EXPORT AND PRICE BEHAVIOUR OF CASHEWNUT IN INDIA

By

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THESIS

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DECLARATION

I, hereby declare that the thesis entitled **"Export and price behaviour of cashewnut in India"** is a bonafide record of research work done by me during the course of research and that it has not been previously formed the basis for the award to me of any degree, diploma, fellowship or other similar title, of any other University or Society.

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Certified that this thesis entitled **"Export and price behaviour of cashewnut in India"** is a bonafide record of research work done independently by **Ms. Jeethu M. Gopalan** under my guidance and supervision and that it has not formed the basis for the award of any degree, diploma, fellowship or associateship to her.

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ABBREVIATIONS

ACF – Autocorrelation Function

AIC – Akaike Information Criteria

ANN – Artificial Neural Network

ARIMA – Auto Regressive Integrated Moving Average

CGR – Compound Growth Rate

CV – Coefficient of Variation

DES – Double Exponential Smoothing

c & f – Cost and freight

MAD – Mean Absolute Deviation

MAE – Mean Absolute Error

MAPE – Mean Absolute Percentage Error

MSD – Mean Squared Deviation

MSE - Mean Squared Error

NPC – Nominal Protection Coefficient

PACF – Partial Autocorrelation Function

SBC – Schwartz Bayesian Criterion

SES – Single Exponential Smoothing

Introduction

1. INTRODUCTION

Cashew (*Anacardium occidentale L.*) belonging to the family Anacardiaceae is considered to be a native to the northern part of South America (Brazil). The English name cashew is derived from the Portugese name ‘Caju’ which in turn came from the Tupi-Indian word ‘acaju’. Cashew was introduced to India by the Portugese in the 16^{th} century and was spread along the laterite hill slopes in the western areas from Bombay to Cape Comorian and to the sandy soils on the eastern coast as well as over inland areas in the southern states. Today, India among the 28 cashew growing countries, is the largest area holder, processor and importer of cashewnuts. India holds a major share of 45 to 54 percent in the global trade from 24 percent of its cashew area. The Indian cashew industry, apart from being a prominent national exchequer, also provides sustainable employment opportunities to 5.5 lakh workers annually, mostly women. Inspite of the domestic production of over 6 lakh tonnes, India depends heavily on import of raw nuts from Asian and African countries like Tanzania, Guinea Bissau, Indonesia, Mozambique etc. for its processing industry.

1.1 Global Scenario of Cashew

Cashew is grown in India, Brazil, Vietnam, Tanzania, Mozambique, Indonesia, Sri Lanka, and other tropical Asian and African countries. India with a cashew area of 9.23 lakh ha is the largest area holder in the world. This is followed by tropical African nation Cote d’ Ivoire (8.6 lakh ha) and Brazil (7.52 lakh ha).

Vietnam with an area of 3.4 lakh ha and a total production of 11.59 lakh tonnes has now surpassed India to emerge as the largest cashew producer. India with 6.13 lakh tonnes holds the second position in terms of global production and contributes to 17.5 per cent of it (FAO STAT, 2009). Nigeria stands third with a total production of 5.94 lakh tonnes. The global situation of cashew in 2009 is as shown in Table 1.1.

Table 1.1 Area, production, productivity of cashew in the world

Country	Area (ha)	Production (MT)	Productivity (Kg/ha)
Benin	243900	69700	285.7
Brazil	752021	102002	135.6
Cote d'Ivoire	860000	370000	430.2
Ghana	59000	28400	481.3
Guinea Bissau	240500	91100	378.7
India	923000	613000	664.1
Indonesia	309900	174300	562.4
Kenya	30000	8600	286.6
Madagascar	16500	6200	375.7
Malaysia	7500	12400	1653.3
Mozambique	77000	67200	872.7
Nigeria	330000	594000	1800
Philippines	28134	134681	4787.1
Senegal	16200	5700	351.8
Sri Lanka	22710	6490	285.7
Thailand	23847	37857	1587.4
Vietnam	340300	1159600	3407.5
Others	27793	20417	734.6
Total	4308305	3501647	812.7

Source; FAOSTAT, 2009

The world production of cashew in 2009 is estimated to be around 35.01 lakh tonnes. Between the period 1980 and 1995, the world raw nut production has increased from 4.22 lakh tonnes to 8.78 lakh tonnes registering an increase of 108 per cent and though the growth rate has been fluctuating during 1995-2000, it shows an increase by 40 per cent since 2000 (Bhat, 2009). While raw nut production in South East Asian countries has registered 10-fold increase since 1980, Latin American countries have shown a three-fold increase during the same period. Today, India is the largest importer of cashewnuts in the world. Bulk of imported nuts coming from African nations are processed and re-exported as kernels to the American and European zone.

India, which enjoyed monopoly in International cashew kernel trade now faces stiff competition from Vietnam and Brazil.

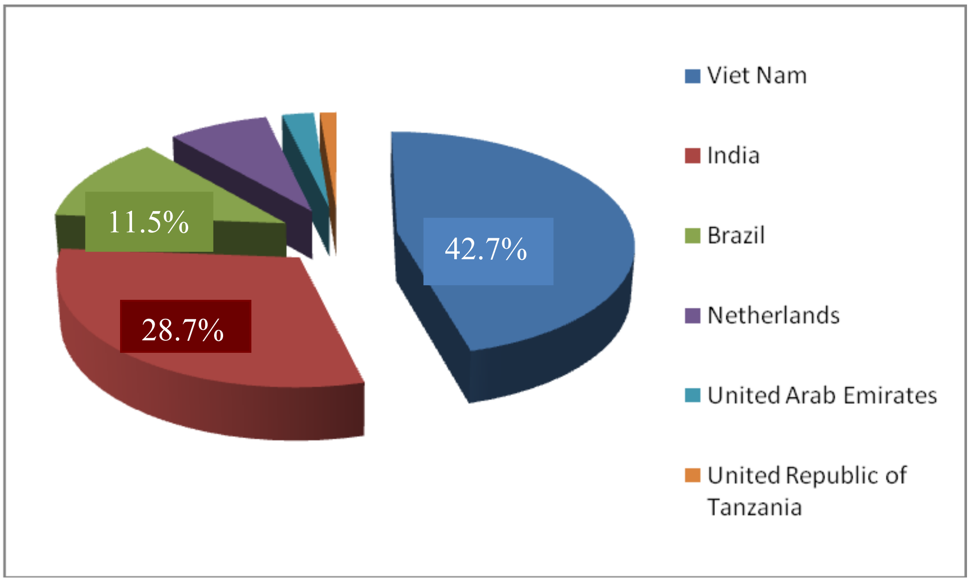

Fig. 1.1 Top Exporters of Cashew kernels (FAOSTAT, 2009)

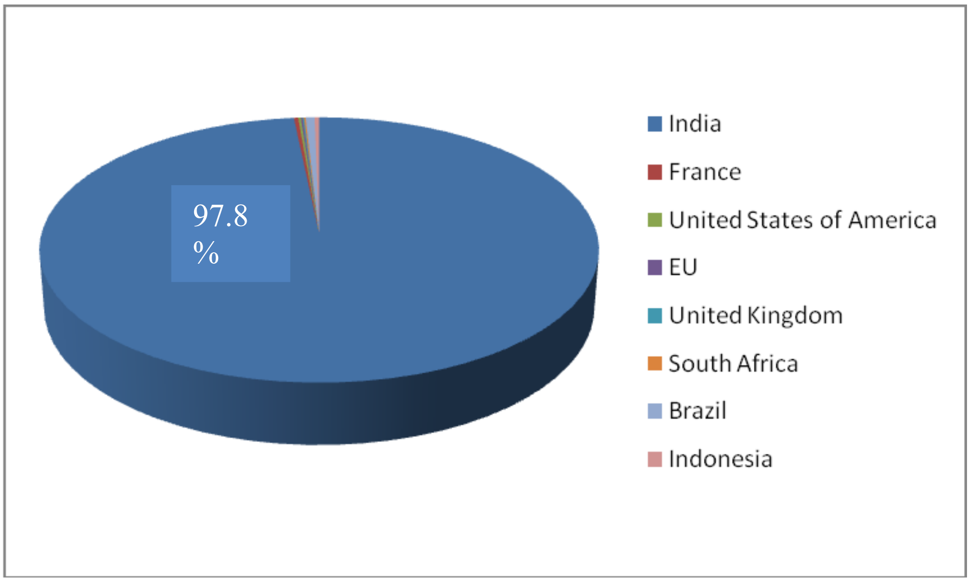

Fig. 1.2 Top Importers of Cashewnuts (FAOSTAT, 2009)

1.2 Indian Cashew Scenario

In India, cashew is grown mainly in Maharashtra, Goa, Karnataka and Kerala along the west coast and Tamil Nadu, Andhra Pradesh, Orissa and West Bengal along the east coast. Maharashtra, the leading producer among the states with an area of 181000 ha and production of 208000 MT has the highest productivity of 1149 kg per ha. Kerala despite its low area (78000 ha) has a productivity of 910 kg per ha, among the highest in the country. The cultivation and promotion of cashew in non-traditional areas of Chattisgarh, West Bengal and North Eastern states like Meghalaya, Tripura, Manipur and Nagaland is really significant.

Table 1.2 Area, production, productivity of cashew in India

State	Area (ha)	Production (MT)	Productivity (Kg/ha)
Kerala	78	71	910
Karnataka	119	57	478
Goa	56	24	428
Maharashtra	181	208	1149
Tamil Nadu	135	65	481
Andhra Pradesh	183	107	584
Orissa	149	91	610
West Bengal	11	11	1000
Others	33	19	575
Total	945	653	691

Source: DCCD, Kochi (2010-11)

India has been earning sizeable foreign exchange by exporting cashew kernels and has had a pre-eminent position in the global cashew trade. The major buyers of Indian cashew are United States, United Kingdom, Japan and the Middle East. While export earnings from cashew have been increasing over the years, raw nut imports have also been increasing to meet the demands of cashew industry. But it is ironical that even with imports of around 5 lakh tonnes, the requirements of the cashew industry are still not met. Hence, increasing domestic production would not only meet the export needs but would also create a competitive edge to the Indian kernels in the International trade environment. By analyzing the temporal and spatial variations in the price of cashewnut, the present study would ensure remunerative price for farmers' produce and thereby help the industry to turn out their operations for better economic returns to remain competitive in the international trade.

1.3 Objectives of the Study

The present study entitled 'Export and price behavior of cashewnut in India' is undertaken with the specific objectives of examining the export behaviour and analyzing the secular trend, seasonality, cyclical and irregular movements in the price of cashewnut in India and to evolve a reliable price forecasting model.

1.4 Scope of the Study

Cashewnut is a commodity of commerce and Kerala has been the nucleus center of cashew trade in India as the market price in Kerala is considered to be the benchmark price in other states. Reliable price information is an urgent need for all stakeholders as cashewnut exhibits high price volatility. In the above context, market intelligence assumes much significance as it would be helpful for the cashew farming community in planning their operations in an economically viable manner either immediately or in the long term. This would also help the exporters to study the trade scenario and plan appropriately.

1.5 Limitations of the Study

Cashewnut being a seasonal commodity, market transactions are restricted to the period from February to June. Due to the non-availability of monthly cashew nut prices for the whole year, the analysis of the present study has been carried out using monthly average cashew kernel prices from various sources. Also, the analysis is purely based on price of cashew kernels alone. A multivariate analysis including factors like prices of other edible nuts like almonds, pistachios, walnuts and exim policies concerning global cashew trade has not been attempted due to the non-availability of data.

1.6 Presentation of the Study

The study is organized in to five chapters including the present one. Chapter two presents review of literature relevant to the study. The third chapter deals with brief description of the methodological aspects, analytical tools and conceptual issues. The results of the study and discussion of the findings are presented in chapter four. The fifth chapter summarizes the major findings and conclusions drawn from the analysis, along with the policy implications thereof.

Review of Literature

2. REVIEW OF LITERATURE

The literature review is a critical discussion and summary of literature that is of relevance to the particular area of research and helps to justify the proposed methodology. In this chapter an attempt has been made to review the important past studies relevant to the present study from the point of view of objectives as well as methodology. The review of literature is presented under the following heads:

2.1 Growth Rate and Trend Analysis

2.2 Export Behaviour and Export Competitiveness

2.3 Price Behaviour

2.3.1 Secular Price Movements

2.3.2 Seasonal Price Movements

2.3.3 Cyclical Price Movements

2.3.4 Irregular Price Movements

2.4 Forecasting Models

2.5 Market Integration

2.1 Growth Rate and Trend Analysis

Anonymous (1986) reported that the yield rate in cashew has been declining even though the area under cashew has increased. The decline has been from 664 kg per ha in 1963-64 to mere 77 kg per ha in 1978-79. Improvement of the existing plantation, introduction of new high yield varieties, application of fertilizers and plant protection chemicals to the young trees could revitalize the production.

Ashalatha (2000) in a study on growth rate of cashew in two periods Period-I, covering 1956-57 to 1970-71 and period-II, covering 1971-72 to 1998-99 observed that the growth rate of area, production, productivity, kernel export, raw cashew import, cashewnut shell liquid – unit value of export were showing positive trend but the cashew nut shell liquid quantity exported showed negative growth and non-significance due to the decline in the import of raw nuts (-0.75%) and decreased prices for Indian cashew in the world market during 1980-1990.

Mamatha *et al.* (2002) reported that the growth rate of cashew area has declined in Kerala (-4.32% per annum) due to conversion of cashew area into rubber plantations. The cashew production growth rates were positive and significant for Andhra Pradesh (10.16%), West Bengal (12.56%), Karnataka (7.72%), Tamil Nadu (12.84%) and Maharashtra (24.95%). The growth rate of production in Orissa was negative (-5.25%) and non-significant due to decline in the productivity. The productivity growth rate in Goa (-7.78%), Kerala (-0.96%), Orissa (-7.49%) and Tamil Nadu (-0.14%) have indicated negative and decreasing trend. The growth rate of area (5.20%), production (2.26%) and productivity (2.87%) at all India level show positive, significant and increasing trend.

The trend in production of sorghum in comparison with other competing crops in seven major sorghum growing states of India during the past two decades (1980-81 to 1998-99) was analysed by Rao et al. (2003) using the measure of

Compound Growth Rate (CGR). The analysis indicated a negative trend in the growth of production in all states under study except Maharashtra.

Velavan (2004) revealed that the world growth rate of area and production of cashew in the preliberalisation period (1980-81 to 1990-91) was higher than the post-liberalisation period (1991-92 to 2000-01). However, India's growth rate of cashew area was higher in postliberalisation period (4%) than the pre-liberalisation period (1.5%) but the production growth rate was slightly lower in the post-liberalisation (4.63%) than the pre-liberalisation period (4.82%). The import growth rate (20.89 %) of raw nuts in India was higher than the export growth rate of processed nuts (6.31 percent). This is due to the large-scale dependence on raw nuts to meet the domestic and export demand by India. The import growth rate of India was reduced drastically from 23.94 per cent per year in the preliberalization period to 7.07 percent in the post-liberalization period. The main reason for the reduced availability of raw nuts from South East Asia and other African countries is not only because of crop failure but also predominance of international competitors like Vietnam and Brazil.

Sebastian *et al.* (2004) studied the annual compound growth rate of area under cashew for the period 1952-53 to 1999-2000. The whole period was divided into two sub-periods; period-I and period-II comprising of the years 1952-53 to 1975-76 and 1976-77 to 1999-2000 respectively. CGR was highest (5.97%) in period-I as compared to the whole period (2.22%) and showed declining trend in period-II (-1.82%). A positive significant growth rate of production was noticed (3.76%) in period-I with stagnation in production growth rate (0.02%) in whole period and showing a declining trend (-1.18%) in period-II. The increase in area during first period has contributed to the increase in production by 3.76 per cent per annum. The negative productivity growth rate was registered in the whole period (-2.11%) as well as in period-I (-2.08%) with a low and positive growth rate recorded in period-II (0.87%). The production growth rate recorded a positive trend (2.62%) in period-I but a negative growth rate (-2.37%) in period-II. The productivity showed a decline in both period-I (-3.54%) and period-II (-0.76%).

2.2 Export Behaviour and Export Competitiveness

Rajashekharan and Radhakrishnan (1989) analysed the export performance of cashew and noticed that India's share in world cashew kernel export, which was almost one hundred per cent in 1950, declined sharply to 55 per cent in 1986. In 1987-88, their share further declined to 42 per cent. The main reasons were identified as non-availability of raw nuts, inadequate quantity and stiff competition from other countries like Brazil. They suggested that if the country is not to lose further, it is essential that raw nut production should be increased preferably by increasing the productivity.

Gulati *et al*. (1994) concluded that the commodities like rice, banana, grapes, sapota, leeches, onion, tomato and mushroom were highly competitive with Nominal Protection Coefficient (NPC) less than 0.75, while wheat, mango, potato and tomato paste were moderately competitive with NPC ranging between 0.75 to 1.00.

Palanichamy and Kumar (1994) analysed the performance of Cashew export in India and found that 68 per cent of variations in export are explained by the variables; export price, domestic price, domestic production and consumption.

Balasubramanian and Rema (1996) in a study on cashew nut export reported that the trend in export was found to be directly correlated to imports and a high correlation was found in such a way that for every tonne of kernel exported, 5 tonnes of raw nuts was imported. The dependence of cashew nut export trends on the international market price for kernels and on the foreign exchange rate of the Indian rupee was examined.

Mamatha (1996) calculated the Nominal Protection Coefficient's (NPC) for Indian coffee by taking United States coffee price as the reference price. The NPC of coffee types namely plantation, Arabica and Robusta under the exportable hypothesis were 1.3, 1.3, and 1.85 respectively in1995, indicating that Indian coffee exports were not competitive and it was not an efficient exportable commodity.

Behura and Naik (1997) observed that the contribution of India's cashew kernel to the global market was 60 to 70 per cent of the world cashew trade. The exports of cashew kernel from India has increased from 32,260 tonnes in 1981-82 to 69,680 tonnes in 1995-96 and registered a compound growth rate of 6.49 per cent. India's export position in the international market especially USA (the largest importer of Indian cashew kernels) was getting eroded by stiff competition from Brazil due to its close proximity to US market and also other tree nuts like almond, pistachios, walnuts. They are competing with cashew kernel in the global nut trade. Further, they reported that the domestic raw nut production and raw nut import have positive impact on the export of cashew kernel from India but domestic consumption has negative influence.

The export competitiveness of Indian cashew was analysed by Ashalatha (2000) using the Nominal Protection Coefficient. Under the exportable hypothesis, NPCs were found to be lesser than unity with an average value of 0.91, implying that Indian cashew kernel is competitive in the export market.

Sundaravaradarajan *et al.* (2001) indicated that the quantity of kernels exported and production of raw cashew showed desirable instability but instability in import of raw cashew was undesirable. They further suggested that suitable action should be taken to increase the domestic production of raw cashew nuts through developing high yielding varieties and infrastructure for post-harvest operations, warehousing and diversifying the market for cashew kernels by strengthening the non-traditional markets.

Jayesh (2001) used the Nominal Protection Coefficient technique for the export competitiveness of Indian pepper. Under the exportable hypothesis, the nominal protection coefficient value was found to be lesser than unity (0.849) in

Calicut and (0.817) in Sirsi markets, indicating that the Indian pepper is competitive in the international market and is an efficient export oriented commodity.

Rameshchand (2002) observed that the pepper export from India have average NPC value of 0.92, indicating marginal competitiveness of pepper.

Mruthyunjaya and Chauhan (2003) indicated that the average NPC of cashew kernel export from India was found to be less than unity (0.79), which indicated that the cashew kernels export from India were marginally competitive.

Bhat (2004) reported that India's imports of raw cashew nuts has increased from 4.01 lakh tonnes valued at Rs. 1231 crores in 2002-03 to 4.53 lakh tonnes valued at Rs. 1401 crores in 2003-04. The major countries, which have supplied raw nuts to India during 2003- 04, were Ivory Coast, Tanzania, Guinea-Bissau, Benin, Indonesia, Mozambique and Ghana supplying 87.11 per cent of total imports in terms of quantity and 88.81 per cent in terms of value. The export of cashew kernels from India was 1.01 lakh tonnes valued at Rs. 1804.40 crores in 2003-04. USA was the biggest buyer of Indian cashew kernel with 48503 tonnes valued at Rs. 881.6 crores followed by Netherlands (12237 tonnes valued at 210 crores), UAE (6239 tonnes valued at Rs. 102.4 crores) and Japan (5522 tonnes valued at Rs. 101.9 crores) during 2003-04. India had exported 6926 tonnes of cashew nut shell liquid valued at Rs. 7.03 crores during 2003-04; USA was also the largest buyer of Indian CNSL, which accounts for 6600 tonnes valued at Rs. 644.68 lakhs.

Guledgudda (2005) in his study on production and export performance of cashew reported that the import growth of raw cashewnut in pre-liberalisation period in terms of quantity, value and unit value was increasing and positively significant as compared to postliberalisation period. This was attributed to increase in the unit prices of imported raw nuts as well as increase in imports of raw nuts.

Thomas *et. al.* (2009) observed that the export of cashewnuts showed an increasing trend from 1996-97 to 2002-03 but a declining trend was observed by 2007-08.

Balasubramanian (2009) reported that during the last five years there has been tremendous increase in imports to meet the exports to the tune of 90-100 percent and the participation of Indian cashew production has been very low. The study revealed that more than 50 percent of export earnings got drained for import.

Ramanathan *et al* (2009) examined the direction of exports and imports of cashew in the pre-liberalisation (1980-81 to 1991-92) and post-liberalisation (1992-93 to 2003-04) periods. The results have shown that USA and Netherlands were major importers of Indian cashew in both periods.

The study on the growth of cashewnut industry in India by Vellingiri and Thiyagarajan (2007) assessed the overall profile of the Indian cashew industry, particularly in terms of production and exports. The results indicated that cashew production in India has been fluctuating during the recent years and suggests that the cashew industry needs certain incentives to achieve a higher growth rate of production as well as exports in future.

