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Price behaviour of coconut in major markets of Kerala: A time series analysis

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Abstract
Changes in the price behaviour of coconut in major markets of Kerala (Alappuzha and Kozhikode) were analysed for two periods *viz.*, Period I (from 1980-01 to 1995-96) and Period II (from 1996-97 to 2015-16) and the variations in price due to trend, cyclical, seasonal and irregular fluctuations were calculated. There was considerable and distinctly different seasonality in the price of coconut in Alappuzha and Kozhikode markets for both the periods. In spite of high fluctuations, coconut price in the long run had shown an increasing trend in both Alappuzha and Kozhikode markets for both the periods. It was observed that the seasonality and irregular variations in the price were more prominent in the primary commodity than the processed commodity like copra.

Keywords: price behaviour, coconut, secular trend, seasonal variation, cyclical variation

Introduction

Coconut (*Cocos nucifera* L.) is a plantation tree crop cultivated around the world. It exerts a profound influence on the rural economy of India by supporting the livelihoods of more than 10 million people in the country. It also contributes to the national agrarian economy with an annual contribution to the tune of ₹ 9000 crores to the GDP and foreign exchange earnings of about ₹ 1200 crores (Chowdappa and Jayasekhar, 2016) [4]. India has produced 22167 million nuts from an area of 2.09 million hectares with a productivity of 10614 nuts per hectare in the year 2015-16.

The country, at global level, stands third in world area and first in production with the share of 17 per cent and 31 per cent respectively (CDB, 2016). The area under coconut in the country had steadily gone up from 1.08 million hectare in 1980 to 2.09 million hectares in 2015-16 indicating an increasing trend in the long run (GOK, 2016). Among the major coconut growing states in India, Kerala, the "*land of coconuts*" has the longest history of coconut cultivation.

Stable price and adequate marketing facilities are essential for the development of agriculture. This is especially true for perennial crops like coconut which involves large investment and long gestation period. However, one of the most distressing features of the coconut economy of Kerala during the past two decades was the frequent fluctuations in the prices of coconut and coconut products which affect its future prospects. Therefore, besides improving productivity of coconut, remunerative and steady price also play a crucial role in increasing production. Moreover, coconut being a perennial crop which involves high investment when compared to seasonal and annual crops, price stability assumes more significance in motivating farmers to make investment in coconut cultivation. Hence a study was carried out to analyse the price behaviour of coconut in major markets of Kerala *viz.*, Alappuzha and Kozhikode. The year 1995 when World Trade Organization (WTO) came into existence was regarded as a turning point in the growth of Indian agriculture. Since 1995, when trade and tariff reforms were introduced, it has become one of the determining factors of price behaviour of coconut. As mentioned elsewhere, the study period was divided into two sub-periods, Period I (from 1980-01 to 1995-96) and Period II (from 1996-97 to 2015-16). In order to analyse the price behaviour, the monthly price data of coconut were decomposed into four components *viz.*, secular trend, seasonal variation, cyclical variation and irregular variation, assuming a multiplicative model of time series.

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Methodology
Analyses of price behaviour
Price behaviour of coconut was studied using the techniques of classical time series (Croxton *et al*., 1979; Spiegel, 1992) [6, 10]. It was analysed using a multiplicative model by which the time series data on price of coconut in major markets 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

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 coconut prices in the long run (1980 to 2015) in major markets of Kerala was studied by fitting suitable trend equations.
Models attempted were as follows,
Linear trend:
$Yt = a + bt$
Quadratic trend
$Yt = a + bt + ct^2$
Cubic trend
$Yt = a + bt + ct^2 + dt^3$
Exponential trend
$Yt = ab^t$

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

Estimation of cyclical variation
The oscillatory movements in a time series with a period of more than one year are referred as cyclical variations. Cyclic variations in the price of coconut in major markets of Kerala were studied using 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 is 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,

$$(T \times S \times C \times I)/ T = S \times C \times I$$

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.

$$(S \times C \times I) / S = C \times I$$

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.

