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RESEARCH ARTICLE :

An economic analysis of integration of oil markets in Tamil Nadu

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SUMMARY : India was an exporter of edible oilseeds and oils in 1960's, but it depends upon imports to the extent of nearly 50 per cent of its edible oils requirements as on date. In this situation, India needs to protect the consumers as well as oilseed growers. This has become all the more important as any decrease in world market prices is certain to affect the domestic prices of oilseeds and hence the income and levels of livings of these farmers. A study to analyze the integration of oilseed markets in economy of Tamil Nadu was found necessary so as to suggest suitable strategies to increase the production of oilseeds in the state and simultaneously working out measures for taking advantage of trade openness in a dynamic setting without affecting the basic objective of domestic food and nutritional security. During 1970s, area of most of the oilseeds crop increased in Tamil Nadu and this recorded the positive growth than production and productivity. During 1980s, oilseeds recorded positive growth both in area as well as production. During 1990s, only oilseeds crop has recorded the enormous growth in productivity than area as well as production. During 2000-01 to2005-06, the oilseeds had less negative growth in production than area as well productivity. When 1970-71 to 2005-06 periods was analyzed as a whole, the oilseeds crops had shows rapid growth in production as well productivity. Tables 1 through 3 the supply response function estimated for the present study describes would reveal factors considered by farmer while deciding about area to be allotted for different crops. Lagged price and lagged yield of groundnut crop were the significant factors affecting the decision of farmers to allocate the area under crops. The Cointegration analysis describes the two groundnut market prices (Chennai, Mumbai markets) were in non-stationarity condition, hence, these two markets were two ways co integrated.

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BACKGROUND AND OBJECTIVES

Indian vegetable oil economy is the fourth largest in the world, next to U.S.A, China and Brazil, accounting for about 14.5 per cent of the world's oilseeds area and 6.65 per cent of the production, Currently, India accounts for 6.8 per cent of the oil meal production, 5.9 per cent of the oil meal export, 6.1 per cent of the vegetable oil export, 9.00 per cent of the vegetable oil import and 9.3 per cent of the edible oil consumption of the world.(In and

B. Indler,1997).The diverse agro-ecological conditions in India are suited for growing as many as nine annual oilseeds crops *viz.*, groundnut, rapeseed-mustard, sunflower, sesame, soyabean, safflower, castor, linseed and niger and two perennial oil crops *viz.*, coconut and palm.

Status of Indian oilseeds economy :

Oilseeds play the second important role in the Indian agricultural economy, next only to food grains in terms of area, production and market value. They occupy a distinct position after cereals, constituting 14.87 per cent of the country's gross cropped area and accounting for nearly 1.4 per cent of the gross national product and 7 per cent of the value of all agricultural products. In India, oilseed crops are mostly grown under rainfed conditions and they support the livelihood of small and marginal farmers in arid and semi-arid regions of the country. They occupy an area of 27.86 million ha with 27.98 million tonnes of production registering a productivity level of 1004 kg/ha (Srinivasan P. V, May, 2004, Paper No. 69, MTID, IFPRI, Washington).

The major oilseeds growing States in terms of share in the national oilseeds area are Madhya Pradesh (20.34 %), Rajasthan (18.87 %), Maharashtra (13.10 %), Gujarat (10.87 %) Andhra Pradesh (10.48 %) and Karnataka (10.26 %). Area under oilseeds in these six States cover about 84 per cent of the total oilseed area and incidentally contributed the same 84 per cent of the total output of oilseeds in the country during 2005-06.Among the oilseeds, soybean ranks first by contributing 36.98 per cent of the total oilseed output during 2006-07, followed by rapeseed and mustard (29.83 %), groundnut (20.59 %) and other six-oilseed crops put together (12.60 %).

The edible vegetable oil industry is one of the most vibrant industries in India, with an annual turn over of Rs.38,070 crores (Central Statistical Organisation. 2007. National Accounting Statistics, Govt. of India, New Delhi. (Central Statistical Organization, 2005-06). It is the most complex one in terms of co-existence of large number of vintage models of units of different sizes and ownerships such as public, co-operative and private sectors following different production technologies. The per capita consumption of edible oil in India grew from 4.1kg in 1971-72 to 11.2 kg in 2006-07. It almost tripled from 1970's to 2006-07. Changes in income, consumer preferences, imports and prices are the major reasons for increase in per capita consumption in India.

