Research Article

Journal of Plantation Crops, 2004, 32 (3) : 68-71

An economic analysis of temporal price instability and supply response in arecanut

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(Manuscript Received 20-10-2003; Revised : 12-12-2004; Accepted : 8-9-2004)

Abstract

The present study is partly a methodological attempt where a non-parametric regression frame was used to analyze the time series data on arecanut. Sudden change/shift points were observed in price, area and production data of arecanut by fitting kernel weighed local linear regression with dummy variables for shift. The data has been classified into different periods based on the shift points. The differential growth rates and trends in various periods are substantiated based on available literature, observations and assumptions. Three shift points (four periods) were observed in price data, two shift points (three periods) in area and one shift point (two periods) in production and productivity. Although the prices were stable after the drastic fall in 1972-73, from mid-eightyies onwards, frequent price fluctuations were observed. Commercialization of arecanut trade made the marketing system highly complicated and conducive for the trade manipulations. The price instability revealed in the irregular time series component proved the poor market intelligence in arecanut trade.

Key words: Arecanut, non parametric regression, price instability, shift points

Introduction

India is the largest producer of arecanut in the world with an area of 0.313 million hectares, producing 0.379 million tonnes of arecanut (CMIE, 2002). Arecanut prices, which showed a steady increase in almost all markets of India from 1948-49, had an unprecedented fall in 1972-73. However with improvement in the marketing system, the price showed continuous increase since 1974 till 1985-86. From 1986 onwards the price fluctuations were very much prevalent and the year 1999-00 experienced a drastic fall in areca prices (Rethinam and Sivaraman, 2001). In principle, the prices move up and down with the change in supply and demand composition. But in case of arecanut there are instances where the prices have risen or fallen even though the supply is more or less constant. Here the price instability is not only due to variation in supply position, but also due to other factors like transportation facility, efficiency of market intelligence service, availability of credit and storage facilities and above all availability of a marketing system free of exploitation (Nambiar, 1974). Arecanut marketing is a complicated system where large number of intermediaries are involved. In India, arecanut is used only for masticatory purpose and outside India it has almost no demand. Even within India the habit of chewing is slowly declining (Das, 1985). The price variations have become almost a regular feature in the market, which widely affect the poor growers who entirely depend upon the areca income for their livelihood.

The present study attempts to find out the locations of sudden changes/shift points if it exists in arecanut time series data and compares the different periods obtained on the basis of estimated shift points. This paper analyzes the supply response to find out how arecanut area has responded to the price fluctuations.

Materials and Methods

The secondary data from 1957 to 2002 on arecanut area, production and prices obtained from Directorate of Economics and Statistics, New Delhi and Directorate of Arecanut and Spices Development, Calicut were used for the study.

Locations of change/shift points have been obtained by fitting kernel weighted local linear regression

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with dummy variables for the shift followed by Jose and Ismail, 2001. In the present analysis to identify the shift point, the time series data with in equidistant time points has been taken as $x_t=t/n$, $t=1,..,n$. The kernel weighted local linear regression estimates of a smooth regression function $m(x_t)$ and its slope $m'(x_t)$ of the standard regression model $y_t=m(x_t)+e_t$, $t=1,..n$ are the solutions of a_0 and a_1 respectively to the following weighted least squares problem (Fan, 1993).

Minimize $$\sum_{j=1}^{n}\left[y_j - a_0 - a_1(x_j - x_t)\right]^2 K\left(\frac{x_t - x_j}{h}\right)$$

where K is a bounded symmetric kernel density function and h is the bandwidth. The mean regression function $m(x_t)$ with $p(^31)$ change/shift point at x_{kj}, $j=1,..,p$ can be written as

$$m(x_t) = g(x_t) + \sum_{j=1}^{p}[\Delta_{kj} + \Lambda_{kj}(x_t - x_{kj})]I_{(kj,3)}(x_t) \quad , t=1,\ldots,n$$

Where g is the smooth function, D_{kj} and L_{kj} are the size of shift in the function and its derivative at the shift point x_{kj}, $j=1,..p$ and I is the indicator function. The unknown shift points x_{kj}, $j=1,...p$, are estimated by solving the weighted least squares problem

$$\sum_{j=1}^{n}\left\{y_j - a_0 - a_1(x_j - x_t) - \left[\Delta_t - \Lambda_t(x_j - x_t)\right]I_{(x_t,3)}(x_j)\right\}^2 K\left(\frac{x_t - x_j}{h}\right)$$

for all $x_t \hat{I}\ [h,\ 1-h]$ and let s_t be the ratio of the mean regression sum of squares due to the estimates of D_t and L_t to the mean residual sum of squares corresponding to the point x_t. The estimates of the shift points $\hat{x}_{kj}$, $j=1,...,p$ are the points where $s_t \hat{I} A_j$ is maximum, where,

$$A_j = [h, 1-h] - \sum_{i=1}^{j-1}([\hat{x}_{ki} - h), (\hat{x}_{ki} + h)], \quad j=1,\ldots,p$$

If the number of shift points is not known in advance, then p is fixed in such a way that the maximum of $s_t \hat{I} A_p$ is grater than or equal to its critical value $C_a(p)$ and the maximum of $s_t \hat{I} A_{p+1}$ is less than its critical value $C_a(p+1)$. The critical value is worked out as $C_a(p) = F_{a^*}$, where, $a^* = 1-(1-a)^{1/n^*(p)}$, $n^*(p)$ is the number of observations in the set A_p, F_{a^*} is the value of F distribution with $(2,\ 2nh-2)$ degrees of freedom and a^* level significance.