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,

$$(C \times I) / C = I$$

Results & Discussion
Trend analyses of price of coconut
Trend is a general tendency of the data to increase or decrease over a long period of time. In order to understand the long run price behaviour of coconut, trend analysis was done separately for each of the product-market combination by applying the method of least squares. Different functional forms were attempted to explain the underlying trend in the price behaviour and the model having the highest R^2 value was taken as the best fit. The results showed that in the case of coconut price in Kozhikode market, power function was found to be the best fit model in Period I, while polynomial function was found to be suitable for prices in Alappuzha market in Period I, II and Period II in Kozhikode market (Fig. 1 to 4). The price of coconut showed an increasing trend in both the markets in the long run.
As explained already, in spite of high fluctuations, coconut price in the long run had shown an increasing trend in both Alappuzha and Kozhikode markets during Period I and II. The above results are in line with the findings of Haridoss and Chandran (1997) [8], Babu (2005) [2] and Babu *et al*. (2009) [3] who reported high fluctuations in coconut prices in major markets of Kerala.

Seasonal variations in the prices of coconut
Seasonal variations are the periodic and regular movements in a time series within a year (Croxton *et al*., 1979) [6]. Seasonality in the production of agricultural commodities is the main reason for price fluctuations. The seasonal variations in the prices of coconut during Period I and II were analysed using ratio to moving average method and the results are presented below.
The seasonal variations in the price of coconut in Period I and II as presented in Table 1 revealed that the peak price for coconut in the Alappuzha market during Period I was observed in December whereas, the trough in the price was observed in April. The period from October to March was found to be the buoyant phase and April to September was observed as the depressed phase (Fig. 5). During Period II, the buoyant phase was found to be from November to February

with peak price in December and the depression phase was observed from April to October with the trough being in July (Fig. 6).

In Kozhikode market, during Period I, an entirely different seasonal behaviour was observed for coconut prices. The buoyant phase was found to be from July to December with peak price in September. The depression phase was observed from March to June with the trough being in May (Fig. 5). During Period II, the peak price for coconut was found in February and the lowest price was found in October (Fig. 6).

The above results are in line with the findings of Babu and Sebastian (1996) [1], Babu *et al.* (2009) [3], and Indraji (2016) [9] who reported high fluctuations in coconut prices during the period from 1990-01 to 2015-16. Even though Alappuzha and Kozhikode markets were highly integrated, the seasonal behaviour of coconut prices in these markets was distinctly different. Presumably, it was due to the difference in the pattern of market arrival of coconut in both the markets. The market arrivals of Kozhikode market were from Malabar region whereas, that of Alappuzha market was from Southern parts of Kerala. The difference in harvesting pattern was found to be the main reason for this price behaviour. The farmers in northern Kerala harvest coconut less frequently, only three to four times as compared to the farmers in southern Kerala who harvest six to seven times a year.

The above results are in conformity with the findings of Babu (2005) [2] who reported that the highest and lowest prices for coconut showed different pattern in Alappuzha and Kozhikode markets. To summarise the discussion, there was considerable seasonality in the price of coconut in Alappuzha and Kozhikode markets in spite of the fact that coconut is a perennial crop and its production takes place round the year. As mentioned earlier, the seasonal behaviour of coconut in Alappuzha and Kozhikode market was distinctly different.

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 coconut and copra were worked out by averaging the cyclical-irregular data after eliminating the trend and seasonal variations from the original data. The cyclical indices of coconut for Alappuzha and Kozhikode markets for different periods are presented in Fig. 7 and 8. During Period I, four to five cycles were visible in coconut prices without a distinct cyclical pattern. In other

words, more than two cycles were observed in the case of coconut with the length of the cycle varying over time. Hence, wide fluctuation in the prices of coconut was observed in both the markets.

Cyclical variation of coconut prices during Period I was dissimilar in Alappuzha and Kozhikode markets. However, during period II, a similar pattern was observed in the case of coconut in these markets. It could be inferred from the above results that the prices of coconut showed highly pronounced cyclical variations during both the periods. But it was found that the marked similarity in the cyclical variations was observed not only among the two products but also among the different markets.

Irregular variations

Irregular variations in the prices of coconut occurred owing to numerous non-recurring and irregular circumstances which were beyond the human control. Fig. 9 to 12 represents the irregular variations in the prices of coconut during Period I and II separately. It was observed that the irregular variations in coconut prices were highly unpredictable and did not follow any uniform pattern over the period. The intensity of irregular variations was more visible in coconut prices but the dissimilarity in irregular variations in coconut prices among different markets was also observed. Highly irregular variations were expected in coconut prices as it is a primary produce characterised by bulkiness and short shelf life. Moreover, coconut being a small holder's crop, producer sells it immediately after harvest at prevailing market price.