2.3 Price Behaviour

Borah and Dutta (1991) studied the price behaviour of rape and mustard in Assam during the period from 1971-72 to 1989-90. They fitted linear trend equation to the wholesale price data of both the crops. The study revealed the existence of a positive price trend for rape and mustard in all the major markets of Assam.

According to a study conducted by Balasubramanian and Rema (1996) on pricing trend of raw cashewnut in India, it was observed that Indian rawnuts are fairly priced against the international price for kernels. They also reported that Kerala rawnut price is a determining factor for fair price of rawnuts in other producing regions. The pricing trends of raw cashew nuts in different states are evaluated and the effect of a monopoly procurement policy in 1981, 1982 and 1988-93 on the price obtained by farmers was also critically discussed.

Alemayehu and Atteri (2000) analysed the price behavior of onion and potato in the Delhi wholesale market employing multiplicative scheme to time series data on their arrival and prices in the market. It was concluded from the study that both trend and seasonality components were significant for potato but trend was non-significant for onion.

Angles (2001) in his study on pricing trend in the markets of Erode, Cochin and Duggirala revealed that wholesale prices showed increasing trend over the years. Among the markets, the increase in wholesale price trend was observed to be the highest in the case of Erode market (221.51%), followed by Cochin (191.66%), Sangli (96.33%) and Duggirala (84.74%). The trend coefficients were found to be significant at one per cent level in all the markets.

Sebastian (2001) in his study on supply response of cashewnuts observed that average relative price of cashewnuts in the previous three years had a significant influence on area. He also obtained a positive relationship between yield and price as well as relative yield. This finding is of utmost importance in a free economy where price mechanism is allowed to operate as a balancing factor between supply and demand.

Varghese (2004) analyzed the price behaviour of cardamom in Kerala based on the data collected for the auction, wholesale and export prices of cardamom from 1970-71 to 2000-01. It was observed that the auction, wholesale and export prices have shown an upward trend and these three prices were moving almost in the same manner.

Pawar *et al.* (2004) studied the behaviour of prices and arrivals of pomegranate in Solapur market in Maharashtra from 1991 to 2000 and found that the arrivals of pomegranate were high during the months of July, August, September and

December and the lowest arrivals in the month of April. The price indices of pomegranate revealed that the highest price was in the month of February, followed by January and March. The prices were observed lowest in the month of April, May and September. The coefficient of correlation between arrivals and prices exhibited negative relationship.

Asmatoddin *et al.* (2009) analyzed the arrivals and price behaviours in APMC market, Parbhani during the year 2004-05 to determine price index fluctuations for important pulse crops. The data on monthly arrivals and prices were obtained from the record of APMC, Parbhani for nine years from 1996-97 to 2004-05. The result revealed that the peak arrivals of greengram were in the month of October and the highest price index recorded was in the month of March. The price index touched to the lowest 83 per cent and to the peak value of 105 per cent. In pigeon pea, the arrival index was the highest in the month of January whereas, the price index was highest in the month of September, and the price index varies in the range of 93 to 107 per cent.

Anjaly *et al*. (2010a) analyzed the price behavior of black pepper (ungarbled and garbled) using the data on domestic price at Kochi market for Malabar Ungarbled Pepper and international price at US (New York) market for Garbled Pepper. Month wise modal price data for the period from January 1996 to September 2009 were analyzed using various functional forms, but no satisfactory fit was observed based on R^2 values and standard errors. Hence, trend lines were fitted with single exponential smoothing. It was observed that the price of ungarbled pepper at Kochi market exhibited no specific trend.

Anjaly *et al*. (2010b) analyzed the price behavior of cardamom using the data on domestic price at Vandanmettu market in Kerala. Month wise modal price data for the period from August 1996 to October 2009 were analyzed using various functional forms, but no satisfactory fit was obtained based on R^2 values and standard errors. Hence, trend lines were fitted with single exponential smoothing. It was observed that cardamom prices were subjected to considerable fluctuations during the period from

1996 August to 2003 October, depicting a mixed trend. The period from July 2007 was characterized by a growth phase in cardamom prices.

In the present study, price behaviour was studied using the techniques of classical time series analysis (Croxton *et al.,* 1979; and Enders, 1995). This approach assumes that any time series can be decomposed into four essential components, viz., trend, seasonal, cyclic and irregular components. They are discussed under the following heads:

2.3.1 **Secular Price Movements**

In the long run a time series may show a tendency to increase, decrease or remain as such. The general direction in which the time series move over a long period of time is referred to as the secular trend (Croxton e*t al.,* 1979; Spiegel, 1992).

The tendency of prices to move up or down over a longer period of time is termed as trend or secular price movements. A trend is usually established based on at least 10 to 15 years data. The long-term trend in price of any commodity or group of commodities is the net result of forces affecting either demand or supply over a long span. The trends in price of individual commodities usually follow the general price level in the economy. In India the general price level had been raising since second five year plan (Acharya and Agarwal, 1991).

Agarwal (1986) argued that even though four time period elements viz., trend, cyclical, seasonal and irregular movements were found associated with the changes in prices, secular and seasonal fluctuations played an important role in guiding the farmers and traders in decision making on production and marketing areas**.**

Krishnankutty (1989) studied the secular trend in the price of construction timber in Kerala for the period from 1956-57 to 1984-85. Moving averages of real prices were used in order to smoothen out the effect of year to year fluctuations in prices. From the real prices plotted, it was observed that the real price was increasing over the whole period. But the increase was not monotonic and three distinct periods could be identified during which the prices followed more or less linear pattern. It was found that prices registered a small decline prior to the period from 1966 to 1969 but thereafter increased at a normal rate. The period from 1976-77 to 1984-85 was characterized by a drastic increase in prices, which could be due to stoppage of clear felling of natural forest and the consequent drastic reduction in the timber supply.

Borah and Dutta (1991) studied the price behaviour of rape and mustard in Assam during the period from 1971-72 to 1989-90. They fitted linear trend equation to the wholesale price data of both the crops. The study revealed the existence of a positive price trend for rape and mustard in all the major markets of Assam.

Kesavan and Geetha (1992) subjected the wholesale price data of dairy and meet products from the four metropolitan centres of India for the period from 1978 to1989 to trend analysis using simple linear equation. The trend analysis showed that the prices of milk always showed an upward trend, which could be due to the pressure of demand from the ever increasing population as well as the influence of cost factors.

Salam *et al.* (1992) analyzed the trends in cashew production in Kerala. They fitted trend lines to the area, production and productivity indices using linear, quadratic, exponential, modified exponential and logistic functions. As these functional forms did not yield a satisfactory fit in terms of R^2 values and standard errors, a three year moving average was used to depict the trend.

Selvarajan *et al.* (1993) examined the data on the wholesale price of potato in Nilgiri district for a period of 30 years from 1961-62 to 1990-91. The trend value was calculated for production and price by using a second-degree polynomial function and noted that the prices in general exhibited an increasing trend though wide spread seasonal fluctuations were there.

Hosmani (2001) conducted a trend analysis in price of groundnut and cotton using the monthly market prices. The long-term trend component and the growth rate of prices over the years were estimated by fitting a linear regression equation to the de-randomized yearly data on groundnut and cotton prices. The trend analysis revealed that there was a significant annual increase in price of both the commodities.

The general movement of prices of sorghum in seven major sorghum growing states of India, Rao et al. (2003) using the method of least squares. The analysis revealed an increasing trend in all states under study; the average increase in prices varying from Rs. 29.94 in Gujarat to Rs. 17.35 in Maharashtra.

Murthy *et al.* (2008) determined the price trends and seasonal variations in onion, over the years in Belgaum, Dharwad and Bijapur markets in Karnataka. The price trends of onion were analyzed from 1991 to 2005 in the Dharwad market, 1990-2005 in Belgaum and 2001-2005 in Bijapur. The analysis of price trend studied using power function showed that the price of onion in these three markets exhibited an increasing trend.

Babu *et al*. (2009) conducted a study to segregate the secular trend, seasonal, cyclical and irregular components in the price of coconut and major coconut products like copra and coconut oil in India based on month wise price data for the period from 1976-77 to 2004-05. The prices showed an increasing secular trend. The pre WTO situation was explained by a power function for Kochi whereas the compound function explained the trend for Alapuzha and Kozhikode. The post WTO situation was explained by quadratic function in the case of Kochi market whereas cubic function found to give better fit in the case of the other two markets viz., Kozhikode and Alapuzha. The domestic price of copra and coconut oil were found to be higher than the international price. It was also found that the domestic markets were well integrated among themselves and with the international market.

Anjaly *et al*. (2010) analyzed the price behavior of partially dehusked coconut, using the data on month wise modal price prevailed at Thrissur market for a period from 2000 to 2009. The trend analysis was carried out using various functional forms, but no satisfactory fit was observed based on R^2 values and standard errors. Hence, trend lines were fitted with single exponential smoothing which had a Mean Absolute Percentage Error (MAPE) value of 4.18 per cent.

Jayasree *et al*. (2011) analyzed the secular trend in the domestic price of black pepper at Kochi market for a period of 15 years from January 1995 to December 2010. Trend lines were fitted with single exponential smoothing and the fit had a MAPE value of 7 per cent. The price of ungarbled pepper in Kochi market exhibited no specific trend. The prices were increasing steadily to reach the peak price of Rs. 247/Kg in October 1999, and declined thereafter. It reached the trough price of Rs. 56/Kg in November 2004, thereafter it is showing an increasing trend.

2.3.2 **Seasonal Price Movement**

Seasonal movements refer to the identical or almost identical patterns of movement followed by a time series during corresponding months of successive years. Those movements, which recur, with some degree of regularity, with in a year are referred to as seasonal movements (Croxton *et al.,* 1979; Spiegel, 1992). Seasonal or intra-year price variations are regularly occurring upswings and downswings in prices that occur with some regularity during the year. Seasonal price variations resemble a cycle covering a period of 12 months or less. The seasonal variation in prices is mainly due to the seasonality in supply and factors affecting the stocking decisions of the traders (Acharya and Agarwal, 1991).

Singh *et al.* (1993) studied the trends in arrivals and prices of potatoes in Jalandhar district of Punjab state during the period from 1975-76 to 1989-90 and identified the seasonal patterns in the movement of potato prices. They reported that during the post harvest period, the indices of prices remained low and fluctuated widely. These fluctuations were mainly because of the seasonal and perishable nature of the crops. They concluded that the seasonal nature of agricultural production resulted in price fluctuations.

The price behaviour of coconut and coconut products was examined by Babu and Sebastian (1996) in Kerala using monthly data from 1971 to 1990. They reported that the price of coconut was subjected to pronounced seasonal fluctuations despite the production of nuts round the year. The prices of coconut, copra and coconut oil showed seasonal buoyant phase from November to February for coconut and August to December for copra and coconut oil. A depressed phase was noted from March to October for coconut and February to June-July for copra and coconut oil. The seasonal peak in coconut production was coupled with seasonal trough in coconut prices and vice versa, thereby indicating the prevalence of a distorted market in the state to the disadvantage of coconut growers as bulk of their produce was disposed as raw nuts immediately after harvest when prices were abysmally low. It was also found that the seasonal behavior of coconut was influenced by seasonality in copra and coconut prices. Correlation among seasonal indices revealed that the seasonal indices of copra prices and coconut prices were highly associated and seasonal price behavior in coconut was following seasonality in copra and coconut prices with one month, two month and three months lag.

Agarwal and Dhaka (1998) studied the relationship between the arrivals and prices of spice crops in Rajasthan. The study revealed that arrivals of chillies were higher in February and the wholesale prices of dry chillies were also higher in February when the first lots of new chillies arrived in the market. Prices reached to the peak level in September when arrivals were low. The pattern of market arrivals of cumin and coriander seed also revealed the existence of seasonality.

Karunakaran *et al.* (2001) observed that the fluctuation in the import and export prices of cashew nut and kernels was mainly because of seasonality in production, processing and also because of market forces. During the harvesting time of the crop in India i.e. in May and June, the seasonal index of cashew nut import price were found to be less than 100. Maximum seasonal index was during July to September as it was the off-season for the crop. Seasonal index of less than 100 per cent during months of November, December, January and May, could be due to higher supply from the raw nut exporting countries.

The seasonal variations in the prices of sorghum in seven major sorghum growing states of India was analysed by Rao et al. (2003) by constructing seasonal index numbers using percentage centered moving average method. Among the states, the average seasonal price variation was highest in Karnataka (34.05%) and lowest for Tamil Nadu (9.20%).

Babu *et al.* (2009) analyzed the seasonal components in the price of coconut and major coconut products like copra and coconut oil in India. The study was based on month wise price data for the period from 1976-77 to 2004-05. It was observed that there were marked seasonal variations in the prices of coconut and its products, with coconut prices remaining low during the months of peak production in March to April; and high when production was low during July to August.

Kumar *et al.* (2009) analyzed the seasonality in arrivals and prices of important vegetable crops in Bangalore market for the period from 1999 to 2008. The secondary data pertaining to monthly arrivals (Qtls) and prices (Rs/Qtls) of green-chilly, onion, potato and tomato were collected from Agricultural Produce Market Committee (APMC) and Karnataka State Agricultural Marketing Board, Bangalore. For the evaluation of seasonality in arrivals and prices, multiplicative time series analysis, twelve month centered moving average and two-way ANOVA were used. In all the crops with respect to arrivals and prices, the seasonality was present within a year and seasonal pattern did not change over the years in the market except in onion price.

In a study conducted by Anjaly *et al*. (2010a), an attempt has been made to analyze the seasonal movements in price of black pepper based on the month wise modal price data for the period from January 1996 to September 2009. It was observed that the domestic as well as international price of pepper exhibited considerable seasonality. The buoyant phase for ungarbled pepper in Kochi market was observed during July to October, with the peak price in October, while the trough price was during February, which coincided with the peak harvest season and higher market arrival in Kerala. In the case of international price of garbled pepper, the peak was found during April to May, whereas the trough was occurring in the months of December and January.

Anjaly *et al*. (2010b) studied the seasonal variations in price of cardamom in Vandanmettu market. The study was based on month wise modal price data for the period from August 1996 to October 2009. It was observed that cardamom price exhibited considerable seasonable effect. April and September months were characterized by peak prices, whereas December represented the trough month and the prices were low during the period from October to March. The harvest period of cardamom in Kerala synchronizes from October to February, with peak harvest takes place in October, November and December months.

Anjaly *et al.* (2010c) worked out the seasonal indices for the prices of partially dehusked coconut to capture the seasonal patterns in the price data. The study was conducted with month wise modal price data for the period from January 2000 to December 2009. It was observed that the prices were found to be peak during December to January, while the prices were found to be under downward pressure during the period from March to August. The period from October to December marks a period of low arrivals of coconut in the domestic market and the period from March to September marks the maximum arrival of coconut in Kerala, synchronizing with the peak in production.

2.3.3 **Cyclical Movements**

Cyclical movements refer to the long-term oscillations or swing followed by a time series about a trend line. These cycles may or may not be period with the result that they may not recur at regular intervals (Croxton *et al.,* 1979; Spiegel, 1992).

Satish *et al*. (1983) attempted to detect the presence of cycle of twelve month duration and a long term cycle in the arrivals and price series of Jowar by harmonic analysis. Monthly modal data on arrivals and prices for the period from 1970 to 1978 for Hubly market and for the period from 1956 to 1978 for Gadang market were subjected to time series analysis. The results had shown that there were the presence of cycles of length 3 and 4 years for prices and arrivals respectively.

Borah and Dutta (1991) analysed the wholesale price data of rape and mustard in Assam state for the period from 1971-72 to 1989-90, and found that price of rape and mustard exhibited cyclical variation. They reported that the length of price cycle for these crops varied from one to four years.

Selvarajan *et al.* (1993) using harmonic analysis reported that there existed nine complete cycles (from trough to trough) in the price of potato in Nilgiri district during the past 30 years with the maximum length of cycle being six years. He attributed the cyclic behaviour to the variation in production characterized by the occurrence of drought, incidence of pest and diseases and favorable monsoon that in turn influenced price levels. The length of price cycle was less as compared to production cycle indicating that fluctuation in price was comparatively high. The price cycle fluctuated about 61 per cent above and 38 per cent below the average. Perishability, bulkiness and seasonality explained the greater amplitude in price cycle. Also the magnitude of the swing was high in the early years due to the lack of organized marketing facilities and absence of market information.

Sudhakar (1996) studied the price trend of turmeric in Andhra Pradesh from 1981-82 to 1993-94 with the help of a non-linear trend projection. The trend line showed the presence of wide cyclical movements in turmeric prices. Each cycle spread about eight year span, in which recession was observed for five years and revival for three years. The extent of fluctuation was also very sharp indicating the presence of huge gap between boom prices and depression price. They attributed the cyclic trend to the demand-supply gap existing in the case of turmeric and also to the fact that supply of turmeric was positively correlated to its price i.e. as the supply increases, price also increased.

Hosmani (2001) analyzed the cyclical component of fluctuations in the prices of cotton and groundnut in Dharwad district of Karnataka using twelve month centered moving average method. They graphically analysed the de-randomized data on prices for both the crops and found out the presence of a four to five year cycle in groundnut prices and a two to three year cycle for cotton price. They attributed the presence of such short duration cycles to the demand and price of cotton and groundnut prevailing in important markets of the state as well as the neighboring state.

Jayasekhar *et al*. (2005) analyzed the cocoa economy with special reference to Indian scenario. The time series analysis of cocoa prices revealed a regular cyclical pattern of price movement resulting from structural deficits and surpluses of cocoa bean stocks.

Murugananthi *et al.* (2008) analyzed the price behavior of turmeric based on the 20 years of price data collected from the Erode regulated market in Tamil Nadu. The study concluded that five year price cycles were observed in the turmeric price data.

Babu *et al.* (2009) studied the cyclical components in the price of coconut and major coconut products like copra and coconut oil in India. The study was based on month wise price data for the period from 1976-77 to 2004-05. Price cycles of three to four years were observed for all the considered products. It was also interesting to note that the amplitude of cycle was found to wane in the post WTO period of the study.

Anjaly *et al*. (2010a) analyzed the cyclical variations in the price of black pepper (ungarbled and garbled) using the month wise modal price data for the period from January 1996 to September 2009. The prices of pepper showed pronounced cyclical variations both in the domestic as well as international markets. It was observed that the length of the cycle lasted for about six years.

Anjaly *et al*. (2010b) studied the cyclical movements in price of cardamom in Vandanmettu market based on the month wise modal price data for the period from August 1996 to October 2009. It was observed that the price cycles do appear in the cardamom prices. The analysis revealed that the cardamom prices from the period March 1998 to October 2002, represents a boom phase lasting for about five years, while the period from November 2002 to March 2006 represents a recession phase, lasting for about three and half years. The length of the total cycle is estimated to about eight years.

2.3.4. **Irregular Movements**

Irregular or random movements refer to the sporadic motions of time series and represent the residue of movements after trend, cyclic and seasonal movements have been accounted for (Croxton *et al.*, 1979; Spiegel, 1992). In practice the cycle would be so erratic and interwoven with irregular movements that it would be nearly impossible to separate them. Hence, in the analysis of time series into its components, trend and seasonal movements are directly measured while cyclic and irregular fluctuation are left together after other elements have been removed (Gupta, 1984). Hence, research attempts to isolate irregular price components are also scanty.

Acharya and Agarwal (1991) argued that irregular price fluctuations are non-systematic price behavior. No generalization can be made about irregular price fluctuations because of diversity in their nature and irregularity of the cause and effect relationship in their occurrence. They are caused by factors outside the general trend, cycle and annual or seasonal component and therefore may not recur in future.

According to Agarwal (1991), oilseeds and edible oils were highly sensitive crops capable of misuse for speculative activities on a large scale. Unscrupulous traders and stockists resorted to large-scale black marketing and hoarding on the slight excuse of damage to the standing crops or increase in demand owing to approaching festival season. This resulted in making the edible oil price volatile with rampant and unpredictable day to day price movements.

Selvarajan *et al.* (1993) estimated the price of potato in Nilgiri district market using regression equation and accounted the difference between the computed price and actual price of potato to the cyclic and irregular variation arising as production and price were mainly influenced by the exogenous variables viz., vagaries of climate, perishability, seasonality and bulkiness.

Hosmani (2001) while studying the price behavior of groundnut and cotton in Dharwad district found out that there was irregular component of price variation. But he ignored the irregular component in the price trend, as it was not the major component of price variation in the case of these crops.

Mathew (2002) explained that extraneous factors like drought and flood were contributing to irregularity in price. He reported the *El Nino* phenomenon in 1997 when whole of south India was reported to be under the grip of a draught. As a result the production declined and the price of coconut and coconut products went up phenomenally.

Babu *et al.* (2009) analyzed the irregular components in the price of coconut and major coconut products like copra and coconut oil in India, based on month wise price data for the period from 1976-77 to 2004-05. There was wide spread irregular movements in the price of coconut and its products under reference. Widespread irregular movements were found to contribute to higher price fluctuations.

Anjaly *et al*. (2010) analyzed the irregular variations in price of black pepper (ungarbled and garbled) using month wise modal price data for the period from January 1996 to September 2009. The study was shown that the pepper prices were subjected to high irregular variations during the period under consideration. The random variations differed considerably among the two different markets trading in the two different forms of commodity, but the pattern of random shocks is found to be similar.

2.4. Forecasting Models

Bogahawatte (1988) applied Box and Jenkins Auto Regressive Moving Average approach (ARIMA) to reveal that the forecast values were lower when compared with the actual values. Ignoring seasonality , the retail prices showed that price history provided no improvements in forecasting future price changes.

Nabi and Shahabuddin (1988) used Box-Jenkins univariate model for forecasting the price of various grades of natural rubber (NR). The data for the analysis were based on the monthly average daily free on board (f.o.b) prices of natural rubber for the period from January 1977 to May 1987. The price of the various grades of rubber was forecasted using a single model comprising a backward shift operator and two parameters for autoregressive and moving average respectively. The percentage of absolute errors, the measure used to indicate the precision of the estimated price, ranged between 2.64% and 3.30%.

Empirical analysis of the application of the neural network in financial time series showed that ANN model outperformed the traditional time series models in most cases in forecasting stock prices and exchange rates (White, 1988).