The compound growth rates were computed for area, production and yield of arecanut based on the exponential function

$$Y = AB^T$$

Where, Y is the variable, for which growth rate is calculated, T is the time variable and A and B are the regression coefficients.

The time series data of price has been analyzed using the additive decomposition model.

$$P_t = T + C + I$$

Where, P_t is observation on price for period t, T is trend component, C is cyclical component and I is irregular component

Supply response analysis has been carried out using log linear distributed lag model of the form

$$LnA_t = a + b\ LnP_{t(k)} + v$$

Where, A_t is current area under arecanut, $P_{t(k)}$ is the weighted average prices for the previous k years (weights were assigned based on the correlation coefficients). The log linear form of acreage response was chosen because it provides direct estimates of supply elasticity. The Ordinary Least Square (OLS) method was used for the estimation.

Results and Discussion

Time series data on area, production, productivity and prices of arecanut in India is given in Table1.

Table 1: Time series data on arecanut area, production, yield and prices

Years	Area ('000 Ha)	Production ('000 T)	Yield (Kg/Ha)	Price (Rs/Qtl)
1956-57	94	75	789	290
1960-61	113	95	845	459
1964-65	126	107	854	573
1968-69	157	140	890	696
1972-73	176	148	829	414
1976-77	171	165	967	755
1980-81	185	196	1058	1384
1984-85	186	219	1179	1864
1988-89	203	248	1221	2080
1992-93	227	256	1131	5532
1993-94	235	271	1197	4871
1994-95	250	290	1188	5931
1995-96	255	296	1159	6123
1996-97	261	308	1178	6505
1997-98	273	333	1218	7005
1998-99	277	330	1189	9052
1999-00	289	334	1157	13181
2000-01	291	379	1211	7886
2001-02	NA	NA	NA	4702
2002-03	NA	NA	NA	4200

Source: Directorate of Economics and Statistics, New Delhi

Three shift points (four periods) were observed in arecanut prices, two shift points (three periods) in area

and one shift point (two periods) in production and productivity. The locations of the above shift points along with the compound growth rates (trend equations in case of price data) of different periods of price, area and production are given in Tables 2, 3 and 4 respectively. Trend lines of different periods in price data are given in Figure1.

Table 2. Price trend

Shift point	Period	Trend equation	R^2
1970-71	Period I (1956-57 to 1970-71)	Y=294.9+28.2X	0.88
1986-87	Period II (1971-72 to 1986-87)	Y=118.4+120.8X	0.84
1998-99	Period III (1987-88 to 1998-99)	Y=1014.8+549.5X	0.91
—	Period IV (1999-00 to 2002-03)	Y=15024-3012.7X	0.88

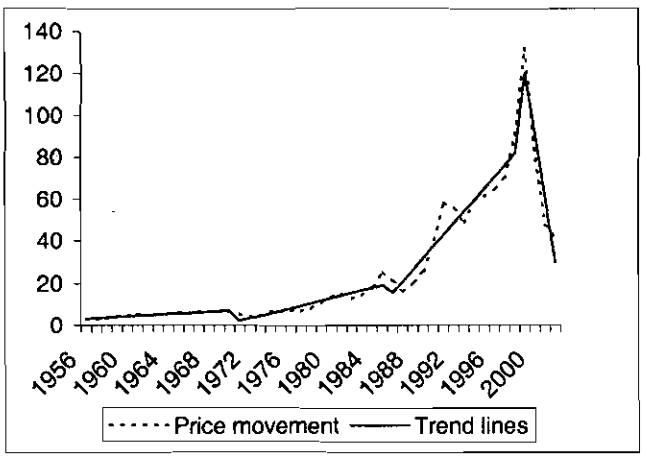

Fig 1. Arecanut price movement and Trend lines

In Period I up to 1970-71, the arecanut domestic prices exhibited a stable and steady trend with no fluctuation. In 1972-73, the prices registered a marked fall owing to various reasons like surplus production, market speculation and fall in consumption (Velappan and Paulose, 1974).

Central Arecanut and Cocoa Marketing and Processing Co-operative Ltd (CAMPCO) which came into existence in 1973, succeeded in reviving the market within a short period (see the trend line in Period II). From 1987-88 onwards the processed arecanut products like 'pan masala' and 'ghutka' captured a good market share and the demand and prices of arecanut improved further. Thus the remunerative prices and demand for the product induced further area expansion even to the non-traditional areas. The scope and demand for the processed areca products attracted a number of traders into arecanut marketing. Despite the widespread consumption of the produce all over India, the production was localized in a few states which left the field open for market speculators and middle men. This coupled with lack of proper market information and the absence of an organized marketing network caused the arecanut price fall in 1999-2000.

