PRICE BEHAVIOUR OF NENDRAN BANANA IN KERALA: AN ECONOMIC ANALYSIS

By

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(2017-11-045)

THESIS

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DECLARATION

I, hereby declare that the thesis entitled **"Price behaviour of Nendran banana in Kerala: An economic analysis"** is a bonafide record of research done by me during the course of research and that it has not 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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CERTIFICATE

Certified that this thesis entitled **"Price behaviour of Nendran banana in Kerala: An economic analysis"** is a record of research work done independently by **Ms. Shana K. K. (2017-11-045)** under my guidance and supervision and that it has not previously formed the basis for the award of any degree, diploma, fellowship or associateship to her.

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Introduction

1. INTRODUCTION

Banana (Musa paradisiaca L.) is a tropical fruit called as “Apple of Paradise”. It is one among the oldest fruits known to mankind from pre-historic times and a major fruit crop grown in India. Banana has its origin in tropical region of South East Asia and is currently grown in more than 150 countries (GOI, 2015). Banana is grown in all tropical regions and plays a significant role in the economies of many developing countries. Banana is a staple fruit and also an export commodity. Being a staple fruit, banana contribute to the food security of millions of people in the developing world, and also provide income and employment to rural population.

India is the leading producer of banana in the world and has produced 30.8 million tonnes of banana from an area of 8.84 lakh hectare with a productivity of 34851 kg per hectare in the year 2017-18 (GOI, 2018). India contributes about 29 per cent in of the world banana production and occupies the highest area under banana in the world. Remarkably 15.5 percent of the total global area under banana belongs to India (Table 1.1). Bananas are the world’s most exported fresh fruit in terms of volume and value. India has a fair share in Asian exports and has exported 107.5 thousand tonness of banana (FAO, 2018) worth 48 million USD during the year 2017-18 (APEDA, 2018).The major destinations of India’s banana are UAE, Saudi Arbia, Iran, Kuwait and Bharain respectively. These countries have imported more than 50 per cent of India’s banana.

The area under banana in India had steadily gone up from 2.91 lakh hectares in 1980 to 8.84 lakh hectares in 2017-18 and the production increased from 4.35 million tonnes to 30 million tonnes during the same period. The main banana growing states in India are Tamil Nadu, Maharashtra, Gujarat, Andhra Pradesh and Karnataka.

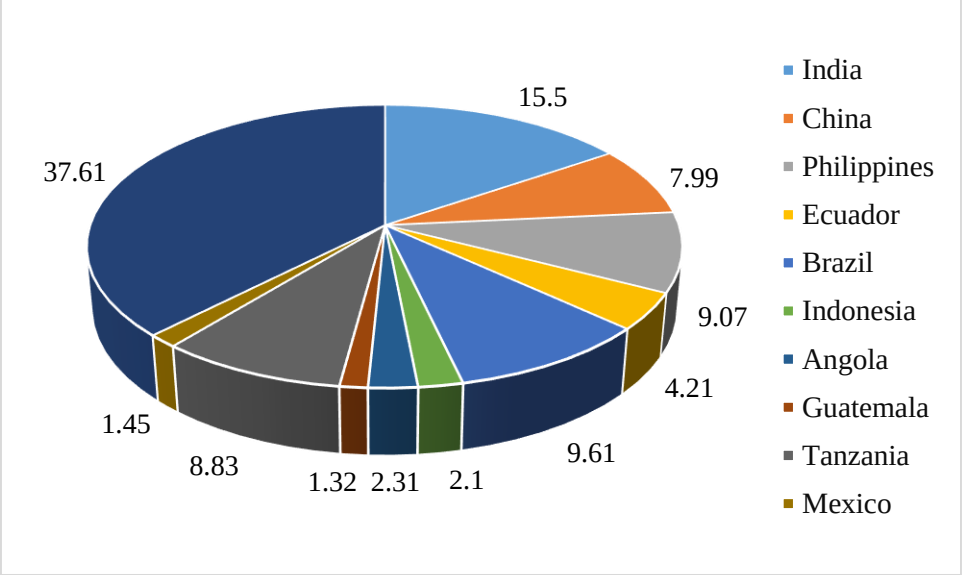

Fig. 1.1 Country-wise area under banana production

Commercially, bananas are classified into dessert types and culinary types. The culinary types have starchy fruits and are used in the mature unripe form as vegetables. Important cultivars include Dwarf Cavendish, Robusta, Monthan, Poovan, Nendran, Red banana, Nyali, Safed Velchi, Basrai, Ardhapuri, Rasthali, Karpurvalli, Karthali and Grand Naine etc. The fruit is easy to digest, free from fat and cholesterol. Banana powder is used as the first baby food. It helps in reducing the risk of heart diseases when used regularly and is recommended for patients suffering from high blood pressure, ulcer, arthritis, gastroenteritis and kidney disorders (GOI, 2018).Processed products, such as chips, banana puree, jam, jelly, juice, wine and halwa can be made from the fruit. The tender stem, which bears the inflorescence is extracted by removing the leaf sheaths of the harvested pseudostem and used as vegetable.

Kerala has produced 5658 lakh kg of banana from an area of 62108 hectares with a productivity of 9110 kg per hectare in the year 2017-18 (GOK, 2018). Nendran is one of the most important commercial varieties of banana grown in Kerala, occupying about 50 per cent of the total area under banana. The long and thick fruits with good keeping quality make Nendran widely acceptable among consumers.

Medicinally, fruit of Nendran is a good laxative and fruit pulp contains vitamins B_1, B_2, B_3, vitamin C, amino acids, iron, calcium phosphorus and proteins in substantial amount which are included in the daily need diet for human beings (Das, 2010). The varietal characteristics of Nendran banana include, diversity in plant stature, bunches with 5-6 hands of about 6-12 kg. Fruits have a distinct neck with thick green skin turning buff yellow on ripening. Fruits remain starchy even on ripening. Chips made from fruits at 80 per cent maturity are of very high demand.

Kerala is the biggest consumer of Nendran banana. There is year round demand for Nendran banana in the state. There is inadequacy in the supply which is covered by Nendran brought from other states. This results in wide price fluctuations which is also due to the seasonal behaviour of production and market arrivals. Banana is marketed in localized primary markets near the production unit and different prices are existing in each market, indicating a weak association among these markets. The chances of distress sales and market glut during harvest are also existing because of perishability of the crop. The farmers are not obtaining remunerative prices for their crop and the difficulties arising due to the production risk and price risk are high in the banana economy. In the above background, the present study entitled “Price behaviour of Nendran banana in Kerala: An economic analysis” was taken up with the following objectives

- To analyze the time series properties of prices of Nendran banana
- To study the integration between prices in different markets in Kerala
- To ascertain the volatility in prices

- To evaluate the relationship between market arrivals and wholesale prices
- To determine the major constraints with regard to pricing and marketing

Scope of the study

There exists scope for increasing productivity in all producing zones of India by adopting improved cultivation practices. Besides production, equal emphasis on provision of optimum marketing facilities is also required. Wide fluctuations have been observed in the price of Nendran, resulting in income variability of farmers.Higher price volatility means higher costs of managing risks which would eventually translate into higher consumer prices. Stable price and adequate marketing facilities are essential for the development of agriculture and Nendran farmers are facing difficulties because of the wide fluctuation in prices as well as the arrivals in markets. Market information on Nendran banana is essential for producers in planning and market led production. In Kerala, the mechanism for price stabilization is weak in case of fruit crops, especially for Nendran banana even though it has higher consumer preference. However, the minimum support price, which is to protect the farmer to get a minimum profit for the produce during excessive price fall has not been introduced for fruit crops including banana till date.

Limitations of the study

The study is confined to the major markets of Vegetable and Fruit Promotion Council of Kerala among three representative districts. The results from this study are based on inference from these markets. During secondary data collection, errors arising from data entry and loss of data due to 2018 floods were also encountered. Hence the results of the study are subjected to these limitations. However, every effort was made to minimize the errors.

Presentation of the thesis

The thesis entitled 'Price behaviour of Nendran banana in Kerala: An economic analysis' is presented under the following five headings. First chapter 'introduction' includes a brief note on the importance and current status of banana economy in India, objectives, scope and the limitations of the study. Similar works in the same and related areas of research are presented in the second chapter 'review of literature'. Third chapter is on 'methodology' which is comprised of details of design of the study and various methods adopted for carrying out the research work and its analysis. The results of the study have been presented and discussed in the fourth chapter 'results and discussion', followed by 'summary and conclusions' in the fifth chapter.

Review of literature

2. REVIEW OF LITERATURE

Literature review is an important part as far as any research work is considered. It provides a theoretical basis for the researcher and also helps in determining the nature of research work. In this chapter, an attempt has been made to review important past studies which are relevant to the present study and are presented under the following headings:

2.1 Trend and growth rate analysis

2.2 Price behaviour of banana

2.3 Price volatility

2.4 Market integration and price transmission

2.5 Constraints in pricing and marketing

2.1 TREND AND GROWTH RATE ANALYSES

Trend is a component of the time series which gives the general tendency of the data for a long period. It is the smooth, regular and long-term movement of a series, A trend can be positive or negative depending on whether the time series exhibits an increasing long term pattern or a decreasing long term pattern. Growth rates refer to the percentage change of a specific variable within a specific time period.

Patil *et al.* (1987) worked out the trends and growth rates in area, production and productivity and the factors responsible for change in land under banana crop in Jalgaon district from 1950-51 to 1979-80. The area under banana increased enormously from 6600 hectares to 33400 hectares and the production of banana rose by 68.9 per cent in the same period. Net irrigated area and one year lagged price of banana together constituted nearly 97 per cent of the variation in the acreage under banana.

Devi *et al*. (1990) estimated the trends in area, production and yield of banana in Kerala state. The trend for a period of 17 years from 1970 to 87 was explained by fitting quadratic function. The study revealed that banana production in the state showed an increasing trend (94.57per cent) because of the intensive cultivation practices and favorable price factors. The study also indicated that the main contributing factor for production of banana in Kerala state during seventies was area or the extensive cultivation, while it was yield due to intensive cultivation in the eighties. The study concluded that banana cultivation had become productivity oriented in the recent years.

Raju *et al.* (1990) evaluated the compound growth rates of area and production of selected fruit crops in Andhra Pradesh for the period 1970 - 1983 by fitting logarithmic function. The compound growth rate of production of grape was found to be 12.09 per cent and statistically significant.

Ali (2000) computed the variations in area, production and productivity of banana in Meghalaya along with other horticultural products. The study found that the production of banana displayed increasing trend during the period from 1973- 74 to 1990- 91 but showed a declining trend during 1990- 91 to 1994- 95. The production of banana was correlated to area of cultivation indicating a significantly higher yield than other crops. For controlling the fluctuation in growth, improved production technique and marketing facilities were recommended.

Ganjal (2002) studied the area, production and productivity of banana in Karnataka using growth rate analysis. The growth rates in area (6.69 per cent) in Karnataka state between 1980 and 2000 was significantly higher than all the other major banana growing states and the all India average.

Deka and Sarmah (2004) attempted to estimate trends in area, production and productivity of banana in the state of Assam for the period from 1980-81 to 1999-2000 using production function analysis. The fitted trend revealed that area and production of banana in the reference period had showed an upward trend in the initial year, but decreased prominently thereafter. It was also observed that the growth in production of banana was mostly influenced by the growth in area rather than productivity.

Maduka (2004) reported that India was the world's largest producer of banana with a production of 10.8 million tonnes during 2002-2003. Area under the crop hiked from 0.2 million hectares in the early 70s to 0.49 million hectares in 2002. Production during the same period increased from 3.0 million tonnes to 16.81 million tonnes. Tamil Nadu and Maharastra were the highest banana producing states in India followed by Karnataka, Andhra Pradesh, Madhya Pradesh, and Orissa.

Phuke, *et al.* (2004) assessed performance and export potential of banana in India and estimated trend in growth of banana production. During the period from 1990-91 to 2001-02 area and production exhibited a linear growth at the rate of 2.14 and 5.63 per cent respectively. The study also suggested policy initiatives to increase production for exports which require the improvement of post-harvest handling and marketing facilities.

Khandikar *et al.* (2009) examined the performance of banana in Maharashtra using time series data on area, production and productivity of banana pertaining to the period from 1995-96 to 2006-07. It was found that, the regression coefficient was positive for area and production, indicating increasing trends in area and production of banana. Similarly, the growth analysis of productivity indicated positive growth in overall productivity of banana.

Jeyakumar (2010), identified banana as one among the important fruit crops grown in India. The area under banana had increased from 0.47 million hectares to 0.68 million hectares during the periodfrom 2000 to 2005 whereas, production increased

from 14.14 million tonnes to 16.82 million tonnes during the same period. India was the largest producer of banana with 21 per cent of world output during the year 2006. Hi-tech cultivation of crop was observed to be economically viable resulting in increase in productivity, improvement in product quality and early crop maturity with the produce commanding premium price.

Ganesan (2016) investigated the growth and instability in banana production and exports during the post-WTO period in India and reported that the growth rates of area and yield of bananas were less. The share of banana exports in total exports and total banana production is small when compared to other countries. India being the largest producer of bananas in the world, harness huge potential in banana exports.

The area under cultivation of banana in Kerala decreased during the period 2006-07 to 2009-10, causing a decline in the level of production. Thereafter the area of cultivation increased continuously till 2013-14. The production of banana was found growing over the years and the same trend was also visible in the production during the period, with the exception of 2007-08, 2009-10 and 2012-13 (Priyanka and Harikumar, 2016).

2.2 PRICE BEHAVIOUR OF BANANA

Price behaviour explains the movement of prices over time along with components contributing to the particular movement. A time series is composed of trend, seasonal variation, cyclic vlariation, and irregular variation. Trend gives the general tendency of the data for a long period. Any pattern showing an upward and downward movement around a given trend for a period of more than one year is identified as cyclical variation. Seasonal variations are the regular fluctuations of time series occurring in a period of one year. The random and unpredictable components which are beyond human control gives the irregular variations.

Tilekar and Pawar (1989) analyzed the price differential in banana markets of Jalgaon district of Maharashtra for the year 1985-86. Coefficient obtained through regression analysis between size of lots and prices was positive implying that larger the size of lots sold, higher was the price realized. The time of sale was also found to be affecting the price received from the sales.

Borle and Kalyankar (1993) studied arrivals and prices of banana in cooperative society in Nanded during the year 1992. Analysis of seasonality revealed that majority of produce was available during July and December comprising about 82.56 per cent of total arrivals in the year. Prices per quintal was found to be maximum in the month of august. The results of correlation analysis between arrivals and prices indicated negative correlation implying that prices decreased with increase in arrival of fruits.

Chavan *et al.* (2009) conducted a study on arrivals and prices of banana in Parbhani market of Maharashtra state and identified that the peak period for banana arrivals was from October to November and peak month for prices was March. The monthly prices and arrivals showed inverse relationship on tabular analysis such that prices were minimum when the arrivals were maximum.

Godara and Bhonde (2010) evaluated the arrivals and prices of major fruits including banana in APMC, Azadpur from 2003-04 to 2005-06 using seasonality indices and concluded that arrivals of most of the fruits were higher in the peak season of crop and lower in the non-harvest season.The results of correlation analysis between arrivals and prices indicated negative correlation for all fruits implying that prices decreased with increase in arrival of fruits.

Guruprasad (2011) overviewed the marketing management of banana in Karnataka and explained that for the period from 2000 to 2010, prices in Bangalore market showed a positive growth with a compound growth rate of 0.50 per cent and for arrivals it was found to be insignificant. The instability in banana arrivals and prices was studied using the Co-efficient of Variation and was found that arrivals and prices

were stable over the period. Multiple linear regression equation was fitted for determining the relationship between the prices and market arrivals of banana and the negative sign of regression coefficient indicated that increase in prices was not accompanied by increase in arrivals during the study period. The correlation coefficient computed for banana in regulated market was 0.38 showing a nonsignificant pattern of association between arrivals and prices. The persistent decline in arrivals and increase in prices were attributable to decrease in the production of banana and also the increase in domestic consumption.

Jayasree *et al.* (2012) conducted time series decomposition of price of cassava in Kerala to identify the components such as trend, seasonal, cyclic and irregular variations.The trend analysis using method of least squares and single exponential smoothening model established that prices grew steadily within a small range. The ratio to moving average method was used to estimate the seasonal index.The residue method was employed for determining the cyclical properties in the data and short duration cycles were visible from July 1999 to June 2001and from December 2001 to March 2004.

Rahman (2012) attempted to characterize food prices in India and observed that price of fruits and vegetables are interspersed with frequent booms and declines. The mean duration of cycles for onion, potato and banana were 31.2, 35.6 and 37.2 months respectively which implied that the prices almost triple up in the expansionary part of a cycle and that too within a short duration. High amplitude for banana prices was mainly due to the harvest effect which could be imputed from the larger number of cycles they exhibited. For fruits and vegetables, which are seasonal and highly perishable in nature, the storage facilities were inadequate resulting in market glut immediately after the harvest, causing prices to plunge to extremely low levels. Consequently, when the supplies shrink during the post-harvest season, the prices recover and rise when the next harvest arrives.

In the important banana markets of India, Reddy *et al.* (2012) observed that when major portion of the produce reached the market during peak season, the prices generally fell which in turn led to reduction in farmers' income. Relationship between market arrivals and wholesale prices were worked out using correlation coefficient between arrivals and current prices and one month lagged prices. Inverse relationship was noticed in Mumbai, Kolkata, and Delhi markets for corresponding months indicating that the increase in arrival leading to decline in price. While Ahmedabad and Bangalore markets showed positive relationship, in Mumbai market previous month price did not influence significantly on arrivals in the current month.

Kachroo *et al.* (2014) analyzed the behaviour of arrivals and prices of citrus in Jammu and observed inverse relationship between prices and arrivals. It was found that the seasonal nature of citrus generated market glut leading to sharp fall in prices during the post-harvest season, adversely affecting the farmers. The highest market arrivals corresponded with the harvesting date of the crop and was found to be highest in December resulting in decreasing trend in prices.

Pauline and Ajjan (2014) observed an uptrend in the banana prices from August to October each year in major banana markets in south India. Prices contribute significantly to the pace and direction of development by serving as market signals on the relative scarcity or abundance of a given product (Akintunde *et al.*, 2012).

Sowjanya *et al*. (2015) used distributed lag model approach for analyzing the relationship between arrivals and prices of paddy in Nalgonda district of Andhra Pradesh for 2011-12. The study revealed that the arrivals of paddy was significantly influenced by current prices P_t and lagged prices P_{t-1} (one month lag). One rupee increase in current prices was found to increase the market arrivals by 0.374 quintal and one rupee rise in lagged prices Pt-1 (one month lag) could increase market arrivals by 1.339 quintal.

Priyanka and Harikumar (2016) analysed the price behaviour of major food crops in Kerala and reported that price of banana showed a negative trend from 2008 to 2014. Price of banana was highest in 2008-09 and recorded 51.6 per cent of increase, later in 2014-15 the price declined by 22.87 per cent.

Verma *et al.* (2018) worked out the seasonality of market arrivals of soybean in selected districts of Rajasthan using seasonality indices. It was evident that more than 70 per cent of the total arrivals of soybean to market were immediately after harvest, thereafter arrivals decreased in the subsequent seasons. The Pearson correlation coefficient calculated between market arrivals and prices of soybean showed negative correlation significant at oneand five per cent level of significance. This indicated that prices decreased with increase in market arrivals and vice versa.

Preethi *et al.* (2018) segregated secular trend, seasonal, cyclical and irregular components of monthly price data of coconut in major markets of Kerala for two periods viz., from 1980-81 to 1995-96 and from 1996-97 to 2015-16 assuming a multiplicative model of time series analysis. Study showed that despite the high price fluctuations, coconut price in the long run exhibited an increasing trend.The seasonal variations analysed using ratio to moving average method revealed that behaviour of coconut prices in Alappuzha and Kozhikode markets was distinctly different, presumably due to the dissimilarity in the pattern of market arrival of coconut.More than two cycles with varying lengths were observed and irregular variations were found highly unpredictable and not following any uniform pattern during the entire study period.