ANNs have been widely used for solving many forecasting and decision modeling problems (Hiew and Green, 1992). Investigators have been attracted by

ANN’s freedom from restrictive assumptions such as linearity that are often needed to make the traditional mathematical models tractable.

Gupta (1993) forecasted the tea production in India using the ARIMA model. The model was developed using monthly tea production data in India for the period from January 1979 to July 1991 and forecasts were made for the future 12 month periods.

Mani (1993) conducted a study to forecast the egg production, egg price and feed price in Salem, Coimbatore, Thanjavore and Madhurai districts of Tamil Nadu. Egg production details for the period from 1977-78 to 1988-89 and average monthly wholesale egg price for the period from 1959-60 to 1989-90 were collected and analyzed. Time series models viz., simple extrapolation models (linear trend model, exponential growth curve, and autoregressive trend model), single exponential smoothing method, decomposition method (ratio to moving average decomposition method) and stochastic time series models (ARIMA) were used for the analysis. The results had shown that ratio to moving average decomposition method was obtained as the appropriate model for forecasting egg production, egg price and feed price in all the four markets.

In a study conducted by Vroomen and Douvelis (1993), an autoregressive-integrated-moving-average (ARIMA) model was used to forecast the season-average soybean price in USA for the marketing years 1989-90 to 1991-92. These forecasts, made during each month of the marketing year, were compared with USDA forecasts. Results indicated that ARIMA models typically outperform USDA forecasts, especially early in the marketing year, indicating that within-season USDA forecasts may be improved by incorporating information from ARIMA models.

Douvelis (1994) used an autoregressive-integrated-moving average (ARIMA) model to forecast the season-average sunflower seed price for the marketing years 1991-92 to 1993-94. The model forecasted the price for each month of the marketing year. These forecasts were then weighted by the average estimated volume of farmer sales during each month of the marketing year, to calculate the season average price received by farmers. The ARIMA forecasts came very close to the actual price early during the marketing season.

Kozhadi *et al.* (1995) applied neural networks to forecast the corn futures and found that the forecast error of the neural network model was between 18 and 40 per cent lower than that of the ARIMA model.

Moody (1995) had presented empirical result for forecasting the US index of industrial production and argued that superior performance can be obtained using state-of-the-art neural network models than using conventional linear time series and regression methods. Recently, the ANNs have been extensively studied and used in macroeconomic forecasting (Zhang *et al*., 1998).

Tse (1995) examined the lead-lag relationship between the spot index and futures prices of the Nikkei stock average by using daily data in the post-crash period and investigated the interaction between the spot and futures series through the error correction model. It was found that lagged changes in the future prices affected the short-term adjustments in the spot index but not vice-versa. Forecasting models were also constructed using the univariate time series approach and vector autoregressive method. He concluded that for the post sample forecast comparison, the error correction models produced the best results. The vector autoregressive method performed better, while the univariate time series method had given the poorest forecasts.

Aal and Garni (1997) used univariate Box-Jenkins time-series analysis for modeling and forecasting monthly domestic electric energy consumption in the Eastern Province of Saudi Arabia. ARIMA models were developed using data for five years and evaluated on forecasting new data for the sixth year. The optimum model derived was a multiplicative combination of seasonal and nonseasonal autoregressive parts, each being of the first order, following first differencing at both the seasonal and nonseasonal levels. Compared to regression and abductive network machine-learning models previously developed on the same data, ARIMA models required less data, had fewer coefficients, and were more accurate.

The study by Hamm and Brorsen (1997) on forecasting the quarterly and monthly US farm price of pigs revealed that the monthly neural network model outperformed a monthly ARIMA model with respect to the mean square error criterion and performed similar to ARIMA model with respect to turning point accuracy.

RunSheng (1999) forecasted the timber price with univariate autoregressive integrated moving average (ARIMA) models employing the standard Box-Jenkins modeling strategy. Using quarterly price series from Timber Mart-South, results showed that most of the selected pine pulpwood and saw timber markets in six southern US states can be evaluated using ARIMA models, and that short-term forecasts, especially those of one-lead forecasts, are fairly accurate. It was suggested that forecasting future prices could aid timber producers and consumers alike in timing harvests, reducing uncertainty, and enhancing efficiency.

In a study conducted by Krishnankutty (2001), the future prices of teak (*Tectona grandis*) in three girth classes (based on mid-girth, under bark and of logs) in Kerala, India were predicted using the autoregressive integrated moving average (ARIMA) models. The data used for price forecasting was based on the average annual current prices of teak girth class 1, 2 and 3. The prices in girth classes for the period from 1999-2000 to 2015-16 were forecasted.

The two-layered feed-forward network can be a useful forecasting alternative to the widely popular Box-Jenkins linear model (Hwarng and Ang, 2001). The neural networks had been shown to be a promising tool for forecasting financial time series and it was shown that neural networks with an appropriate amount of historical knowledge had a better forecasting performance than neural networks trained with a larger training set (Walczak, 2001). Prudence (2002) had shown that the ANN model outperformed the ARIMA model within the sample predictions of core inflation in Jamaica and captured all the turning points.

Sarada and Prajneshu (2002) studied the pattern of pesticide consumption in India in the post-Green Revolution era using the annual data from 1966 to 1999. An autoregressive integrated moving average (ARIMA) approach was adopted to forecast pesticide consumption and to examine how long this trend is likely to continue. It was concluded that the declining trend in India's pesticide consumption is likely to be reversed in the near future.

Rajaraman and Datta (2003) fitted univariate ARIMA models to past agricultural outcomes for forecasting the state level agricultural production. Forecasting was conducted for five states viz., Punjab, Rajasthan, Karnataka, Andhra Pradesh, and Uttar Pradesh. The forecasts for 2002-03 showed negative growth for Rajasthan (-1.7%) and Andhra Pradesh (-3.5%). The forecasts for Punjab and Karnataka were positive, 1.8 and 5%, respectively.

Menon *et al*. (2006) forecasted the cardamom price using Box and Jenkins Autoregressive Integrated Moving Average (ARIMA) model. The study was based on the data on monthly cardamom price for the period from August 1985 to December 2005.The results showed that an ARIMA model with parameters as (2, 1, 0) provided satisfactory forecast of the cardamom price with 80 per cent accuracy. The model satisfied the stationary conditions and residuals were independent and had non-significant autocorrelations.

Yayar and Bal (2007) conducted a study to predict corn oil price based on ARIMA (Autoregressive Moving Average Processes) methodology. ARIMA models have been applied to forecast commodity price. These models are based on time series analysis and provide reliable and accurate forecasts. This approach is suitable for short term price forecasting, i.e. a weeks, a month, a quarter, a year. In this study monthly corn oil price were used from January 1994 to December 2005. Monthly corn oil price of 2006-2007 year were forecasted.

Muruganananthi *et al.* (2008) presented an overview of the price forecasting methods (autoregressive integrated moving average (ARIMA) models and artificial neural networks (ANNs)) used by the Domestic and Export Market Intelligence Cell (DEMIC) of the Centre for Agricultural and Rural Development Studies, Tamil Nadu Agricultural University. It then presented two case studies of forecasting reports prepared by DEMIC: the first concerned with the price forecasts for making sowing and selling decisions for chillies, and the other concerned with the price forecasts for turmeric in Tamil Nadu. Chilli price was forecasted using monthly price data collected from Virudhunagar regulated market for the period of January 2000 to December 2007. They also analyzed and forecasted the scenario of turmeric prices based on the 20 years of price data collected from Erode regulated market and concluded that there could be upward trend in turmeric prices in the forthcoming season. The case studies confirmed the validity of the forecasts.

Ajjan *et al*. (2009a) forecasted the price of Poovan banana in Tamil Nadu using ANN model. Trichy market was selected for the study. The price of Poovan banana in Trichy market was forecasted using different ARIMA models and ANN. Among the different ARIMA models ARIMA 101was preferred because of the lowest standard error and AIC. The results had shown that ANN was the best model for forecasting the Poovan banana price due to the less MAPE value when compared to the ARIMA 101.

Ajjan *et al*. (2009b) conducted another study to forecast the price of turmeric in Tamil Nadu. Price data on turmeric finger was collected from Erode regulated market for the period from 1986 to 2006. Various ARIMA models and ANN were tried on these data to forecast the price of turmeric in Erode regulated market. Among the different ARIMA models ARIMA 111 was preferred because of the lowest AIC and MAPE value. Hence, ARIMA 111 model performance was compared with ANN model. It was found that ANN was the suitable model for forecasting turmeric price due to the smaller value of MAPE when compared to the ARIMA 111.

Ajjan *et al* (2009c) observed that majority of rural producers were unable to understand and interpret the market and price behaviour to their advantage. Hence they attempted accurate timeseries forecasting for economic variables using the univariate ARIMA model.

Assis *et al* (2010) compared the forecasting performance of different time series methods for forecasting cocoa bean prices. The monthly average price data of cocoa bean graded SMC 1B for the period from January 1992 – December 2006 was used. Four different types of univariate time series models were compared viz., exponential smoothing, ARIMA, generalized autoregressive conditional heteroscedasticity (GARCH) and the mixed ARIMA/ GARCH models. Root mean square error (RMSE), mean absolute percentage error (MAPE), mean absolute error (MAE) and Theil's inequality coefficient (U-STATISTICS) were used as the selection criteria to determine the best forecasting model. This study revealed that the time series data were influenced by a positive linear trend factor while a regression test result showed the non-existence of seasonal factors. The Autocorrelation Function (ACF) and Augmented Dickey Fuller (ADF) tests have shown that the time series data was not stationary but became stationary after the first order of the differentiating process was carried out. Based on the results of the expost forecasting (starting from January until December 2006), the mixed ARIMA/ GARCH model outperformed the exponential smoothing, ARIMA and GARCH models.

The study on forecasting rice exports from India by Sivaramani and Mathur (2010) using the Box-Jenkins methodology revealed that ARIMA (0,1,1) was the best fitting model among different alternative models fitted as adjudged using Akaike

Information Criteria (AIC) or Schwartz Bayesian Criterion (SBC). The forecasts showed that exports of rice would rise to 6.21 MT by 2015.

2.5 Market Integration

Market integration is defined as the interrelationship between price movements in two markets (Lele, 1967). The degree of correlation can be taken as an indicator of the extent to which the markets are integrated. Market integration exists when prices of homogeneous commodities in spatially separated markets move mutually in response to the forces of demand and supply. The speed at which prices in the markets adjust to departures from their equilibrium relationship is taken as an indicator of marketing efficiency. The integration of markets is thus captured through the movement of prices across regions and time (Blyn, 1973).

Baharumshah and Habibullah (1994) examined whether the prices of black and white pepper in a market were in parity with the prices in a reference market. Cointegration tests were applied to spatial price relationships among regional pepper markets in order to show that regional markets for pepper in Malaysia are closely interrelated. The cointegration technique was applied to weekly pepper prices for six regional markets in the state of Sarawak, Malaysia, The period of observations spans from the first week of January 1986 to the last week of December 1991. The empirical results suggested that regional pepper markets in Sarawak in Malaysia were highly cointegrated.

Bahura and Pradhan (1998) conducted a study to find out whether marine fish markets in Orissa are integrated to bring about efficiency in the marketing system. The data pertaining to marine fish prices prevailed in different fish markets in the state were collected for the period from January 1984 to December 1992. Bivariate price correlation as well as the methodology developed by Engle and Granger (1987) was used for the analysis. The results had shown that these markets were not integrated, though there was some evidence of integration among the Cuttak and Paradip markets due to close proximity of these two markets and good communication.

Thorsen (1998) studied the spatial integration in Nordic timber market. The degree of spatial integration was tested through a co-integration analysis and a complete identification of the statistical models for long-run structure. When the results were interpreted in terms of factor price equalization and efficient commodity arbitrages, the Nordic timber markets were found to be strongly integrated.

Arvind (2000) in his study on performance of India's rice exports uses co-integration approach to test the extent of integration between Indian Domestic Rice Market (New Delhi) and the major world rice markets (Bangkok and Houston). The results clearly indicate that the domestic rice market was not integrated, in the long run with the major rice markets of the world *i.e.,* Bangkok and Houston. This is inferred from the fact that 'b' co-efficient of the price series integration were less than their respective Dickey Fuller critical values.

Ashalatha (2000) assessed the extent of market integration between domestic and world markets for cashew using co-integration technique. The world markets selected were USA and Netherlands along with world reference price. The coefficients were found to be negative in all the three cases evaluated viz; India-US, India-Netherlands and India-International reference price.

Ramakumar and Sundaresan (2000) attempted to study the horizontal integration in the pricing of coconut, copra, and coconut oil between the regional markets within Kerala and between Kerala and Mumbai markets using the cointegration method. For testing the regional integration of coconut markets within Kerala, monthly price data for the last 20 years were used and the weekly prices for the two years (1995 and 1996) were used for a comparative study of the prices in the Kerala and Mumbai markets. The results showed that prices in the major markets within Kerala were spatially integrated and the prices in the Mumbai market and the Kerala market were not cointegrated.

Amit et al. (2004) studied the integration among apple markets using the co-integration method. The selected markets were Bangalore, Mumbai, Calcutta, Chandigarh, Delhi and Chennai. The analysis proved that Delhi, Chennai and Mumbai markets are well integrated indicating the existence of price dependency.

Babu (2005) conducted a study to know the similarities in the price movement of copra and coconut oil in the domestic market with that in the international market. Inter correlation matrices were worked out separately for the pre WTO period and post WTO period. For copra, cif price to Europe from Indonesia/ Philippines was taken as the international price and for coconut oil cif price to Rotterdam was considered as the international price. The results had shown that both during pre WTO and post WTO periods, prices prevailed in the three main domestic markets in India viz., Kochi, Alapuzha and Kozhikode were found to be correlated with the international price, but the level of association was low.

Jayasree *et al*. (2010) conducted a market integration study on pepper spot prices at Kochi with international price at the New York market using the cointegration method as suggested by Johansen 1991. The analysis was based on the month wise price data for a period of 15 years from January 1995 to December 2010. The cointegration equation was found to be significant at one per cent level, indicating that the two series were highly integrated. There were indications of mutual influence being exerted by the two markets on each other.

Kanaka (2011) reported that integration among domestic and international prices exists for crops like tea, coffee, cotton, sugar, tobacco and groundnut using the Granger causality test.

Materials & Methods

3. MATERIALS AND METHODS

A scientific study requires appropriate research design to draw meaningful inferences. The present study entitled "Export and price behaviour of cashewnut in India" was undertaken with the specific objective of investigating the export behaviour and price behaviour of cashew in India, and to evolve a reliable price forecasting model. The relevant methodology of the study is presented under the appropriate heads given below.

3.1 Data for the study

The present study named "Export and price behaviour of cashewnut in India" is mainly based on the secondary data published by various institutions. The data regarding the area, production and productivity of cashew in major states of India was collected for the period from 1965-66 to 2010-2011. The export and import details of cashew in India were collected for the period from 1980-81 to 2010-11. The month wise average prices of cashew kernels (export grade W320) in the domestic market (Kollam) and international market (London) was collected for a period of 13 years from January 1999 to December 2011. W320 are the most popular kind of cashew kernels and consumed the most worldwide.

3.2 Source of data

The secondary data pertaining to the area, production and productivity of major cashew growing states in India was collected from the Directorate of Cashewnut and Cocoa development, Kochi and various issues of their publication, *The Cashew and Cocoa Journal.* The month wise average prices of cashew kernels in domestic market were collected from the Kerala State Cashew Development Corporation, Kollam and the Directorate of Economics and Statistics, Trivandrum. The details about export and import of cashewnut in India and International prices of cashew kernels at London market were obtained from

Cashew Export Promotion Council of India, Kochi and various issues of their publication, *Cashew Bulletin.*

3.3 Period of study

The data on area, production and productivity of cashew in India and Kerala were collected for the period from 1965-66 to 2010-2011. The data regarding the export and import details of cashew in India were collected for the period 1981-82 to 2010-11. The entire period has been divided into two sub-periods; the period from 1981-1992 was taken as the pre-liberalisation period and the period from 1993-2011 formed the post-liberalisation period. The data on monthly average price of cashew kernels for international and domestic markets was collected for the period from January 1999 to December 2011.

3.4 Markets selected for the Study

The domestic market at Kollam was selected for studying the price behaviour of cashew kernels in India because Kollam is a major processing centre and it is through the Cashew Development Corporation located at Kollam that bulk of cashewnut imports take place. London was chosen as the International market as it is a major market for cashew kernels in the world. However, due to the non-availability of modal prices, the monthly average prices have been used for the study.

3.5 Compound Growth Rate

Growth rate of a variable is defined as the rate of change per unit time, usually a year. The Compound Growth Rates (CGR) of area, production, productivity, export and import of cashewnut was estimated by fitting the exponential function.

$$Y = AB^t \ldots\ldots\ldots\ldots (3.1)$$

where,

Y = Area/ production/ productivity / export/ import of cashewnut

A = Intercept

B = Regression coefficient

t = No. of years

Taking logarithmic transformation

$$\ln Y = \ln A + t \ln B \text{ .... } (3.2)$$

$$Y' = a + bt \text{ .... } (3.3)$$

where,

$Y' = \ln Y$, $a = \ln A$, $b = \ln B$

$$\text{Compound Growth Rate} = (\text{antilog } b - 1)*100 \text{ .... } (3.4)$$

3.6 Trend Analysis using Index numbers

Index numbers are devices for measuring differences in the magnitude of a group of related variables having different units (Croxton *et al.*, 1979). Index numbers on area, production and productivity and export-import of cashew in India were worked out using the formula;

$$I_t = (P_t / P_0)\, 100 \text{ .... } (3.5)$$

where,

I_t = Index number

P_t = Current year value for the variable

P_0 = Base year value for the variable

The index number for area, production and productivity of cashewnut in India and major cashew growing states during 1993 to 2011 were worked out. Index numbers were also worked out for export and import of cashew in India for the same period. The respective triennial mean value of the years 1991-92, 92-93 and 93-94 were taken as the base year value for 1993-94.

3.7 Analysis of Price Behaviour

Trend, seasonal, cyclical and irregular components of price movements of cashew kernels were estimated as per Croxton *et al*., 1979 and Enders, 1995. A multiplicative model of the following form was used for the same.

$$Y(p) = T \times C \times S \times I \quad \ldots\ldots\ldots\ldots\ldots (3.6)$$

where,

Y (p) = Monthly average price of cashew kernels

T = Trend Component
C = Cyclical Component
S = Seasonal Component
I = Irregular/ Random Component

The decomposition of time series in to the above four different components was made using Minitab 16.0 and SPSS 16.0.

3.7.1 **Estimation of Trend Values**

Trend analysis was carried out separately for domestic as well as international markets by the method of least squares. Various functional forms viz., linear, quadratic, exponential, logarithmic etc. were tried to explain the underlying trend in cashew prices. But no satisfactory fit was obtained based on R^2 values and standard errors. Hence, trend lines were fitted with exponential smoothing methods viz., single and double exponential smoothing.

Exponential smoothing is a particular type of moving average technique applied to time series data to produce smoothed data for presentation. The exponential smoothing method weighs past observations by exponentially decreasing weights to forecast future values which is a smoothed estimate of average growth at the end of each period.

3.7.2 **Estimation of Seasonal Variations**

Seasonal variations in a time series are due to the rhythmic forces which operate in a regular and periodic manner over a period of 12 months. In order to obtain a statistical measure of the patterns of seasonal variations in the time series, seasonal indices are worked out by removing the effect of other components like trend, cyclical and irregular components in the data.

3.7.3 **Estimation of Cyclical Variations**

Cyclical fluctuations are the oscillatory movements in a time series with period of oscillation more than one year. Cyclical variations are of longer duration than a year and do not exhibit regular periodicity. To assess the cyclical variation in a time series, residual method is commonly employed and it is done in three steps.

a. Removal of trend component

   It can be represented as,

   $$\frac{TxCxSxI}{T} = CxSxI \quad \text{.................} \quad (3.7)$$

b. Removal of seasonal effect (deseasonalization)

   $$\frac{CxSxI}{S} = CxI \quad \text{...................................} \quad (3.8)$$

c. Removal of irregular component (smoothening)

   12- month moving averages were taken to smoothen the irregular variations and nullify their influence. Finally we get C.

3.7.4 **Estimation of Irregular Variations**

The irregular indices were obtained by dividing the cyclical-irregular indices (equation 3.9) by the cyclical indices and multiply it with 100 to express in percentage.

It is given as,

$$\frac{CxI}{C} = I \ldots\ldots\ldots (3.9)$$

3.8 Price Instability

The instability in prices were studied using the coefficient of variation (CV).

$$CV = (SD/ Mean)*100 .... (3.10)$$

where,

CV = Coefficient of Variation

SD = Standard Deviation

3.9 Export Competitiveness

Export competitiveness of cashew was assessed using Nominal Protection Coefficient (NPC). NPC is the ratio of the domestic price of the commodity to its border price.It can be given by the formula,

$$NPC = Pd / Pb ....(3.11)$$

Pd = Domestic Price of Commodity

Pb = Border or Reference price of commodity

A value of NPC less than unity confirms export competitiveness, while value of NPC greater than unity indicates the absence of export competitive advantage (Datta, 2001).

In the present study, an attempt has been made to analyze the export competitiveness of Indian cashew kernels using nominal protection coefficient. NPC values for the period from 1999 to 2011 were worked out by taking the price of cashew kernels at Kollam market as the domestic price and that of London market (c&f prices) as the border price.

3.10 Price Forecasting

In this study, an attempt has been made to evolve a reliable price forecasting model for cashew kernel in Kollam as well as London markets using various methods such as moving average method, single exponential smoothing, double exponential smoothing, ANN model and Box-Jenkins ARIMA model.

3.10.1 Price forecasting using Moving Average Method

In simple moving average forecast, the mean of the past k observations is used as a forecast. This implies equal weights (1/k) for all data points. A moving average forecast of order k, or MA(k) is given by

$$F_{t+1} = \frac{1}{k} \sum_{i=t-k+1}^{t} Y_i \quad \text{......................(3.12)}$$

Where F_{t+1} is the forecast in the t+1 period, Y_i is a datapoint in the time series.