Table 1: Seasonal indices for coconut price

| Month | Period I | | Period II | |
| | Coconut | | Coconut | |
	Alappuzha	Kozhikode	Alappuzha	Kozhikode
January	109.80	101.79	100.78	103.28
February	107.00	103.51	102.10	105.77
March	103.40	102.36	100.13	105.16
April	92.71	103.69	98.20	102.03
May	92.82	103.11	98.60	97.86
June	93.91	102.23	98.06	100.49
July	95.72	98.59	97.75	99.38
August	95.21	96.61	98.60	96.66
September	94.90	92.79	99.20	94.40
October	100.71	95.62	99.42	94.32
November	109.01	99.73	101.20	99.94
December	111.71	99.96	102.68	100.64
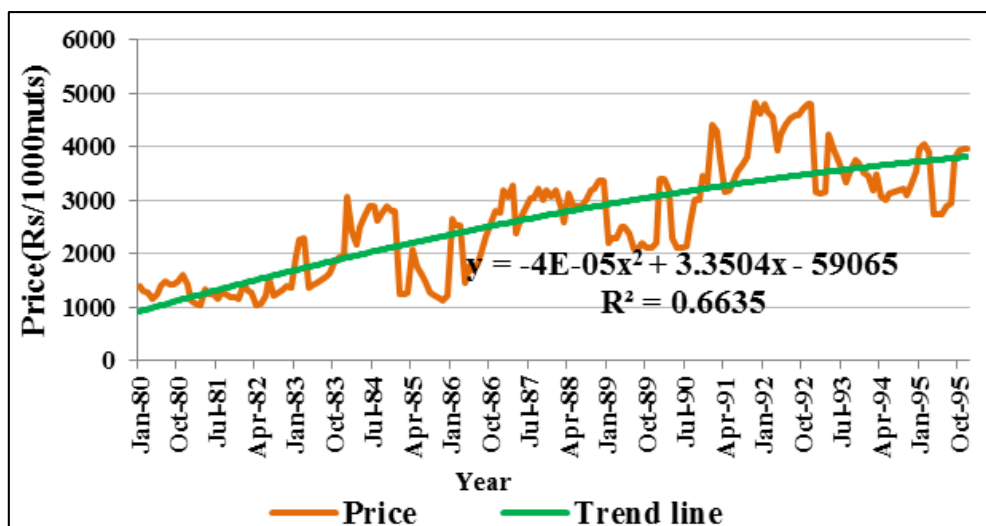
Fig 1: Trend in coconut prices in Alappuzha market - Period I
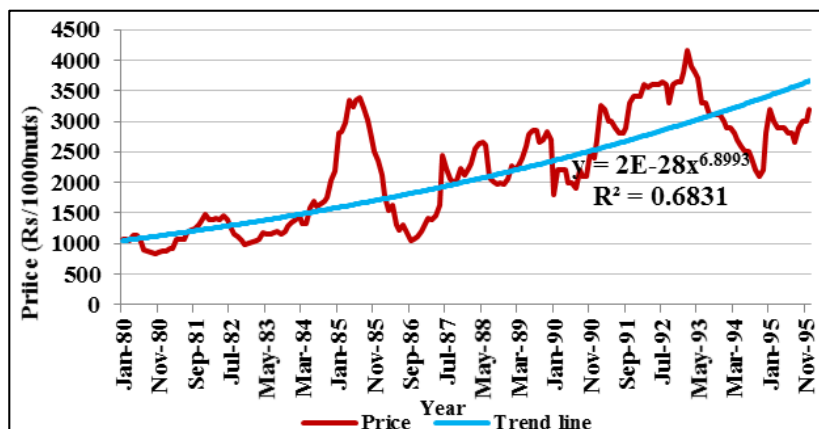
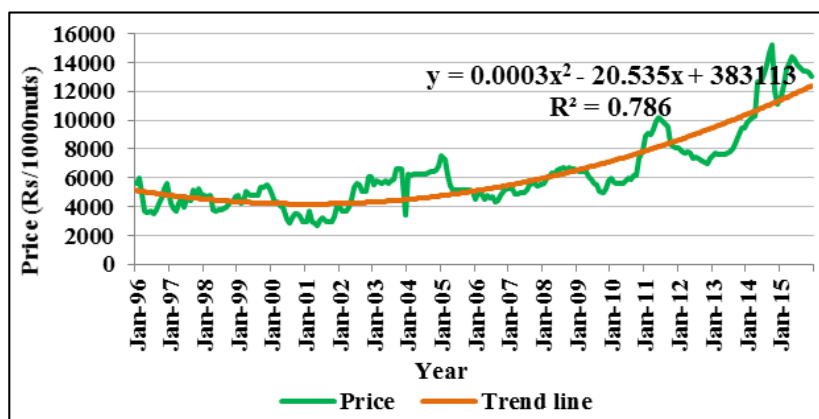**Fig 2:** Trend in coconut prices in Kozhikode market - Period I