2.3 PRICE VOLATILITY

Price volatility is the fluctuation or variability of commodity prices over a period of time.Price instability refers to the tendency of the price of a commodity to fluctuate sharply and unpredictably. Commodity prices in the international as well as domestic markets are susceptible to instability.

Savithri (1999) examined the prices of agricultural commodities in Kerala and confirmed that instability in prices decreased during 1991 and increased thereafter. Autoregressive Conditionally Heteroscedastic approach was used for analyzing changes in mean price levels and variability of each commodity after liberalization. It was observed that wholesale and farm prices of agricultural commodities in Kerala were highly unstable during the selected period. For banana, instability analysis pointed out that the instability (CVI) was highest and ranks of variation (CV) were lowest when compared to other crops.

According to Morgan and Gilbert (2010), the important causes of price volatility in agriculture were production and consumption shocks. Production fluctuated because of variations in area planted or because of yield variations, typically due to weather shocks while, variation in consumption were attributable to demand shocks due to changes in income as well as prices of substitutes and shifts in tastes.

Malik *et al.* (2010) studied the factors affecting commodity prices in Indian commodity market. They reported that price hike in agricultural products was caused by a combination of factors, including droughts in important grain-producing regions, low stocks of cereals and oilseeds, increased use of feedstock to produce bio-fuel and rapidly rising oil prices.

Gilbert (2010) assessed the price volatility of major agricultural food commodities and concluded that agricultural prices in general, were very volatile during the period from 2006 to 2008 and in 2009. World prices of banana exhibited statistically significant rise in the price volatility from 45.2 per cent during the period 1970-1989 to 65.5 per cent during 2000-2009.

According to Abbott (2012) prices of agricultural commodities have experienced extraordinary fluctuations and continuous increase since 2002. He argued that this has led to high price volatility, food inflation, poverty and hunger. Combined with inadequate market price transmission, high food prices have increased the levels

of food deprivation, driven millions of people into food insecurity and threatened long term global food security.

Lukas and Matthias (2013) found that the major contributing factors of domestic food price volatility were previous period volatility, stocks, production short falls, international price volatility, functionality of markets and transaction costs. While volatility in the previous period lead to persistence of domestic price volatility; stocks stabilized and production shortfalls destabilized the domestic prices.

Bhavani *et al.* (2015) evaluated the presence of price fluctuations in the domestic markets for chillies using ARCH-GARCH analysis for the period from 1997 to 2011. Persistent fluctuations in chilli prices were noticed in all the markets and was intense in Nagpur market. The acreage adjustments driven by the lagged prices, production variation in the country, distribution of rainfall, prices of the competing crops, export demand, and prices of the competing crops were observed to be the factors influencing volatility. The farmers if given right market advisory could take advantage of the same for obtaining additional net returns.

Sekhar *et al.* (2016) reviewed the food inflation and volatility of major food commodities in India and reported that the price volatility was higher for perishable commodities such as fruits and vegetables than the nonperishable ones. Econometric analysis of the determinants of volatility pointed out the importance of supply and demand factors although their relative importance varied across commodities. Volatility was computed using the 'ratio' method and conditional variance methods such as ARCH/GARCH, and Threshold Arch models. It was argued that volatile international prices caused higher instability in the domestic prices and increased the prevalence of food insecurity.

Bodade (2017) attempted to evaluate the soybean price movement across major markets of Madhya Pradesh. The ARCH-GARCH analysis was carried out to assess the presence of fluctuations in the prices of Soybean in Betul, Dewas, Dhar, and Indore

markets. The results showed the existence of price fluctuation in Dewas market alone as indicated by the sum of Alpha and Beta which was close to one (1.0238) whereas in other markets, price fluctuations were absent during the study period.

Dudhat (2017) analyzed the price volatility of groundnut in major domestic markets of Andhra Pradesh, Gujarat, and Tamil Nadu from 1996 to 2016 by means of various statistical time series models. Univariate AutoRegressive Integrated Moving-Average (ARIMA) model and conditional heteroscedsatic GARCH model were fitted to price data for examining volatility. A comparative study of the fitted models was carried out using Root Mean Square Error (RMSE), Mean Absolute Error (MAE) and Mean Absolute Percentage Error (MAPE) and the Gaussian GARCH model was found to be the best in terms of forecasting accuracy. Higher persistence of volatility was ascertained in Rajkot market compared to other two markets.

Mahesh (2018) estimated the price volatility of cotton in Haryana during 2005-2016 by using Coefficient of Variation. The intra year prices in selected cotton markets remained stable with less than 10 per cent of variation during the study period. For the overall period, Coefficient of Variation ranged from 28.50 to 30.88 per cent indicating the occurrence of slightly higher volatility in the study period. It was proposed that the increased volatility could be addressed through stock management and employment of risk management strategies such as crop insurance, future markets etc.

Mittal *et al.* (2018) studied the volatility trends in domestic and international prices of rice and wheat, and found that even though both the prices were volatile, the degree of volatility was higher in the international prices. The standard deviation of logarithm of prices was used to work out the price instability. The volatility in domestic prices was attributed to internal production shocks rather than international prices. This separation was due to domestic policy measures, such as market support to farmers and procurement of food grains for public distribution and price stabilization.

Sadiq *et al.* (2018) worked out the price volatility of important banana markets in India viz. Chennai, Mumbai, Hyderabad, and Ahmedabad. It was inferred that markets were vertically integrated and volatility in the current banana wholesale market prices will depend on external shocks from respective retail markets and information on the preceding month price. The estimated sum of α and β coefficients of GARCH model was close to 1, signifying high volatility in the spot prices of banana in the selected wholesale markets which persisted for long time. The reason for persistence of volatility in the prices could be due to seasonality in arrivals from the banana producing regions in the country.

2.4 MARKET INTEGRATION AND PRICE TRANSMISSION

Market integration occurs when prices in different locations or related goods follow similar patterns over a long period of time.It is an indicator that explains how much different markets are related to each other.When market integration exists, the events occurring within two or more markets are exerting effects that also prompt similar changes or shifts in other markets that focus on related goods.

Sharma and Tiwari (1997) calculated the extent of market integration across important temperate stone fruit markets of North India for the period from1977 to 1991 using correlation coefficients and stated that, Ambala-Karnal and Karnal-Delhi market pairs displayed interaction of higher order as shown by high significant correlation coefficient above 0.80. For plum markets, there were low and non-significant correlations in the price movements which indicated poor market integration. The study concluded that the integration in most of the market pairs considered, was either poor or of intermediate order.

Nkendah *et al.* (2007) analyzed the spatial integration of plantain markets in Cameroon and the results showed a weak integration of the production and consumption markets. This was attributed to the asymmetric transmission of the price information between the consumer markets and the producer markets which prevented

the entry of wholesalers into the plantain marketing chain. With respect to the reference market, the differential of price was weak in period of abundance but significantly increased in period of shortage. There was delayed transfer of price variations of plantain in the local market to the peripheral markets and the reactions were at different degrees. The adjustment speed of prices remained low indicating an insufficient arbitration between reference and peripheral markets.

Virmani and Mittal (2006) in working paper on domestic market integration reported 12–14 per cent higher consumer prices in the southern states, Kerala, Karnataka, Andhra Pradesh and Tamil Nadu as compared to rest of the states in India. Uniform decline of Coefficient of Variation in prices shown across all the commodities and their subgroups between the years 1994 and 2004 presented strong evidence of market integration in India.

Bathla (2008) measured the extent to which agricultural reforms have led to higher integration of agriculture markets across the states and attributed the absence of complete spatial market integration to; regional bias in the price and procurement policy, partial reforms under the APMC, delayed transmission of price information across the markets, weak transport and other infrastructural difficulties. Encouraging interaction between the spot and futures market, and organized retail and removing/modifying inter-state trade barriers in the movement of agricultural commodities were suggested.

Philip (2008) used cointegration technique to examine the validity of the market integration hypothesis with reference to prices of rubber in Kerala and pointed out existence of integration in rubber prices during the post reform period. The price changes of rubber were transmitted from peripheral to main market and vice versa during the WTO reform period. It was found that the Cochin market was integrated with the Kottayam market in the long run, while the price signals were being transmitted in the short run as well.

Vasisht *et al*. (2008) observed the price relationships among vegetable and fruits markets by means of Johansen's multivariate co-integration, Augmented Dickey Fuller (ADF) test, and Vector Error Correction models. High volatility in the prices of commodities were evident from the results of major markets. Presence of long run relationship was manifested across some of the state level markets for less perishable commodities. Price integration was found to be very weak for highly perishable commodities which was present only among a very few markets.

Acquah (2012) conducted an econometric analysis of the spatial market integration of selected plantain markets in Ghana using co integration analyses and vector error correction model. The degree of spatial market integration was calculated using wholesale prices from three markets and there existed long run relationship among the prices displaying efficient marketing. In addition, the vector error correction model proved that most of the disequilibrium in the market was corrected within two weeks.

Reddy *et al.*, (2012) examined the market variability and price integration in major banana markets of India and observed that Delhi markets had maximum arrivals followed by Mumbai, Bangalore, Kolkata and Ahmedabad markets. The significant integration of Ahmedabad market with Bangalore (0.579) and Mumbai (0.598) markets were indicated by the zero order correlation matrix between average wholesale prices of banana. Further, Bangalore market was found to be significantly integrated with Mumbai (0.757) market. The other selected markets showed no or weak integration with each other which might be due to non-movement of produce from one market area to another since commoditywas highly perishable.

Beag (2014) confirmed the presence of cointegration in major apple markets of India, inferring long-run price association among the markets. The results of Granger causality test showed that Delhi was the price-determining market. Hyderabad was found to be relatively more efficient as it depicted most bidirectional causal relations

with other markets. No causal relations were shown between market pairs such as Ahmedabad - Kolkata and Bengaluru - Kolkata. The results of impulse response functions have confirmed that the speed as well as magnitude of shocks given to Kolkata and Bengaluru markets were relatively less transmitted to other markets.

Pauline and Ajjan (2014) studied integration of banana markets in India and pointed out that banana prices were relatively higher in Trivandrum, Chennai and Hyderabad markets than other markets. Volatility was determined using Coefficient of Variation and was found higher in Hyderabad and Chennai. Results of the study confirmed strong integration of banana markets over space and time indicating that banana farmers are earning similar prices at a particular point of time. So it was concluded that any policy implication or market intervention programme in any market would impact the banana price in other markets.

Mishra and Kumar (2016) in a study of spatial integration of potato wholesale markets of Uttarakhand examined the dynamics of short-run price responses using Vector Error Correction Model (VECM). The results indicated that five potato markets responded on the long-run cointegrating equations while the short-run speed of price adjustment was almost absent. Moreover, it was found that the longer the distance between the markets, the weaker the integration was. An improved market information system was required to increase the efficiency of potato markets and the system should be able to disseminate market information about price, demand and supply of produce in time and enable intermediaries to make proper production and marketing decisions.

Tingre (2016), in an attempt to evaluate the price stability of soybean for major markets of India showed that there was long run equilibrium relationship and co-integration between them. The prices of soybean during months of June to August were higher in all selected markets. For the selected markets the prices series were free from the consequences of unit root and were stationary at first difference. Most of the

markets showed bidirectional influence on soybean prices of each other. Akola, Bailhongal, Kota and Latur market, recorded high price volatility in Soybean prices.

Marwa *et al.* (2017) worked out the market integration of agricultural products in Indonesia using linear regression modelling with Ordinary Least Squares (OLS) and the Index Market Connection model. Rice market was found to be integrated with respect to price both at consumer and producer levels due to the relatively smooth information on price at the market and adequate mobility of people and products between the two markets. The relatively good mobility between markets was supported by good transportation facilities and infrastructure. If there was a price difference between the two markets then the rice was found to be sold in a market offering relatively higher price.

Sadiq *et al.* (2018) used monthly time series data to investigate market integration of banana in India during the period from2008 to 2017. Empirically, the Law of One Price (LOP) was found to be moderate in the horizontal integrated wholesale markets, strong in the retail markets and efficient in all the vertical integrated markets.Mumbai market was observed to be the most efficient both from the horizontal and vertical dimensions, as they respond fast to price news and corrected the disequilibrium in the short run.

2.5 CONSTRAINTS IN PRICING AND MARKETING

Rajagopal (1987), studied the economics of fruit production and marketing in India for selected crops using Garett ranking technique. It was found that producers were not getting a better share in consumer's rupee due to constraints like high marketing charges, long marketing chain; and over involvement of intermediaries. He also recommended promotion of direct sales and co-operative marketing to provide a better share to the producers in the final price of fruit crops.

Vigneshwara (1988) reported that the major marketing problems confronted by banana growers were fluctuation in prices, the excess involvement of intermediaries, high transportation and storage costs, and absence of grading and standardization. Minor problems included the inadequacy of finance facilities, non-availability of efficient market information system, lack of packaging facilities, and absence of organization among growers etc.

Mourya *et al*. (1996) analyzed the profitability of banana plantation in Hajipur district in Bihar and suggested policy measures for the improvement of fruits and vegetables marketing. The measures included strengthening of bargaining power of small farmers to get higher price, development of markets intelligence network through television and other mass media, establishment of cold storage facilities within reach of producers, enabling longer storage of perishable products, and thereby increasing the supply of seasonal crops and realization of higher prices.

Singh *et al*. (1996) in their study on economic analysis of banana in unorganized sector in middle Gujarat reported that the marketing cost was high, predominantly due to the commission of middleman which together accounted for about 86per cent of marketing expenses. The expenses could be minimized or eliminated by efficiently implementing the agricultural produce market act for banana.

Sivanathan and Jahanmohan (1999) examined the constraints in marketing of banana in Cauvery delta zone of Tamil Nadu and opined that the practice of opting pre-harvest contractors at the time of 50 per cent maturity of the crop was generally prevalent in the area. The main constraints in banana marketing were observed to be wide fluctuations in price of banana and non-institutional agencies and their market practices. Violation of contract at the time of price drop was common practice imposing heavy loss to the farmers. Absence of institutional agency like regulated market for banana, cooperative banana marketing agency and farmers association were the other constraints.

Nagargoje (2000) analysed the marketing of banana in Marathwada region and opined that, fluctuation in prices, non-availability of loans and lack of marketing facility were the major constraints for the banana industry.

Lakshmi (2012) attributed the substantial underdevelopment of the present marketing system in Tamil Nadu to reasons such as lower price offered to the farmers, wide gap between the farm price and the final market price at the consumer level which ranged between 200 to 300 per cent, the major share of the price taken away by the traders and the commission agents, and lack of market intelligence to the farmers and traders. Further, high transportation cost in road transport compelled the small farmers to sell their produce at the producer's level at lower prices. The farmers were also obliged to give various marketing charges and trade allowances and the sales were carried out at the negotiated rate which was often disadvantageous to them.

Krishnamurthy *et al.* (2012) in their study on the analysis of marketing and production constraints of banana revealed that, fluctuation in market price was the major constraint followed by interference of middle men, problem of commission agents, transportation problems, and cheating. These were experienced by 78per cent of the respondents. The improvement of marketing facilities and transportation along with fixation of support price were suggested for the betterment of the banana growers.

Anap *et al.* (2014) reported that constraints faced by banana farmers of Wardha district of Maharashtra included higher commission of the market intermediaries, delayed payment, malpractices during weighing and lack of standard weighing instruments in market. Lack of proper storage and processing methods and inadequacy of agro-processing units were also noted.

Pauline (2014) examined the value chain of banana in Tamil Nadu and found that, the major concerns for farmers were delayed payment of dues after procurement and arbitrary deductions by the procuring parties. Insufficient working capital for post-harvest marketing management and higher costs associated with transportation,

inadequate and uneconomical service provided for cold storage, grading and product handling, coupled with collusion of middlemen and buyers at the point of price fixation were some other causes of concern. Besides, lack of regulatory systems for bananas, no agreed grades/standards for domestic market and low technical capacity for ripening led to high post-harvest losses. Defects in auction system have led trader's cartels to fix the ruling prices that causes price instability.

Important constraints faced by improved variety banana growers in Konkan region were inadequate supply of labour (70 per cent) followed by absence of credit in time (60.66 per cent), irregular load shedding, arbitrary reduction in prices and fluctuation in prices. The formation of banana growers' marketing co-operative, regulated market with better infrastructure and establishment of banana processing plants in the study area were recommended (Hande et,al., 2014).

Kumar *et al*. (2015) compared the marketing aspects of tissue culture and sucker propagated banana and observed similar restraints for marketing of both types. Unavailability of banana market nearer to farm or village was the major problem felt by farmer. Lack of regulated market, non availability of proper storage facilities, lack of grading and packaging, high cost of transportation, delayed payment for the produce sold, and price fluctuation of the produce were among the other problems.

Ranchhodbhai (2015) studied the information needs and marketing constraints of banana growers and found out that major constraints faced by respondents were lack of risk bearing capacity, lack of cooperation among farmers and low decision making ability in selling. Low price of banana, fragmented production, and lack of support price constituted the economic constraints. Marketing problems included lack of reliable updated Information on marketing and lack of storage facilities.

Kumari (2018) estimated the problems and constraints in banana cultivation in Bhagalpur district of Bihar and found that all sample growers considered the price fluctuation as the major issue. In addition, the non-availability of proper market and

dominance of pre-harvest contractors was also considered as limiting factor in order of 100, 64 and 44 per cent by three categories of growers, respectively. Most of the quantity of produce was marketed through pre–harvest contractors because the contractor provide around 50 per cent of the payment to meet the immediate needs of production, consumption and for social activities of the growers. The marketing linkages were not stabilized due to the existence of large number of small un-organized banana producers. The present market facilities were not favorable for providing the farmers a remunerative price for the produce.

Nayak *et al.* (2018) attempted to evaluate the constraints in marketing of banana in Durg district of Chhattisgarh using Garrett's Ranking technique and found that high price fluctuations was the major issue faced by banana growers with mean score of 72.26. Unremunerated price was the second important problem (70.20) which was mainly due to the absence of cold storage and processing facilities at the market centers. High commission charges (64.85), lack of regulated market (60.48), high transportation cost (56.89) were the other constraints faced. The marketing problems emphasized by the intermediaries were lack of cold storage facilities, non-availability of banana processing units, inadequate market infrastructure, and shortage of electricity supply.

Methodology

3. METHODOLOGY

The methodology is the general research strategy that outlines the way in which research is to be undertaken and identifies the methods to be used in it. The present study, "Price behaviour of Nendran banana in Kerala: An economic analysis" attempts to estimate the trends in area, production and productivity of banana in Kerala and to analyse the price behaviour of Nendran banana along with an understanding of integration between major markets in Kerala. This chapter gives a brief sketch of the methodology used for the present study including types of data collected, tools of analysis and the concepts used in the study.

3.1 TYPES OF DATA

The present study is mainly based on secondary data. The data on area, production and productivity of banana in Kerala, monthly price and arrivals data of Nendran banana in major markets of Kerala and other secondary data published by various institutions were collected to analyse the trend and price behaviour of Nendran banana during the period from 1980 to 2018. The primary data was collected from the selected farmers using a pretested interview schedule by personal interview schedule for analysisof constraints in marketing and pricing of Nendran banana.