Oilseeds policy in India :

India followed the policy of import substitution in the oil seeds and edible oil sector till 1994-95. This policy of doubling the output in order to stabilise the oilseeds production in the country, led to diversification into new crops such as soybean and sunflower in the place of rapeseed-mustard and groundnut. India became self-reliant in edible oils almost up to 98 per cent and oilseeds meal occupied major share in exports from India.

Imports of oilseeds and edible oils were canalized through the State Trading Corporation (STC) while exports of oil cakes were restricted. Similarly, exports of oilseeds and oils were restricted (banned) where as the exports of oil cakes were allowed. The imported oils were passed on to state governments for sale through Public Distribution System (PDS) at administered prices. These prices included custom duty and service charges of STC, since 1989. A part of imported oil was also allotted to vanaspati industry at concessional rates. To ease the supply position and to support rapid technological change in the oilseeds sector, certain development programmes were also pursued. They were:

i) Oilseed Grower's Co-operative Project ii)National Oilseed Development Project iii)Technology Mission on Oilseeds and iv)Integrated Scheme of Oilseeds, Pulses, Oil palm and Maize.

With the surge in import of edible oils, India began making frequent tariff adjustments since 1998 with a view to bring down the growth of imports and protect domestic oilseed growers and processors from imports and to cushion the effect of fluctuating world prices on domestic consumers. The tariff hikes also made the tariff on soybean oil increasingly preferential since tariff on palm, rapeseed and sunflower oils could be raised well above the 45 per cent tariff binding of soyabean oil. In addition to adjusting tariff, the Government established a Tariff Rate Value (TRV) system for palm oil in August 2001 and for soyabean oil in September 2002.

To check and control the spiraling inflationary situation, the Government of India reduced import duty for all crude edible oils to zero level with effect from. 1.4.2008. Simultaneously, it also reduced import duty for all refined edible oils to 7.5 per cent with effect from 1.4.2008.

The problem focus :

In 1960s, India was an exporter of edible oilseeds and oils, but it depends upon imports to the extent of nearly 50 per cent of its edible oils requirements as on date. In this situation, India needs to protect the consumers as well as the Indian oilseed growers. This has become all the more important as any decrease in world market prices is certain to affect the domestic prices of oilseeds and hence the income and levels of livings of these farmers. A majority of oil millers are small entrepreneurs and wide fluctuations in prices of oilseed and edible oils could affect their livelihoods also.

A study to analyze the integration of oilseed markets in economy of Tamil Nadu was found necessary so as to suggest suitable strategies to increase the production of oilseeds in the state and simultaneously work out measures for taking advantage of trade openness in a dynamic setting without affecting the basic objective of domestic food and nutritional security.

With the above background and with the broad objective of analyzing the integration of oilseeds market in Tamil Nadu; the present study was taken up with the following specific objectives.

The specific objectives of the study are

– To analyses the temporal growth in area, production and productivity of major oilseed crops grown in Tamil Nadu;
– To estimate the average and acreage Response of Oilseeds in India;
– To estimate the integration of important Oilseeds market in Tamil Nadu (Local) with central market (Mumbai).

RESOURCES AND METHODS

Monthly time series data on the prices of groundnut for the period from 1970-71 to 2005-06 for local (Chennai) and central markets (Mumbai) prices were collected. Monthly time series data on the prices of groundnut and gingelly from January1994 to May 2008 in the local market and central market were collected to study the co-integration.

Secondary data of area, production, productivity of groundnut and gingelly for thirty six years (1970-71 to2005-06) were analysed to estimate the compound growth rates and the co-efficient of variation. Besides, co-efficient of variation of the farm harvest prices for groundnut and gingelly were also calculated.

The acreage response model for groundnut was worked out. Monthly price data of groundnut crop in local (Chennai) market and also central (Mumbai) market data for fourteen years (1994-2008) were used in the co integration model.

Also, co-integration was done for the groundnut kernel prices in Chennai market and ground nut kernel prices in Mumbai market to test the change in the influence of prices in local market over the central market.

Market integration :

The market integration concept explains the relationship between the prices prevailing in two markets that are spatially separated. When markets are integrated, it implies that the markets in the system operate in unison, as a single market system.

Ravallion (1986) opined that if trade would take place at all between any two regions, then price in the importing region would equal to price in the exporting region plus the unit transport cost incurred by moving between the two. If this could hold true, then the markets can be said to be spatially integrated.

