR) model is popularly used for estimating systems of interrelated time series and for calculating the influence of random disturbances on the systems of variables. The VAR approach includes the need for structural modeling by considering the each dependent variable in the system is a function of the lagged values of all of the dependent variable in the system. The bivariate Vector auto Regression (VAR) model enjoys a preference than the Ordinary Least Squares (OLS) method because VAR excludes the problem of autocorrelation.

The equation of the VAR is,

\[ R_{St} = \alpha_S + \sum_{i=1}^{k} \beta_{St} R_{St-1} + \sum_{j=1}^{l} \gamma_{Fj} R_{Fj-1} + \epsilon_{St} \]

\[ R_{Ft} = \alpha_F + \sum_{i=1}^{k} \beta_{Ft} R_{Ft-1} + \sum_{j=1}^{l} \gamma_{Sj} R_{Sj-1} + \epsilon_{Ft} \]
Where $R_{St}, R_{Ft} =$ Return of spot and futures at time $t$

$\alpha_S, \alpha_F =$ Constant of spot and futures

$H =$ Hedge ratio

$R_{Ft} =$ Return of future at time $t$

$\varepsilon_{St}, \varepsilon_{Ft} =$ Error term of spot and futures

In order to calculate the hedge ratio and hedging effectiveness the above equation is solved and errors are estimated.

The Vector Error Correction Model (VECM) follows the same method as per the VAR model. One of the differences in this method is that the VECM is applied on the data if the two series are to be co-integrated. The VAR model does not take into account that the possibility of the dependent variables may be co-integrated in the long run. If the spot and future series of prices are co-integrated in the long run, the VECM model is to be applied.

In this study the natural log values of spot and future prices are used for the analysis of cointegration. The Johansen’s Cointegration test is applied on the prices of cardamom, pepper and rubber. The result obtained by applying the cointegration test is that the spot and future prices of pepper and rubber are to be co-integrated. So the Vector Error Correction Model (VECM) is applied to find out whether there exist a short run relationship between the spot and future prices of pepper and rubber.

The equation of VECM is as follows.

$$R_{St} = \alpha_S + \beta_S S_{t-1} + \gamma_F F_{t-1} + \sum_{i=2}^{k} \beta_{Si} R_{St-i} + \sum_{j=2}^{l} \gamma_{Fj} R_{Ft-j} + \varepsilon_{St}$$

$$R_{Ft} = \alpha_F + \beta_F S_{t-1} + \gamma_S F_{t-1} + \sum_{i=2}^{k} \beta_{Fi} R_{Ft-i} + \sum_{j=2}^{l} \gamma_{Sj} R_{St-j} + \varepsilon_{Ft}$$

VAR MGARCH Model is applied to study the hedging performance of cardamom, pepper and rubber the relationship between their spot price and future price were studied using bivariate linear regression model. The two variables used are the the
return of spot and futures prices so as to obtain the stationary series. The return of daily closing spot prices are taken as dependent variable and return of daily closing futures prices are taken as the independent variable.

\[
R_{St} = \alpha_S + \sum_{i=1}^{k} \beta_{St} R_{St-1} + \sum_{j=1}^{l} \gamma_{Fj} R_{Fj-1} + \varepsilon_{St}
\]

\[
R_{Ft} = \alpha_F + \sum_{i=1}^{k} \beta_{Ft} R_{Ft-1} + \sum_{j=1}^{l} \gamma_{Sj} R_{Sj-1} + \varepsilon_{Ft}
\]

\[
\begin{bmatrix}
  h_{ss} \\
  h_{sf} \\
  h_{ff}
\end{bmatrix} =
\begin{bmatrix}
  C_{ss} \\
  C_{sf} \\
  C_{ff}
\end{bmatrix} +
\begin{bmatrix}
  \alpha_{11} \alpha_{12} \alpha_{13} \\
  \alpha_{21} \alpha_{22} \alpha_{23} \\
  \alpha_{31} \alpha_{32} \alpha_{33}
\end{bmatrix}
\begin{bmatrix}
  \varepsilon_{s}^2 \\
  \varepsilon_{f}^2
\end{bmatrix}
+ \begin{bmatrix}
  \beta_{11} \beta_{12} \beta_{13} \\
  \beta_{21} \beta_{22} \beta_{23} \\
  \beta_{31} \beta_{32} \beta_{33}
\end{bmatrix}
\begin{bmatrix}
  h_{ss} \\
  h_{sf} \\
  h_{ff}, t-1
\end{bmatrix}
\]

where, \(h_{ss}\) and \(h_{ff}\) are the conditional variance of the errors \(\varepsilon_{st}\) and \(\varepsilon_{ft}\) and \(h_{sf}\) is the covariance.

\[
h_{ss,t} = C_{ss} + \alpha_{ss} \varepsilon_{st-1}^2 + \beta_{ss} h_{ss,t-1}
\]

\[
h_{sf,t} = C_{sf} + \alpha_{sf} \varepsilon_{st-1} \varepsilon_{ft-1} + \beta_{sf} h_{sf,t-1}
\]

\[
h_{ff,t} = C_{ff} + \alpha_{ff} \varepsilon_{ft-1}^2 + \beta_{ff} h_{ff,t-1}
\]

\[
H_t = \frac{h_{sf,t}}{h_{ff,t}}
\]

The residual of the regression level of commodities exhibit conditional heteroscedasticity because small variations generate small variations and large variations generate large variations. Hence in order to find out the reason for the volatility of return of spot prices, GARCH (1 1) Model was applied.
3.4.7 Limitations of the study

1 The present study is primarily based on the secondary data collected from various exchanges.

2 The study is limited to three commodities namely cardamom, pepper and rubber.

3 The study covers the daily closing spot and near month futures prices of cardamom, pepper and rubber.

4 The various aspects of commodities cultivation, procurement, harvesting, warehousing and marketing etc., have not been considered in detail as the study is mainly concentrated on the impact of futures trading on cardamom, pepper and rubber.