3.2 SOURCES OF DATA

The time series data on area, production and productivity of banana in India and of Nendran banana in Kerala from 1980 to 2018 were collected from various issues of Agricultural Statistics and Statistics for Planning published by the Directorate of Economics and Statistics, Thiruvananthapuram and website of National Horticultural Board and Indiastat.com.The time series data on monthly prices of Nendran banana for the years 2003-2018 were collected from website of Directorate of Marketing and Inspection, National Informatics Centre and AGMARKNET. The monthly data on arrivals and prices of Nendran banana in major domestic markets of Kerala for the years

from 2012 to 2018 were collected from the selected Vegetable and Fruit Promotion Council Kerala (VFPCK) markets of the districts such as Thiruvananthapuram, Ernakulam, and Kozhikode. The main items of observation such as socio-economic features of the sample farmers and constraints in pricing and marketing were collected from the selected farmers.

3.3 PERIOD OF STUDY

Data pertaining to area, production, productivity and price of banana in Kerala were collected for the period from 1980 to 2018 and data on arrivals and prices of Nendran banana in major markets were collected for the years from 2003 to 2018. The primary data collection was carried out from February 2019 to April 2019.

3.4 AREA OF STUDY

The trend and growth rate analyses were done considering Kerala state as a whole. Kozhikode, Ernakulam, and Thiruvananthapuram markets were selected for the study on price behavior of Nendran banana, representing north, central, and south Kerala respectively. Thiruvananthapuram district, which has the largest quantity of arrivals among the three districts was selected for primary data collection for constraint analysis and studying the socio economic profile of the sample farmers.

3.4.1 Thiruvananthapuram district

Thiruvananthapuram, the capital of Kerala, is located on the west coast of India near the extreme south of the mainland. Renowned as the ‘Evergreen city of India’, Thiruvananthapuram is characterized by its undulating terrain of low coastal hills.The geographical area of the district is 0.219 million hectare which accounts for 5.64 per cent of the total geographical area of the state, out of which 72.67 per cent is cropped. According to the 2011 census, the district has a population of 3,307,284 making it the second most populous district in Kerala. Major crops cultivated are coconut, rice, tapioca, tuber crops, banana, black pepper, and vegetables.

3.4.1.1 Location

Thiruvananthapuram district lies between 8.17° and 8.54° North latitudes and 76.41° to 77.17° East longitudes. It is bordered by Kollam District to the north, Thirunalveli and Kanyakumari Districts of Tamilnadu state to the east and south respectively. The western part of the district is bounded by the Arabian Sea and has a coastal length of about 78 km. As per the 2011 census, there are six taluks namely Thiruvananthapuram, Chirayinkeezhu, Neyyattinkara, Nedumangadu, Varkala, and Kattakada. The taluks are again subdivided into 12 block Panchayats.

3.4.1.2 Land utilization pattern

The total cropped area in the district was 0.15 million hectares and the net area sown was 0.13 million hectares constituting around 58.96 per cent of the total area of the district. Forest land accounted for 22.79 per cent of the total geographical area while the cultivable waste land was only 1.8 per cent. The land put to non-agricultural uses was 15.10 per cent of the total area and the share of area sown more than once was 13.70 per cent. The details of land utilization pattern in the district are given in Table 3.1.

3.4.1.3 Topography and climate

The climate of Thiruvananthapuram district is generally hot and tropical. Presence of enormous forest reserves have a favorable effect on the climate and induce rains. The minimum temperature ranges between 22.6 and 24.9º C and the maximum between 29.4 and 32.6º C.The rainy season starts during the South West monsoon which sets by end of May/beginning of June and extends up to September, during which the district receives most of its annual rainfall while the North East monsoon starts from the second half of October. The annual rainfall is 1,827.7 mm, the district is characterized by very high precipitation which is spread over very few wet days and a long dry season (December - May). There is a marked gradient from the eastern hilly

region to the sea rapidly re-conveying the rainfall back to the sea through short, fast, west flowing rivers.

Table 3.1 Land utilization pattern of Thiruvananthapuram district in 2017-18

Particulars	Area in Hectares	Percentage to total geographical area
Forest land	49861	22.79
Land put to non-agricultural uses	32207	14.72
Barren and uncultivable land	169	0.08
Permanent pastures and grazing land	0	0.00
Land under miscellaneous tree crops	23	0.01
Cultivable waste land	472	0.22
Fallow other than current fallow	851	0.39
Current fallow	2861	1.31
Marshy land	1	0.00
Still water	2696	1.23
Water logged area	16	0.01
Social forestry	22	0.01
Net area sown	129602	59.24
Area sown more than once	26482.08	12.10
Total cropped area	156084	71.34
Total geographical area	218781	100.00

Source: Agricultural Statistics 2017-18, Directorate of Economics and Statistics, Kerala

3.4.1.4 Soil

The district is enriched with different types of soils including red loams, coastal alluvium, riverine alluvium, lateritic soil, brown hydromorphic soil and forest loam. Most predominant soil is lateritic soil and is mainly found along the midland, mostly reddish brown to yellowish red in colour. Brown hydromorphic soils are confined to

valley bottom in the midland, red loamy soils are mainly seen in southern part of the district and the lowland area is dominated by alluvium.

3.4.1.5 Demographic features

As per the 2011 census, the population of the district was estimated to be 3,307,284 with a population density of 1509 per Sq. Km. The population growth was recorded as 2.25 per cent during the decade 2001-2011 and the literacy rate was 92.66 per cent. The district has a sex ratio of 1088 females for every 1000 males.

3.4.1.6 Water resources

The important rivers draining the district are Neyyar, Karamana, and Vamanapuram River, originating from the Western Ghats. There are 10 major back waters in the district. From Table 3.2, it is clear that the major source of water in the district is private wells which contribute around 58 per cent to the total.

Table 3.2 Area under irrigation in Thiruvananthapuram district (2011-12)

Source	Area in Hectares	Percentage to the total irrigated area
Government canal	4242	52.64
Private canal	83	1.03
Government tanks	354	4.39
Private tanks	61	0.76
Government wells	2	0.02
Private wells	2763	34.29
Minor irrigation	-	-
Other sources	544	6.75
Tube wells	9	0.11
Total	8058	100.00

Source: Panchayat Level Statistics, 2011-12, Thiruvananthapuram.

3.4.2 Description of selected Panchayats

Two blocks having the largest area under banana in Thiruvananthapuram district, Parassala and Nemom were selected for the present study. Two Panchayats from each block were selected *i.e.*, Maranalloor and Balaramapuram from Nemom block and Chenkal and Parassala Panchayats from Parassala block.

3.4.2.1 Distribution of area in selected Panchayats

Distribution of areain Parassala and Nemom blocks is presented in Table 3.3. It was found that 81 per cent of total area in Chenkal Panchayat was dryland. Only 14.63 per cent of the total area in Parassala Panchayat was found to be under wetland. In Nemom block, 80.31 per cent of total area in Maranalloor Pachayat was dryland whereas, 16.33 per cent of total area in Maranalloor Panchayat was wetland.

Table 3.3 Distribution of area based on type of land in selected Panchayats

Block	**Panchayat**	**Area in Hectares**			
		Wetland	Dryland	Others	Total
Parassala	Chenkal	828.69 (17.03)	3957.68 (81.34)	79.10 (1.62)	4865.47 (100.00)
	Parassala	718.49 (14.63)	3719.17 (75.78)	470.13 (9.57)	4907.79 (100.00)
Nemom	Maranalloor	859.56 (13.88)	4971.06 (80.31)	359.20 (5.80)	6189.82 (100.00)
	Balaramapuram	426.18 (16.33)	1978.13 (75.82)	204.37 (7.85)	2608.68 (100.00)

Source: Panchayat Level Statistics, 2011, Thiruvananthapuram.

Note: Figures in parentheses indicate per cent to row total

3.5. SAMPLING DESIGN

The survey was conducted in Thiruvananthapuram district, Parassala and Nemom blocks, which were having the highest area under bananawere selected for the study. In order to conduct the primary survey, two Panchayats from each block were selected using random sampling method. They were Maranalloor and Balaramapuram Panchayats from Nemom block and Chenkal and Parassala Panchayats from Parassala block.

The list of Nendran banana farmers was collected from the Swasraya Karshaka Samitis of the respective Panchayats under the Vegetable and Fruit Promotion Councils. Twenty farmers were randomly selected from each Krishibhavan, making a total sample size of 80. In order to understand the problems faced by farmers during marketing and pricing, data were collected from the selected farmers using pretested interview schedule by personal interview method.

3.5.1 Collection of data

The data pertaining to socio-economic profile of farmers and socio-economic constraints in pricing and marketing were collected from the sample farmers using a well-structured interview schedule. Based on the survey details of these farmers, calculations and ranking were carried out.

3.6 ANALYSES OF DATA

Both primary and secondary data were analyzed using different analytical tools which are explained below.

3.6.1 Primary data

The primary data collected from the sample respondents in the study area was tabulated and expressed in averages and percentages.

3.6.2 Trend and growth rate analyses

Trend in area, production and productivity of banana in India and of Nendran banana in Kerala were analysed using the time series data collected from publications of National Horticultural Board and Directorate of Economics and Statistics, Thiruvananthapuram. The compound growth rates of area, production and productivity were worked out by fitting exponential function of the form,

$$Y_t = ab^t$$

Where,

Y_t : Area/production/productivity of banana

a : Intercept

b : Regression coefficient

t : Number of years

Taking logarithms on both sides,

$$\ln Y_t = \ln a + t \ln b$$

$$Y_{t'} = A + B$$

Where,

$Y_{t'}$: $\ln Y_t$

A : ln a

B : ln b

Compound Growth Rate of a variable is the rate of change per unit time, usually a year. The method of Ordinary Least Squares was adopted to estimate the co-efficient (b). Compound Growth Rate in percentage was calculated using the relationship,

Compound Growth Rate (CGR) = (Antilog B – 1) X 100

3.6.3 Analyses of price behaviour

Price behaviour of Nendran banana was studied using the techniques of classical time series (Croxton *et al*., 1979; Spiegel, 1992). It was analysed using a multiplicative model by which the time series data on price of Nendran banana in major markets of Kerala *viz*, Kozhikode, Ernakulam and Thiruvananthapuramfor the period from 1980 to 2018 were decomposed into different components such as trend, seasonal, cyclical and irregular variations.

The multiplicative model is of the form,

$$Y(t) = T \times S \times C \times I$$

Where,

Y(t) : Value of a variable at time t

T : Secular trend

S : Seasonal variation

C : Cyclical variation

I : Irregular variation

3.6.3.1 Estimation of trend value

Trend is the general tendency of the data to increase or decrease during a long period of time. The trend in Nendran banana prices in major markets of Kerala from 2003 to 2018 was studied by fitting suitable trend equations.

Models attempted were as follows,

Linear trend:

$$Y_t = a + bt$$

Quadratic trend

$$Y_t = a + bt + ct^2$$

Cubic trend

$$Y_t = a + bt + ct^2 + dt^3$$

Exponential trend

$$Y_t = ab^t$$

3.6.3.2 Estimation of seasonal variation

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 were calculated by employing 12 point centered moving average method after removing the effect of other components *viz*., trend, cyclical variation and irregular variation.

3.6.3.3Estimation of cyclical variation

The oscillatory movements in a time series with a period of more than one year are referred as cyclical variations and such variations in the prices of Nendran banana in major markets of Kerala were studied using a multiplicative model of time series. The estimation of cyclic variations was done in three steps.

1. Removal of trend components
2. Removal of seasonal effect
3. Removal of irregular components

1. Removal of trend components

The effect of trend component was removed from the time series data by dividing each of the original values by the corresponding trend values and expressing the same in per cent. That is,

(T X S X CX I)/ T = S X C X I

Then such data consists of seasonal, cyclical and irregular components.

2. Removal of seasonal effect

The trend eliminated data for each month is divided by the corresponding seasonal index and the result is multiplied by 100.

(S X C X I) / S = C X I

3. Removal of irregular components

Removal of irregular variation is very difficult because it is highly entangled with cyclical movements. To get cyclic variations clearly, the data has to be smoothened by using short period moving averages.

3.6.3.4 Estimation of irregular variation

Random or irregular fluctuation in a time series which are not accounted for estimating seasonal, cyclical and secular variation is referred as irregular variation. These fluctuations are purely random, erratic and unpredictable and this occurs due to numerous non-recurring and irregular circumstances which are beyond the control of human. Irregular indices are obtained by dividing the cyclical- irregular indices by the cyclical indices. Symbolically,

(C X I) / C = I

3.6.4. Relationship between arrivals and prices

3.6.4.1 Correlation analysis

Correlation analysis was adopted to evaluate the nature and magnitude of association between arrivals and prices of Nendran banana in major VFPCK markets. Data pertaining to the period from 2013 to 2015 was subjected to analysis. The coefficient of correlation 'r' was calculated using the following equation.

$$r = \frac{\sum xy - \frac{\sum x \sum y}{n}}{\sqrt{\left[\sum x^2 - \frac{(\sum x)^2}{n}\right]\left[\sum y^2 - \frac{(\sum y)^2}{n}\right]}}$$

Where,

x = prices of Nendran banana for the period

y = Arrival of banana in VFPCK market

3.6.4.2 Variability analysis for arrivals and prices

This analysis was carried out to know the extent of variations in arrivals and prices of Nendran banana in VFPCK markets and for this purpose monthly price data for six years was considered. Coefficient of Variation was calculated using the following equation.

$$\text{Coefficient of Variation (CV)} = \frac{\text{Standard deviation}}{\text{Mean}} \text{ x } 100$$

3.6.5. Market integration and price transmission

3.6.5.1 Cointegration

Cointegration is regarded as the empirical equivalent of the theoretical concept of a long run relationship between two or more variables. Pairwise and multiple co-integration analysis of Nendran banana prices in the selected markets were carried out

for the period from 2003 to 2018. The concept of market integration describes the relationship between the prices in two or more than two spatially separated markets. When markets are integrated it indicates that the markets in the system operate in unison, as a single market organisation.

There are different tools for testing the existence of cointegration relationships among non-stationary variables. Johansen (1998) developed Maximum Likelihood (ML) method of cointegration, to study explicitly whether two or more markets are integrated,. There are two steps in carrying out cointegration,

1) Testing for stationarity

2) Testing for cointegration

1. Testing for stationarity

To confirm appropriate model specification and to reduce the possibility of arriving at misleading results, it is important to evaluate the characteristics of the time series data. This involves tests for establishing the order of integration of the variables.

The extensively used tests for unit roots are the Dickey Fuller (DF) and Augmented Dickey Fuller (ADF) tests. The null hypothesis for both the tests is such that 'the time series has a unit root' or in other words, it is non-stationary. The DF test was applied by running the regression of the following form,

$\Delta P_t = \beta_1 + \delta P_{t-1} + u_t$

Where,

$\Delta P_t = (P_t - P_{t-1})$; $Pt = \ln p_t$

The ADF test was run with the equation,

$$\Delta Y_t = \beta_1 + \delta P_{t-1} + \sum_{i=1}^{P} \alpha_i \Delta P_{t-i} + \in_t \quad (1)$$

$$\Delta Y_t = \beta_1 + \delta P_{t-1} + \beta_2 t + \sum_{i=1}^{P} \alpha_i \Delta P_{t-i} + \in_t \quad (2)$$

Where,

$\Delta P_{t-1} = (P_{t-1} - P_{t-2})$

$\in_t$ for t = 1, ... , N is assumed to be Gaussian white noise *i.e.*, $\in_t \sim (0, \sigma^2)$. The equation (1) is having constant term and no trend, whereas the second one (2) is with constant and trend. The number of lagged terms, 'p' is selected to ensure that the errors are uncorrelated. In all the tests, the null hypothesis was $\delta = 0$ which implied that the time series 'Y_t' was non-stationary. In the current study, ADF tests were used to determine the stationarity of the price variables.

2. Testing for cointegration

The test for finding the order of integration of each variable in the model was to establish the time series as non-stationary and how many times the variable needed to be differenced to result in a stationary series. However, first differencing is not an appropriate solution to the non-stationarity problem and it prevents the detection of the long-run relationship that can be present in the data, *i.e*. the long-run information is lost, which is precisely the main question being addressed.

The economic interpretation of co-integration is that, if two (or more) series are associated to form an equilibrium relationship spanning the long-run, then even though the series themselves may contain stochastic trends (*i.e.*, be non-stationary) they will nevertheless move closely together over time and the difference between them will be stable (*i.e*., stationary). The concept of co-integration mimics the existence of a long-run equilibrium to which an economic system converges over time and 'u_t' defined

above can be interpreted as the disequilibrium error (*i.e*., the distance that the system is away from equilibrium at time t).

An approach to testing for co-integration is to construct test statistics from the residuals of a cointegrating regression in levels mostly using Engle Granger and Augmented Engle Granger tests. However, in the case of a system of variables Johansen Maximum likelihood procedure (Johansen and Juselius, 1990) is the most applicable method, since it permits the existence of co-integration between the systems of variables without imposing any bias on the estimates. The Johansen test for co-integration is a multivariate unit root test which estimates the co-integrating rank 'r' in the multivariate case and is also able to estimate the parameters 'β' of these co-integrating relationships. This test procedure is most efficient because it identifies the number of co-integrating vectors between the non-stationary level variables in the context of a Vector Error Correction Model (VECM). Basically, this is a Vector Auto Regression (VAR) model in error correction form. In a system with two or more variables, a VECM, like the VAR model, treats each variable as potentially endogenous and relates the change in one variable to past equilibrium errors and to past changes in all variables in the system.

Following Johansen and Juselius (1990), the maximum likelihood method of co-integration is explained as follows:

If 'P_t' denotes (nx1) vector of I(1) prices, then the k^{th} order vector autoregressive (VAR) representation of 'P_t' may be written as 'k'.

$$P_t = \sum_{i=1} \Pi_i P_{t-1} + \mu + \beta_t + e_t \ (t = 1, 2 \ldots . t)$$

The procedure for testing co-integration is based on the error correction (ECM) representation of 'P_t' given by

$$\Delta Pt = \sum_{i=1}^{K-1} \acute{\Gamma}i \Delta P_{t-i} + \Pi_i P_{t-k} + \mu + \beta_t + e_t$$

Where,

$\Pi i = -(1- \Pi_1 - \ldots\ldots - \Pi_t)$; i= 1, 2… K-1; $\Pi = -(1-\Pi_1-\ldots. - \Pi_k)$.

Each of the Π_1 is an n x n matrix of parameters; 'e_t' is an identically and independently distributed n-dimensional vector of residuals with zero mean and variance matrices. Ωe; 'μ' is a constant term and t is trend. Since, 'P_{t-k}' is I (1), but 'ΔP_t' and 'ΔP_{t-I}' variables are I (0). Equation will be balanced if Π Pt-k' is 1(0). So, it is the Π matrix that conveys information about the long run relationship among the variables in 'P_t'. The rank of Π, r, determines the number of co-integrating vectors, as it determines how many linear combinations of 'P_t' are stationary. If r = n, the prices are stationary in levels. If r = 0, no linear combination of 'P_t' is stationary. If 0 < rank (Π) = r < n, and there are n x r matrices 'ά' and 'β' such that Π = άβ, then it can be said that there are 'r' co-integrating relations among the elements of 'P_t'. The co-integrating vector 'β' has the property that 'βP_t' is stationary even though 'P_t' itself is non-stationary. The matrix ά measures the strength of the co-integrating vectors in the ECM as it represents the speed of adjustment parameters. Two likelihood ratio test statistics were proposed. The null hypothesis of at most 'r' co-integrating vectors against a general alternative hypothesis of 'more than r' co-integrating vectors was tested by

$$\text{Trace statistic } (\lambda\text{-trace}) = -T \sum \ln (1- \lambda_i)$$

The null hypothesis of r co-integrating vectors against the alternative of r + 1 is co-integrating vectorstested by the maximum Eigen value statistic (λ max) = -T ln (1-λ_{r+1}).

'λi' are the estimated Eigen values (characteristics roots) obtained from the Π matrix. T is the number of usable observations (Johansen and Juselius, 1990).The number of co-integrating vectors indicated by the tests is an important indicator of co-movement of the prices. An increase in the number of co-integration vectors implies an increase in the strength and stability of price linkages.