Fig 3: Trend in coconut prices in Alappuzha market – Period II
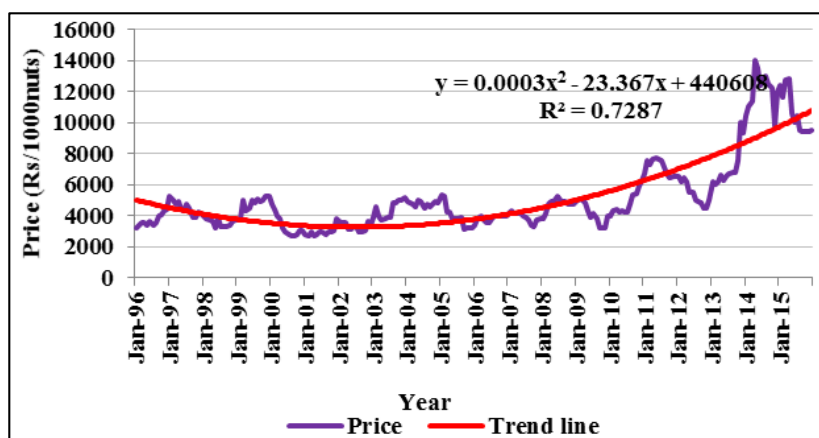

Fig 4: Trend in coconut prices in Kozhikode market – Period II
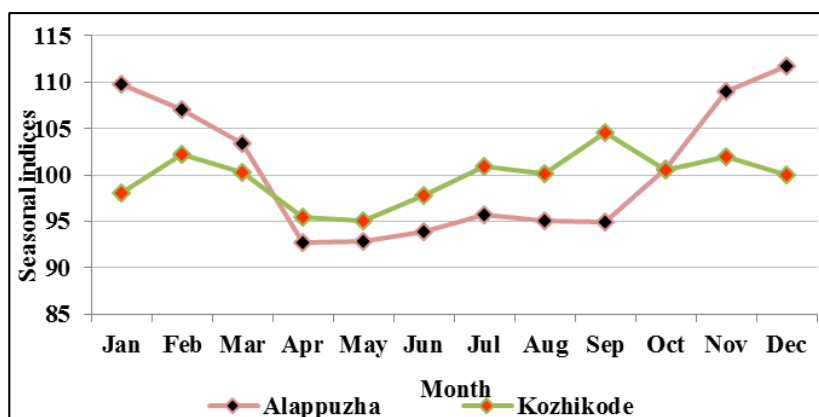

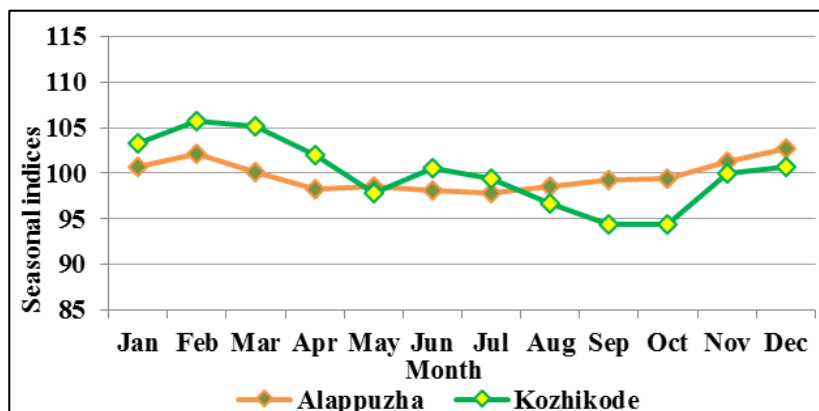**Fig 5:** Seasonal indices for coconut prices - Period I