Table 3. Compound growth rate (Area)

Shift point	Period	CGR (%)
1974-75	Period I (1956-57 to1974-75)	4.23
1985-86	Period II (1975-76 to 1985-86)	0.90
—	Period III (1986-87 to 2000-01)	3.11

At the time of partition in 1947 nearly fifty percent of the total area under arecanut was in East Bengal region (now Bangladesh). Since the Indian production was insufficient to meet the local demand, the country was regularly importing large quantities of arecanut from other producing countries. The unrestricted imports of foreign arecanuts was found to have a depressing effect on the internal prices of the commodity; therefore, efforts were made to increase the production within the country (Sikka and Ravindran, 1973). Thus, Period I (1956-57 to 1974-75) had the highest compound growth rate of area (4.23%)(Table 3).

In 1971-72 the prices of arecanut fell steeply, and during 1974 the yellow leaf disease had partially wiped out the areca gardens in Kerala, which was a major areca growing state. Due to heavy loss of areca palms and reduced yield, farmers of Kerala got attracted to grow more remunerative cash crops in place of arecanut (Velappan and George, 1982). Consequently, the growth rate in area declined to 0.9% during the period II (1975-76 to 1985-86). During the mid eightyies the processed and value- added arecanut products namely 'paan masala', 'ghutka' and 'paan parag' made entry into the market. Slowly the arecanut prices went up; subsequently, arecanut area also expanded and registered a compound growth rate of 3.11% in Period III (1986-87 to 2000-01).

Table 4: Compound growth rate (Production & Productivity)

Shift point	Period	CGR (%)	
		Production	Productivity
1982-83	Period I (1956-57 to 1982-83)	3.92	1.04
—	Period II (1983-84 to 2000-01)	2.82	0.41

The CGR of production in period I was 3.92 and period II was 2.82. The figures for productivity were 1.04 and 0.41 in period I and II respectively. The increase in production during 1961-71 was mainly due to area expansion while during 1971-82 improvement of productivity was largely responsible for this (Sikka, 1985). Naturally during the initial years of area expansion the growth rate in production would be high and later in spite of the best management practices the growth rate of production and productivity would decline. Moreover from mid-eighties onwards, due to the remunerative

prices in the market, arecanut area expanded to the non-traditional areas where the conditions are not that favourable for areca cultivation (Anitha, 2000). Thus, in Period II (1984-2001) the compound growth rate of production (2.82) and productivity (0.41) were low in comparison to Period I (1957-83).

Supply response analysis has been carried out using log linear distributed lag model,

$$LnA_t = a + b\ LnP_{t(k)} + v$$

Different lag periods (k=1,2,...,6) were compared based on the mean square error (MSE) of the fitted values and found that k=4 gives minimum MSE. The estimated acreage response function, $LnA_t = 3.48 + 0.243 LnP_{t(4)}$ revealed that weighed average of lagged arecanut prices had significant impact on area allocation with supply elasticity of 0.243.

Analysis of trend component in annual series of prices involves ascertaining the general direction of the price movements over years (Fig 2).

Cyclical and irregular components were isolated from annual series of arecanut prices using least square method.

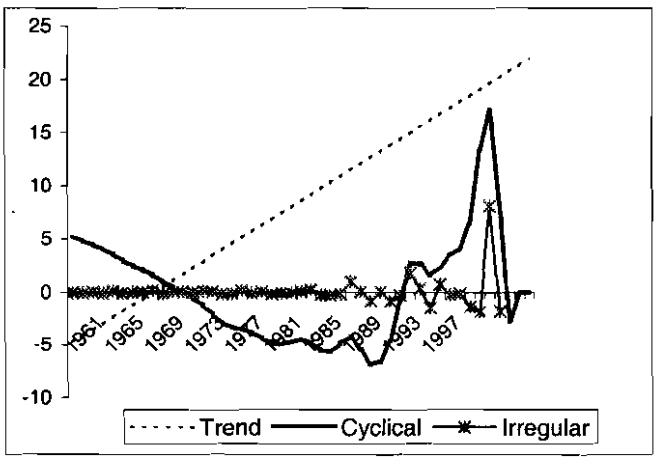

Fig 2. Time series components of arecanut prices

It can be observed from Fig.2 that there were ups and downs in the cyclical component but it cannot be described as regular oscillation. It is very clear that for the initial 30 years, the irregular component is totally absent in arecanut price data (Fig 2) later years, the irregular component was very much prevalent. These irregularities in arecanut prices can be very well related to the commercialization of areca produce and market imperfections.

Arecanut area expansion was the need of the time during 1950's but area expansion continued even after attaining self-sufficiency in the crop. The compound growth rate of arecanut acreage during last 15 years showed that the area is still expanding. Declining growth rates of arecanut production and productivity indicates that area expansion has taken place in non-traditional States. The supply response analysis revealed the arecanut area response to the prices is significant. In the WTO regime, arecanut has already moved to the OGL (open general licence) list from the restricted list. The market is highly sensitive and the ban campaign on arecanut-processed product is strong. Thus the arecanut market is becoming highly unpredictable.

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