3.6.5.2 Granger Causality Test

Cointegration between two variables implies the existence of causality between them in atleast one direction (Granger, 1980). Cointegration itself cannot be used to make inferences about the direction of causation between the variables. The Granger Causality test provides additional evidence for the presence and direction of price transmission occurring between two series. If two markets are integrated, the price in one market 'P_D' would be found to Granger-Cause the price in the other market, 'P_I' and/or vice versa. The test involves estimating the following pair of regressions

$$P_{Dt} = \sum_{i=1}^{n} \alpha_i P_{It-i} + \sum_{j=1}^{n} \beta_j P_{Dt-j} + u_{1t} \ldots\ldots (1)$$

$$P_{Dt} = \sum_{i=1}^{n} \lambda_i P_{It-i} + \sum_{j=1}^{n} \delta_j P_{Dt-j} + u_{2t} \ldots\ldots (2)$$

Unidirectional causality from 'P_{1t}' to 'P_{Dt}' is indicated if the estimated coefficients on the lagged 'P_{1t}' in the first regression are statistically different from zero as a group and the set of estimated coefficients in lagged 'P_{Dt}' in (2) is not statistically different from zero. Conversely, unidirectional causality from 'P_{Dt}' to 'P_{1t}' exists if the set of lagged 'P_{1t}' in the first regression is not statistically different from zero and the set of lagged 'P_{Dt}' coefficients in (2) are statistically different from zero. Bilateral causality is suggested when the sets of 'P_{1t}' to 'P_{Dt}' coefficients are statistically different from zero in both the regressions. When the sets of both the coefficients are not statistically significant in both the regressions, independence is suggested.

3.6.6. Volatility of banana Prices

3.6.6.1 Intra-annual volatility

The extent of volatility in the prices of Nendran banana and the temporal changes of volatility were examined by constructing a series of annual observations from monthly and weekly data by using intra-annual standard deviation of changes in log prices (Gilbert, 2006) and scaled inter-annual range as suggested by Parkinson (1980), Garman and Klass (1980) and Kunitomo (1992).

The intra-annual volatility in monthly prices was measured as the intra-annual standard deviation of changes in log prices, which is defined as

$$S_{YM} = \sqrt{\frac{1}{11}\sum_{m=1}^{12}(\ln P_{y,m} - \ln P_{y,m-1} - \delta y)^2} \text{ for year y,}$$

Where $\delta y = \frac{1}{12}(\ln P_{y,12} - \ln P_{y,0})$ is the y^{th} year drift and $P_{y,0} = P_{y-1,12}$

This estimate is scaled onto an annual basis using the factor of $\sqrt{12}$

3.6.6.2 Inter-annual volatility

The inter-annual volatility measure or the scaled inter-annual range called as the Parkinson's measure as suggested by Parkinson (1980) and modified by Garman and Klass (1980) and Kunitomo (1992) was used to estimate the inter-annual volatility of monthly prices.

Parkinson's measure is defined *as* $S_y^p = \left(\frac{(\ln P_y^H - \ln P_y^L)}{2\sqrt{\ln 2}}\right)$

Where, $P_y^H = \text{Max}_{m-1}^{12} P_{y.m}$, is the highest monthly average price in the year and $P_y^L = \text{Min}_{m-1}^{12} P_{y,m}$ is the lowest monthly average price in the year. This estimate is an unbiased estimate of the annual price volatility on the assumption that the price process follows a random walk.

3.6.6.3 Instability in annual prices

Instability indices were used to examine the extent of variation involved in annual prices of banana. Price instability refers to the tendency of the price of a commodity to fluctuate sharply and unpredictably. A good instability measure should be unit free, robust and measures deviations from the underlying trend (Chand and Raju, 2009). The Cuddy-Della Valle Index, instability derived from exponential trend, and Coppock's instability index were used to determine the instability in monthly price for the period from January 2003 to December 2018.

3.6.6.3.1 Cuddy-Della Valle Index

The annual instability in prices was measured by Cuddy-Della Valle Index (Cuddy and Della Valle. 1978) which is given as

$$\text{Cuddy-Della Valle Instability Index (\%)} = \text{CV x}\sqrt{1 - \bar{R}^2}$$

where,

CV is the coefficient of variation in per cent, and $\bar{R}^2$ is the coefficient of determination from a time trend regression adjusted for its degrees of freedom.

3.6.6.3.2 Instability Index derived from exponential trend

Another measure of instability in annual prices is measured as the percentage deviation of prices from their exponential trend levels and is estimated as follows:

$$\text{Instability Index} = \frac{1}{n}\sum_{t=1}^{n}\left[\frac{|Y_t - y_t|}{y_t}\right] \text{x } 100$$

Where,

$Y_{(t)}$ is the observed magnitude of the variable.

$y_{(t)}$ is the magnitude estimated by fitting an exponential trend to the observed value

n is the number of observations.

The vertical bar indicates the absolute value (i.e. disregarding signs).

3.6.6.3.3 Coppocks Instability Index

The annual instability of prices of banana was also measured using Coppocks Instability Index (CII). CII is calculated as the antilog of the square root of the logarithmic variance using the following formula:

$$CII = (\text{Antilog})\sqrt{[V\log - 1]} \times 100$$

Where,

$$V\log = \frac{1}{(N-1)}\Sigma\ (\log P_{t+1} - \log P_t - M)^2$$

$$M = \frac{1}{N-1}\Sigma\ (\log P_{t+1} - \log P_t)$$

P= Price of banana

M = Arithmetic mean of the differences between logs of P_t and P_{t+1}, P_{t+1} and P_{t+2}

V log = Logarithmic variance of the price series

3.7 Constraints in pricing and marketing of banana

The constraints related to marketing and pricing of Nendran banana were identified and analysed as explained below. Analysis of various constraints faced by banana farmers, was carried out using Garette ranking technique. As the first step in constraint analysis, major problems faced during marketing and pricing were identified.

The respondents were then asked to rank the identified problems and the ranks were converted into percent position by using the following formula,

$$\text{Per cent position} = \frac{100 \text{ x } (\text{Rij} - 0.5)}{\text{Nj}}$$

Where,

R_{ij} = Ranking given to the i^{th} attribute by the j^{th} individual

N_j = Number of attributes ranked by the j^{th} individual.

These percentages were converted into scores by referring to the Garrett's table, (Garrett and Woodworth, 1971). Thus for each factor, the scores of various respondents were added and the mean value was estimated. The mean score values were arranged in the descending order. The attribute with the highest mean value was considered as the most important problem and the others followed in order.

Results and Discussion

4. RESULTS AND DISCUSSION

The present study entitled “Price behaviour of Nendran banana in Kerala: An economic analysis” was conducted in Kerala with the objectives of analysing trend, price behaviour, market integration, price volatility, and determining constraints with regard to pricing. The results are discussed in eight sections as given below.

4.1 Trend in area, production and productivity of banana

4.2 Growth rates in area, production and productivity of banana

4.3 Price behaviour of Nendran banana

4.4 Market integration

4.5 Relationship between arrivals and prices

4.6 Volatility of prices

4.7 Socio-economic profile of the sample farmers

4.8 Constraints in pricing and marketing of banana

4.1 Trend in area, production and productivity of banana

An attempt has been made in this section to analyse the growth pattern of banana in India and Kerala with respect to area, production and productivity over time (1980-2017) and the results are explained under two headings viz., Indian scenario and Kerala scenario.

4.1.1 Indian scenario

The area, production and productivity of banana in India during the period from 1980-81 to 2017-18 as presented in Fig. 4.1 revealed that, India has produced 30 million tonnes from an area of 8.84lakh hectares with a productivity of 34851 kg per hectare in the year 2017-18. The area under banana in India had steadily gone up from 2.91 lakh hectares in 1980 to 8.84 lakh hectares in 2017-18 and the production increased from 4.35 million tonnes to 30 million tonnes during the same period. The productivity had increased from 15000 kg per hectare to 34,851 kg per hectare during the above period. Peak production of banana was observed in the year 2017-18. It was found that area, production and productivity of banana in India during the period from 1980-81 to 2017-18exhibited an increasing trendas shown in Fig. 4.2 to 4.4.

The results of the trend analysis of area, production and productivity of banana in India was in line with the findings of Phuke (2004) who observed an increasing trend in the area and production during the period from 1990-91 to 2001-02. Maduka (2004) also reported a noticeable increase in the area of banana from 1970 to 2000.

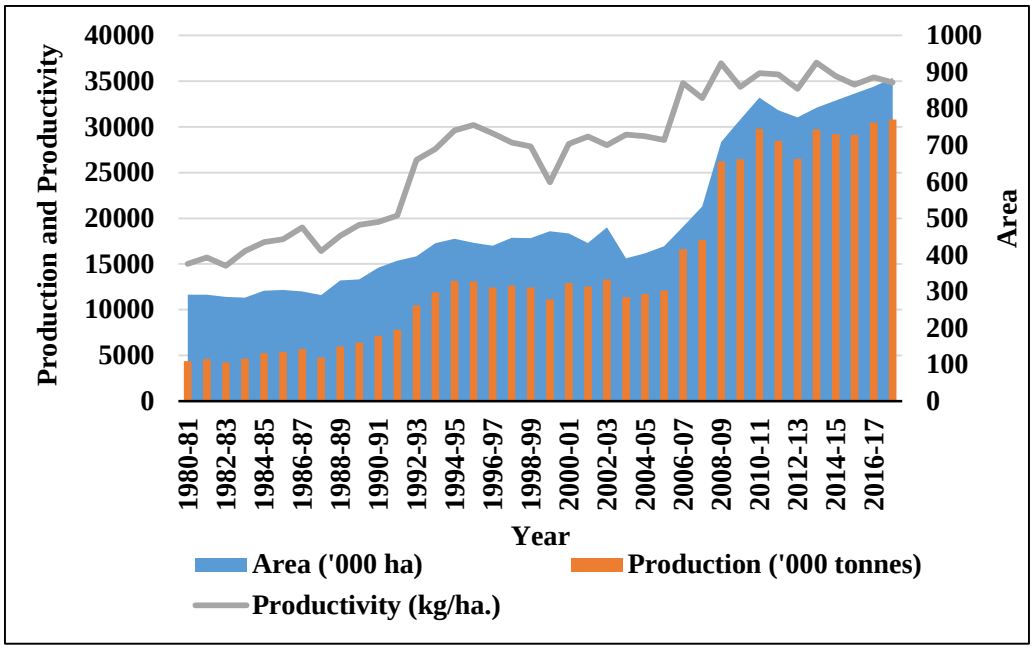

Fig. 4.1Area, production and productivity of banana in India

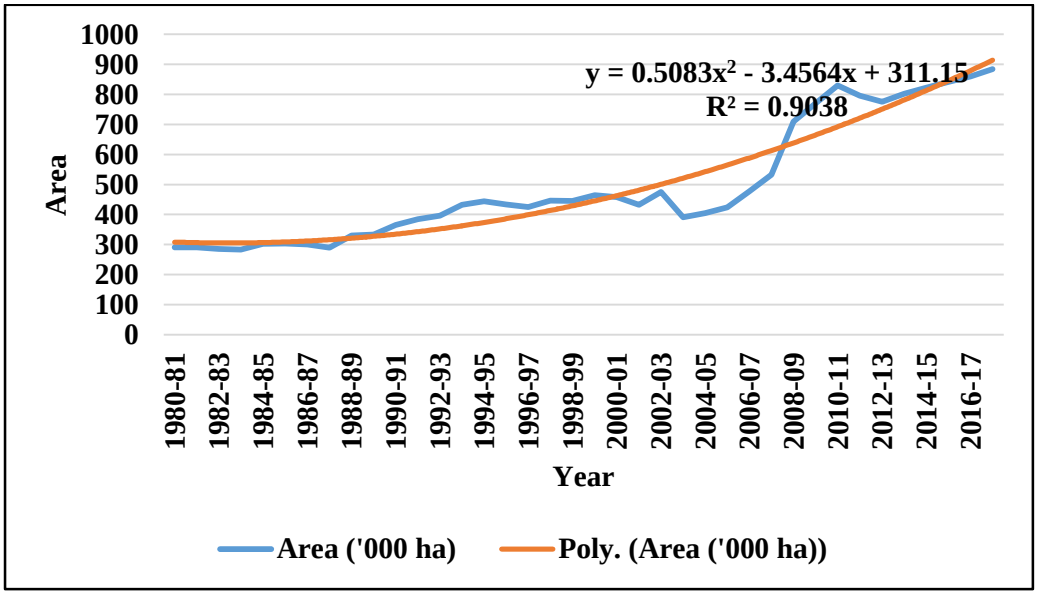

Fig. 4.2 Trend in area under banana in India

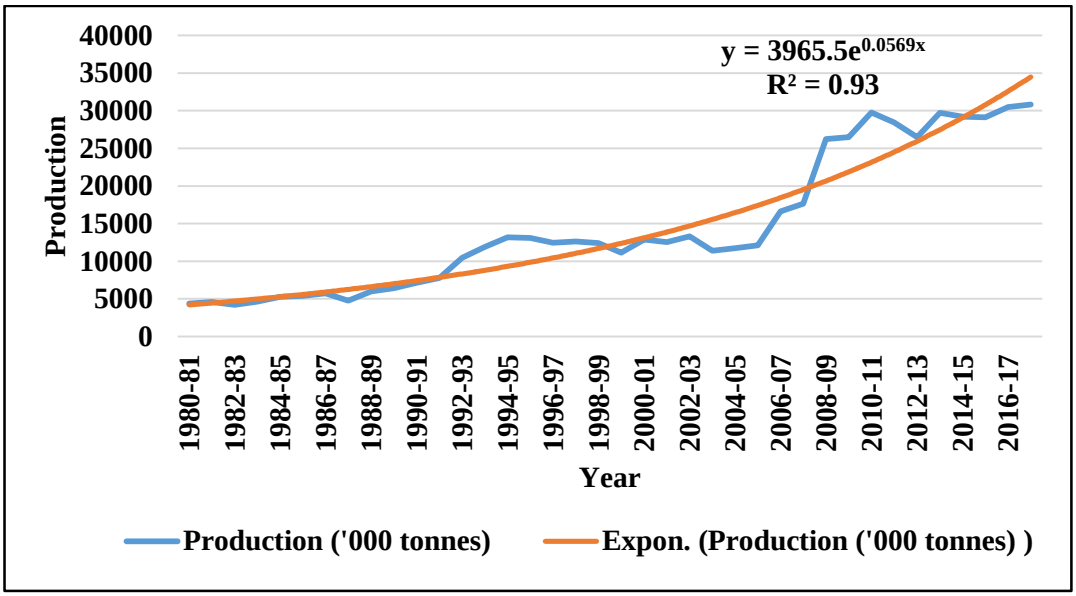

Fig. 4.3 Trend in production of banana in India

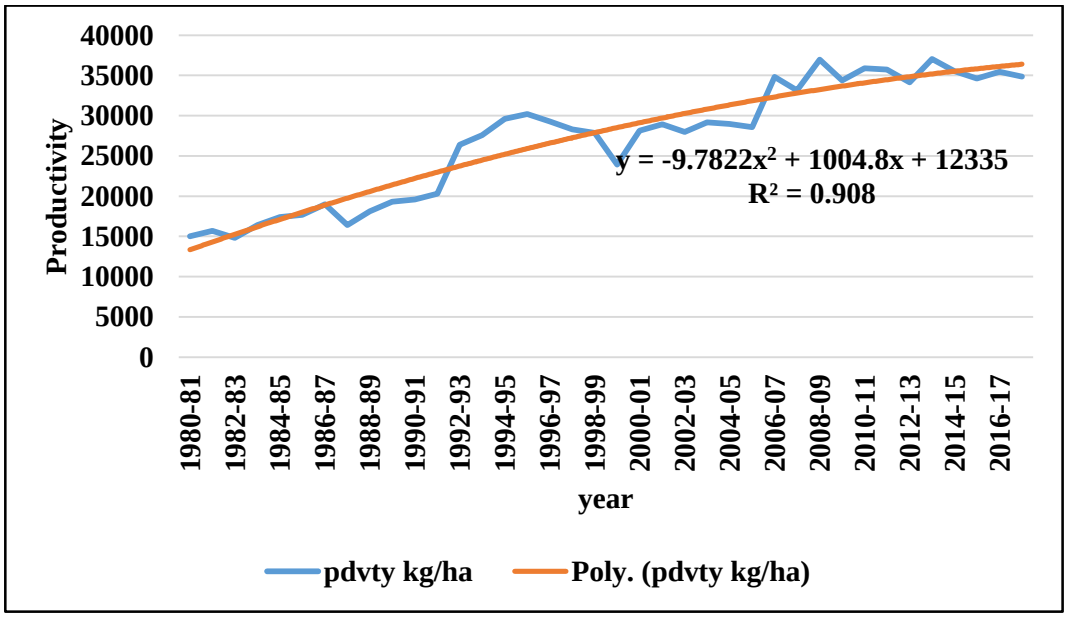

Fig. 4.4 Trend in productivity of banana in India

4.1.2 Kerala scenario

The area, production and productivity of banana in Kerala during the period from 1980-81 to 2017-18 as presented in Fig. 4.5 revealed that, Kerala has produced 565.8 million kg of banana from an area of 62,108 hectares with a productivity of 9110 kg per hectare in the year 2017-18.

As evident from Fig. 4.6 to 4.8, there was continuous increasing trend in case of area and production during the period from 1980-81 to 2017-18. The coefficient of determination was 0.92 and 0.55 respectively. However, the productivity, with coefficient of determination 0.85 showed decreasing trend during the same period.

The area and production in Kerala showed an increasing trend but the productivity was found declining over years. This can be attributed to the decrease in efficiency of production due to improper input usage and lack of scientific management practices. The above results of the trend analysis for area, production and productivity of banana in Kerala was in line with the findings of Devi *et al*. (1990) who reported that banana production in the state had an increasing trend because of the intensive cultivation practices and favorable price factors for banana.