3.10.2 Price forecasting using Exponential Smoothing methods

3.10.2.1 ***Single exponential smoothing***

In moving average method, we forecast the next observation by taking an average of the most recent observations. In exponential smoothing methods, the most recent observation will be given more weight, ie, we exponentially decrease weights as the observations get older.

The specific equation for single exponential smoothing is

$$F_{t+1} = \alpha Y_t + (1-\alpha) F_t \text{ .... } (3.13)$$

where,

F_{t+1} = forecast at time period t+1

Y_t = Original observation at time period t

α = Smoothing constant, between 0 and 1

The forecast F_{t+1} is based on weighing the most recent observation Y_t with a weight α and weighing the most recent forecast F_t with a weight $(1-\alpha)$.

3.10.2.2 ***Double exponential smoothing***

When the data shows a trend, double exponential smoothing method is employed to study the underlying trend in the time series data.

Double exponential smoothing is defined in the following manner,

$$S_t = A_t + B_t \text{.......... } (3.14)$$

where,

$A_t = \alpha X_t + (1-\alpha) S_{t-1}, 0 < \alpha < 1$

$B_t = \beta (A_t - A_{t-1}) + (1 - \beta) B_{t-1}, 0 < \beta < 1$

Here, the parameter α is a smoothed estimate of the value of the data at the end of each period and β is for trend.

3.10.3 Price forecasting using ANN model

Artificial Neural Network (ANN) is an information processing algorithm similar to the brain cells (neurons) learning to recognize shapes and patterns. It is a mathematical structure designed to mimic the information processing functions of a network of neurons in the brain. Each neuron, individually, functions in a quite simple fashion. It receives signals from other cells through connection points, averages them and if the average over a short period of time is greater than a certain value, the neuron produces another signal that is passed on to other cells. It is the high degree of connectivity rather than the functional complexity of the neuron itself that gives the neuron its computational processing ability. Neural networks are very sophisticated modeling techniques, capable of modeling extremely complex functions. The neural network user gathers representative data, and then invokes training algorithms to automatically learn the structure of the data. The methodology used in this study consisted of an Artificial Neural Network, trained with the well-known error back propagation learning algorithm.
The application of Artificial Neural Network (ANN) modeling in time series owes its origin to the works of Swanson and White (1997). ANN modeling in time series analysis was popularized by Zhang *et al*. (1998).The Zaitun Time Series software (version 2.1) was used for ANN modelling in the study.

3.10.4 Price Forecasting using ARIMA model

The acronym ARIMA stands for “Auto-Regressive Integrated Moving Average.” Box and Jenkins (1970) are credited with illustrating a methodology for building autoregressive integrated moving average (ARIMA) forecasting models. Their work has had an enormous impact on the theory and practice of modern time series analysis and forecasting. ARIMA models are, in theory, the most general class of models for forecasting a time series which can be stationarized by transformations such as differencing and lagging.

Lags of the differenced series appearing in the forecasting equation are called "auto-regressive" terms, lags of the forecast errors are called "moving average" terms, and a time series which needs to be differenced for making it stationary is said to be an "integrated" version of a stationary series. An ARIMA model is classified as an "ARIMA (p,d,q)" model, where: p is the number of autoregressive terms, d is the number of non-seasonal differences, and q is the number of lagged forecast errors in the prediction equation.

In the Box and Jenkins framework, a functional form of the following form has been used for estimating times series models

$$Y_t = a_0 + a_1 Y_{t-1} + \ldots\ldots\ldots a_p Y_{t-p} + \varepsilon_t + \beta_1 \varepsilon_{t-1} + \ldots\ldots\ldots \beta_q \varepsilon_{t-q} \ldots\ldots\ldots\ldots\ldots\ldots (3.15)$$

Box and Jenkins popularized a three stage method aimed at selecting an appropriate model for the purpose of estimating a univariate time series. This model is based on the assumption that the time series is stationary because the estimation procedures are available only for stationary series. The three main stages in developing a Box-Jenkins time series model are;

3.10.4.1 Model Identification
3.10.4.2 Model Estimation
3.10.4.3 Model Validation

3.10.4.1 **Model Identification**

In the identification stage, the visual examination of the time plot of the series, the autocorrelation function (ACF) and the partial autocorrelation function (PACF) is carried out to check for the stationarity of the series. A time series is said to be stationary, when its mean, variance, and autocorrelation function are constant. If the model is found to be non stationary, stationarity could be achieved by differencing the series. Then the next step in the identification process is to find the initial values for the parameters p and q. They could be obtained by looking for significant autocorrelation and partial autocorrelation coefficients.

3.10.4.2 **Model Estimation**

At the identification stage, one or more models are tentatively chosen that seem to provide statistically adequate representations of the available data. Then the parameters of the models are estimated by least squares as advocated by Box and Jenkins. Standard computer packages like SPSS was used for finding the estimates of relevant parameters using iterative procedures.

3.10.4.3 **Model Validation**

The third stage of the Box-Jenkins methodology involves diagnostic checking. The two most commonly used model selection criteria are the Akaike Information Criterion (AIC) and the Schwartz Bayesian Criterion (SBC).

$$AIC = T \ln (\text{sum of squared residuals}) + 2n \quad (3.16)$$

$$SBC = T \ln (\text{sum of squared residuals}) + n \ln (T) \quad (3.17)$$

where,

n = Number of parameters estimated (p + q + possible constant term)

T = Number of usable observations

In order to get a precise comparison of the alternative models, T should be kept fixed. Ideally, the AIC and SBC will be as small as possible. As the fit of the model improve, the AIC and SBC approach $-\infty$.

Another standard practice to check the fitness of the model is to plot the residuals of the estimated model. It is important that the residuals from an estimated model be serially uncorrelated. Any evidence of serial correlation implies a systematic movement in the $\{Y_t\}$ sequence that is not accounted by the coefficients included in the model. Hence, any of the tentative models yielding non-random residuals should be eliminated from consideration. To check for correlation in the residuals construct ACF and PACF of the residuals of the estimated model. If most of the sample autocorrelation coefficients of the residuals are within the limits ± 1.96/ N (where N is the number of observations up on which the model is based), then the residuals are white noise indicating that the model is a good fit.

Among the various accuracy measures used in the above models, the best model was selected based on lowest mean absolute percentage (MAPE) error values.

$$MAPE = \frac{1}{n}\sum_{t=1}^{n}\frac{|Y_t - F_t|}{Y_t}\times 100 \quad \text{………..} (3.18)$$

where Y_t is the actual price and F_t is the forecasted price, n is the total number of observations.

3.11 Validation of price forecast

The validation of price forecast is done by comparing the predicted price with the actual price that prevailed in the market during a month under consideration. This is in order to confirm the reliability of the selected model for predicting the prices. The accuracy of price forecast is estimated by deducting the percentage ratio (the ratio obtained by taking the absolute deviation of the actual and predicted prices to the actual price and expressing in percentage) from 100. The formula maybe given as,

$$\% \text{ forecast accuracy} = 100 - \left|\frac{Y_t - F_t}{Y_t}\right| \times 100 \quad \text{………..} (3.19)$$

Where Yt is the actual price and Ft is the predicted price.

3.12 Market integration

In the present study, cointegration test was used to estimate the degree of integration among the markets. The approaches as developed by Engle and Granger (1987), Johansen (1988, 1991); Johansen and Juselius (1990) primarily assume the existence of a long run linear relation between prices, which indicates a long run equilibrium relationship.

The integration of domestic market and international market was studied using the cointegration method (Johansen, 1991). Under Johansen's cointegration test, we determine whether the given set of non-stationary series is cointegrated or not. The null hypothesis assumes that no two series are co integrated.

In a Vector Auto Regression (VAR) of order p as given below:

$y_t = A_1 y_{t-1} + \ldots + A_p t_{t-p} + Bx_t + \varepsilon_t$ .... (3.20)

y_t is a k-vector of non-stationary I(1) variables, x_t is a d vector of deterministic variables, and is thus a vector of innovations. If there are k endogenous variables, each of which has one unit root, there can be from zero to k-1 linearly independent, cointegrating relations. The Augmented Dickey Fuller (ADF) test was done to test the stationarity of the original price data (both domestic and international), and gave statistically non significant estimates, which meant that the two series were non-stationery.

Each column of the matrix gives an estimate of a cointegrating vector. The cointegrating vector is not identified unless we impose some arbitrary normalization. The software EViews 3.1 version was used for the estimation as it adopts a normalization scheme that solves the r cointegrating relations for the first r variables in the y_t vector as a function of the remaining k- r variables.

The Granger Causality Test was carried out to determine the dependence of these markets on each other. Granger Causality Test was also performed using EViews 3.1 version.

EViews runs bivariate regressions of the form

$y_t = \alpha_0 + \alpha_1 y_{t-1} + \ldots + \alpha_l Y_{t-l} + \beta_1 x_{t-1} + \ldots + \beta_l x_{t-l}$.......... (3.21)

$$x_t = \alpha_0 + \alpha_1 x_{t-1} + \ldots + \alpha_l x_{t-l} + \beta_1 y_{t-1} + \ldots + \beta_l y_{t-l} \quad (3.22)$$

for all possible pairs of (x, y) series in the group. The reported F-statistics are the Wald statistics for the joint hypothesis, $\beta_1 = \beta_2 = \ldots.\beta_i = 0$.

3.12 Important concepts used in the Study

3.12.1 White Noise Process: It is a sequence of uncorrelated random variables with mean zero and variance σ^2. i.e. when there is no pattern in a time series, it is said to represent white noise.

3.12.2 Autocorrelation Function (ACF): The ACF is an important guide to the properties of a time series. It measures the correlation between observations at different distances apart and is a powerful tool to identify a preliminary model for the time series. When all autocorrelation coefficients are not significantly different from zero, it forms a stationary series. When all the ACFs are close to zero, it represents a white noise.

3.12.3 Partial Autocorrelation Function (PACF): It measures the value of a series with the values lagged by one or more cases after the effects of the correlations at the intervening lags have been removed. It must be closer to zero for a series to be stationary.

3.12.4 Mean Absolute Percentage Error (MAPE): The mean absolute percentage error is the mean or average of the sum of all the percentage errors for a given data set taken without regard to sign. It is a measure of accuracy commonly used in quantitative methods of forecasting.

$$MAPE = \frac{1}{n}\sum_{t=1}^{n}\frac{|Y_t - F_t|}{Y_t} \times 100$$

3.12.5 Mean Absolute Error (MAE) or Mean Absolute Deviation (MAD): The mean absolute error is used for analysing the quality of different forecasts. Here, regardless of whether the errors are positive or negative, we take their absolute values only.

$MAE = 1/N \sum \left| Y_t - F_t \right|$

3.12.6 Mean Squared Error (MSE): The mean squared error is a measure of accuracy computed by squaring the individual error for each item in a data set and then finding the average or mean value of the sum of those squares.

Results & Discussion

4. RESULTS AND DISCUSSION

Indian cashew is renowned world-wide for its excellent quality. The cashew industry earns sizeable export revenue through export of cashew kernels besides providing employment to over a million people, especially women workers. However, the global competitive environment has changed significantly during the last decade with the arrival of new competitors in the export market and the emergence of new markets thereby creating a volatile market environment. Against this background, the present study attempts to analyze the export and price behaviour of cashewnut and evolve a reliable price forecasting model. The results are presented under the following heads.

4.1. Area, production and productivity status

4.2. Export and import status of cashew in India

4.3. Price behaviour

4.3.1. Secular trend

4.3.2. Seasonal variations

4.3.3. Cyclical variations

4.3.4. Irregular variations

4.4. Price instability

4.5. Export competitiveness

4.6. Price forecasting

4.7 Validation of price forecasts

4.8 Market Integration

4.1 Area, Production and Productivity Status of Cashew

In the present study, the annual growth pattern of cashew in India has been analyzed with special reference to the major cashew growing states viz. Maharashtra, Andhra Pradesh, Orissa and Kerala using the method of Compound Growth Rate (CGR). The performance of cashew in the country and major growing states have been analysed in the post-liberalisation period (1993 to 2011) by the method of Index numbers.

4.1.1 **Indian scenario**

The area, production and productivity of cashewnut has been increasing over the years. The growth pattern of cashew in India with respect to area, production and productivity using the method of CGR is given in Table 4.1.

Table 4.1 Decade-wise CGR analysis in India

Year	Area	Production	Productivity
1965-75	5.84	4.11	-1.64
1975-85	1.17	3.83	2.63
1985-95	1.59	5.02	3.37
1995-2011	2.54	3.61	1.04
Entire period (1965- 2011)	2.71	4.20	1.45

The results revealed that during the entire period, the area under cashew registered an overall CGR of 2.71 along with the production growth of 4.20 due to concerted efforts taken by the Govt. of India in implementing various programmes for the development of cashew through the five-year plans. It was also found that growth rate of production was the highest during 1985-95, due to the contribution of both productivity (3.37 percent) and area (1.59 percent).

In general, area and production exhibited high growth rates in all decades. This is in line with the studies by Mamata *et al* (2002) who reported positive growth rates for area, production and productivity of cashew in India as the crop was being taken up on a commercial scale. It may be noted that the fourth five-year plan (1969-1974) gave special focus on area expansion and production of quality planting material, which by the end of the plan has had a positive effect in increasing both area (by 28.5%) as well as production (by 16.9%). The World Bank aided project on cashew was implemented in the sixth five-year plan (1980-1985) during which the production expanded by 25.6%. A major change that took place during the course of the eighth five-year plan was banning the use of seedlings for new plantations and establishment of regional nurseries for the production of quality planting material. From the ninth plan, development of cashew was continued under the centrally sponsored scheme on development of cashew and cocoa with an outlay of 70 crores for the plan period. With the launch of National Horticulture Mission (NHM) in 2006, development of cashew is covered under that Mission. During the ninth (1997-2002), tenth (2002-2007) and eleventh (2007-2012) plans, there has been special emphasis to remove senile plantations and replant with high yielding varieties which has positively increased area (by 68.6%) and production (by 87%).

Table 4.2 Area, Production and Productivity of Cashew in India with Indices

Year	Area	Indices	Production	Indices	Productivity	Indices
1993-94	553086	100	316363	100	583.11	100
1994-95	577200	104.35	321640	101.66	557.24	95.56
1995-96	634970	114.80	417830	132.07	658.03	112.84
1996-97	659000	119.14	430000	135.91	652.50	111.89
1997-98	700900	126.72	360000	113.79	513.62	88.08
1998-99	706000	127.64	460000	145.40	651.55	111.73
1999-00	686100	124.04	520000	164.36	757.9	129.97
2000-01	720000	130.17	450000	142.24	625	107.18
2001-02	770000	139.21	470000	148.56	610.38	104.67
2002-03	770000	139.21	506000	159.94	657.14	112.69
2003-04	774000	139.94	535000	169.10	691.21	118.53
2004-05	799000	144.46	544000	171.95	680.85	116.76
2005-06	837000	151.33	573000	181.12	684.58	117.40
2006-07	854000	154.40	620000	195.97	725.99	124.50
2007-08	854000	154.40	620000	195.97	725.99	124.50
2008-09	893000	161.45	695000	219.68	778.27	133.46
2009-10	923000	166.88	613000	193.76	664.13	113.89
2010-11	945000	170.85	653000	206.41	691.01	118.50

The trend indices for the post liberalization period as presented in Table 4.2 indicated that area under cashew has been steadily increasing but production showed wide fluctuations in certain years due to stagnant growth shown by productivity. This maybe because productivity was computed based on total area under cashew and not yielding area. As cashew starts yielding only from the third year, the increase in area in a particular year is not fully transformed to production the same year which is reflected in productivity levels as well. Development of new technology and their efficient transfer holds the key to increase productivity and become self-sufficient in raw nut production.

4.1.2 **Maharashtra**

Maharashtra is the leading producer of cashew in India with an area of 1.81 lakh ha and production of 2.08 lakh MT. It also holds the record for the highest productivity of 1149 kg/ha. From a meagre area of 12834 ha and production of 2704 M.T. in 1965-66, the rise of the crop in the state has been tremendous.

Table 4.3 Decade-wise CGR Analysis in Maharashtra

Year	Area	Production	Productivity
1965-75	9.93	6.8	-2.84
1975-85	7.97	14.75	6.27
1985-95	12.65	13.33	0.61
1995-2011	5.64	8.96	3.14
Entire period (1965- 2011)	6.17	12.03	5.51

The decade-wise CGR analysis as given in Table 4.3 revealed that the state registered an overall growth of 6.17 for area, 12.03 for production and 5.51 for productivity during the entire study-period. Production registered the highest CGR value in 1975-85 because both area and productivity equally contributed to increasing production. The same trend has been followed in 1995-2011. The trend indices with respect to area, production and productivity of cashew in the state have been worked out and plotted in Fig. 4.2.

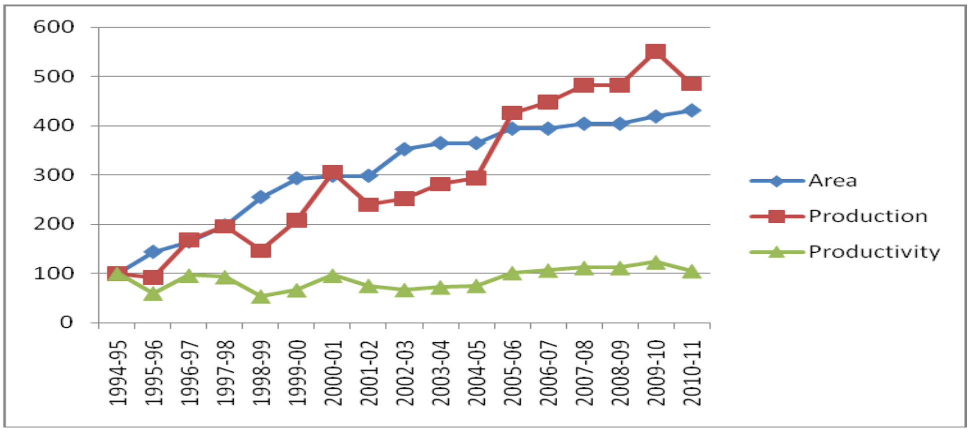

Fig. 4.1 Trends in Indices of Area, Production and Productivity of Cashew in Maharashtra

It is clear from Fig. 4.1 that there has been a steady rise in area during the post-liberalisation period. The productivity showed a more or less stagnant growth while production exhibited an increasing trend with many fluctuations. Though Maharashtra contributes to 31.9 per cent of the total production in India, only 25 per cent of it is processed in the state. Understanding the scope for ample processing units, special efforts have been taken by the Department of Agriculture, Govt. of Maharashtra from 2002-03 to establish small-scale cashewnut processing industries by initiating the facility of subsidies to start the same. While production has increased by 80.8 per cent during the 9-year period, productivity has risen by 47 per cent. It is to be noted that both production and productivity of cashewnuts have kept pace with the increased number of processing units in the state.

4.1. 3 **Andhra Pradesh**

Andhra Pradesh with an area of 1.83 lakh ha has the largest area under cashew in the country. Being the second largest cashew producer in India, it contributes to 16.4 per cent of the total production. The decade-wise CGR analysis is presented in Table 4.4.

Table 4.4 Decade-wise CGR Analysis in Andhra Pradesh

Year	Area	Production	Productivity
1965-75	3.25	6.44	3.09
1975-85	9.59	8.4	-1.08
1985-95	2.89	9.02	5.96
1995-2011	3.95	3.63	-0.31
Entire period (1965- 2011)	5.09	7.02	1.83

During the study period (1965-2011), the state has registered an overall growth of 5.09 in area and 7.02 in production. It is clear from the above table that production registered highest growth rates during 1985-95, mainly due to increased area (9.02) and productivity (5.96). It is also clear that production has registered high CGR values for all the decades. This has become possible due to the developmental initiative of rejuvenating aged and poor yielding gardens and by providing financial and technical assistance for establishing new orchards under the State plan and State Horticulture Mission.

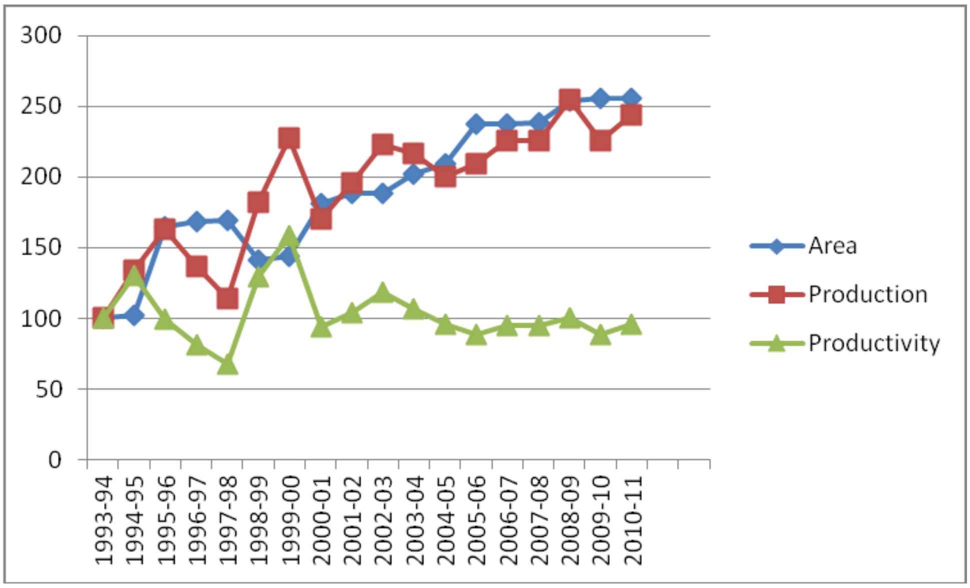

Fig. 4.2 Trends in Indices of Area, Production and Productivity of Cashew in Andhra Pradesh

As is evident from Fig. 4.2, both area and production indices have shown an increasing trend after 2005-06. As already explained, this has become possible after the launch of NHM programmes in the state.