Narasimhan *et al.* (1988) investigated the short - run inter-relationships between prices of oils and oilseeds in Bombay market by applying Koyck's distributed lag model revealed the existence of integration between these markets. However, price integration in many cases was found to be unidirectional, indicating that substitution was possible only in one direction and not both ways. This was due to the technology and cost constraints involved in substituting one oil for an other apart from consumer preference.

Nasurudeen and Subramanian (1995) in their attempt to estimate the extent of vertical and horizontal integration of oil and oilseed prices using the Koyck's distributed lag model, revealed that the assumption of complete oil price integration could not be fully accepted. The results of vertical integration confirmed the hypothesis that changes in oilseed price was linked to changes in its oil and cake prices. The Mumbai oilseed market showed the characteristics of perfect market condition by its quick adjustment to price changes.

Multiple Co-integration technique of market integration analysis using maximum likelihood method was developed by Johansen (1988) and extended by Johansen and Juselius (1990).

Granger (1986) postulated that when there is a pair of series Xt and Yt each of which is I (l), a linear combination of these two series will also be I (l). This means that there exists a long run equilibrium relationship between the two series. The basic idea behind co-integration of series that the presence of co-integration ensures that the series will move closely together in the long run since the difference between them is stationery with well defined mean and variance.

In the present study, the concept of co-integration developed by Engle and Granger (1987) has been used for testing market integration.

Ravallion (1986) proposed a dynamic model of spatial differentials to test market integration. The main advantage of this method is that one could distinguish between the concepts of short-run market integration and a long-run adjustment process. Besides, the hypothesis of market integration could be tested within a more general model as restricted forms. However, this method was also not free from limitations. It was pointed out that there existed a strong presence of multi-collinearity among the explanatory variables, which would result in obtaining biased estimates which are used to test the hypotheses. Tests that are based on biased estimates would naturally be misleading. Further, the conventional methods discussed above have also been ignored the major properties of time series variables like non-stationarity, which might have resulted in yielding unreliable results.

Most market commodity prices, whether international or domestic, are basically non-stationary. A stochastic process is said to be stationary, if its mean and variance between any two time periods depend only on the distance or lag between the two time periods and not on the actual time at which the covariance is computed (Gujarati, 2004). If time series data like prices which are non-stationary are used, it usually would yield a high R^2 and t ratios which are biased towards rejecting the null hypothesis of no relationship even if there is a relationship between the variables concerned (Granger and New Bold, 1977).

The underlying principle of co-integration analysis is that, although many economic time series may tend to trend upward or downward over time in a non-stationary fashion, group of variables may drift together. Co-integration tests start with the premise that for a long-run equilibrium relationship to exist between two variables, it is necessary that they should have the same inter-temporal characteristics. Thus, the first step involves testing for stationarity of the variables. Economic interest in the theory of testing the unit roots have led to the development of a variety of tests to test for the order of integration and the presence of unit roots in time series data. In econometrics, a time series that has a unit root is known as a random walk, which is an example of a non-stationary time series. If the original series is found to be non-stationary, the first differences of the series are tested for stationarity. Thus, the number of times a series must be differenced, before it becomes stationary is referred to as the 'order of integration' *i.e.*, if the series attains stationarity after differencing 'd' times, then it is said to be integrated of the order 'd' represented as I(d).

Stationarity :

Before analyzing any time series data, testing for stationarity is a pre-requisite since econometric relations between time series have the presence of trend components (Davidson and Mackinnon 1993). A series which is stationary after being differenced once is said to the integrated of order 1 and denoted by I (1). In general, a series which is stationary after being differenced d times is said to be integrated of order 'd' and it is denoted by I (d). A series which is stationary without differencing is said to be I (o).

Thus, $I(1) = Yt = Q + Y_{t-1} + E_t$

$I(0)\ \Delta Y_t = Y_t - Y_{t-1} = Q + E_t$

A test of stationarity (non- stationarity) that has become widely popular over the past several years is the unit root test, which is explained below :

$$Y_t = ° Y_{t-1} + U_t \quad (1)$$

where U_t is a white noise. If $\rho = 1$ *i.e.*, in the case of unit root of (1) becomes a random walk model without drift which is non - stationary stochastic process.

Let us substract Y_{t-1} from both sides of (1)

$$Y_t - Y_{t-1} = ° Y_{t-1} - Y_{t-1} + U_t$$
$$aY_t = (° -1)\ Y_{t-1} + U_t$$
$$aY_t = ¢\ Y_{t-1} + U_t \quad (2)$$

when, $\delta = \rho - 1$ and Δ is as usual first difference operator.