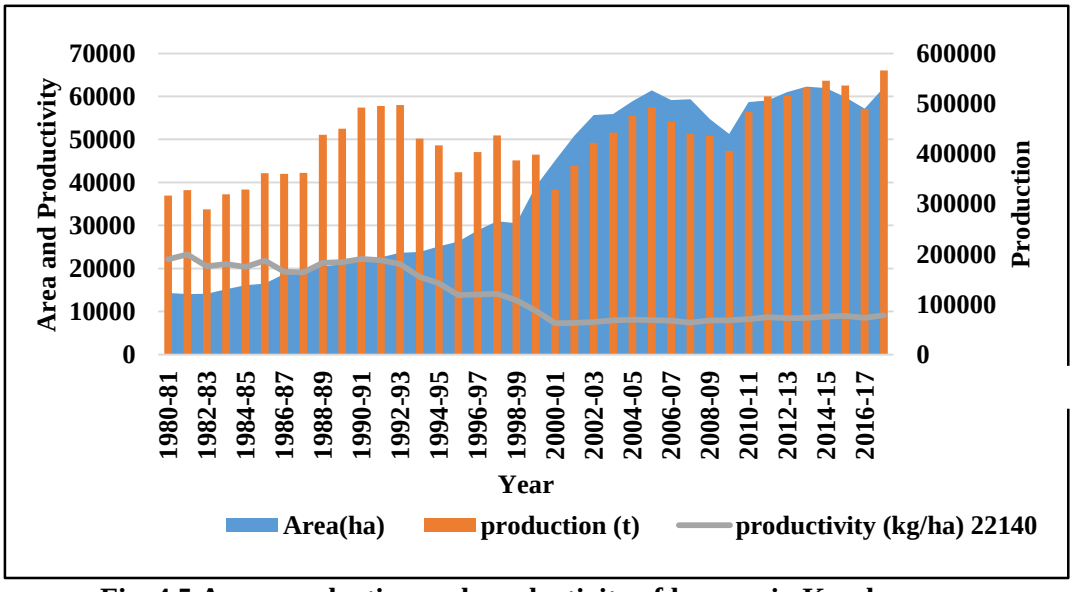

Fig. 4.5 Area, production and productivity of banana in Kerala

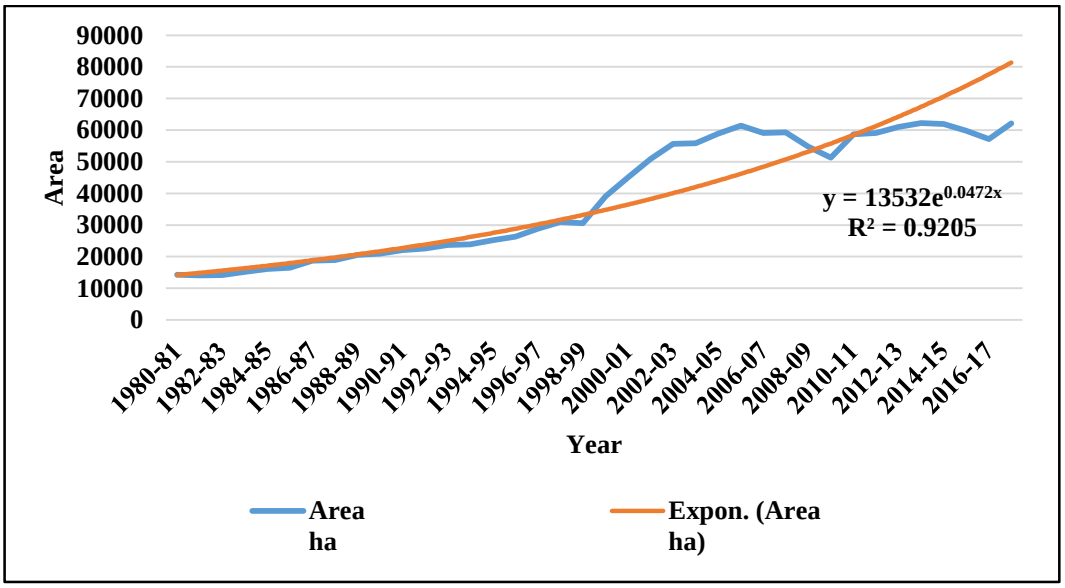

Fig. 4.6 Trend in area under banana in Kerala

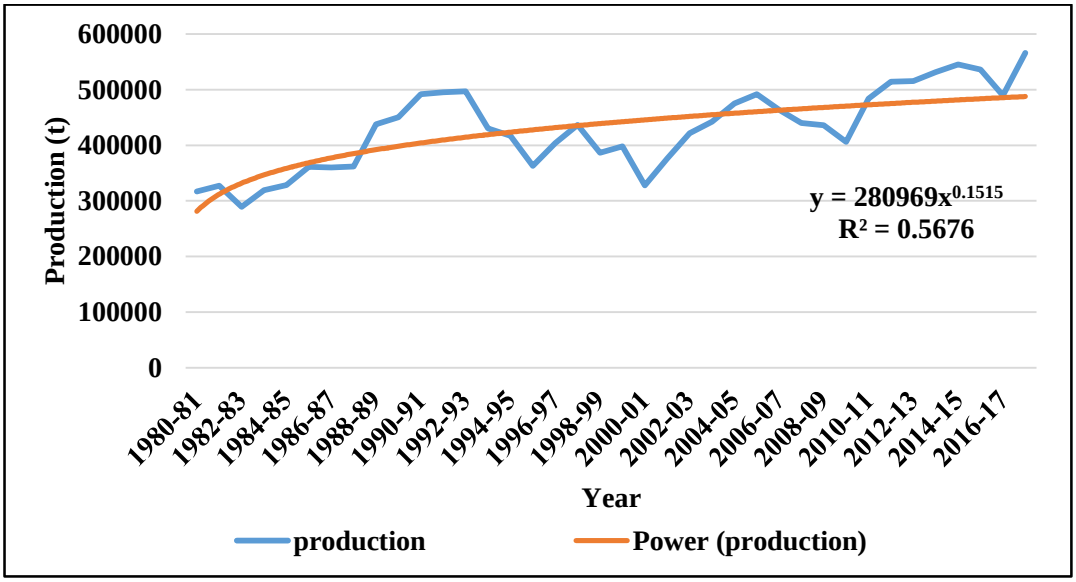

Fig. 4.7 Trend in production of banana in Kerala

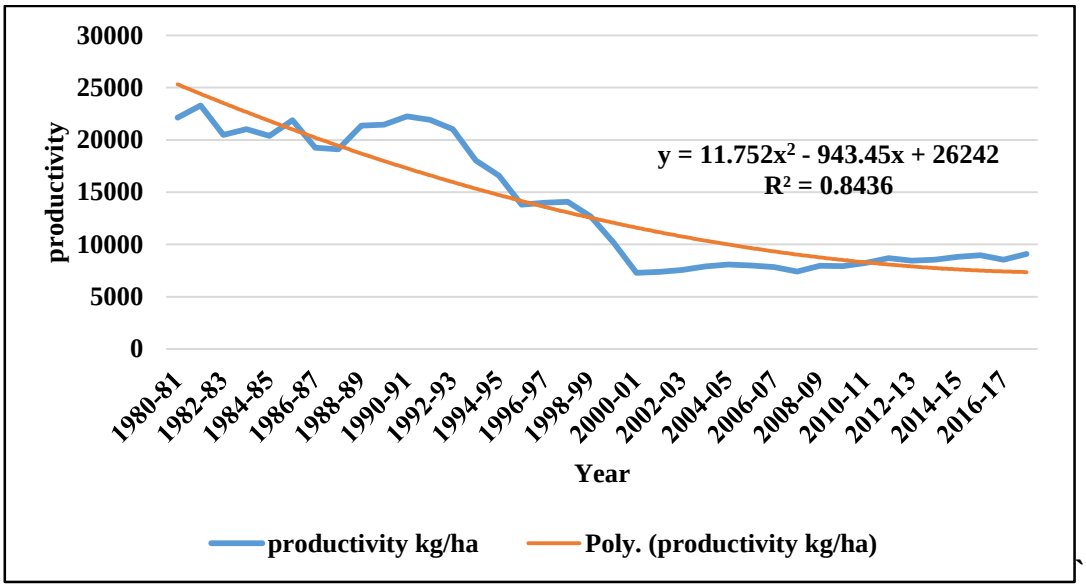

Fig. 4.8 Trend in productivity of banana in Kerala

4.2 Growth rates of area, production and productivity of banana

The results of the trend analysis have provided an outline of the changes in area, production and productivity of banana in India and Kerala. In order to incorporate the year to year variation in area, production and productivity, the compound growth rates have been computed.

Growth rate of a variable may be defined as the rate of change per unit of time, usually a year. Here, exponential growth model was fitted for the time series data on area, production and productivity of banana and the results are discussed under two headings *viz.* India and Kerala. The entire period (1980-01 to 2017-18) has been divided into two sub periods namely Period I (1980-81to 1995-96) and Period II (1996-97 to 2017-18). For the two sub-periods as well as for the entire period, the compound growth rates in area, production and productivity of banana were estimated.

4.2.1 India

The estimated growth rates of area, production and productivity of banana in India for the entire period and sub-periods using an exponential model are presented in Table 4.1.

Table 4.1 Compound annual growth rate of area, production and productivity of banana in India (Per cent per Annum)

Particulars	Growth rate	t value	R^2
Overall period (1980-81 to 2017-18)			
Area	3.24**	16.81	0.89
Production	5.86**	21.86	0.93
Productivity	2.53**	15.10	0.86
Period I (1980-81 to 1995-96)			
Area	3.30**	9.82	0.87
Production	8.22**	10.31	0.88
Productivity	4.76**	9.10	0.86
Period II (1995-96 to 1997-2018)			
Area	4.37**	8.89	0.80
Production	6.04**	9.73	0.83
Productivity	1.60**	6.79	0.70

Note: ** Indicates significance at one per cent level

Analysis of growth rates in area, production and productivity of banana in India using exponential models showed that, during the overall period under the study, there was significant and positive growth in area (3.24 per cent), production (5.86 per cent) and productivity (2.53 per cent). It was observed that the combined influence of growth in area and productivity resulted in significant and positive growth in production during the overall period. During Period I, the growth in area, production and productivity was

3.30 per cent, 8.22 per cent and 4.73 per cent respectively which revealed that, the higher growth in production was due to the combined contribution of both area and productivity. Even with a low growth rate in productivity of 1.60 per cent in Period II, the production exhibited a growth of 6.04 per cent, which could be attributed to the growth of 4.37 per cent in area.

The above analysis on the growth performance of banana in India revealed that area, production and productivity of banana had shown an increasing trend. Even though the growth rate in area has increased from period I to period II, growth rate in production has decreased which could be attributed to the reduction in productivity. However, the growth in area, production and productivity during the overall period under study was significant and positive.

4.2.2 Kerala

Analysis of exponential models for the estimation of growth rates in area, production and productivity of banana in Kerala revealed that, throughout the whole duration under the study (1980-81 to 2017-18) there has been considerable changes in the growth. During the overall period growth in productivity was negative (-3.41 per cent) but growth in area and production showed a hike of 4.83 per cent and 1.27 per cent respectively. It is evident from the Table 4.2 that even with a growth of 4.83 per cent, production grew only by 1.27 per cent because of the negative growth in productivity. During Period I growth in area (4.61 per cent) and production (2.26 per cent) were positive but the growth in production was negatively influenced by the growth rate of productivity (-2.25). Similar trend was observed in period II during which the growth rates in area, production and productivity were 2.99 per cent, 1.74 per cent and -1.24 per cent respectively. Growth in production (1.74 per cent) was less in period II compared to period I due to the sharp fall in growth of area.

Table 4.2 Compound growth rate of area, production and productivity of banana in Kerala

Particulars	Growth rate	t value	R^2
Overall period (1980-81 to 2017-18)			
Area	4.83**	20.41	0.92
Production	1.27**	7.26	0.59
Productivity	-3.40**	-11.25	0.78
Period I (1980-81 to 1995-96)			
Area	4.61**	24.89	0.98
Production	2.26**	2.85	0.37
Productivity	-2.25**	-3.16	0.42
Period II (1995-96 to 1997-2018)			
Area	2.99**	5.53	0.60
Production	1.74**	6.05	0.65
Productivity	-1.21**	-2.02	0.17

Notes: ** Indicates significance at one per cent level

4.3 Price behaviour of banana

Besides improving productivity of banana, remunerative and steady price also play a crucial role in increasing production. Bananabeing an annual crop, there is high probability of regular price fluctuations. So it is necessary to ensure steady price to protect the bananafarmers. In this context, an attempt was made to analyze the price behavior of bananain major Vegetable and Fruit Promotion Council of Kerala markets

viz., Kozhikode, Ernakulam and Thiruvananthapuram. Monthly wholesale prices of banana (from 2003 to 2018) from these markets were collected and analysed.

In order to analyse the price behavior, the monthly price data of banana was decomposed into four components *viz*., secular trend, seasonal variation, cyclical variation and irregular variation, assuming a multiplicative model of time series and the results are described below under appropriate headings.

4.3.1 Trend analysis of price of banana

Trend can be defined as the general tendency of a time series data set to increase or decrease over a long period of time. In order to identify the long run price behavior of Nendran banana, trend analysis was done separately for each market by applying the method of least squares. Different functional forms were attempted to explain the underlying trend in the price behaviour and the model with highest R^2 value was taken as the best fit.

The trend in banana prices in Kozhikode, Ernakulam and Thiruvananthapuram markets as presented in Fig. 4.9 to 4.11 showed that in spite of the regular ups and downs; price exhibited an increasing trend in the long run. In all the three markets, exponential function was found to be the best fit model. The coefficients of determination were 81.5per cent, 78.6per cent, and 82.4per cent in the respective markets.

Despite the fluctuations, banana price in the long run had shown an increasing trend in all markets viz., Kozhikode, Ernakulam and Thiruvananthapuram. The above results are in line with the findings of Pauline and Ajjan (2014) who observed an increasing trend in the banana prices in major banana markets of south India.

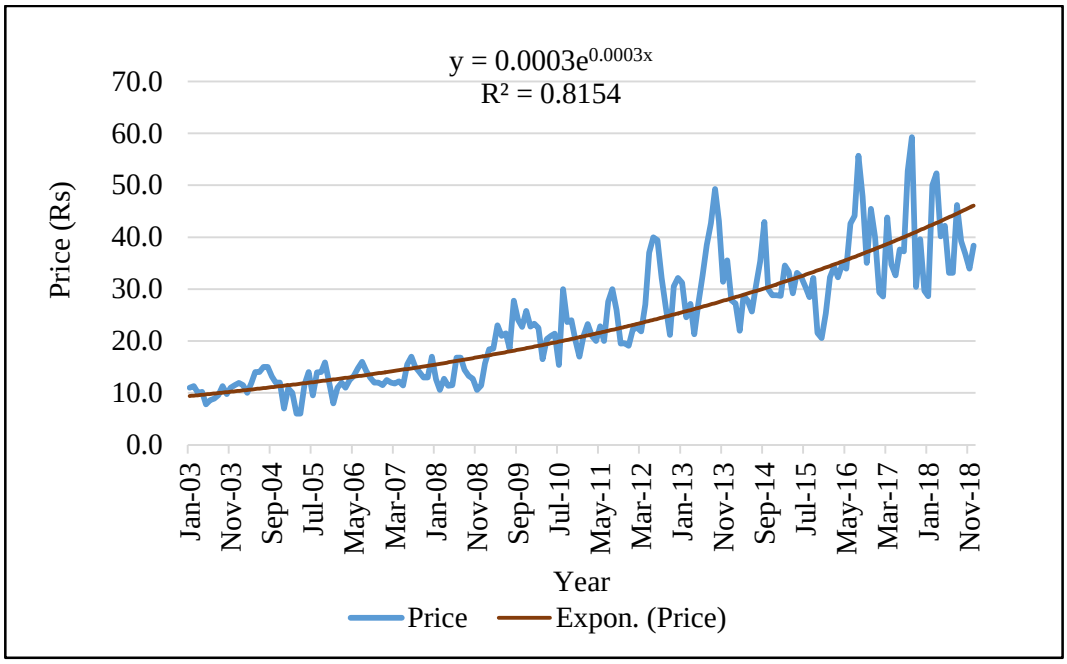

Fig. 4.9 Trend in Nendran banana prices in Kozhikode market

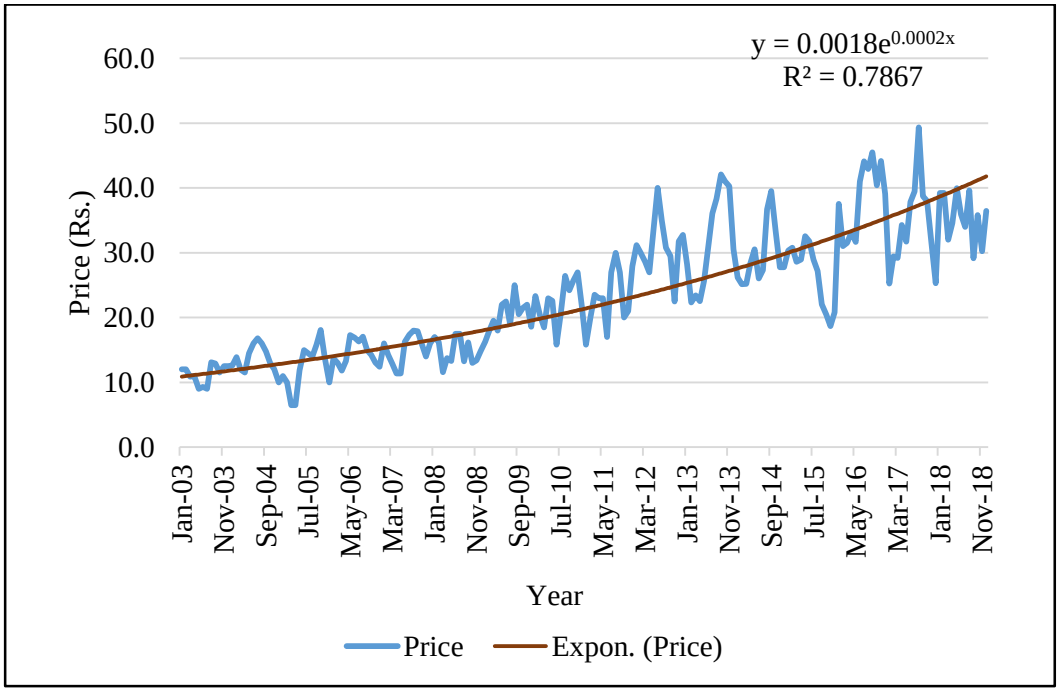

Fig. 4.10 Trend in banana prices in Ernakulam market

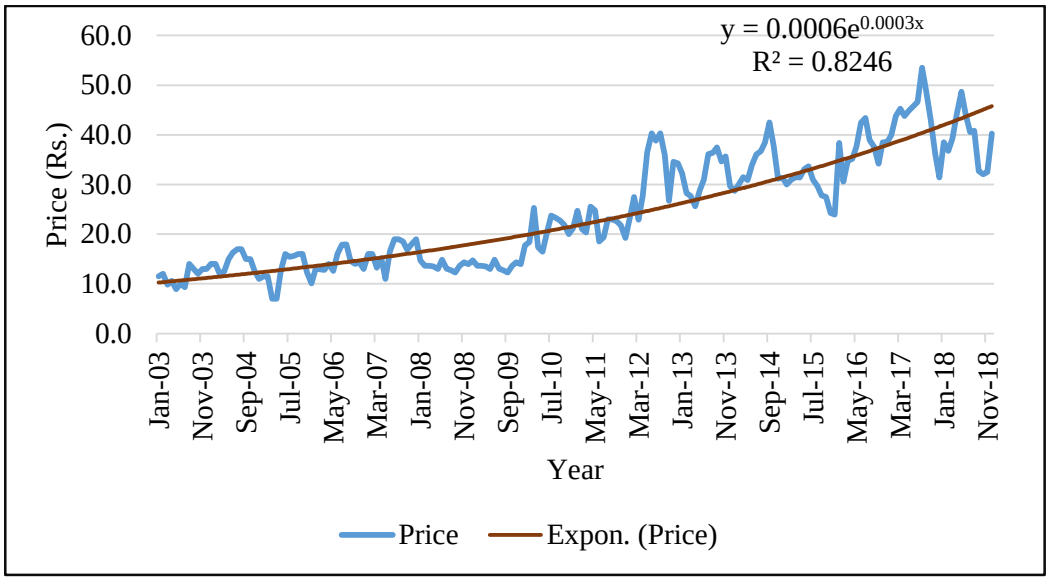

Fig. 4.11 Trend in banana prices in Thiruvananthapuram market

4.3.2 Seasonal variations in the prices of banana

The variations in time series data which occur at specific regular intervals less than 12 months, such as weekly, monthly and quarterly intervals are called seasonal variations. Seasonality in the production of agricultural commodities is the main reason for price fluctuations. The seasonal variations in the prices of banana during 2003 January to 2018 December were analyzed using ratio to moving average method and the results are presented below.

The seasonal variations in the prices of banana from 2003 to 2018 are presented in Table 4.3. It revealed that the highest price for bananain Kozhikode market was observed in August whereas, the lowest price was observed in December. The period from June to November was found to be the buoyant phase and December to May was observed as the depressed phase (Fig. 4.12).

In Ernakulam market also, the highest price was observed in the month of August. The buoyant phase was found to be from June to October. The depression phase was observed from November to May with the trough being in March (Fig. 4.13). In Thiruvananthapuram market, the buoyant phase was found to be from June to October. The depression phase was observed from November to May with the trough being in December (Fig. 4.14).