4.1.4 **Orissa**

Orissa accounted for 13.93 per cent of the total cashew production in India during 2010-11. The crop is commercially cultivated in 28 districts (out of the total 30) and covers an area of 1.49 lakh ha. There was a considerable increase in cashew area (by 77%) in 1979, four years after the creation of Orissa State Cashew Development Corporation by the Govt. of Orissa. The decade-wise CGR analysis as is evident from Table 4.5 revealed that production of cashew in Orissa registered the highest growth rate during 1975-85 due to increased area under cashew in the particular decade.

Table 4.5 Decade-wise CGR Analysis in Orissa

Year	Area	Production	Productivity
1965-75	21.82	7.77	-11.53
1975-85	11.32	15.75	3.97
1985-95	2.81	9.83	6.82
1995-2011	2.65	6.26	3.51
Entire period (1965- 2011)	8.01	11.52	3.25

Even though area grew only by 2.81 percent during 1985-95, production grew immensely mainly due to the increased productivity (6.82). The overall increase in area and production during the study period were 8.01 and 11.52 respectively.

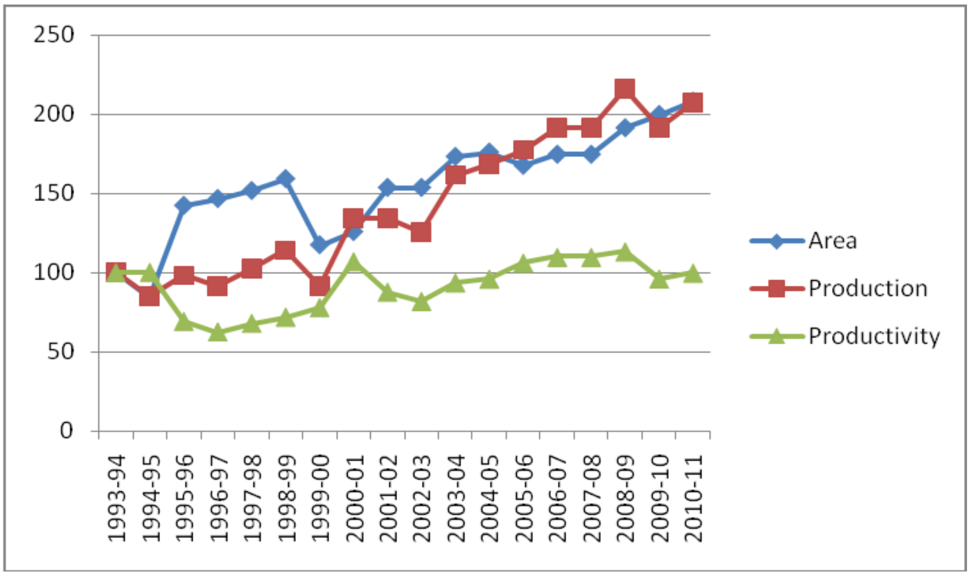

Fig. 4.3 Trends in Area, Production and Productivity of Cashew in Orissa with Indices

As can be seen from Fig. 4.3, while area showed an increasing trend after 2000, the productivity has fallen. Production reached its peak in 2008-09 but has fallen the following year. Plantations under cashew were gaining momentum since 2005-06 particularly after the implementation of the National Horticulture Mission (NHM) programmes in the state. Out of the 800 cashew processing units in the country, 117 are located in 13 districts of Orissa with a total capacity of 11406 M.T. per annum. Orissa offers tremendous scope for cashew cultivation as its naturally occurring cashew areas can be taken up extensively so that farmers will be benefited in the long run.

4.1.5 **Kerala**

During the initial stages of the study period, Kerala remained the sole leader in area and production of cashew in the country contributing to more than 30 per cent till the year 1971. Though Kerala witnessed increasing trend in area and production upto the mid 90s, a drastic fall can be seen in 1995-96, where the share came down to 18 per cent. Since then, the states of Andhra Pradesh, Orissa and Maharashtra have been forefront players in the country. While a decade back, Kerala held the third position in area and second in production, it has now been pushed to sixth place in area and fourth in production.

Table 4.6 Decade-wise CGR Analysis in Kerala

Year	Area	Production	Productivity
1965-75	2.95	1.98	-0.93
1975-85	-1.09	0.36	1.47
1985-95	-4.05	-6.66	-2.71
1995-2011	-1.54	-1.14	0.41
Entire period (1965- 2011)	-0.4	-0.24	0.15

The decade-wise growth rates as presented in Table 4.6 revealed that with a CGR of -4.05 for area and -6.66 for production (area falling by 32 per cent and production by 52 per cent), the fall in area, production and productivity was the biggest during 1985-1995. The negative growth rates have been due to the fact that farmers have shifted to more remunerative crops like rubber. This finding is similar to the reports by Salam et al (1993) who reported that relative profitability of rubber was the main reason for decreased cashew area. This is also in line to the reports by Mamatha *et al.* (2002) who observed that the growth rate of cashew area has declined in Kerala (-4.32% per annum) due to conversion of cashew area into rubber plantations. Increased labour shortage in the 'hand-crafted' processing industry have been another reason for the decreased acreage. Plantation Corporation of Kerala has stopped the application of pesticides in cashew plantations due to social issues which has increased tea-mosquito and stem borer attacks. But, despite Kerala's low area (78000 ha), it has a productivity of 910 kg per ha, among the highest in the country, which substantiates the positive value for CGR for productivity. For the entire study period, both area and production have registered a negative CGR of 0.4 and 0.2 respectively.

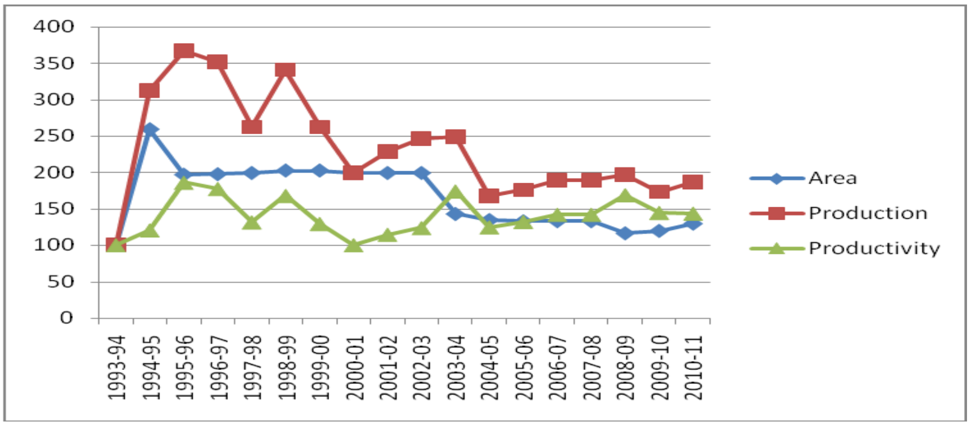

Fig. 4.4 Trends in indices of area, production and productivity of cashew in Kerala

As can be seen from Fig. 4.4, both area and production grew immensely in 1993-94 but trend in area was reversed in the later years with a stagnant growth till 2003-04 after which it has fallen and a small rise is visible after 2009. Towards the end of 2009, both area and production have risen giving hopes to the once prosperous industry.

It maybe noted that concerted efforts are needed to improve cashew plantations in India. In 2010-11, West Bengal and other north-eastern states contributed to 3 lakh

MT of the total cashew production. West Bengal also exhibited very high productivity of 1000kg/ha. Thus, the role played by non-traditional cashew growing areas gives scope in improving the production scenario. Senile plantations should be replanted with good quality grafts, more marginal and waste lands should be brought under cashew and measures should be taken by the government to deem the status of Plantation crop to cashew.

4.2 Export and Import Status of Cashew in India

In India, cashew is primarily an export-oriented commodity and has accrued an export earning of Rs. 2598.2 crores from the export of cashew kernels and Rs. 31.85 crores from the export of CSNL during the year 2010-11. Export of raw nuts from India was prominent upto the 1990s after which India has stopped raw nut export due to insufficient raw nut production. India continuously holds a major share of 45 to 54 per cent in the global trade over the years, while Brazil has been maintaining its position in a uniform manner, contributing to 16 to 20 per cent. Though India is a major supplier in the global market, her position is seen declining at four to five per cent per annum while Vietnam has now risen to a more competitive edge in the world market.
The major market for India is the American zone consuming 50 to 60 per cent of the total exports of cashew kernels from India. The next major consumers are European zone and the Middle East taking 20 to 24 per cent of the total exports. In the present study, export and import growth patterns have been analysed in the pre-liberalisation (1980-1993) and post-liberalisation (1993-2011) periods using the method of CGR. The trend indices with respect to export and import of cashew in India in the post liberalization period have been worked out using the method of Index numbers to know whether India has had its competitive edge in the liberalized world.

4.2.1 **Export Status**

India is the second largest cashew exporter with 28.2 percent of the world market share in 2009 (Fig. 1.1). The major markets of Indian cashew are USA, UK, Japan, Netherlands, Australia, Canada and Middle East countries. There has been an increase of 197 percent in the volume of export of cashew kernels during the period 1981-2011 (Appendix I). The export value of cashew kernels have also increased from Rs. 59.04 per kg to Rs. 283.7 per kg during the same period. Table 4.7 analyses the CGR of exports of cashew kernels and CNSL in India in the pre and post-liberalization periods.

Table 4.7 CGR of exports of cashew kernels and CNSL in India

Period	Pre-liberalisation 1981-82 to 1992-93		Post-liberalisation 1993-94 to 2010-11		Entire period 1981-82 to 2010-11	
	Cashew kernels	CNSL	Cashew kernels	CNSL	Cashew kernels	CNSL
Quantity (MT)	5.39	0.74	2.78	11.38	5.24	2.85
Value (Rs.Crs)	15.68	8.13	5.71	15.75	11.88	8.98

As is clear from Table 4.7, growth in export of cashew kernels have considerably fallen in the post-liberalisation period as compared to the pre-liberalization period. This is mainly due to the emergence of new players like Vietnam and Brazil in the International market from which India faces stiff competition. Vietnam, a late entrant to cashew nut processing, is in a position to offer competitive rates due to sufficient raw material as well as high level of productivity. The growth in volume and value of exports in the post-liberalisation period as shown in Fig. 4.5 revealed that quantity of exports have shown an increasing trend upto 2004-05 with a sudden decline during 2005-06 due to the increased availability in the world market at low prices. From 2007-08 onwards, volume and value of exports show a declining trend. This is in line with the studies by Thomas *et. al.* (2009) who reported that the export of cashew showed an increasing trend from 1996-97 to 2002-03 but a declining trend was observed by 2007-08. The wide fluctuations shown in the value of exports maybe due to the fluctuations in the quantity exported.

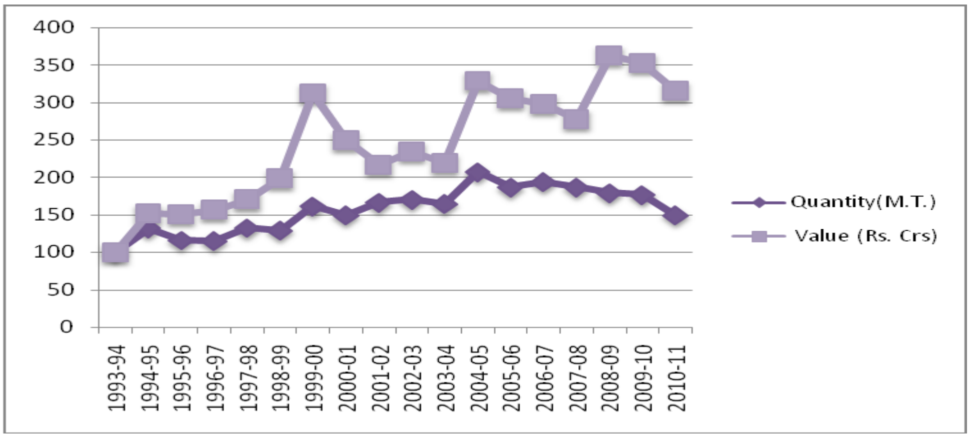

Fig. 4.5 Trends in indices of volume and value of kernel exports

The growth in quantity and value of CNSL exports from India have been increasing during the study period. While quantity of exports have increased by 129 percent, the value has increased from 2.34 crores to 31.85 crores. The unit price of CSNL has increased from Rs. 4.72 to Rs. 28.03 per kg during the study period. From Table 4.7, it is clear that unlike exports of cashew kernels, CNSL exports have substantially increased in the post-liberalisation period. This is because of the increasing demand for the product in the industrial sector which got more benefitted from the economic reforms. CNSL is a versatile industrial raw material which has applications in polymer based industries such as paints and varnishes, laminating resins, foundry chemicals and intermediates for chemical industry.

The export volume of processed kernels have also increased in the country (Appendix II). In certain years, abrupt falls have been registered because of the non-availability of cashew kernels for value addition as most quantity is exported as kernels as such. But, the industry has revived giving scope for roasted Indian kernels in the International market.

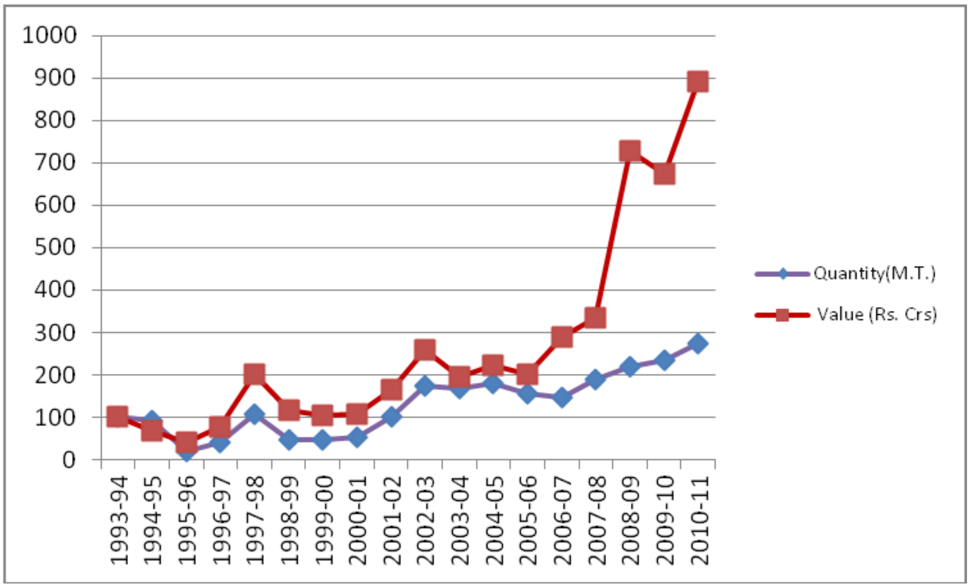

Fig. 4.6 Trends in indices of quantity and value of export of CNSL in India

As shown in Fig. 4.6, growth in quantity of CNSL exports have been stagnant upto 1996-97. While the export of cashew kernels fell in 2007-08, the exports of CNSL gained momentum and increased to 7813 tonnes valued at Rs. 1197 lakhs registering an increase of 27.2 percent from the previous year. Realization of good prices would encourage the production of this by-product.

4.2.2 **Import of Cashew nut**

India contributed to 97.8 percent of the total imports making India the largest importer of raw cashew nuts in the world. Cashew nuts are imported in the country for the purpose of re-export of processed kernels since India has a labour cost advantage in this commodity. During the year 2010-11, India imported 5.04 lakh MT of cashew nuts valued at 2479.75 crores from different countries (Appendix III).

Table 4.8 CGR of cashew imports in India

Period	Pre-liberalisation 1981-82 to 1992-93	Post-liberalisation 1993-94 to 2010-11	Entire period 1981-82 to 2010-11
Quantity (MT)	28.63	8.45	11.73
Value (Rs.Crs)	41.59	10.22	20.2

From Table 4.8, it is clear that both volume and value of imports of cashew nuts have increased smoothly during the pre-liberalization period. But the trend changed during the post-liberalization period which has registered low CGR values in both quantity as well as value of exports. This is in line with the findings of Guledgudda (2005) who reported that the growth in import of raw cashewnut in pre-liberalisation period in terms of quantity, value and unit value was increasing and positively significant as compared to postliberalisation period. This is mainly because African countries which were traditional raw nut suppliers have revamped their cashew processing facilities in order to export as processed kernels which fetch higher prices in the export market than raw nuts.

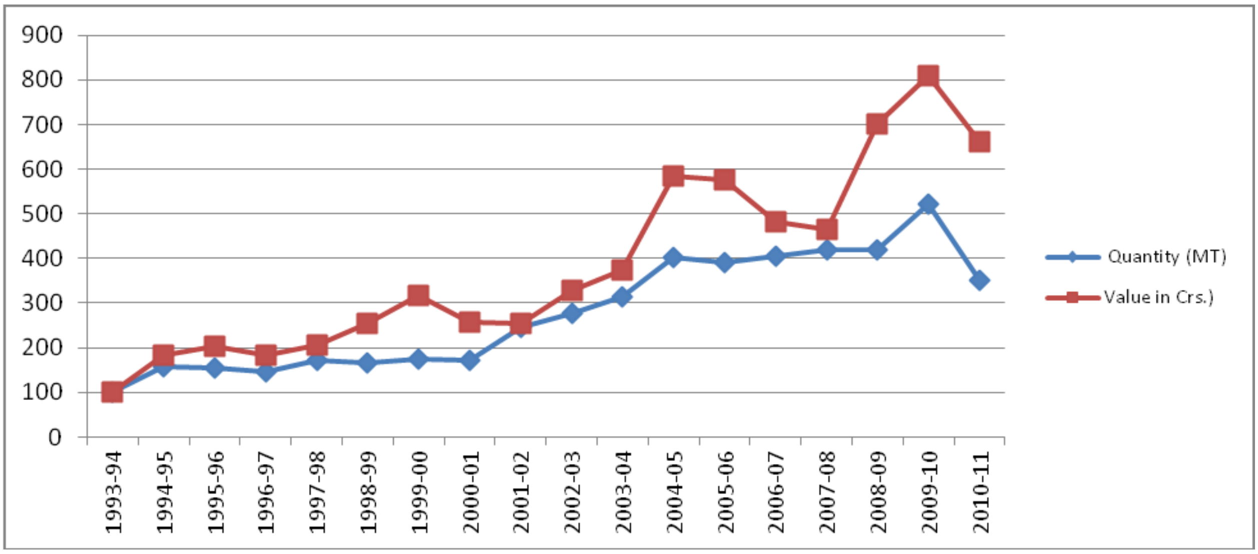

Fig. 4.7 Trend in indices of volume and value of cashewnut import in India

As is evident from Fig. 4.7, growth in quantity of imports have been stagnant upto 2000-2001, but showed an increasing trend afterwards till 2007-08. Imports drastically declined in 2010-11 probably due to the civil war in Ivory Coast and policy ban on exports of unprocessed cashew nuts in many countries of the African zone. The fluctuations in value of import have been due to the fluctuations in quantity imported.

4.2.3 **Net Export Earnings**

The major problem facing the Indian cashew industry is the acute shortage of raw cashew nuts within the country. It was inferred from the analysis that in India, imports have been increasing on a higher rate than exports which is detrimental to the foreign exchange earnings of the country. While export has been increasing at 6 per cent per annum, import was increasing at 15 per cent per annum. As reported by Balasubramanian and Rema (1996), the trend in export was found to be directly correlated to imports in such a way that for every tonne of kernel exported, 5 tonnes of raw nuts was imported. As against the processing requirement of 12-13 lakhs per annum, the domestic production of raw cashew nuts is only 6 lakhs per annum. Consequently, the cashew processing industry has been resorting to import of raw nuts for processing and exports from African and South East Asian countries.

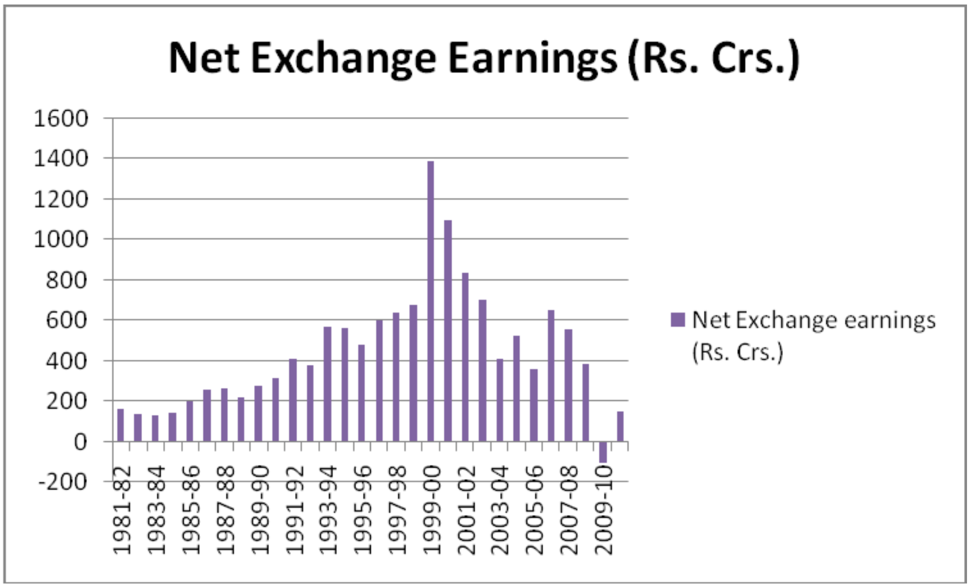

Fig. 4.8 Trend in net foreign exchange earnings from the cashew industry

The net earnings as shown in Fig. 4.8, has increased and reached its peak value in 1999-2000 but has then declined with wide fluctuations in between. This is a clear indication that after 2000, the export of kernels have increased mainly due to the heavy dependence on the imported raw nuts to meet the processing requirements. It was also found that the earnings were negative in 2009-10 and out of the total import volume of 752854 MT, the kernel exports were only 1.081 lakh MT (Appendix I). The increased imports in the particular year was because domestic production had decreased by 11.7 percent from the previous year. This finding is in tune with the reports of Balasubramanian (2009) who found that the contribution of Indian cashew production to meet the exports has been very low.