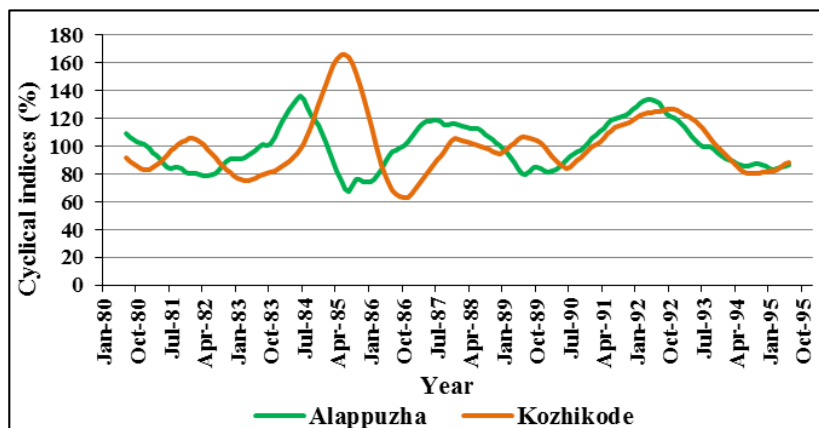**Fig 6:** Seasonal indices for coconut prices - Period II

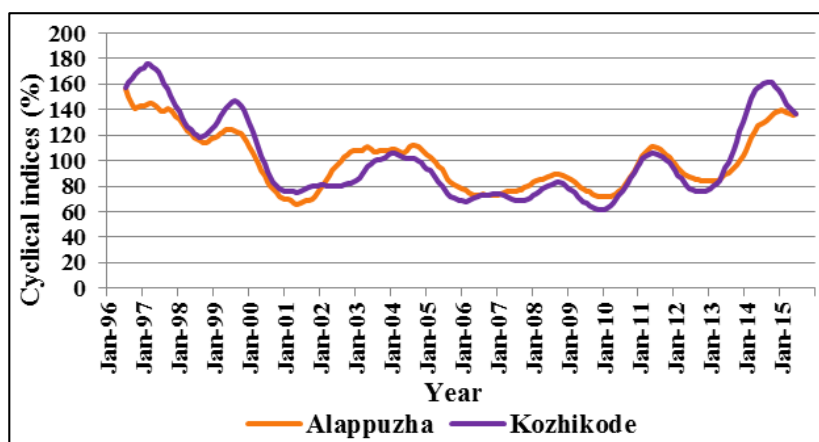**Fig 7:** Cyclical variation in coconut prices - Period I

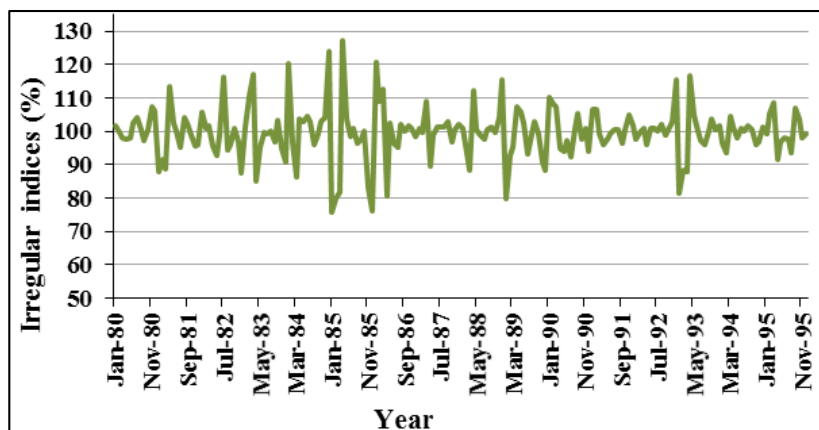**Fig 8:** Cyclical variation in coconut prices - Period II