Testing null hypotheses :

The null hypothesis is: $H_0: \delta = 0$, this would mean that $\rho = 1$ then, a unit root, *i.e.*, time series under consideration is non- stationary. Before proceeding to estimate (2), it may be noted that if $\delta = 0$, the model becomes $\Delta Y_t = Y_t - Y_{t-1} = U_t$. Since, U_t is the white noise, it is stationary which means that the first difference of a random walk time series is also stationary. Take the first difference of Y_t and regress these on Y_{t-1} and test whether the slope of the regression co-efficient (δ) is zero or not. If it is zero, then it is concluded that Y_t is non-stationary and if δ is negative, then Y_t is stationary.

Under the null hypothesis that $\delta = 0$ *i.e.*, $\rho = 1$, the value of ρ the estimated co-efficient of Y_{t-1} does not follow t – distribution, even for large samples, *i.e.*, it does not have an asymptotic normal distribution.

Dickey and Fuller (1979) have proved under null hypothesis that $\delta = 0$, ρ the estimated value of the co-efficient of Y_{t-1} in (2) follows the t (tau) statistics. They have calculated critical value of the t (tau) statistic on the basis of Monte Carlo Simulations. The tau (t) statistic is known as Dickey-Fuller test. Interestingly, if the hypothesis that ä = 0 is rejected (*i.e.* the time series is stationary), Students t – test can be used.

The nature of unit root process is such that it may have random walk process and it may have no drift or it may have drift or it may have both deterministic and stochastic trends. To allow for various possibilities, the Dickey Fuller test is estimated in three different forms under the null hypothesis.

Y_t is a random walk $\Delta Y_t - \; = \delta \, Y_{t-1} + U_t$. Y_t is a random walk with drift

$\Delta Y / t = \beta_t + \delta \, Y_{t-1} + U_t$ Y_t is a random walk with drift around a stochastic trend and

$$\text{a}\mathbf{Y\ t} = \ _t + \ _2\mathbf{t} + ¢\ \mathbf{Y}_{t-1} + \mathbf{U}_t$$

where, t is the time or trend variable. In each case, the null hypothesis is that $\rho = 0$, that is, there is a unit root. The time series is non- stationary and the alternate hypothesis is that $\delta \leq 1$, the time series is stationary. If null hypothesis is rejected, it means that Y_t is stationary time series with zero mean. Yt is stable with non-zero mean $\frac{B_1}{1 \quad L}$ if, Y_t is stationary around deterministic trend.

In applying Dickey-Fuller test, it was assumed that the error term Ui was serially uncorrelated. But in the case of Ui are correlated, Dickey Fuller have developed a test known as augmented Dickey-Fuller test. This test was conducted by augmenting the preceding three equations by adding lagged values of the dependent variable (Y). The augmented Dickey-Fuller test, consists of estimating the following Regression model

$$\text{a}\mathbf{Y}_t =: \ _1 + \ _2\mathbf{t} + ¢\ \mathbf{Y}_{t-1} + \sim\mathbf{t}\ \Sigma\text{a}\ \mathbf{Y}_{t-1} + \mathbf{Et}$$

E is a white noise

In Augmented Dickey-Fuller, it is tested whether $\delta = 0$ or not and the ADF follows the same asymptotic distribution as that of the DF statistic so that the same critical values can be used.

The most widely used tests for unit roots are the Dickey-Fuller test (DF) and the Augmented Dickey-Fuller test (ADF). Both would test the null hypothesis that the series has a unit root or in other words, it is not stationary. The DF test is applied by running the regression of the following form.

$$\text{a}\mathbf{Y}_t = \ _1 + ¢\ \mathbf{Y}_{t-1} + \mathbf{U}_t$$

where, $\Delta Y_t = (Y_1 - Y_{t-1})$; $Y_t = \ln Y_t$

The ADF test is run with the equation :

$$\Delta Y_t = \beta_1 + \delta Y_{t \quad 1} + \alpha_i \sum_{i=1}^{m} \Delta Y_{t \quad i} + e_t$$

where, $\Delta Y_t = (Y_t - Y_{t-1})$; $\Delta Y_{t-1} = (Y_{t-1} - Y_{t-2})$

The critical values of the‘t’ statistic of the lagged term have been tabulated by Dickey and Fuller (1979). They have also been considerably extended by Mackinnon (1991) through Monte Carlo simulations.Once it is established that the two price series are non stationery, and then analysis for Co-integration was done as follows :

$$\mathbf{GPM}_t = \ _0 + \ _1(\mathbf{GPC}_t) + \mathbf{Z}_t$$

where,

GPM_t = Mumbai groundnut kernel price in t[th] period in Rs./tonne

GPC_t = Chennai groundnut kernel price in t[th] period in Rs./tonne or US$/tone

β_0 = Intercept

β_1 = Value of parameter to be estimated and

Z_t = Random error.