Thus, cashew trade has met with the vagaries of instability due to the development of processing technology in other cashew growing countries, trade restrictions and internal demand. So, all available resources must be channeled to increase output of raw nuts. Increased availability will then enable a competitive situation to emerge and consolidate India’s export position out of home production. It is to the advantage of the Indian raw cashew producer that the second largest market in the world for cashew kernels is India. This advantage should be capitalized for developing export markets continuously. Of late, there has been a rapid expansion of production in West Bengal and the North eastern states including Assam to produce for local demand. This provides a sound base for export marketing in the coming years. The natural proximity of the North-Eastern region to SAARC countries and China must be made used of. These countries would constitute a good beginning to develop export markets and would help Eastern states to develop their own footprint in the export scenario.

4.3 Price Behaviour of Cashew Kernels

Prices in general are volatile. As cashew exhibits high fluctuations in prices, reliable price information is an urgent need for all stakeholders. Remunerative and steady price for any agricultural produce plays a crucial role in increasing production of that commodity. The behavior of prices of cashew kernel in the domestic (Kollam) as well as international (London) markets have been studied for the period January 1999 to December 2011 by analyzing the four components of price behavior viz., secular trend, seasonal, cyclical and irregular variations. The results are presented and discussed in the following section.

4.3.1 **Trend Analysis of Cashew kernel Prices**

The trend analysis of cashew kernel prices was carried out by using the various functional forms viz., linear, quadratic, compound, growth, logarithmic, cubic, sigmoid and, exponential, power, inverse and logistic models. As all the models gave very low R^2 values and very high Standard Error (SE), none of them gave a satisfactory fit. Hence, exponential smoothing methods viz., single exponential and double exponential smoothing were tried to explain the underlying trend in the data. It was observed that single exponential smoothing explained the underlying trend in prices of cashew kernels in both international and domestic markets with a MAPE value of 5 per cent and 3 per cent respectively (Fig. 4.10 and Fig.4.11).

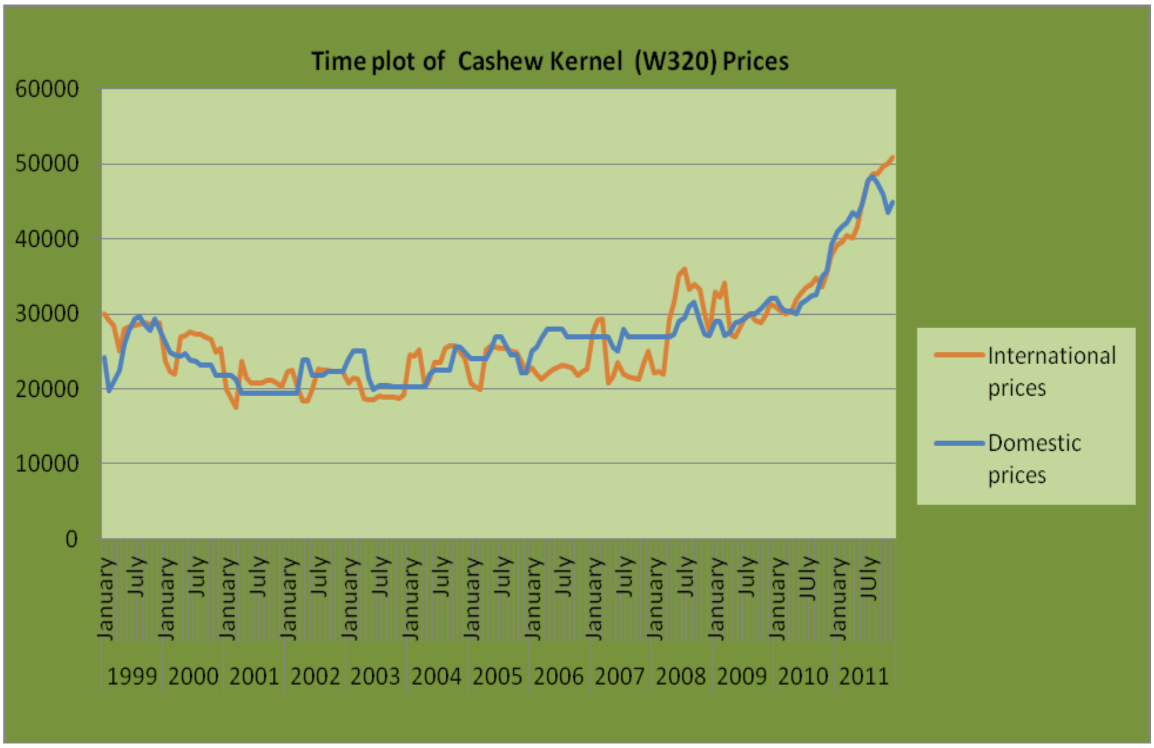

Fig. 4.9 Time plot of Cashew Kernel prices

Both markets first show wide fluctuations and then an increasing trend in prices was noted. It is evident from Fig. 4.9 that the period from 1999 to 2009 February showed much fluctuations in both domestic and international markets, the fluctuations being more prominent in the international arena. The prices of cashew kernels in both markets generally showed an increasing trend from 2009 onwards but the prices in the domestic market abruptly fell in 2011 July. Political unrest in Ivory Coast, erratic temperatures in the cashew growing belts of Ghana, Nigeria and Tanzania have crippled production globally. The unseasonal rains in Vietnam has affected the crop size and drying of kernels. This has inturn led to global supply constraints making the produce dearer for processors.

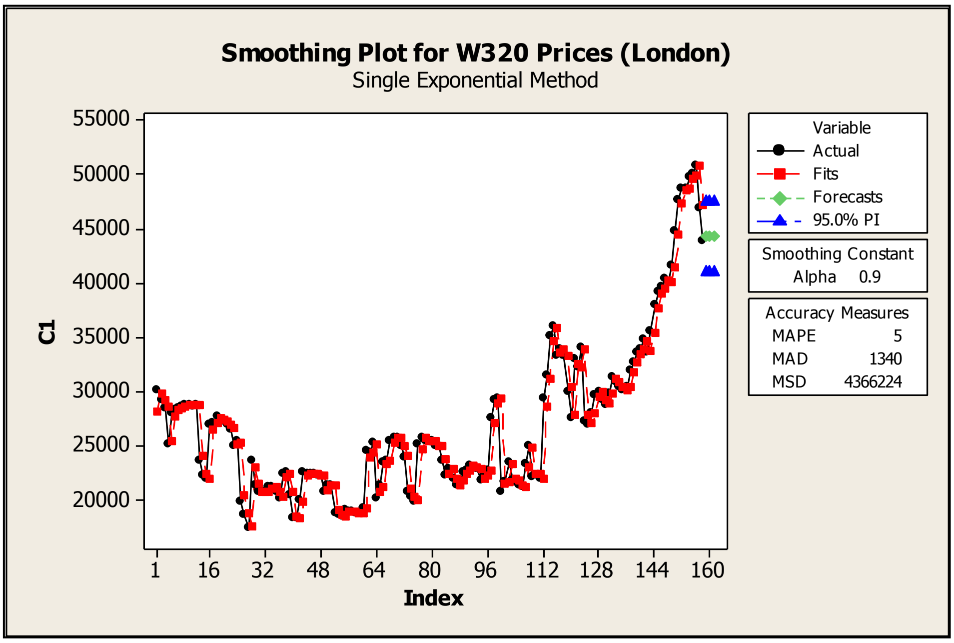

Fig. 4.10 Smoothing Plot for cashew kernel prices in the International market (C1 indicates kernel prices)

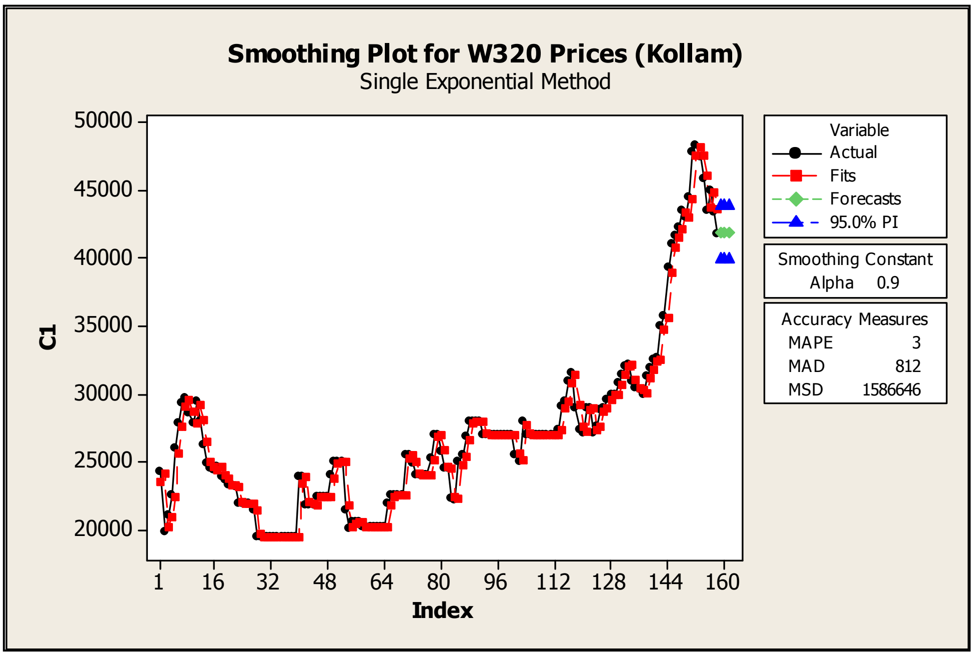

Fig. 4.10 Smoothing Plot for cashew kernel prices in the domestic market (C1 indicates kernel prices)

4.3.2 **Seasonal Variations in Prices of Cashew Kernels**

The effects of seasonality in the arrivals and prices of commodities brought about by the seasonality in crop production is well known and deserves proper consideration while attempting any improvement in the marketing system. The degree of seasonal fluctuations in prices is related to the degree of perishability of the product and availability of storage and other market infrastructure facilities. The seasonal variations in the price of cashew kernels in the international as well as the domestic market was examined by constructing seasonal price indices separately for both the markets.

The seasonal indices for the two markets are presented in Table 4.9 and Fig. 4.12. Cashew flowering starts in December and ends in April and the harvesting period is from February to June. In the domestic market, the buoyant phase was observed during June to July with the highest price index in July and the trough period was observed during March to April with the lowest index in the month of April. In the international market, the buoyant phase was observed during June to August with the peak price in August and the trough period was observed from February to May.

Table 4.9 Seasonal Indices of Cashew Kernel Prices

Month	Domestic market	International market
Jan	100.73	100.37
Feb	100.23	99.23
Mar	97.88	97.37
Apr	97.58	95.79
May	99.93	97.78
Jun	100.93	100.24
Jul	101.01	101.08
Aug	100.39	102.45
Sep	100.16	102.13
Oct	100.88	101.86
Nov	99.543	100.30
Dec	100.69	101.34

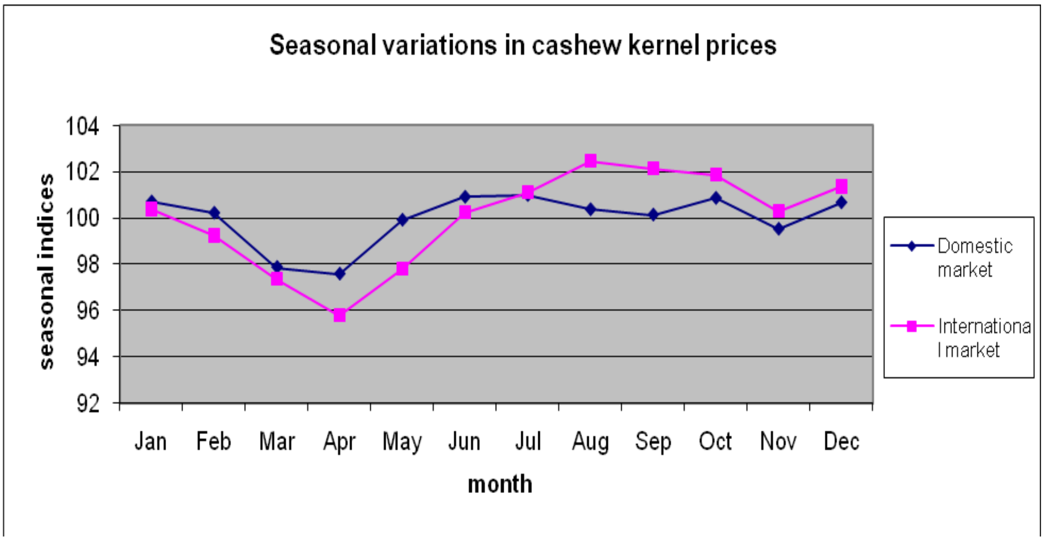

Fig. 4.12 Seasonal variations in cashew kernel prices

As is clear from Fig. 4.12, no drastic reduction in prices were observed in both the markets but when prices in the International market (102.45) rose in August, they fell (100.39) in the domestic market.

4.3.3 **Cyclical Variations in Cashew Kernel Prices**

Cyclical fluctuations are the oscillatory movements in a time series with period of oscillation more than one year. The cyclical indices for the international and domestic markets are depicted in Fig. 4.13. It is clear that cyclical indices of both markets behaved similarly but no price cycles could be identified in prices for both markets.

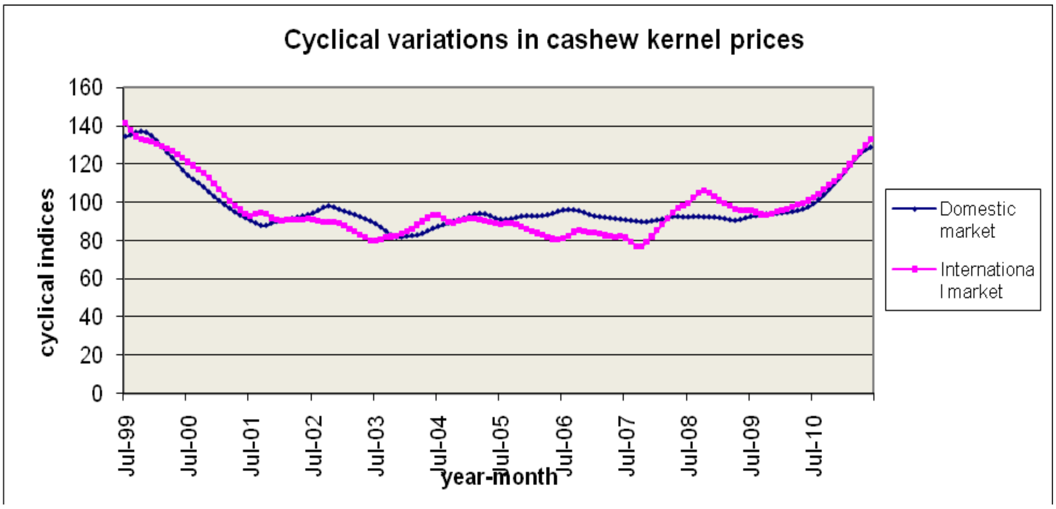

Fig. 4.13 Cyclical variations in cashew kernel prices

4.3.4 **Irregular Variations in Cashew Kernel Prices**

The residual method was employed to work out indices of irregular variations for both international and domestic markets, by eliminating the trend, seasonal and cyclical components from the original data. The indices presented in Fig.4.14 revealed that there were considerable irregular variations in cashew prices in both the markets. The variations were more pronounced in the international market due to decreased production in many cashew-growing regions of the world. Also the number of players increase in the international market scenario leading to more speculative practices ultimately affecting the prices.

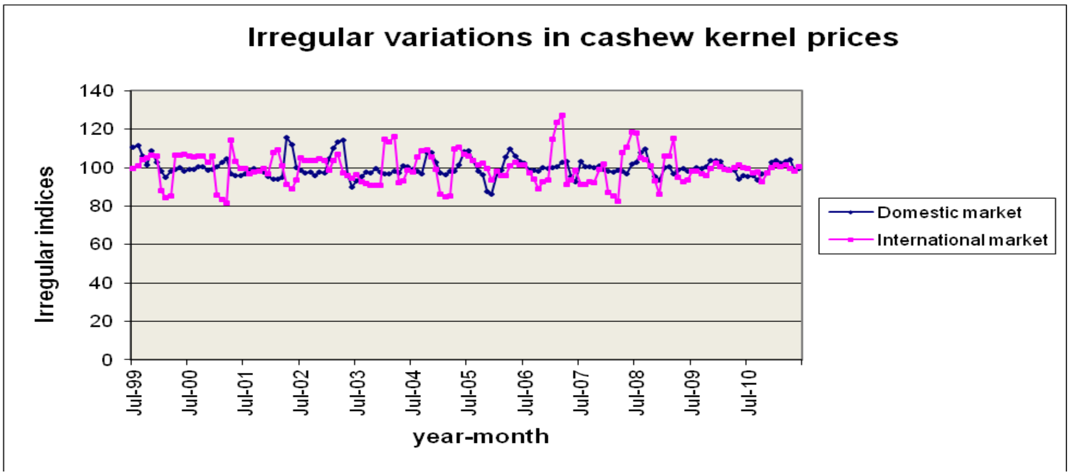

Fig. 4.14 Irregular variations in cashew kernel prices

4.4 Price Instability in Cashew Kernel Prices

The coefficient of variation (CV) obtained for the domestic as well as international markets were 23.87 per cent and 26.46 per cent respectively. This shows the instability in cashew prices during the years under study. This instability in prices pronounces the need for price forecasting in cashew kernels which has been dealt later in this section.

4.5 Export Competitiveness

Trade competitiveness basically depends upon the level of domestic prices relative to international prices. If domestic price of a commodity is lower than the net export prices, the commodity is export competitive, otherwise it is not. An examination of the year wise NPC values (Table 4.10) indicated that cashew kernels were export competitive for many years but not for the entire study period. The years

2002, 2003, 2005-07 did not give the commodity the competitive edge in the International market as international prices were lower than the domestic prices during that period. It was also found that the commodity was least competitive in 2006 (1.21) and most competitive in 2010 that registered NPC value of 0.84.

Table 4.10 Domestic and International Prices of Cashew Kernels with NPCs

Year	Domestic price	International price	NPC
1999	261.64	284.48	0.91
2000	238.07	256.84	0.92
2001	200.02	205.61	0.97
2002	217.68	213.82	1.01
2003	218.71	194.37	1.12
2004	223.85	240.69	0.93
2005	245.35	236.83	1.03
2006	270.25	224.44	1.21
2007	267.91	238.93	1.12
2008	283.21	297.12	0.95
2009	295.35	300.60	0.98
2010	326.71	385.93	0.84
2011	445.15	451.37	0.98

The mean NPC value for the period was 1.02, which is slightly higher than unity indicating that the commodity was not export competitive as a whole but a trend towards gain in export competitiveness was noticed from 2008. This is in contrast with the results of Ashalatha (2000) who reported that under exportable hypothesis, NPCs were found to be lesser than unity with an average value of 0.91 implying that Indian cashew kernels were competitive in the export market. In the present study, because c&f (cost and freight) prices of cashew kernels were taken as the border prices, the highly inflated c&f prices have bought the likely change in the mean NPC value.

4.6 Price Forecasting

Because of the high volatility of prices of agricultural commodities over the past decade, the importance of accurate price forecasting for decision makers has become even more acute. In the above context, market intelligence assumes much significance as it would be helpful for the cashew farming community in planning their operations in an economically viable manner either immediately or in a long term. In this study, an attempt has been made to evolve a reliable price forecasting model for cashew kernel grade W320 in domestic (Kollam) as well as international (London) markets using various methods such as single exponential smoothing, double exponential smoothing, moving average method, ANN model and Box-Jenkins ARIMA model.

4.6.1 **Forecasting of cashew kernel prices using Exponential Smoothing Method**

Single exponential smoothing method was tried to forecast the prices of cashew kernel in domestic and international markets (Fig 4.10 and Fig 4.11). The accuracy measures obtained for this model for domestic and international markets are presented in Table 4.11.

Table 4.11 Accuracy measures using Single Exponential Smoothing Method

Accuracy measures	Domestic	International
MAPE	3	5
MAD	812	1340
MSD	1586646	4366224

When single exponential method was used, MAPE, MAD and MSD values were found to be lower for domestic market than for international market as can be seen from the above table.

Table 4.12 Forecasted Prices using Single Exponential Smoothing Method

Months	Forecasted Price (Rs./Ql)	
	Domestic	London
March' 12	41935 (39947-43924)	44267 (40984-47549)
April' 12	41935 (39947-43924)	44267 (39947-43924)
May' 12	41935 (39947-43924)	44267 (39947-43924)

Figures in parentheses show forecasted price range

As is evident from Table 4.14, the predicted prices using SES were same for the three months which implies that price fluctuations have not been captured using this method. But low MAPE value for domestic market indicated that SES was more suitable in predicting domestic prices as compared to international prices.

4.6.2 Price Forecasting using Moving Average Method

The short term price forecasts for cashew kernels in domestic and international markets were made using moving average method (Fig. 4.15 and Fig. 4.16). Table 4.14 shows the forecasted price of cashew kernels in the domestic and international markets for the months of March'12, April'12 and May'12. The accuracy measures obtained for this model for the two markets are presented in Table 4.13.

Table 4.13 Accuracy measures using Moving Average Method

Accuracy measures	Domestic	International
MAPE	6	8
MAD	1691	2298
MSD	5215678	9748157

As is clear from above Table, MAPE, MAD and MSD values were lower for domestic market when compared to international market. MAPE values obtained for both markets using MA method were higher than the values obtained using the SES model.