Table 4.3 Seasonal indices for Nendran banana prices

Month	Kozhikode	Ernakulam	Thiruvananthapuram
January	94.01	95.44	96.16
February	93.96	97.69	92.62
March	89.72	86.46	92.08
April	92.55	90.12	96.62
May	101.37	99.82	98.84
June	107.75	107.16	108.30
July	110.06	111.82	112.32
August	122.49	116.03	113.87
September	110.04	108.36	106.83
October	94.36	102.06	99.39
November	94.73	96.94	94.08
December	88.96	88.09	88.90

The peak price in all the three markets was observed in August which was due to the upcoming festival of Onam in September and also the associated demand for processed foods like Nendran chips. The price was found to be low from December to march and could be attributed to the decreased consumption. These results were in conformity with the findings of Pauline and Ajjan (2014) who observed an uptrend in the banana prices from August to October each year in major banana markets in south India.

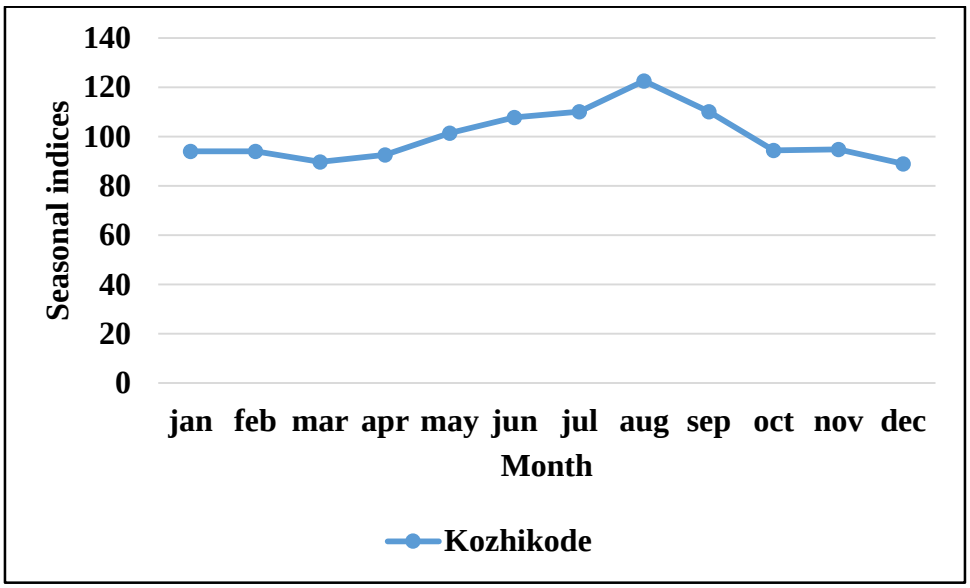

Fig. 4.12 Seasonal indices for Nendran banana prices in Kozhikode

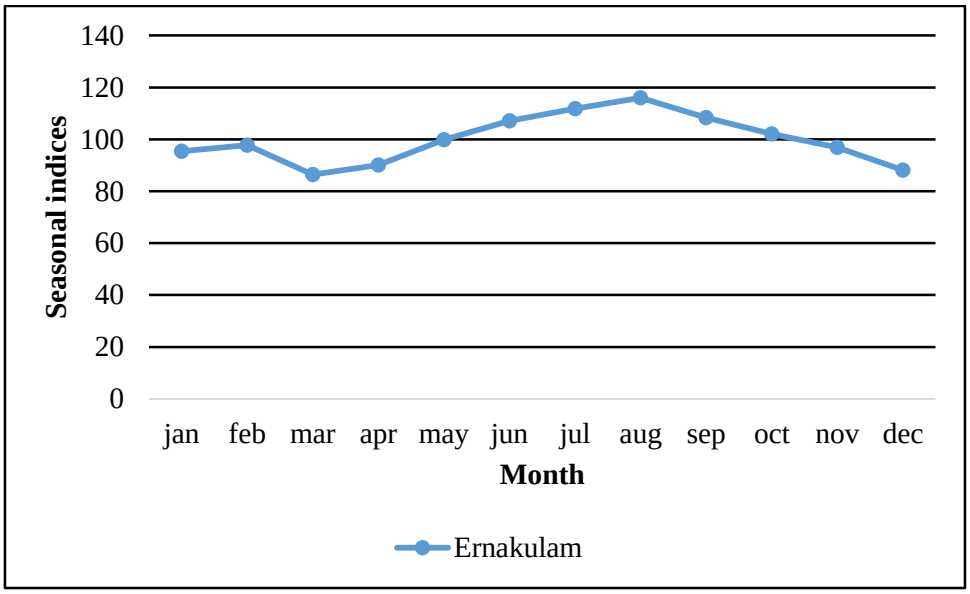

Fig. 4.13 Seasonal indices for Nendran banana prices in Ernakulam

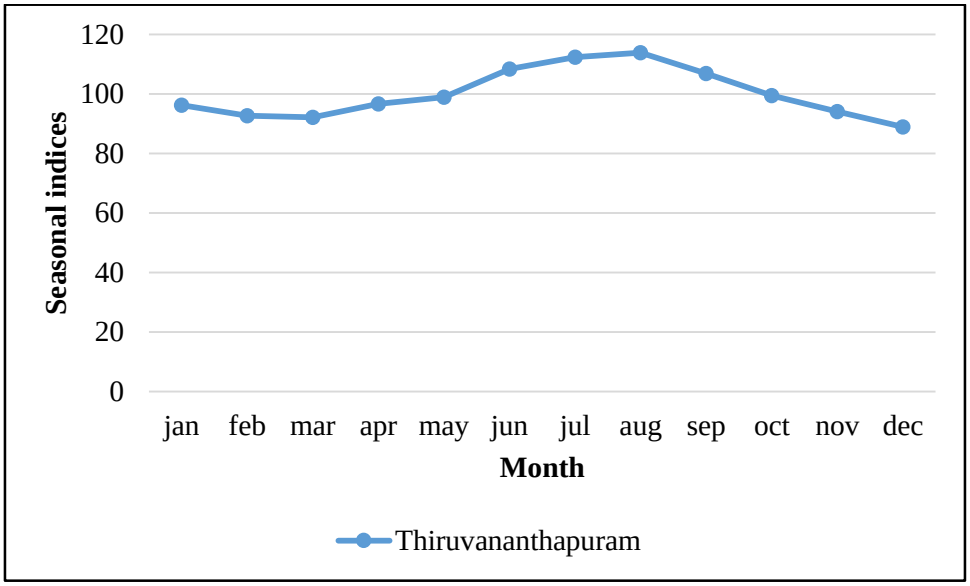

Fig. 4.14 Seasonal indices for Nendran banana prices in Thiruvananthapuram

4.3.3 Cyclical variations

The oscillatory movements in a time series with a period of more than one year are referred as cyclical variations. The indices for the cyclical price variations in Nendran banana were worked out by averaging the cyclical-irregular data after eliminating the trend and seasonal variations from the original data. The cyclical indices of Nendran banana for the selected markets are presented in Fig. 4.15 to 4.17. During the period from 2003 to 2018, one or two cycles of length varying from six to seven years were visible in Nendran banana prices. Hence, wide fluctuation in the prices was observed in all the markets.

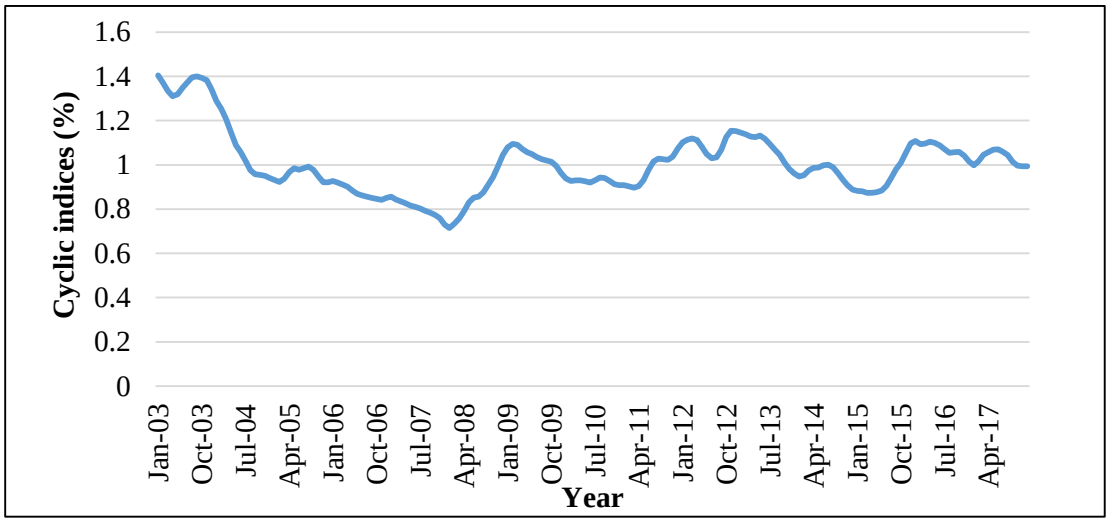

Fig. 4.15 Cyclical variation in Nendran banana prices in Kozhikode

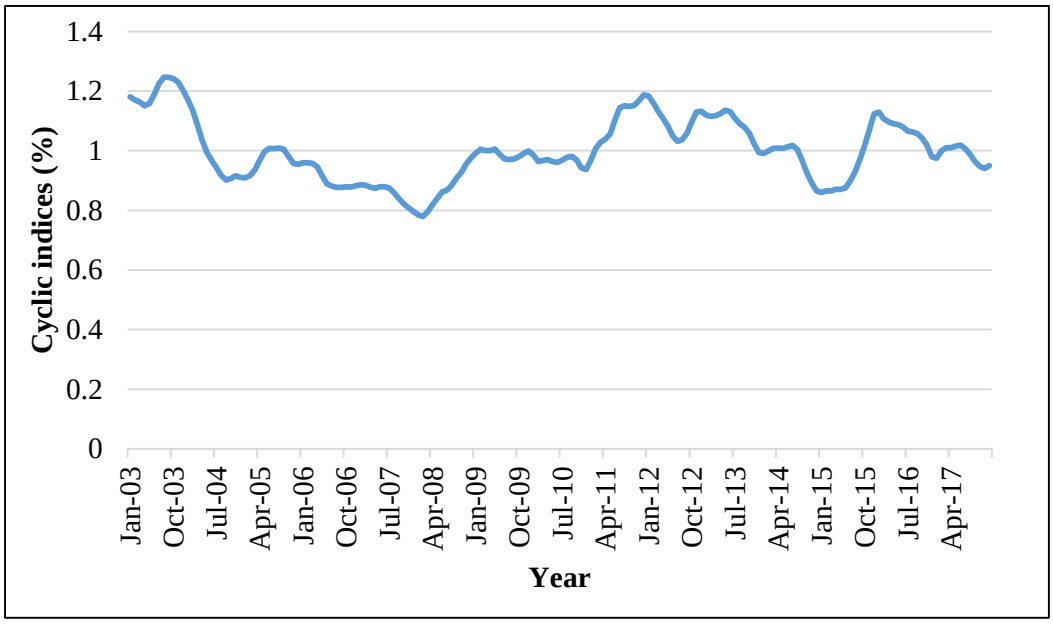

Fig. 4.16 Cyclical variation in Nendran banana prices in Ernakulam

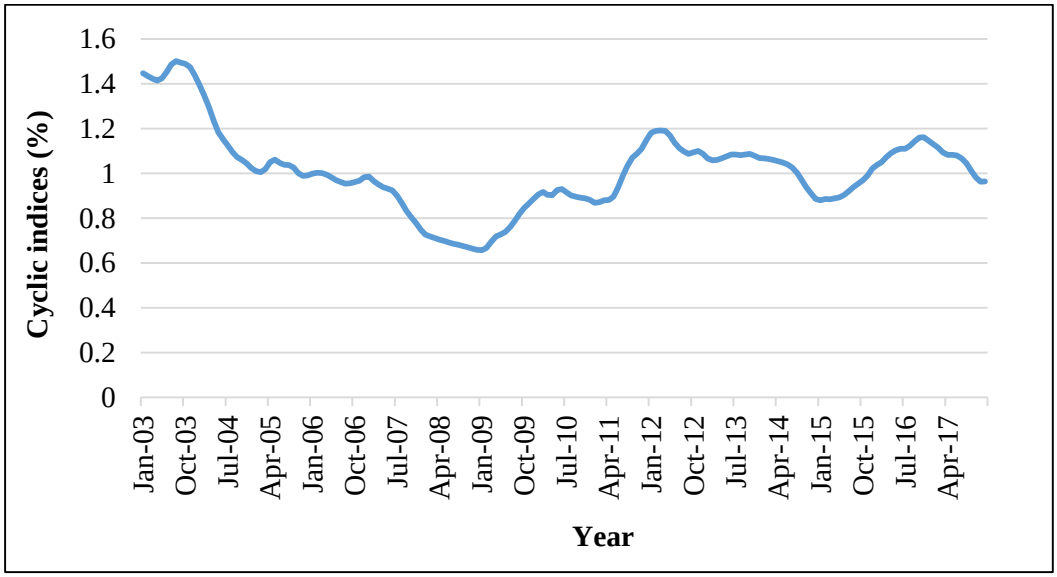

Fig. 4.17 Cyclical variation in Nendran banana prices inThiruvananthapuram

4.6.4 Irregular variations

Irregular variations in the prices of Nendran banana occurred owing to numerous non-recurring and irregular circumstances which are beyond human control. Fig. 4.18 to 4.20 represents the irregular variations in the prices of Nendran banana in Kozhikode, Ernakulam, and Thiruvananthapuram markets. It was observed that the irregular variations were highly unpredictable and did not follow any uniform pattern over the period.

The above results are comparable with the results of studies by Godara and Bhonde (2010). Irregular variations can be expected in banana prices as it is characterised by bulkiness, perishability, and short shelf life. Moreover, banana being a small holder's crop, producer sells it immediately after harvest at the prevailing market price.

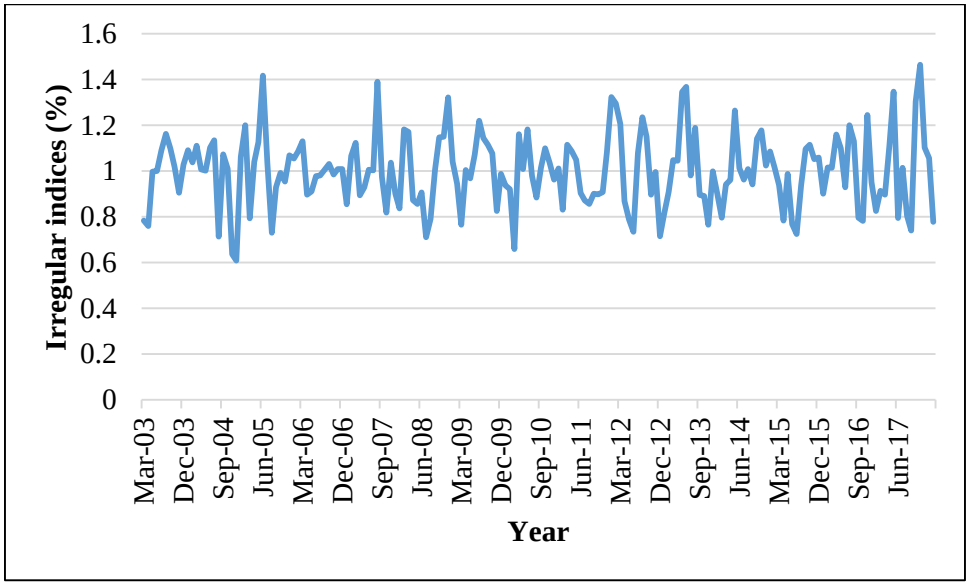

Fig. 4.18 Irregular variationof Nendran banana prices in Kozhikode

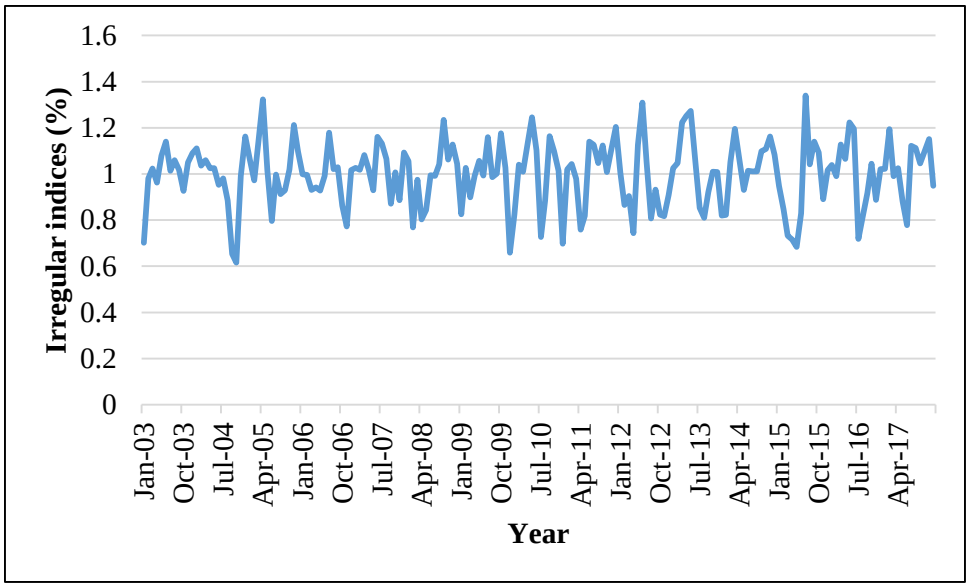

Fig. 4.19 Irregular variationof Nendran banana prices in Ernakulam

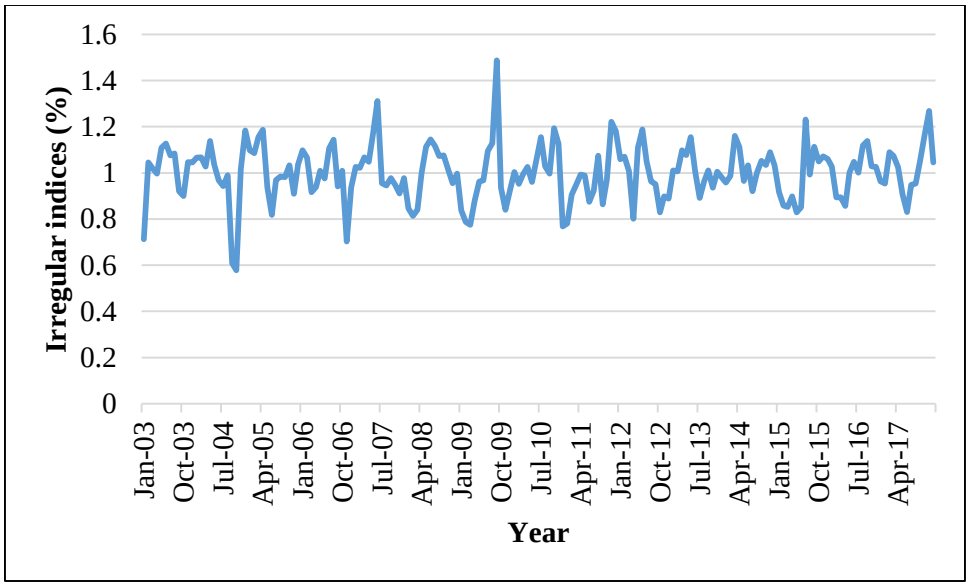

Fig. 4.20 Irregular variation of Nendran banana prices in Thiruvananthapuram

To sum up, secular trend, seasonal variation, cyclical variation and irregular variation were observed in Nendran banana prices. The pattern of seasonality was similar in all the three markets, the peak price was observed in August because of the Onam festival in Kerala and the associated hike in the demand for chips making.