The test was also done for taking GPC_t and GPM_t as dependent and independent variables. Co-integration was done for the groundnut kernel prices in Chennai (local) market and Mumbai (central) market to test the presence of integration.

The difference here lies in the critical values compared for the test statistics. The DF test in the present context is known as Engle-Granger (EG) test whose critical values are provided by Engle and Granger (1987). For the Cointegrating Regression Durbin Watson Test (CRDW), the DW‘d’ statistic obtained from the co-integrating regression can be used. But here, the null hypothesis is that d = 0 rather than d = 2. A significant

CRDW'd' would indicate the presence of co-integration between the concerned variables (Sargan and Bhargava, 1983).

Now, if two time series were co-integrated, then it could be said that there is long run equilibrium between the two series. But there can be disequilibrium in the short run. The Granger Representation Theorem states that if two variables were co-integrated, then there existed an error correction representation of the variables, where the error tended to correct in the long-run.

$$\Delta Y_t = \alpha_0 + \alpha_1 \Delta X_t + \alpha_2 Z_{t\ 1} + \varepsilon_t$$

The speed at which the prices tend to approach the equilibrium in each period (month) depends on the magnitude of a_2 whose expected sign is negative. This negative sign would confirm that the error would correct in the long-run.

Nerlovian lagged adjustment model :

Tripathy and Gowda (1993) analysed the growth, instability and area response of groundnut in Orissa. There was significant increase in area since 1970-1990 at the rate of 10.29 per cent per year. The yield was unstable in many districts. There had been increase in probability of shortfall in the production of groundnut. The per hectare yield was stagnant in the state. The area response was found by regressing area against lagged area, lagged price, price risk, irrigation and rainfall. All variables except rainfall had a significant effect on area. Price and price risk had the most significant effects on the acreage.

The Nerlovian lagged adjustment model was used to study the acreage response for groundnut, *i.e.*, to assess the factors influencing the acreage under groundnut in nmTamil Nadu.

$$At^*=Co+C1Pt-1+U_t \quad (1)$$
$$At-At-1=k\ (At^*-At-1) \quad (2)$$
$$At=bo+b1At-1+b2Pt-1+V_t \quad (3)$$
$$b0=Cok;\ b1=(1-k);\ b2=C1k \text{ and } Vt=Utk$$
$$At=b0+b1LASC+b2LYSC+b3LPSC+b4YRSC+b5PRSC+b6LACC+b7LYCC+b8LP\ CC+b8RF+Vt$$

At - current year area under groundnut crop (ha)

LASC- one year lagged area of groundnut crop (ha)

LYSC - one year lagged yield of groundnut crop (qtl/ha)

LPSC - one year lagged price of groundnut crop (Rs/qtl)

YRSC - yield risk of the groundnut crop measured by standard deviation of three preceding years

PRSC - price risk of groundnut crop measured by standard deviation of three preceding years

LACC - one year lagged area of competing gingelly crop (ha)

LYCC - one year lagged yield of competing gingelly crop (qtl/ha)

LPCC - one year lagged price of competing gingelly crop (Rs/qtl)

RF- Rainfall in (mm) until before one month of sowing for the groundnut crop

Vt - error term.

OBSERVATIONS AND ANALYSIS

The results obtained from the present study as well as discussions have been summarized under following heads :

Growth and variability of area :

The results of Compound growth rates of area of major oilseed crops (Table1)reveal that during 1970s Groundnut had enormous growth in area(2.3%)and for other major crop Gingelly had positive growth.During the period 1980s Gingelly had enormous growth, groundnut continued to have high growth in area (2.3%),during the period 1990s groundnut had less negative growth than gingelly crop.In the recent past years Groundnut only recorded highest growth in area.Groundnut had a very high growth as well as variability in its area.High volatility in prices might be the reason for high volatility in its acreage.