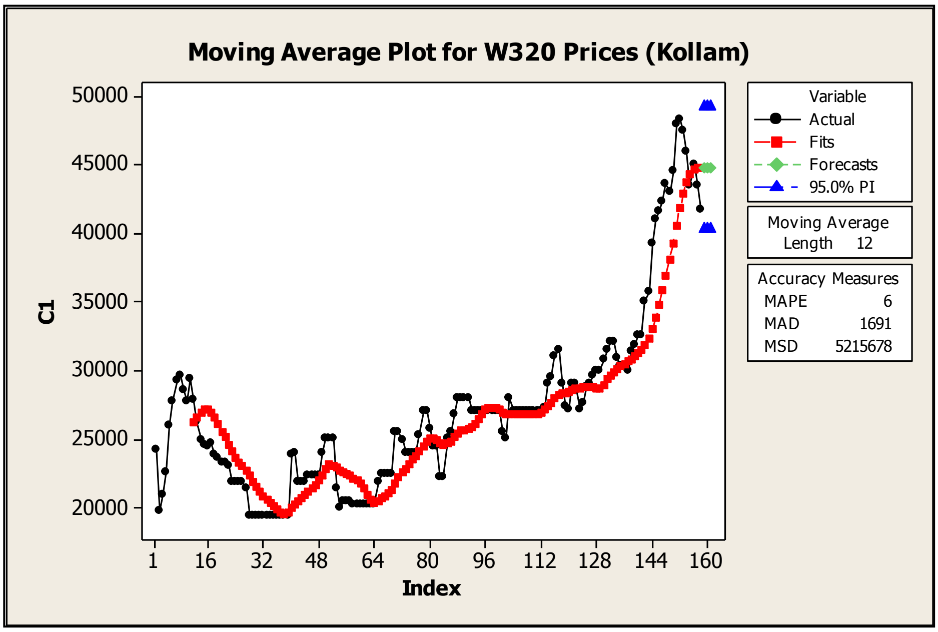

Fig. 4.15 Moving Average plot of Cashew Kernel prices in domestic market (C1 indicates kernel prices)

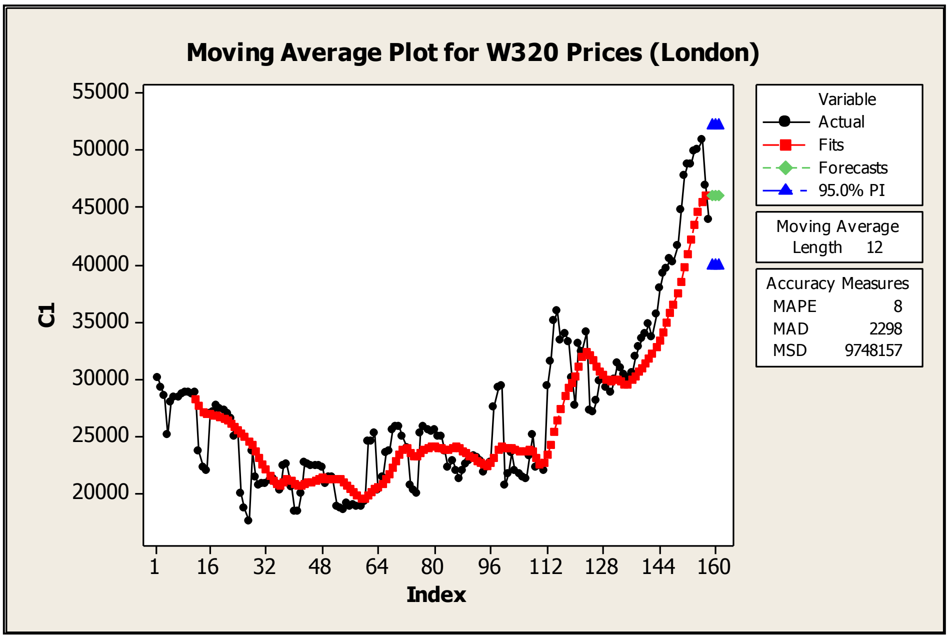

Fig. 4.16 Moving Average plot of Cashew Kernel prices in international market

Table 4.14 Forecasted Price (Rs/Ql) of cashew kernels

Months	Domestic Market	International Market
March' 12	44724 (40248-49200)	45955 (39835-52074)
April' 12	44724 (40248-49200)	45955 (39835-52074)
May' 12	44724 (40248-49200)	45955 (39835-52074)

Figures in parentheses show forecasted price range

Alike SES, MA method also could not capture monthly price fluctuations as the predicted prices were the same for all the three months.

4.6.3 **Price Forecasting using ANN Model**

The price of cashew kernels in domestic market forecasted using this model is given in the Table 4.15. Fig. 4.17 shows the plot of the actual and predicted price of W320 kernels in domestic market using ANN model. The model registered a MAPE value of 3.03.

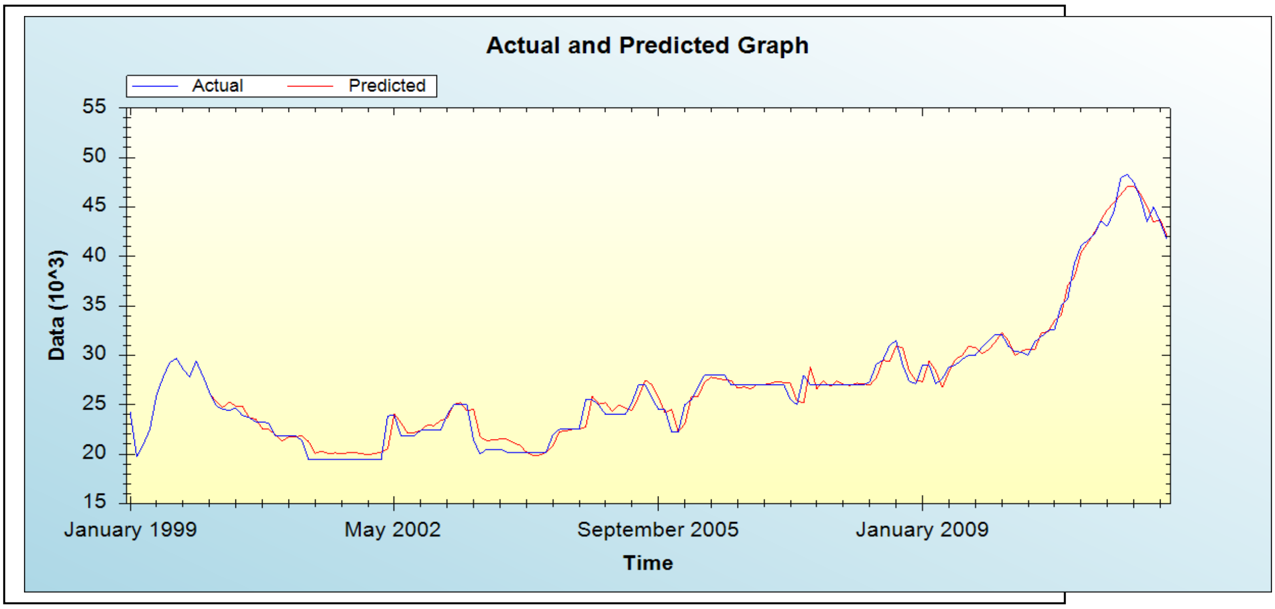

Fig. 4.17 Plot of actual and predicted price of cashew kernel in domestic market

As is clear from the above plot both the actual and predicted prices moved together indicating goodness of the model.

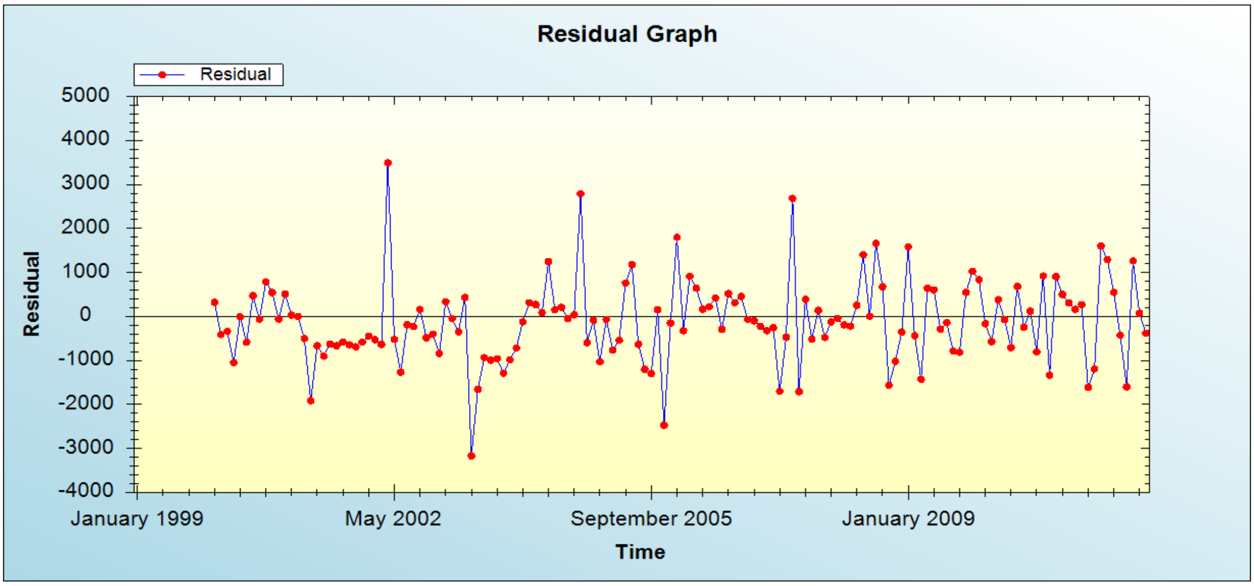

Fig. 4.18 Plot of residuals of cashew kernel prices in domestic market

As is evident from Figure 4.18, the plot of the residuals indicated fitness of the model in predicting cashew kernel prices in domestic market.

Table 4.15 Forecasted Price in Domestic Market using ANN Model

Month	Forecasted Price (Rs/Ql)
March'12	41902
April'12	41463
May'12	41103

As the model gave a low MAPE value of 3.02 and has forecasted different prices for the respective months (Table 4.15), the model has been able to capture the fluctuations in kernel prices in the domestic market. Thus, ANN models have been able to predict kernel prices with statistical accuracy.

The model was also tried to predict the price of cashew kernels in the international market. But the actual and predicted price graph showed wide fluctuations and the plot of residuals was also not satisfactory (Appendix IV). Even the forecasted price for March '12 greatly differed from the actual prices (Appendix V) as compared to other models. So, based on these statistical accuracy measures, it was inferred that ANN was not a preferred model for predicting the price of cashew kernels in the international market.

4.6.4 **Price Forecasting using ARIMA Models**

When ARIMA model was used for forecasting cashew kernel prices in the domestic market, ARIMA (0, 1, 1) was identified as the best model. The plot of actual and predicted prices indicate the fitness of the model (Fig. 4.19). The model gave a MAPE value of 2.73. The accuracy of the model based on MAPE values, ACF and PACF plots of residuals (Fig. 4.20) show adequacy of the model to explain the data. Table 4.16 shows the forecasted prices for the months of March '12, April '12 and May'12.

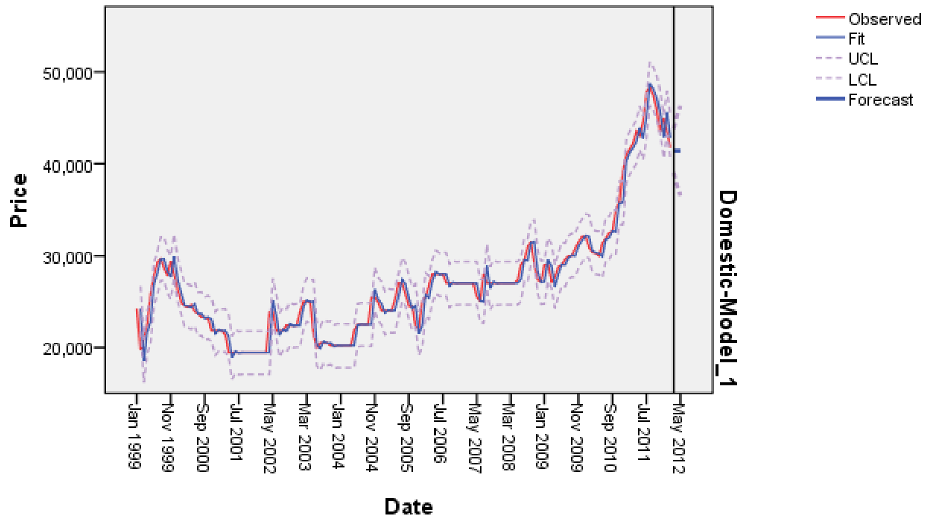

Fig. 4.19 Plot of actual and predicted prices of cashew kernels in Domestic market

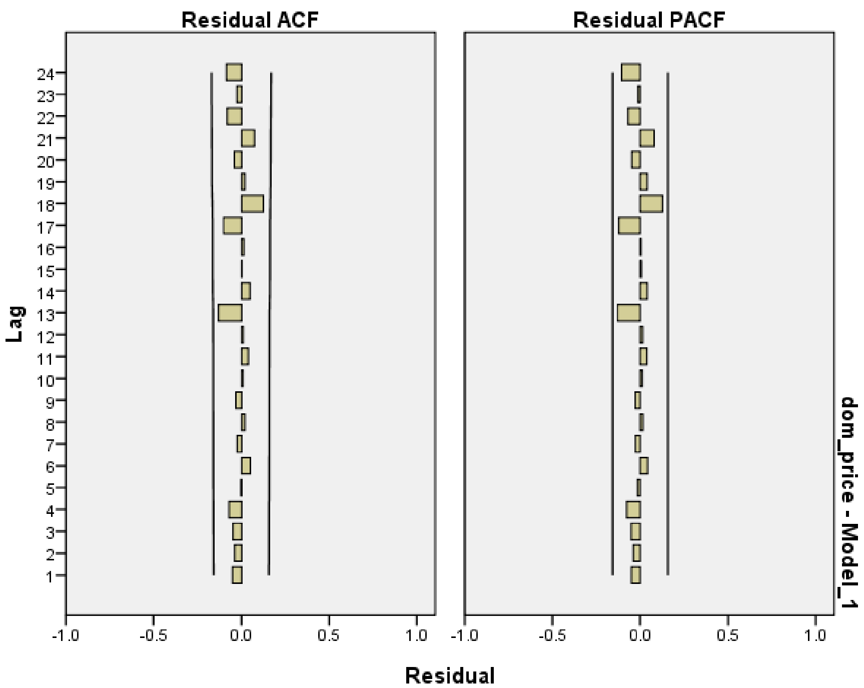

Fig. 4.20 ACF and PACF plots fitted to cashew kernel prices in Domestic market

Table 4.16 Forecasted domestic kernel prices with lower and upper confidence limits (forecasted price range)

Months	Forecasted Price (Rs/Ql)	LCL	UCL
March'12	45626	40718	50534
April'12	45626	39847	51405
May'12	45626	39092	52160

For international (London) market, ARIMA (3,1,0) (0,0,1) was the best model. The plot of actual and predicted prices indicate the fitness of the model (Fig. 4.21). The model gave a MAPE value of 5.12. The accuracy of the model based on MAPE values, ACF and PACF plots of residuals (Fig. 4.22) show adequacy of the model to explain the data. Table 4.17 shows the forecasted prices for the months of March '12, April '12 and May'12.

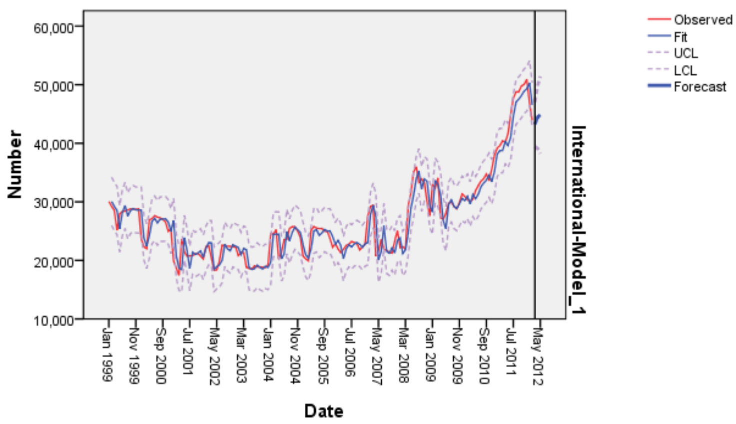

Fig. 4.21 Plot of actual and predicted prices of cashew kernels in International market

Table 4.17 Forecasted international kernel prices with lower and upper confidence limits (forecasted price range)

Months	Forecasted Price (Rs/Ql)	LCL	UCL
March'12	43228	39430	47027
April'12	44492	39119	49864
May'12	44831	38251	51411

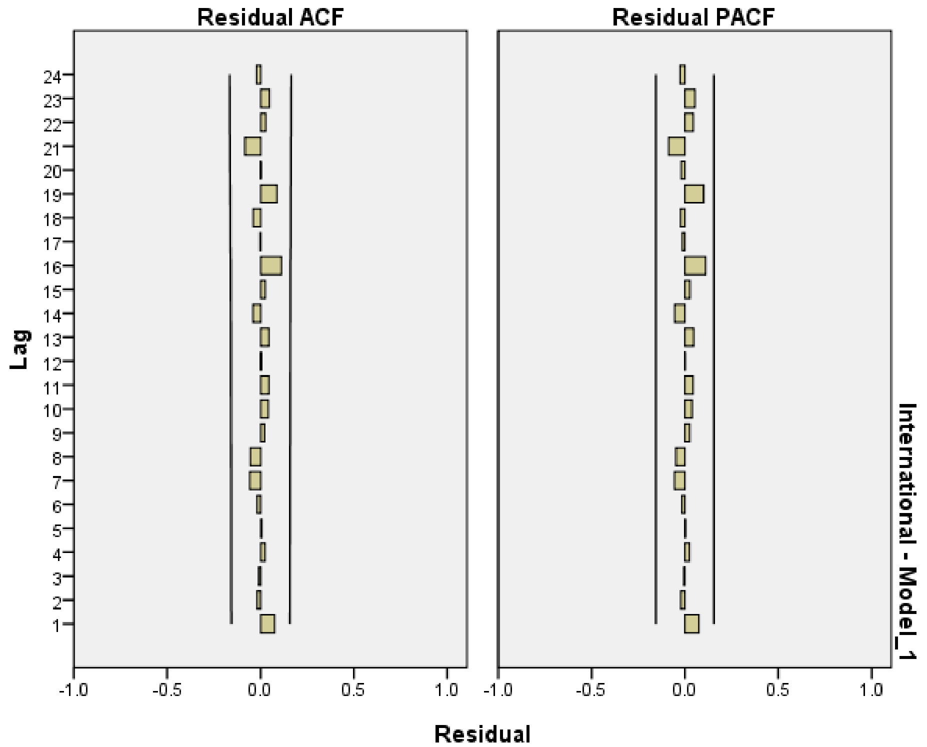

Fig. 4.22 ACF and PACF plots fitted to cashew kernel prices in international market

Table 4.18 MAPE values of forecast models

Model	MAPE Value	
	Domestic	International
Moving Average	6	8
SES	3	5
ARIMA	2.73	5.12
ANN Model	2.86	5.78

As is evident from the above table, out of all the models tried, ARIMA model gave the lowest MAPE values for both domestic and international markets. ANN model gave the second lowest MAPE value for domestic market. Single Exponential smoothing method also gave low MAPE values for both markets. Hence ARIMA, ANN and SES were the better models for predicting cashew kernel prices.

4.7 Validation of Price Forecasts

The predicted price of cashew kernels in the domestic market was validated using the actual market price that prevailed in the domestic market during the period from March'12 to May'12. The validation of the predicted price of cashew kernels in international market was also done by the same method. The domestic prices predicted using different models viz., moving average, single exponential smoothing, ARIMA models and ANN along with percentage forecast accuracy are presented in Table 4.19.

Table 4.19 Validation of Forecasted Price of cashew kernels in Domestic market

Method	Month	Actual price	Predicted price		% forecast accuracy
			Forecast	95 % Confidence interval	
MA	March'12	40500	44724	40248-49200	89
	April'12	43500	44724	40248-49200	97
	May'12	45800	44724	40248-49200	98
SES	March'12	40500	41935	39947-43924	97
	April'12	43500	41935	39947-43924	96
	May'12	45800	41935	39947-43924	92
ANN	March'12	40500	41902	-	97
	April'12	43500	41463	-	95
	May'12	45800	41103	-	90
ARIMA	March'12	40500	45626	40718- 50534	87
	April'12	43500	45626	39847- 51405	95
	May'12	45800	45626	39092- 52160	99

As is clear from above table, MA method has forecasted the kernel prices for the months March and April with high accuracy, but it has predicted a very high price range (confidence limits) which questions its reliability. SES model has predicted the prices for the months of March and April with 97 and 96 percent accuracy and has also predicted a smaller price range. On the other hand, the actual price for the month of May '12 has not fallen within the predicted price range.

Using ANN model, the forecast accuracy was above 90 percent for May and above 95 percent for March and April, but it failed to predict a price range. Among the models tried, only ARIMA model could predict different price ranges for the respective months. The predicted prices for April and May showed more than 95 percent accuracy, even though the actual price for March fell a little outside the predicted range with an accuracy of 87 percent. In general, it maybe concluded that no model could predict domestic kernel prices suitably for all the three months.

The validation of international price forecasts as presented in Table 4.20 indicated that MA, SES and ARIMA models could predict kernel prices for the months March, April and May with more than 90 percent accuracy. But MA and SES models could predict only the same forecast value and range for all the three months. In the case of SES model, the actual prices for April and May have not fallen within the predicted range. ARIMA model could capture the variations in prices as it has predicted different prices and price ranges for the respective months. The actual prices have also fallen within the predicted range with very high forecast accuracy. Hence, ARIMA model proved to be the best in predicting international prices.

Table 4.20 Validation of Predicted Price of cashew kernels in International Market

Method	Month	Actual price	Predicted price		% forecast accuracy
			Forecast	95 % Confidence interval	
MA	March'12	45453	45955	39835-52074	98
	April'12	47647	45955	39835-52074	96
	May'12	48432	45955	39835-52074	94
SES	March'12	45453	44267	40984-47549	97
	April'12	47647	44267	40984-47549	93
	May'12	48432	44267	40984-47549	91
ARIMA	March'12	45453	43228	39430-47027	95
	April'12	47647	44292	39119-49864	93
	May'12	48432	44831	38251-51411	93

4.8 Market Integration

Johansen's cointegration method is the most widely used tool to study market integration. Before the cointegration analysis, it is to be determined whether the two price series are stationary or not. The Augmented Dickey Fuller (ADF) test was done separately for domestic as well as international markets to test the stationarity of the two price series. A time series with constant mean and variance are called as stationary time series. The ADF statistic obtained for both the markets are given in table 4.21 along with MacKinnon critical values. The test gave statistically significant estimates at 1 per cent level of significance, which meant that that the two series were stationary.