4.4 Market integration and price transmission

4.4.1 Cointegration analysis using monthly prices

The concept of market integration explains the relationship between the prices in two or more markets that are spatially separated. In the present study, the nature and extent of price transmission between the three markets, Kozhikode, Ernakulam, and Thiruvananthapuram for banana prices was analysed using both pair-wise and multiple cointegration frame works. Cointegration is regarded as the empirical counterpart of the theoretical notion of a long run relationship between two or more variables. Before attempting cointegration tests, Augmented Dickey Fuller (ADF) test was employed to confirm stationarity of the data and also that the prices were integrated of the same order. A time series exhibits stationarity if the underlying generating process is based on a constant mean or a constant variance. All the price series were transformed into natural logarithms before testing for stationarity as well as cointegration. The estimated test statistics from ADF tests for Nendran banana prices in all the markets at levels and first difference are presented in Table 4.4. The null hypothesis of non-stationarity for banana prices in the markets could be rejected after first differencing.

Cointegration analysis was carried out for the price series which were of the same order of integration. The results of pair-wise cointegration tests between prices of banana are furnished in Table 4.5. The null hypothesis of no cointegration ($r = 0$) was rejected for all the three market pairs *viz*, Kozhikode and Ernakulam market, Ernakulam and Thiruvananthapuram markets, and Thiruvananthapuram and Kozhikode markets. The null hypothesis of presence of cointegration ($r \leq 1$) was confirmed. As a result, it could be observed from Table 4.5 that one cointegration

relationship exists between all the market pairs at 5 per cent level of significance with critical value for r = 0 and r $\leq$ 1 as 15.49 and 3.84 respectively.

As the three market prices were integrated of the same order, the test for cointegration among multiple markets was attempted using the Maximum Likelihood Estimation procedure (Johansen and Juselius, 1990) as it provides most efficient estimate of the cointegrating vectors and also identifies the number of cointegrating relationship among the non-stationary variables. The multivariate cointegration tests for three markets (Table 4.6) confirmed that the null hypothesis of no cointegration (r = 0), could be rejected at five per cent level of significance. But the null hypothesis of r $\leq$ 2 was accepted confirming that there are two or less than two cointegrating vectors among the three markets. This can be indicative of the stable long run relationship between the markets.

Table 4.4 Results of Augmented Dickey Fuller tests for monthly prices

	Market	t-statistic
Levels	**Kozhikode**	-1.50
	Ernakulam	-4.77
	Thiruvananthapuram	-1.88
First difference	**Kozhikode**	-7.34**
	Ernakulam	-15.42*
	Thiruvananthapuram	-10.98**

Notes: * Denotes significance at 5 per cent level

** Denotes significance at 1 per cent level

Table 4.5 Results of pairwise cointegration tests between

Markets	Eigen value	Null hypothesis	Trace statistics
Ernakulam and Kozhikode	0.099	r =0	21.44
	0.011	r ≤1	2.09
Thiruvananthapuram and Ernakulam	0.184	r =0	41.89
	0.017	r ≤1	3.35
Kozhikode and Thiruvananthapuram	0.201	r =0	45.98
	0.018	r ≤1	3.38

Note: Critical value for r = 0 is 15.49 and r ≤ 1 is 3.84 at five per cent level

The results revealed that in case of banana prices, all the three market pairs *viz*, Kozhikode and Ernakulam market, Ernakulam and Thiruvananthapuram markets, and Thiruvananthapuram and Kozhikode markets were integrated with each other over space indicating that the variation in prices in one market influences the prices of the other. This is due to the similarity in the arrival pattern of the markets. It can also be stated that banana farmers were earning similar prices at a particular point of time and market intervention or policy in any market would impact the banana price in other markets. The multivariate cointegration tests for three markets showed that there are two or less than two cointegrating vectors among the three markets. As the number of co-integrating vectors is an important indicator of co-movement of the prices, it can be proved that there is strong and stable price linkages between the markets. The above findings are similar with the results of Reddy *et al.*, (2012) which proved the existence of strong cointegration between major banana markets of India.

Table 4.6 Results of multiple cointegration tests between prices of banana

Markets	Eigen value	Null hypothesis	Trace statistics
Ernakulam, Kozhikode, and Thiruvananthapuram	0.361	r = 0	124.89
	0.174	r ≤ 1	9.66
	0.018	r ≤ 2	3.38

Note: Critical value for r = 0 is 29.79, r ≤ 1 is 15.49, and r ≤ 2 is 3.84 at five per cent level

4.4.2 Direction of price transmission - Granger Causality Tests

The cointegration analysis proved that the banana prices moved together and there is transmission of price signals between Kozhikode, Ernakulam, and Thiruvanathapuram markets and that there is causality at least in one direction. But it does not provide information regarding the direction of flow of information on prices, *i.e*. whether it is in one direction or in both directions. The Granger causality tests provide additional evidence as to whether and in which direction, price transmission is occurring. The results of Granger causality tests are shown in table 4.7.

The tests carried out on monthly prices proved that Kozhikode market caused the market prices of banana in Ernakulam, suggesting unidirectional causality from Kozhikode market to Ernakulam market and not from Ernakulam market to Kozhikode market. Here, the null hypothesis that Kozhikode does not Granger cause Ernakulam market was rejected at one per cent level of significance. Similarly Thiruvananthapuram market was proved to be influencing both Kozhikode and Ernakulam markets at one per cent level of significance.

Table 4.7 Results of the Granger causality tests for monthly prices of banana

Null hypothesis	F statistic	Probability
Kozhikode does not Granger Cause Ernakulam	59.46**	0.00
Ernakulam does not Granger Cause Kozhikode	7.5	0.01
Thiruvananthapuram does not Granger Cause Kozhikode	36.9**	0.00
Kozhikode does not Granger Cause Thiruvananthapuram	1.9	0.17
Thiruvananthapuram does not Granger Cause Ernakulam	59.91**	0.00
Ernakulam does not Granger Cause Thiruvananthapuram	0.11	0.74

Note: ** Denotes significant at one per cent level

The results of the analyses proved the existence of unidirectional causality between Kozhikode and Ernakulam, Thiruvananthapuram and Kozhikode, and Thiruvananthapuram and Ernakulam market prices. Bidirectional causality was absent among the selected markets. Thiruvananthapuram market was the price determining market for both Kozhikode and Ernakulam markets. The prices in Thiruvananthapuram market was found to be influencing prices of other two markets because it was having the maximum quantity of arrivals among the markets studied.

4.5 Relationship between arrivals and prices of banana

The relationship between the monthly prices and average quantity of arrivals of banana to the major VFPCK markets *viz.*, Kozhikode, Ernakulam, and Thiruvananthapuram were studied for the period from January 2012 to December 2018.

4.1.5 Correlation co-efficient between arrivals and prices of banana

Correlation co-efficient between monthly market arrivals and prices of banana was computed to evaluate the pattern of association between them. The results are presented in the Table 4.8. In all the three markets, the prices and quantity of arrivals were found to be significant and negatively correlated as indicated by the negative correlation coefficients.

The correlation coefficients were -0.34, -0.22, and -0.51 respectively for Kozhikode, Ernakulam, and Thiruvanathapuram markets. The results implied that prices decreased with increase in arrival of banana leading to a fall in farmer's income. The results were similar to the findings of Chavan *et al.* (2009) who observed that when the major portion of the produce reached the markets during peak season, the prices generally fell.

Table 4.8 Correlation between arrivals and prices of banana

	Correlation coefficient	**Arrival**	**Price**	**Probability**
Kozhikode	Arrival	1	-0.343**	0.003
	Price	-0.343	1	
Ernakulam	Arrival	1	-0.225**	0.002
	Price	-0.225	1	
Thiruvananthapuram	Arrival	1	-0.514*	0.01
	Price	-0.514	1	

** Denotes significant at one per cent level

* Denotes significant at five per cent level

4.1.6 Variation in arrivals and prices of banana

The instability in arrivals and prices of banana were studied by computing the Co-efficient of Variations. The results of variations in arrivals and prices are presented in Table 4.9. The Co-efficient of Variations were higher for arrivals than prices for Kozhikode and Ernakulam markets. Maximum variability in arrivals was found in Ernakulam market (42.52 per cent) due to the seasonal pattern in the arrivals to the market. Maximum variability in prices was found in Thiruvananthapuram market (24.41 per cent) among the selected markets. Higher the coefficient of variation, lesser is the uniformity and stability. Hence, among the three markets, prices were found to be more stable in Kozhikode market and arrivals were steadier in Thiruvananthapuram market.

Table 4.9 Coefficient of variation for arrivals and prices of banana

Market		C.V (%)
Kozhikode	Arrivals	24.41
	Prices	17.66
Ernakulam	Arrivals	42.52
	Prices	20.56
Thiruvananthapuram	Arrivals	18.12
	Prices	24.41

4.6 Volatility of prices

4.6.1. Intra-annual volatility

Intra-annual volatility measures the dispersion of prices within a year. Monthly prices of Nendran banana during the period from 2003 to 2018 in three different

markets *viz*., Kozhikode, Ernakulam, and Thiruvanathapuram were used for the intra-annual volatility analysis. The intra-annual volatility indices are presented in Table 4.10. It could be observed from the table that the intra-annual volatility of monthly prices of banana was varying irregularly and showed no distinct pattern in all the three markets. The intra-annual volatility in Thiruvananthapuram and Ernakulam markets were found to be more erratic when compared to that of Kozhikode market which was having narrow variations. This is clear from the intra-annual volatility indices of Nendran banana plotted in Fig. 4.21.

Intra-annual volatility in prices shows the instability of returns gained by the producers within a year. Higher the intra-annual volatility, the more deviated the prices will be from an average, indicating an unsteady pattern in the price obtained by the farmers. The Intra-annual volatility thus leads to the uncertainty in the planting decisions of the farmers. The higher the intra annual volatility, the more difficult the optimal planting choice will be.

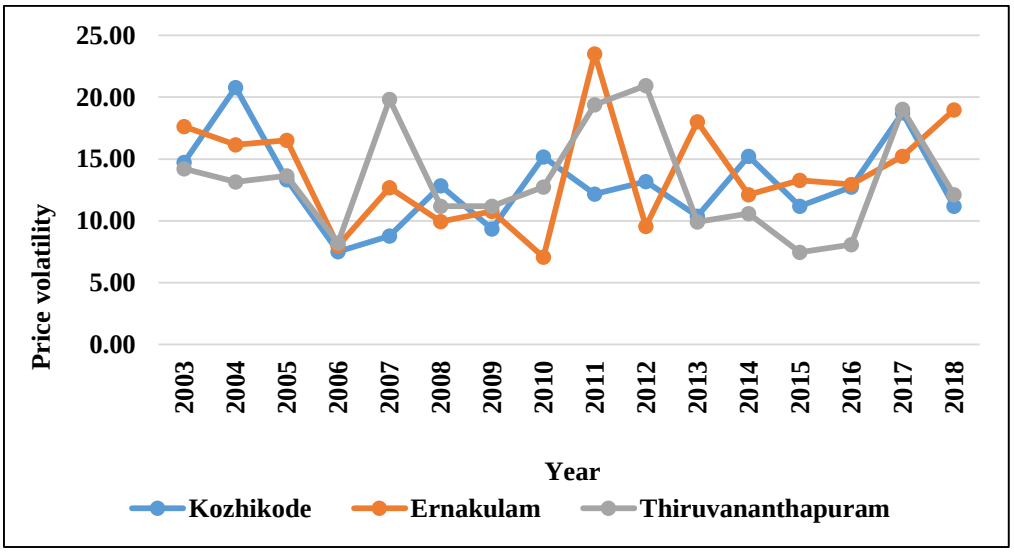

Fig. 4.21 Intra-annual volatility of monthly banana prices (in per cent) in different markets

Table 4.10 Intra-annual volatility of monthly banana prices (in per cent) in different markets

Year	Kozhikode	Ernakulam	Thiruvananthapuram
2003	14.74	17.64	14.21
2004	20.77	16.16	13.14
2005	13.34	16.50	13.65
2006	7.50	7.98	8.22
2007	8.79	12.70	19.82
2008	12.83	9.95	11.18
2009	9.36	10.76	11.18
2010	15.16	7.07	12.75
2011	12.18	23.51	19.40
2012	13.19	9.55	20.94
2013	10.38	18.00	9.91
2014	15.23	12.11	10.60
2015	11.17	13.29	7.47
2016	12.73	12.95	8.08
2017	18.74	15.21	19.03
2018	11.19	18.98	12.11

4.6.2 Inter-annual volatility

The inter-annual volatility measures the dispersion of banana prices between two successive years. Monthly prices of Nendran banana during 2003 to 2018 in three different markets viz., Kozhikode, Ernakulam, and Thiruvanathapuram were used for inter-annual volatility analysis. The inter-annual volatility indices are presented in Table 4.11. It could be observed from the table that even though the inter-annual volatility of monthly prices of banana was varying irregularly, it showed a declining pattern in all the three markets.

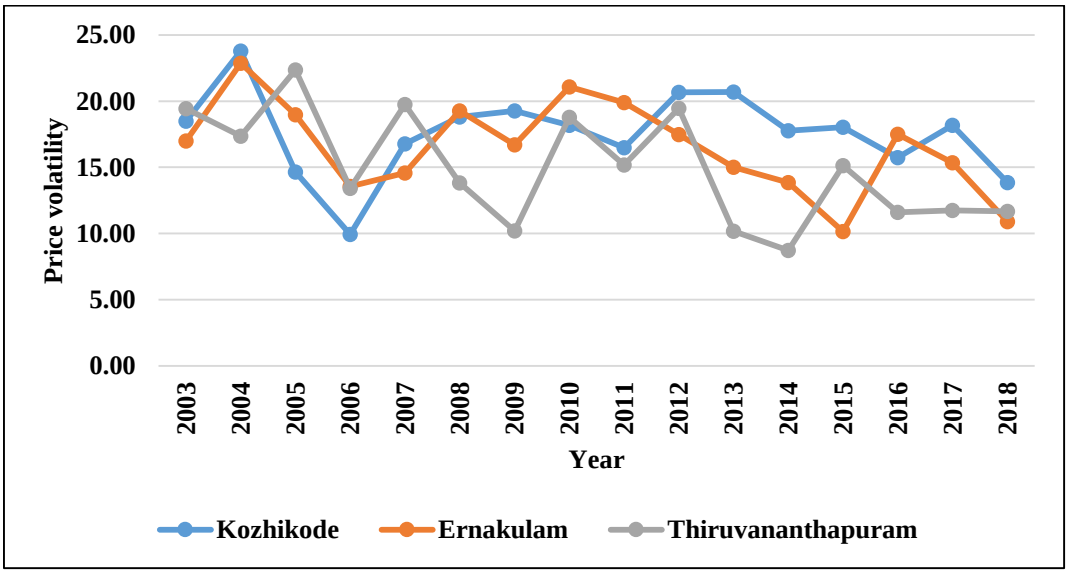

Fig. 4.22 Inter-annual volatility of monthly banana prices (in per cent) in different markets

Table 4.11 Inter-annual volatility of monthly banana prices (in per cent) in different markets

Year	Kozhikode	Ernakulam	Thiruvananthapuram
2003	18.50	16.99	19.44
2004	23.80	22.88	17.35
2005	14.64	18.97	22.36
2006	9.94	13.55	13.43
2007	16.78	14.58	19.75
2008	18.81	19.28	13.82
2009	19.27	16.70	10.19
2010	18.18	21.07	18.78
2011	16.48	19.89	15.18
2012	20.66	17.47	19.46
2013	20.70	15.02	10.18
2014	17.77	13.84	8.73
2015	18.03	10.15	15.13
2016	15.74	17.50	11.59
2017	18.18	15.35	11.74
2018	13.84	10.90	11.68

It is evident from the inter-annual volatility indices of Nendran banana plotted in Fig. 4.21 that the volatility indices for prices of different markets moved closely. Towards the end of the period, the divergence between the prices of different markets was found to be narrow. The magnitude of between the year price fluctuations was found to be decreasing from 2003 to 2018. This was because of the market intervention and strengthening of VFPCK which enabled direct sale of farm exclusion of intermediaries from the marketing channel. Volatility was persisting throughout the period because of the distinct seasonal behaviour of banana.

4.6.3 Volatility of annual prices

4.6.3.1. Cuddy-Della Valle Instability index

The results of the instability in annual prices measured using Cuddy-Della Vale Instability index is presented in Table 4.12. Among the three selected markets, instability was the highest in Thiruvananthapuram market and lowest in Ernakulam market.

4.6.3.2. Instability Index derived from exponential trend

The price volatility of banana estimated as the percentage deviation of the price from its exponential trend level is presented in Table 4.12. Among the three selected markets, instability was the highest Thiruvananthapuram market and lowest in Kozhikode market.

4.6.3.3. Coppock's Instability index

The results of the instability in annual prices measured using Coppock's Instability index is presented in Table 4.12. Among the three selected markets, instability was the highest in Thiruvananthapuram market and lowest in Kozhikode market.

Table 4.12. Instability indices of prices

Market	Instability indices		
	Cuddy-Della Valle Index	Index derived from exponential trend	Coppock's Instability Index
Kozhikode	24.01	19.06	27.07
Ernakulam	20.56	16.07	27.10
Thiruvananthapuram	24.67	19.31	27.13

4.7 Socio-economic profile of the sample farmers

The distribution of sample respondents with respect to age, gender, family size, education, occupation, land holding, annual income and experience in farming is presented below. This section gives an idea about the background information of these respondents and provides a better understanding of the farms as well as the rural farming scenario.

4.7.1 Age

The results as presented in Table 4.13 reveals that majority of the Nendran banana farmers come under the age group of 40 to 60 years (48.75 per cent) and around 26 per cent of them are above 60 years. Only 25 per cent of farmers fall under the category of 20 to 40 years which suggests the indifference of the youngsters to this sector. The decrease in the participation of youth in the sector poses a grave threat to the future of banana cultivation in the state.

4.7.2 Gender

The gender-wise distribution of sample respondents as shown in Table 4.14 reveals that out of 80 the farmers, majority were males (86.25 per cent) and only eleven respondents (13.75 per cent) were females.

Table 4.13 Age-wise distribution of sample respondents

Age	Nemom	Parassala	Thiruvananthapuram
20-40	12 (30.00)	8 (20.00)	20 (25.00)
40-60	18 (45.00)	21 (52.50)	39 (48.75)
>60	10 (25.00)	11 (27.50)	21 (26.25)
total	40 (100.00)	40 (100.00)	80 (100)

Note: Figures in parentheses indicate per cent to column total

Table 4.14 Gender-wise distribution of sample respondents

Gender	Nemom	Parassala	Thiruvananthapuram
Female	5 (12.50)	6 (15.00)	11 (13.75)
Male	35 (87.50)	34 (85.00)	69 (86.25)
Total	40 (100.00)	40 (100.00)	80 (100.00)

Note: Figures in parentheses indicate per cent to column total

4.7.3 Family size

The distribution of sample respondents according to their family size is presented in Table 4.15. The respondents were categorized into three groups *viz*, family consisting of one to three members, four to six members and more than six members. It could be observed from the table that 65 per cent of the farmers came under the category of 4 to 6 members and 26.25 per cent was under the category of 1 to 3 members. Around 9 per cent of the families consisted of more than six members. The availability of labour for farm operations is supposed to increase in accordance with the number of family members.

Table 4.15 Distribution of sample respondents based on family size

Family size	Nemom	Parassala	Thiruvananthapuram
1-3	9 (22.50)	12 (30.00)	21 (26.25)
4-6	27(67.50)	25(62.50)	52 (65.00)
>6	4 (10.00)	3 (7.50)	7 (8.75)
Total	40 (100.00)	40 (100.00)	80 (100.00)

Note: Figures in parentheses indicate per cent to column total

4.7.4 Education

It is imperative to know about the educational status of sample respondents in order to determine the efficiency in any field of activity. Table 4.16 indicates the distribution of farmers according to their educational status. It was observed that 26.25 per cent had secondary education, 23.75 per cent had primary education, 22.50 per cent had pre-degree education, 10 per cent are graduates and diploma holders and post graduates consist of 8.75 per cent each.