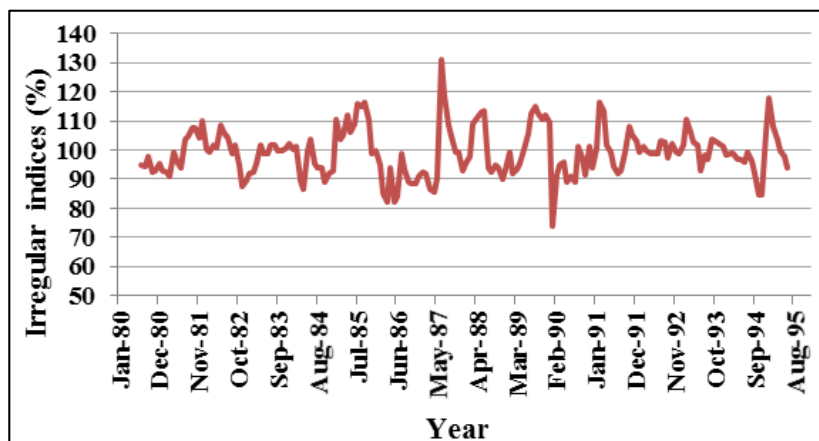**Fig 9:** Irregular indices for coconut prices in Alappuzha market - Period I

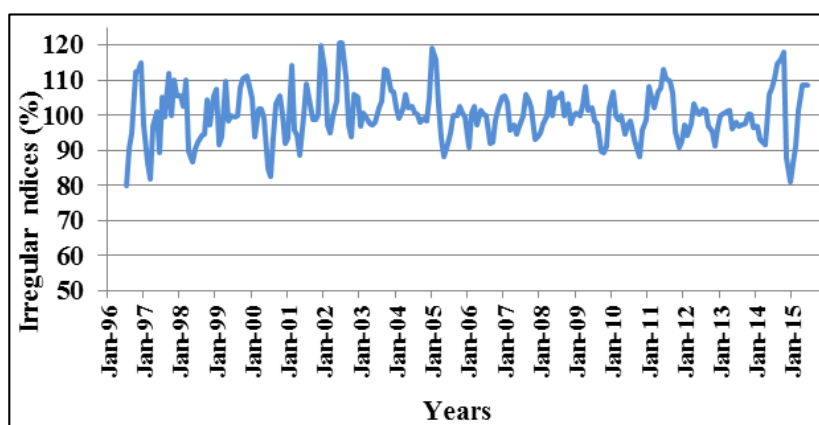**Fig 10:** Irregular indices for coconut prices in Kozhikode market - Period I

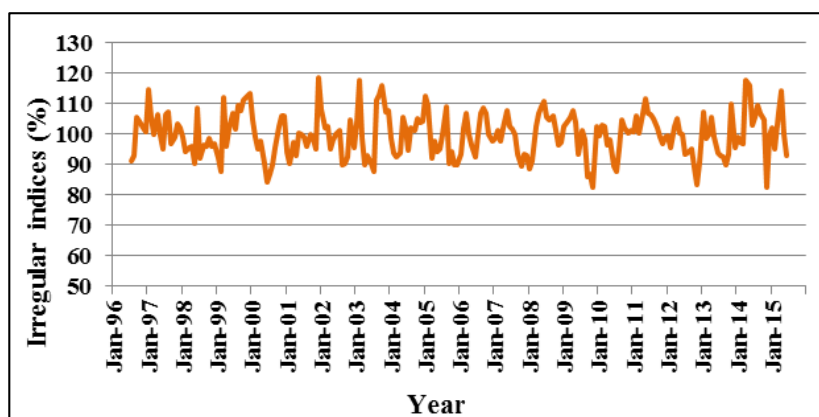**Fig 11:** Irregular indices for coconut prices in Alappuzha market – Period II

Fig 12: Irregular indices for coconut prices in Kozhikode market – Period II

Conclusion
Coconut being a perennial crop which involves high investment when compared to seasonal and annual crops, price stability assumes more significance in motivating farmers to make investment in coconut cultivation. However, one of the most distressing features of the coconut economy of Kerala during the past two decades was the frequent fluctuations in the prices of coconut and coconut products. In spite of high fluctuations, coconut price in the long run had shown an increasing trend in both Alappuzha and Kozhikode markets during Period I (1980-01 to 1995-96) and Period II (1996-97 to 2015-16). In the price behaviour of coconut, secular trend, seasonal variations, cyclical variations and irregular variations were observed. The seasonality and irregular variations were more prominent in the primary commodity. Even though both Period I and Period II showed distinct coconut price behaviour, the price movement in Alappuzha and Kozhikode markets exhibited similar pattern during Period II.

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