The cointegration test was conducted to examine whether the two markets were integrated or not. The results of the cointegration test are given in Table 4.22. It is evident from the Table 4.22 that the null hypothesis of independence of the markets was rejected at 1 per cent level of significance, which indicates that the two markets were integrated.

The pair wise Granger Causality test was carried out to know the direction of influence of one market on the other. Two null hypotheses were tested under this test and gave statistically significant result for the second null hypothesis at one per cent level of significance (Table 4.23). It indicates that there was influence of domestic kernel prices on the international kernel prices and not vice versa. This result is of utmost importance as cashew kernels from Kerala sets the benchmark quality in the world market. Kerala has been the nucleus center of cashew trade in India and the market price in Kerala is considered as benchmark price in other states. A direct correlation observed in this regard is that the price in other areas increases or decreases by Re. 1 per kg of the price collection season (Rema and Balasubramanium, 1996).

India's largest export market is the quality conscious American zone which consumes more than 60 percent of our kernels. India has the second position in the cashew kernel trading scenario and bulk of transactions take place through the

KSCDC, Kollam. Also, even though Vietnam is the largest exporter, its target market is mainly China which is not quality conscious. So in the long run, if the quality standards can be maintained, India can remain a major player in the kernel export scenario.

Table 4.21 ADF Statistic Obtained for domestic and international Markets

Market	**ADF Statistic**
Domestic (Kollam)	-1.678586**
International (London)	-1.971199**

MacKinnnon critical values: 1 % level- -3.4662, 5 % level- -2.8768, 10 % level- -2.5748
** denotes rejection of the null hypothesis at 1 % level of significance

Table 4.22 Johansen's Co integration Test

Market	**Eigen value**	**Likelihood Ratio**	**5 % critical value**	**1 % critical value**	**Hypothesized No. of CE(s)**
Domestic (Kollam)	0.100767	20.20451	18.17	23.46	None**
International (London)	0.025512	3.953913	3.74	6.40	At most 1*

** denotes rejection of the null hypothesis at 1 % level of significance
CE denotes the Cointegrating Equation

Table 4.23 Pair wise Granger Causality Test

Null Hypothesis	F-Statistic	Probability
London does not Granger Cause Kollam	1.69355	0.15462
Kollam does not Granger Cause London	5.02476	0.00080

** denotes the rejection of the null hypothesis at 1 % level of significance

Summary &Conclusion

5. SUMMARY AND CONCLUSION

The cashew industry earns sizeable export revenue through export of cashew kernels besides providing employment to over a million people, especially women workers. However, the global competitive environment has changed significantly during the last decade with the arrival of new competitors in the export market and the emergence of new markets thereby creating a volatile market environment. Cashew exhibiting high price fluctuations, reliable price information is an urgent need for all stakeholders. Remunerative and steady price for any agricultural produce plays a crucial role in increasing production of that commodity. Hence, the study was taken up with the objective of analyzing the export and price behaviour of cashew in India and evolving a reliable price forecasting model for cashew kernel prices in the domestic (Kollam) and international (London) markets.

The present study "Export and price behaviour of cashewnut in India" was conducted based on the secondary data published by various institutions. The data regarding the area, production and productivity of cashew in major states of India was collected for the period from 1965-66 to 2010-2011 from Directorate of Cashewnut and Cocoa development, Kochi and various issues of their publication, *The Cashew and Cocoa Journal.* The details about export and import of cashew in India and International prices of cashew kernels at London market were obtained from Cashew Export Promotion Council of India, Kochi and various issues of their publication, *Cashew Bulletin*. The behavior of prices of cashew kernels (export grade W320) was studied in the domestic market (Kollam) and international market (London) for a period of 13 years from January 1999 to December 2011. The month wise average prices of cashew kernels in domestic market were collected from the Kerala State Cashew Development Corporation, Kollam and the Directorate of Economics and Statistics, Trivandrum. The export and import details of cashew in India was studied for the period 1980-81 to 2010-11 by dividing the study period into pre-liberalisation period (1981-1992) and post-liberalisation period (1993-2011). The trend indices with respect to area, production, productivity and export-import of cashew in India in the post liberalization period were studied using the method of Index numbers.

The growth rates in area, production and productivity of cashew at all-India level and major cashew growing states of India were estimated using the method of Compound Growth Rate (CGR). The decade-wise CGR analysis revealed that production and productivity grew the highest during 1985-95. While the area under cashew registered an overall CGR of 2.71 for the study period 1965-2011, the production exhibited a higher CGR of 4.20. This is due to concerted efforts taken by the Govt. of India in implementing various programmes for the development of cashew through the five-year plans. The trend indices for the post liberalization period indicated that area under cashew has been steadily increasing but production showed wide fluctuations in certain years due to stagnant growth shown by productivity. This maybe because productivity was computed based on total area under cashew and not yielding area. In the case of Kerala which held the third position in area and second in production a decade back, has now been pushed to sixth place in area and fourth in production. During the study period, Kerala registered negative growth rates in area, production and productivity because farmers have shifted to more remunerative crops like rubber. Development of new technology and their efficient transfer holds the key to increase productivity and become self-sufficient in raw nut production.

The CGR analysis of cashew trade in the pre and post-liberalisation periods revealed that exports of cashew kernels and import of raw nuts fell in the post-liberalisation periods clearly indicating that India has not taken full advantage of the global economic reforms. But export of CNSL rapidly grew in the post-liberalisation period indicating its versatile need as raw-material in many industries. An analysis of the net export earnings revealed that earning have been falling since 2000 stressing the need to boost Indian cashew production to meet the export requirement.

The price behaviour of cashew kernels was studied using the techniques of classical decomposition of time series analysis. The monthly average price data on cashew kernels in domestic (Kollam) and international (London) markets were decomposed in to its four components viz., secular trend, seasonal, cyclical and irregular variations. A trend analysis was carried out separately for domestic as well as international market by applying the method of least squares, but no satisfactory fit was obtained based on adjusted R^2 values and standard errors. Hence, Single exponential smoothing method explained the underlying trend in kernel prices in both international and domestic markets. The analysis showed that the cashew kernel prices in both domestic and international markets widely fluctuated during the period 1999 to 2009 February after which an increasing trend in prices was noticed. The prices of cashew kernels in both markets generally increased from 2009 onwards due to global supply constraints but the prices in the domestic market abruptly fell in 2011 July.

The seasonal variations in the price of cashew kernels in the international as well as the domestic markets were studied using seasonal price indices. In the domestic market, the buoyant phase was observed during June to July with the highest price index in July and the trough period was observed during March to April with the lowest index in the month of April. In the international market, the buoyant phase was observed during June to August with the peak price in August and the trough period was observed from February to May. The cyclical indices for the international and domestic markets showed that no price cycles could be identified in prices for both markets. The irregular indices revealed that there were considerable irregular variations in cashew prices in both the markets. The variations were more pronounced in the international market due to decreased production in many cashew-growing regions of the world.

The instability in cashew prices was studied using the coefficient of variation (CV) which was 23.87 per cent for domestic market and 26.46 per cent for international market. The export competitiveness of Indian cashew kernels was measured using (Nominal Protection Coefficient) NPC. The mean NPC value for the period was 1.02, which is slightly more than unity indicating that the commodity was not export competitive as a whole but a trend towards gain in export competitiveness from 2008 was noticed.

Various price forecasting models viz., moving average, single exponential smoothing, double exponential smoothing, ANN and ARIMA models were tried to develop a reliable price forecasting model for cashew kernel prices in both domestic (Kollam) and international (London) markets. ARIMA models was the best in predicting cashew kernel prices in the international market. In the case of domestic market, no model could suitably forecast the market prices. This maybe due to the fact that domestic prices were compiled from various sources. A strong database that keeps daily record of cashew kernel prices should be developed. This would be made relevant market information that reduces price risk.

The market integration studies using the co integration technique showed that both domestic and international markets were integrated. The pair wise Granger Causality test indicated that there was influence of domestic kernel prices on international kernel prices and not vice versa. This result is of utmost importance as cashew kernels from Kerala sets the benchmark quality in the world market.

Based on the foregoing analyses and discussion, the following policy measures are being suggested:

1. Even though India is the largest area holder of cashew, it lags behind in terms of productivity. Replanting the low yielding and senile plantations with high yielding varieties would be a strategic decision to address the low productivity of cashew plantations. Development of new technology and their efficient transfer holds the key to increase productivity and become self-sufficient in raw nut production. Vietnam, a major

competitor with Indian cashew is in a position to offer competitive rates due to sufficient raw material as well as high level of productivity.

2. Increased productivity would not only increase domestic production but reduce dependency on imports for processing. Production has to be enhanced to increase export of processed, salted and roasted kernels because of its immense scope in the global market. Since traditional raw nut suppliers have now taken up processing in their countries, it is the need of the hour that India has to increase production to stay in the export market. This will also enhance export earnings of the country.
3. More efforts need to be taken to improve cashew plantations in non-traditional areas like West Bengal and other north-eastern states which has contributed to 3 lakh MT of the total cashew production in 2010-11. This rapid expansion of production provides a sound base for export marketing in the coming years. The natural proximity of the North-Eastern region to SAARC countries and China should be tapped.
4. There is a need for market diversification by strengthening market in countries like Japan, Australia, Sweden, Kuwait, China etc which are at present good consumers of Indian kernels. Market research is to be undertaken in these countries so that programmes for export promotion can be evolved.
5. CNSL exports have substantially increased in the post-liberalisation period. This is because of the increasing demand for the product in the industrial sector which got more benefitted from the economic reforms. This aspect should be given due regard as far as export markets are concerned.
6. A strong database that keeps daily record of cashew kernel prices should be developed. This would be made relevant market information that reduces price risk. This would also help exporters to plan ahead and price appropriately.

7. Since co-integration analysis revealed that domestic kernel prices influences International prices, this would boost Indian exports and in the long run, if the quality standards are well maintained, India can remain a major player in the kernel export scenario.
8. As future line of work, a multivariate forecasting model which includes factors like prices of other internationally competitive nuts like, walnuts, pistachios, and exim policies affecting global cashew trade maybe developed. This is of prime importance as cashew is an internationally traded commodity with wide global acceptance.

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Appendices

APPENDIX I
Export of Cashew kernels in India during 1981-2011

Year	Quantity(M.T.)	Value (Rs. Crs)
1981-82	30740	181.5
1982-83	30896	135.36
1983-84	36897	150.86
1984-85	32373	179.67
1985-86	37097	225.11
1986-87	43004	327.55
1987-88	36949	322.71
1988-89	34023	276.48
1989-90	44857	360.33
1990-91	50080	443.5
1991-92	52282	673.11
1992-93	57694	749.3
1993-94	73509	1048.91
1994-95	80807	1248.72
1995-96	71094	1241.95
1996-97	70398	1288.27
1997-98	81039	1403.27
1998-99	78988	1634.29
1999-00	98735	2573.24
2000-01	91401	2053.49
2001-02	101728	1782.63
2002-03	104137	1933.02
2003-04	100828	1804.43
2004-05	126667	2709.24
2005-06	114143	2514.86
2006-07	118540	2455.15
2007-08	114345	2289.02
2008-09	109522	2988.4
2009-10	108120	2905.82
2010-11	91559	2598.15

APPENDIX II

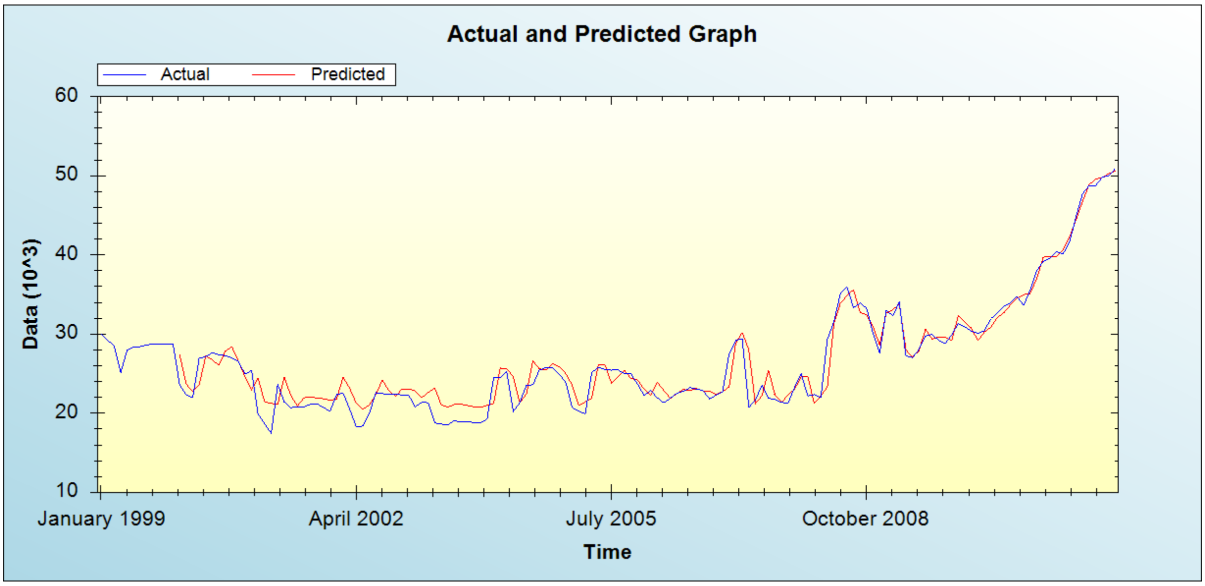
Export volume of processed (salted and roasted) kernels in India during 1991-2010

Year	Quantity (MT)
1991-92	14.28
1992-93	36.94
1993-94	52.18
1994-95	103.45
1995-96	265.91
1996-97	3.39
1997-98	41.04
1998-99	135.75
1999-00	141.56
2000-01	989.25
2001-02	120.56
2002-03	62.3
2003-04	142.3
2004-05	295.1
2005-06	70.5
2006-07	110.4
2007-08	204.9
2008-09	231.03
2009-10	403.9

APPENDIX III
Import of Cashew nuts in India during 1981-2011

Year	Quantity (MT)	Value (Rs. Crs)
1981-82	16057	18.37
1982-83	1485	1.41
1983-84	26877	22.12
1984-85	56161	38.84
1985-86	21945	24.36
1986-87	49149	71.16
1987-88	42609	64.37
1988-89	45150	61.36
1989-90	59591	82.85
1990-91	82639	134
1991-92	106080	266.68
1992-93	134985	376.33
1993-94	191322	482.70
1994-95	228109	690.93
1995-96	222819	760.08
1996-97	212866	687.6
1997-98	247181	769.61
1998-99	241161	958.03
1999-00	253577	1186.16
2000-01	249318	960.84
2001-02	355556	950.01
2002-03	400659	1236.57
2003-04	452398	1400.93
2004-05	578884	2190.94
2005-06	565400	2162.95
2006-07	586044	1811.62
2007-08	605985	1746.84
2008-09	605850	2632.4
2009-10	752854	3037.35
2010-11	504138	2479.75

APPENDIX IV
Plot of actual and predicted price of cashew kernel in international market using ANN model



APPENDIX V
International Prices forecasted by ANN model for March, April and May '12 as against actual market prices

Months	Forecasted prices (Rs./Ql)	Actual price (Rs./Ql)
Jan-12	50781	45453
Feb-12	50811	47647
Mar-12	50799	48432

APPENDIX VI

Top Exporters of raw cashewnuts (FAOSTAT, 2009)

Area	Quantity (tonnes)	Value (1000 $)
Côte d'Ivoire	340318	170383
Guinea-Bissau	127090	100974
Benin	115095	83948
United Republic of Tanzania	95577	68380
Indonesia	60628	62979
Ghana	53077	33308
Mexico	3301	12163
Nigeria	18651	11290
Mozambique	10468	9346
Gambia	3510	3289
Burkina Faso	8722	2291
Guinea	6240	1285
United Kingdom	194	1102
Mali	2148	799
India	540	757
United Arab Emirates	175	704
Madagascar	1212	639
United States of America	115	575
Netherlands	85	541
Kenya	1034	540
Total	848180	565293

APPENDIX VII
Top Importers of raw cashew kernels (FAOSTAT, 2009)

Area	Quantity (tonnes)	Value (1000$)
United States of America	116934	596942
EU	83632	467978
Netherlands	46615	271929
Germany	22886	146172
United Arab Emirates	20116	115116
China	37470	106233
United Kingdom	16422	83654
Australia	13952	67620
Canada	9228	46354
Japan	6644	40169
Belgium	6101	36361
Russian Federation	5945	36320
France	6334	35483
Spain	4212	24915
Lebanon	3829	17529
Sweden	2907	17492
Thailand	3400	16737
Italy	3825	16581
Greece	2619	16043
Luxembourg	1177	14118
Total	414248	2173746

APPENDIX VIII
Area, Production and Productivity of Cashew in the world (FAOSTAT, 2009)

	Area (ha)	Production (MT)	Productivity (Kg/ha)
Benin	243900	69700	285
Brazil	752021	102002	135
Cote d'Ivoire	860000	370000	430
Ghana	59000	28400	481
Guinea Bissau	240500	91100	378
India	923000	613000	664
Indonesia	309900	174300	562
Kenya	30000	8600	286
Madagascar	16500	6200	375
Malaysia	7500	12400	1653
Mozambique	77000	67200	872
Nigeria	330000	594000	1800
Philippines	28134	134681	4787
Senegal	16200	5700	351
Sri Lanka	22710	6490	285
Thailand	23847	37857	1587
Vietnam	340300	1159600	3407
Others	27793	20417	734
Total	4308305	3501647	812

EXPORT AND PRICE BEHAVIOUR OF CASHEWNUT IN INDIA

By

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ABSTRACT OF THE THESIS

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PG Thesis seminar

Name of the student: Jeethu M.Gopalan
Admission No : 2010-11-119

Venue : Seminar Hall
Date : 22-6-2012
Time : 10.00 am

EXPORT AND PRICE BEHAVIOUR OF CASHEWNUT IN INDIA

Abstract

India among the 28 other cashew growing countries is the largest area holder (9.53 lakh ha), processor and importer of cashewnuts. India holds a major share of around 54 percent in the global trade from 21 percent of its cashew area. The Indian cashew industry, apart from being a prominent national exchequer, provides sustainable employment opportunities to 5.5 lakh workers annually, mostly women. As any violent price fluctuations can have adverse effects on the industry, reliable price information is an urgent need for all stakeholders. Hence, the present study "Export and price behaviour of cashewnut in India" was taken up with the objective of analyzing the export and price behaviour of cashew in India and evolving a reliable price forecasting model for cashew kernel prices in the domestic (Kollam) and international (London) markets.

The study was conducted based on the secondary data published by various institutions. The Compound Growth Rate (CGR) and the trend indices for the post liberalization period (1993-2011) indicated that area under cashew has been steadily increasing but production and productivity showed wide fluctuations in certain years. During the study period, Kerala registered negative growth rates in area, production and productivity because farmers have shifted to more remunerative crops like rubber. The CGR analysis of cashew trade in the pre and post-liberalisation periods revealed that exports of cashew kernels and import of raw nuts fell in the post-liberalization periods. But export of CNSL rapidly grew in the post-liberalisation period indicating its versatile need as raw-material in many industries. An analysis of the net export earnings revealed that earnings have been falling

since 2000 stressing the need to boost Indian cashew production to meet the export requirement.

The price behaviour of cashew kernels was studied using the techniques of classical decomposition of time series analysis. The monthly average price data on cashew kernels in domestic (Kollam) and international (London) markets were decomposed in to its four components viz., secular trend, seasonal, cyclical and irregular variations. The analysis showed that the cashew kernel prices in both domestic and international markets widely fluctuated during the period 1999 to 2009 February after which an increasing trend in prices was noticed. The prices of cashew kernels in both markets generally increased from 2009 onwards due to global supply constraints but the prices in the domestic market abruptly fell in 2011 July. Seasonal indices revealed that the buoyant phase was observed during June to July with the highest price index in July and the trough period was observed during March to April with the lowest index in the month of April. In the international market, the buoyant phase was observed during June to August with the peak price in August and the trough period was observed from February to May. The cyclical indices for the international and domestic markets showed that no price cycles could be identified in prices for both markets. The irregular indices revealed that there were considerable irregular variations in cashew prices in both the markets. The instability in cashew prices was studied using the coefficient of variation (CV) which was 23.87 per cent for domestic market and 26.46 per cent for international market. The export competitiveness of Indian cashew kernels was measured using NPC under exportable hypothesis. The mean NPC value for the period was 1.02, which is slightly more than unity indicating that the commodity was not export competitive as a whole but a trend towards gain in export competitiveness from 2008 was noticed.

Various price forecasting models viz., moving average, single exponential smoothing, double exponential smoothing, ANN and ARIMA models were tried to develop a reliable price forecasting model for cashew kernel prices in both domestic (Kollam) and international (London) markets. While ARIMA model proved to be the best in predicting international kernel prices, no model could suitably forecast the prices in the domestic market.

The market integration studies using the co integration technique showed that both domestic and international markets were integrated. The pair wise Granger Causality test indicated that there was influence of domestic kernel prices on international kernel prices and not vice versa. This result is of utmost importance as cashew kernels from Kerala sets the benchmark quality in the world market.

Even though India is the largest area-holder under cashew, it lags behind in productivity. Development of new technology and their efficient transfer holds the key to increase productivity and become self-sufficient in raw nut production. More efforts need to be taken to improve cashew plantations in non-traditional areas like West Bengal and other north-eastern states which has contributed to 3 lakh MT of the total cashew production in 2010-11. By maintaining quality standards, India can remain a major player in the export scenario.