Table 4.16 Distribution of sample respondents based on educational status

Education	Nemom	Parassala	Thiruvananthapuram
Primary	10 (25.00)	9 (22.50)	19 (23.75)
Secondary	13 (32.50)	8 (20.00)	21 (26.25)
Pre degree	8 (20.00)	10 (25.00)	18 (22.50)
Graduate	3 (7.50)	5 (12.50)	8 (10.00)
Diploma	2 (5.00)	5 (12.50)	7 (8.75)
Post graduate	4 (10.00)	3 (7.50)	7 (8.75)
Total	40 (100.00)	40 (100.00)	80 (100.00)

Note: Figures in parentheses indicate per cent to column total

4.7.5 Occupation of respondents

The distribution of sample respondents based on their occupation is given in Table 4.17. It is evident from the table that 65 per cent of the farmers were dependent on agriculture and allied sectors as their main source of income. Only 15 per cent of the farmers were self-employed and 20 per cent were working in public sector.

Table 4.17 Distribution of sample respondents based on their occupation

Block	Nemom	Parassala	Thiruvananthapuram
Agriculture	30 (75.00)	22 (55.00)	52 (65.00)
Public sector	6 (15.00)	10 (25.00)	16 (20.00)
Self employed	4 (10.00)	8 (20.00)	12 (15.00)
Total	40 (100.00)	40 (100.00)	80 (100.00)

Note: Figures in parentheses indicate per cent to column total

4.7.6 Land holding pattern

Table 4.18 depicts the distribution of sample respondents according to the size of land holding. It was observed that 45 per cent were marginal farmers having less than one hectare and 35 per cent of farmers owned 1 to 2 hectares. Large sized land holders constituted 20 per cent, among whom 6.25 per cent possessed holding of more than 5 hectares and 13.75 per cent owned 2 to 5 hectares. The land holding pattern in both the blocks was similar with around 45 per cent having less than one hectare.

Table 4.18 Distribution of sample respondents according to size of land holding

Land holding	Nemom	Parassala	Thiruvananthapuram
<1 ha	17 (42.50)	19 (47.5)	36 (45.00)
1-2 ha	15 (37.50)	13 (32.50)	28 (35.00)
2-5 ha	6 (15.00)	5 (12.50)	11 (13.75)
>5 ha	2 (5.00)	3 (7.50)	5 (6.25)
total	40 (100.00)	40 (100.00)	80 (100.00)

Note: Figures in parentheses indicate per cent to column total

4.7.7 Annual income

The distribution of sample respondents based on their annual income is shown in Table 4.19. A comparison of the two blocks revealed that 17.5 per cent of respondents in Nemom block and 20 per cent in Parassala block had income between ₹ 75000 and 1 lakh. It was also found that sample banana farmers with a high income of above one lakh were more in Nemom block (77.5 per cent) as compared to Parassala block (72.5 per cent).

Table 4.19 Distribution of sample respondents based on their annual income

Annual income	Nemom	Parassala	Thiruvananthapuram
<75000	2 (5.00)	3 (7.50)	5 (6.25)
75000-1 lakh	7 (17.50)	8 (20.00)	15 (18.75)
1 lakh-2 lakh	17 (42.50)	13 (32.50)	30 (37.50)
>2 lakh	14 (35.00)	16 (40.00)	30 (37.50
Total	40 (100.00)	40 (100.00)	80 (100.00)

Note: Figures in parentheses indicate per cent to column total

4.7.8 Experience in farming

The distribution of farmers based on their experience in farming is presented in Table 4.20. The farmers were divided into four categories as having experience upto 10 years, 10 to 20 years, 20 to 30 years and more than 30 years of experience. It could be noted from the table that 45 per cent of the farmers were having 20 to 30 years of experience in banana farming and around 19 per cent have an experience of more than 30 years.

It is clear from the table that, the banana farming was well established in the study area and the farmers were well experienced and this could have contributed towards the higher productivity of banana in the study area.

Table 4.20 Distribution of sample respondents based on their experience

Experience	Nemom	Parassala	Thiruvananthapuram
<10	5 (12.50)	4 (10.00)	9 (11.25)
10-20	11 (27.50)	9 (22.50)	20 (25.00)
20-30	16 (40.00)	20 (50.00)	36 (45.00)
>30	8 (20.00)	7 (17.50)	15 (18.75)
Total	40 (100.00)	40 (100.00)	80 (100.00)

Note: Figures in parentheses indicate per cent to column total

4.8 Constraints in pricing and marketing of banana

An attempt was made in the study to identify the constraints in pricing and marketing of banana faced by the sample farmers by incorporating specific questions in the interview schedule. The responses have been analysed using Garrett's ranking technique and the results are presented in Table 4.21.

The result revealed that the major constraints faced by the respondent farmers was the fluctuations in the prices. It was challenging for most of the farmers to remain in this field because of uncertainty and price instability. The perishability, less storage period and bulkiness leading to the difficulty in handling and transport result in non-uniform prices. This was in conformity with findings of Nagargoje (2000) that, fluctuation in prices is one among the major lacunae of banana industry. High labour and transportation costs were also important constraints faced by the farmers due to which they had to sell their produce at farm gate price rather than going to distant markets.

Table 4.21 Constraints faced by banana farmers

Constraints	Score value	Rank
Fluctuation in price	66.81	1
High labour and transportation charges	65.70	2
Unavailability of institutional credit	51.30	3
Lack of reasonable support price	49.63	4
Lack of reliable information about prices	49.21	5
Low quality of produce	41.16	6
Inadequate contact with middlemen or buyers	38.49	7
Delayed payment	38.38	8

Lack of timely availability of institutional credit was another threat posed to the farmers which lead to delay of intercultural operations and other difficulties. Along with this, the absence of necessary support price was another constraint which makes banana production less attractive. There was also unavailability of market information from reliable sources which made it difficult for the farmers to plan the production and marketing. These results were similar to that of Ranchhodbhai (2015) who opined that lack of information on prices resulted in low decision making ability of farmers. Low quality of produce caused by pest and disease incidence was yet another constraint. This prevented farmers from obtaining premium price for the bananas. Delayed payment for the produce from the market and societies were also among the noted constraints. This was similar to the findings of Kumar *et al.* (2015) who reported delay in payment from the intermediaries as an issue in the banana cultivation.

Summary and Conclusions

5. SUMMARY AND CONCLUSIONS

Banana (Musa sp.) is the second most important fruit crop in India next to mango. It ranks first in production and third in area among fruit crops. Nendran is one of the most important commercial varieties of banana grown in Kerala, occupying about 50 per cent of the total area under banana. Wide fluctuations have been observed in the price of Nendran, resulting in income variability of farmers. Information on market variability and integration will help farmers in adjusting their production in such a way, that they could sell their produce at a time when the prices are reasonably high in the market.

The commodity price trends and volatility affect the incidence of poverty through its impact on employment opportunities and earnings of producers. Higher price volatility means higher costs of managing risks which would eventually translate into higher consumer prices. Stable price and adequate marketing facilities are essential for the development of agriculture and nendran farmers are facing difficulties awing to the incessant variation in prices as well as the arrivals in markets.In this background, the present study entitled 'Price behaviour of Nendran banana in Kerala: An economic analysis' was conducted. The objectives of the study were to analyze the time series properties of prices of Nendran banana, integration between prices in different markets in Kerala, ascertain the volatility in prices, evaluate the relationship between market arrivals and wholesale prices and determine the major constraints with regard to pricing and marketing.

The study was based on secondary data. The time series data on area, production and productivity of banana in India and of Nendran banana in Kerala from 1980 to 2018 were collected from various issues of Agricultural Statistics and Statistics for Planning published by the Directorate of Economics and Statistics, Thiruvananthapuram and website of National Horticultural Board and indiastat.com. The time series data on monthly prices of Nendran banana for the years 2003-2018

were collected from website of Directorate of Marketing & Inspection, National Informatics Centre and AGMARKNET. The monthly data of arrivals and prices of Nendran banana in major domestic markets of Kerala pertaining to the years 2012 to 2018 were collected from the selected Vegetable and fruit promotion council Kerala (VFPCK) markets of the districts such as Thiruvananthapuram, Ernakulam, and Kozhikode. The main items of observation such as socio-economic features of the sample farmers and constraints in pricing and marketing were collected from the selected farmers.

Trend analyses of the growth in area, production and productivity of banana at national level from 1980-81 to 2017-18 showed a significant growth. The Compound Annual Growth Rates for area (3.24per cent), production (5.86per cent), and productivity (2.53 per cent) were significant and positive. The area and production in Kerala showed an increasing trend but the productivity was found declining over years. This can be attributed to the decrease in efficiency of production due to improper input usage and lack of scientific management practices. Even with a Compound Annual Growth Rate of 4.83 per cent in area, the production increased only by 1.27 per cent due to the negative growth rate of -3.4 per cent in productivity per annum.

The price behaviour of Nendran banana in major markets of Kerala *viz*., Kozhikode, Ernakulam, and Thiruvananthapuram for a duration of 16 years (2003-2018) was analyzed by decomposing the monthly price data into four components such as secular trend, seasonal variation, cyclical variation and irregular variation assuming a multiplicative model. Prices in all the three markets showed increasing trend and exponential function was found to be the best fit model. The coefficient of determination were 81.5 per cent, 72.6 per cent and 82.4 per cent in the respective markets. The seasonal variation of Nendran banana price in the markets showed a similar pattern, with peak price in the month of August because of increased demand during Onam season. Price cycles with length varying from six to seven years were

noted in the market price. The irregular variations were highly unpredictable and did not follow any uniform pattern over the period.

Pairwise and multiple co-integration analysis of Nendran banana prices in the above markets were carried out after confirming the stationarity of price series using Augmented Dickey Fuller (ADF) test. The results showed that the markets were integrated, inferring the presence of price association among the markets indicating that banana prices are moving in a similar pattern. This was due to the similarity in the arrival of banana in the markets. In order to provide additional evidence as to whether and in which direction price transmission occurred, Granger causality test was carried out and the existence of unidirectional causality from Kozhikode market to Ernakulam market and from Thiruvananthapuram market to Kozhikode and Ernakulam markets was proved. Thiruvananthapuram market was concluded as the price leader awing to the highest quantity of market arrivals of Nendran banana.

Correlation co-efficient between monthly market arrivals and prices of Nendran banana in Kozhikode, Ernakulam, and Thiruvananthapuram markets from 2013 to 2018 was computed to evaluate the pattern of association between them. In all the three markets, the prices and quantity of arrivals were found to be negatively correlated with correlation coefficients -0.34, -0.22, and -0.51 respectively for Kozhikode, Ernakulam, and Thiruvanathapuram markets. This implied that prices decreased with increase in arrival of Nendran banana. The variability in Nendran banana arrivals and prices was studied computing the co-efficient of variation and maximum variability in arrivals was found in Ernakulam market (42.52 per cent) due to the seasonal pattern in the arrivals to the market. Maximum variability in prices was found in Thiruvananthapuram market (24.41 per cent).

Intra-annual volatility and inter-annual volatility of monthly prices of Nendran banana from 2003 to 2018 were estimated and the prices were found to be highly volatile. The intra-annual volatility showed no distinct pattern in all the three markets.

The magnitude of inter-annual volatility was decreasing throughout and the divergence between the volatility of prices were found to be decreasing towards the latter end. Instability in annual prices worked out using Cuddy-Della Valle Index, instability derived from exponential trend, and Coppock's instability index showed that prices in Thiruvananthapuram market were more volatile than other markets as it was influenced by prices in the markets of Tamil Nadu.

Major constraints identified in the study area were wide fluctuations in prices, high labour and transportation costs, unavailability of institutional credit and lack of reliable information about prices. Price fluctuations and volatility creates uncertainty in the planting and marketing decisions of the farmer. Unavailability of reliable price information makes marketing difficult and farmers become more vulnerable to price risk.

The following policy interventions are suggested based on the above findings of the study:

1. Information relevant to farmers such as prices and quantity of arrival should be collected and made available to farmers in time so as to aid in marketing as well as production decisions. Therefore capacity building in market intelligence of Nendran banana is necessary.
2. Price prediction helps the farmers and also government to make effective decisions regarding production and marketing. Therefore price forecasting of Nendran banana using appropriate techniques should be done.
3. Violent fluctuations were detected in Nendran banana prices which resulted in farmers being deprived of remunerative prices for their crop. Procurement by organizations such as Horticorp is existing for Nendran banana only during periods of excessive price fall therefore, price stabilization through year round procurement and strengthening of the existing scheme is to be carried out.

4. Existence of high volatility in Nendran prices were evident from the study. Therefore the introduction of minimum support price for banana is suggested, in order to safeguard the farmer from high price fluctuations and ensure remunerative income for their produce when the market price is lower than the cost incurred.
5. Expansion of market value can be done through processing of banana, Nendran being the most suitable variety for chips making, integration of processing unit with farm and product diversification can bring about stabilized income to the farmer.
6. In Kerala, the productivity of banana was found to be declining and stagnant over last few years. In order to tackle this problem productivity enhancement measures like adoption of scientific package of practices for nutrient supply, soil and water management and timely plant protection operations are necessary.

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Appendices

APPENDIX I

Survey questionnaire for farmers

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF HORTICULTURE, VELLANIKARA, THRISSUR

Department of Agricultural economics

Price behaviour of Nendran banana in Kerala: An economic analysis

Interview schedule

Survey questionnaire for farmers

District: Block: Panchayath:

1. Socio-economic details of the farmer:

1. Name of the respondent:

2. Age:

3. Gender:

4. Address:

5. Contact number:

6. Educational qualification:

Up to 9th ☐ SSLC ☐ Plus Two ☐

Degree ☐ Post graduation ☐ Diploma ☐

Specify (If any other)……

7. Income details:

- Annual income

<50,000	50000-1 lakh	1 lakh- 1.5 lakh	1.5 lakh- 2 lakh	>2 lakh
☐	☐	☐	☐	☐

- Source of income

Farming alone ☐

Farming+ Business ☐

Farming+ Government job ☐

Farming+ self employed ☐

Specify if any other……

2. Family details:

Sl No.	Name	Relation with respondent	Age	Education	Occupation

3. Land details:

Particulars	Owned land (ha)	Leased-in (ha)	Leased out (ha)	Total (ha)
Wetland				
Dry land				
Total				

4. Crop details:

Sl. No	Crop	Variety	Cropped area (ha)	Main product		By-product	
				Qty (kg)	Value (Rs.)	Qty (kg)	Value (Rs.)

5. Cost of cultivation:

No. of banana plants: Area:

Cost of cultivation:

Main product yield: price/bunch:

Byproduct yield: price/unit:

6. Details of marketing of banana:

Total quantity produced:

Quantity retained for family consumption:

Total marketed quantity:

Nearest primary market:

Distance:

Nearest wholesale maekert:

Distance:

Source of information on price:

Method of sale:

Sl. No	Method of sale	Quantity	Price/unit
1	Village trader		
2	Commission agent/brokers		
3	Primary/retail market		
4	Secondary/wholesale market		
5	Direct sale to consumers		
6	Other modes (specify)		

7. Expenditure:

Sl. No.	Particulars	Amount (Rs)	Remarks
1	Transport cost		
2	Loading and unloading charges		
3	Processing expenses		
4	Storage cost		
5	Brokerage		
6	Other expenses		

8. Constraints in pricing and marketing:

Sl. No	Problem	Occurrence of problem (yes/no)	Rank
	Delayed payment Fluctuation in price High labour and transportation charges Inadequate contact with middlemen or buyers Lack of reasonable support price Lack of reliable information about prices Low quality of produce Unavailability of institutional credit		

Suggestions:

:

:

PRICE BEHAVIOUR OF NENDRAN BANANA IN KERALA: AN ECONOMIC ANALYSIS

By

SHANA K. K.

(2017-11-045)

ABSTRACT OF THESIS

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Faculty of Agriculture

Kerala Agricultural University, Thrissur

DEPARTMENT OF AGRICULTURAL ECONOMICS

COLLEGE OF HORTICULTURE

VELLANIKKARA, THRISSUR – 680656

KERALA, INDIA

2019

Abstract

India is the leading producer of banana in the world with an annual production of 30 million tons from 0.8 million hectares (2017-18). Nendran is one of the most important commercial varieties of banana grown in Kerala, occupying about 50 per cent of the total area under banana. Wide fluctuations have been observed in the price of Nendran, resulting in income variability of farmers. Hence the present study has been carried out with the objectives of analysing the price behaviour and volatility in prices of Nendran banana in Kerala. The study was mainly based on secondary data collected from the major markets of Kozhikode, Ernakulam, and Thiruvananthapuram.

Trend analysis was carried out to understand the growth in area, production and productivity of banana both at national and state levels from 1980-81 to 2017-18. In India, the area, production and productivity of banana showed a significant growth. The area and production in Kerala showed an increasing trend but the productivity was found decreasing. Even with a growth in area of 4.83 per cent, the production increased only by 1.27 per cent due to the negative growth rate of -3.4 per cent in productivity per annum.

The price behaviour of Nendran banana in major markets of Kerala *viz*., Kozhikode, Ernakulam, and Thiruvananthapuram for a duration of 16 years (2003-2018) was analyzed by decomposing the monthly price data into four components such as secular trend, seasonal variation, cyclical variation and irregular variation assuming a multiplicative model. Prices in all the three markets showed increasing trend. The seasonal variation of Nendran banana price in the markets showed a similar pattern, with peak price in the month of August because of increased demand during Onam season. Price cycles with length varying from six to seven years were noted in the market price.

Pairwise and multiple co-integration analysis of Nendran banana prices in the above markets were carried out after confirming the stationarity of price series using Augmented Dickey Fuller (ADF) test. The results showed that the markets were integrated, inferring the presence of price association among the markets. In order to provide additional evidence as to whether and in which direction price transmission occurred, Granger causality test was carried out and the existence of unidirectional causality from Kozhikode market to Ernakulam market and from Thiruvananthapuram market to Kozhikode and Ernakulam markets was proved.

Correlation co-efficient between monthly market arrivals and prices of Nendran banana in Kozhikode, Ernakulam, and Thiruvananthapuram markets from 2013 to 2018 was computed to evaluate the pattern of association between them. In all the three markets, the prices and quantity of arrivals were found to be negatively correlated implying that prices decreased with increase in arrival of Nendran banana. The variability in Nendran banana arrivals and prices was studied computing the co-efficient of variation and maximum variability in arrivals was found in Ernakulam market (42.52 per cent) and maximum variability in prices was found in Thiruvananthapuram market (24.41 per cent).

Intra-annual volatility and inter-annual volatility of monthly prices of Nendran banana from 2003 to 2018 were estimated and the prices were found to be highly volatile. The intra-annual volatility showed no distinct pattern in all the three markets. The magnitude of inter-annual volatility was decreasing throughout and the divergence between the volatility of prices were found to be decreasing towards the latter end. Instability in annual prices worked out using suitable indices showed that prices in Thiruvananthapuram market were more volatile than other markets as it was influenced by prices in the markets of Tamil Nadu.

Major constraints identified in the study area were wide fluctuations in prices, high labour and transportation costs, unavailability of institutional credit and lack of reliable information about prices. Price fluctuations and volatility creates uncertainty in the planting and marketing decisions of the farmer. Unavailability of reliable price information makes marketing difficult and farmers become more vulnerable to price risk. Therefore, suitable strategies for developing market intelligence for Nendran banana including price forecasting and provision to farmers, price stabilization through year round procurement and introduction of support price were suggested as policy interventions.