Growth and variability in production :

The results of compound growth rates of Production (Table 2) reveal that during period 1970s Groundnut had negative growth.During 1990s Groundnut had less negative growth than Gingelly crop.In the recent years Groundnut crops had less negative growth than gingelly crop.During 1970s, 1980s there was no much difference in variability in production. During 1990s Gingelly crop had high variability in production. In the overall year Groundnut had significant variability in production.In Tamil Nadu the production is concentrated in western and southern zones, the two zones with the lowest annual rainfall. Groundnut production increased in the 1980s, but stagnated during the 1990s, due to a decline in area cultivated.

Growth and variability in productivity :

The results of compound growth rates of Productivity (Table3) reveal that during period 1980s Groundnut, Gingelly crops had positive growth in production, during 1990s Gingelly crop had high positive growth than groundnut crop. In the recent years Groundnut crops recorded highly negative growth than gingelly in Productivity.

Variability of the Farm Harvest Prices of major oilseed crops :

The results of co-efficient variation of farm harvest price (Table4) reveal that during1970s, 1980s, 1990s, there was no significant variability in prices of majority of crops,in the recent year Groundnut recorded lowest variability and Gingelly recorded highest variability in farm harvest prices.

Acreage response function of groundnut in Tamil Nadu :

The Co-efficient of lagged yield of groundnut and rainfall were found to be positively affecting the significant factors.

Short run and long run price elasticity :

The results of Short Run and Long Run Price Elasticity (Table 6) reveal that Groundnut price elasticity of supply in short run as well as long run period is more or less same.

The cointegration analysis :

The first step of cointegration analysis was done The Augmented Dickey-Fuller unit Tests for Chennai data the probability Rho values were obtained more than 0.0001 (Appendix 1).

The second step of cointegration analysis was done The Augmented Dickey-Fuller unit Tests for Mumbai data the probability Rho values were obtained more than 0.0001 (Appendix 2).

The third step of the above both Non Stationarity conditionsRegression results are integrated. Then it changed become the stationarity condition.now the probability Rho values were obtained exactly 0.0001 (Appendix 3).

Mumbai= f (Chennai) :

An increase in groundnut kernel price by Re.1/qtl Chennai would result in price increase of groundnut in Mumbai by Rs.1.10/Qtl.

Chennai =f (Mumbai) :

An increase in groundnut kernel price by Re.1/qtl Mumbai would result in price increase of groundnut in Chennai by Rs.0.5/Qtl.

Table 1: Compound growth rates (CGR) and Co-efficients of variation (CV) of the area of major oil seeds crops in Tamil Nadu

Oilseeds crops	1970s		1980s		1990s		2000-01to2005-06		1970-71 to 2005-06	
	CGR (%)	CV	CGR	CV	CGR	CV	CGR	CV	CGR	CV
Groundnut	2.3	39.5	2.3	8.5	-3.8	14.6	-1.9	11.0	-0.1	26.3
Gingelly	0.3	16.6	5.0	18.9	-4.8	17.7	-6.9	18.9	-1.0	22.1

Table 2 : Compound growth rates (CGR) and co-efficients of variation (CV) of the production of major oil seeds crops in Tamil Nadu

Oilseeds crops	1970s		1980s		1990s		2000-01 to 2005-06		1970-71 to 2005-06	
	CGR (%)	CV	CGR	CV	CGR	CV	CGR	CV	CGR	CV
Groundnut	-1.7	35.1	5.1	18.3	-0.5	14.0	-4.1	21.8	1.5	29.6
Gingelly	1.8	21.9	5.4	23.9	-0.2	19.6	-12.3	36.9	0.5	27.9

Table 3: Compound growth rates (CGR) and co-efficients of variation (CV) of the productivity of major oilseeds crops in Tamil Nadu

Oilseeds crops	1970s		1980s		1990s		2000-01 to2005-06		1970-71 to 2005-06	
	CGR(%)	CV	CGR	CV	CGR	CV	CGR	CV	CGR	CV
Groundnut	-3.9	95.0	2.7	12.3	3.4	11.0	-2.3	11.7	1.6	56.0
Gingelly	1.5	9.5	0.4	9.3	4.8	17.5	-5.8	19.7	1.6	23.0

Table 4: Co-efficient variation of the farm harvest prices of major oilseed crops in Tamil Nadu

Oilseeds crops	1970s	1980s	1990s	2000-01to 2005-06	1970-71 to 2005-06
Groundnut	43.3	24.5	23.6	14.0	82.8
Gingelly	20.7	22.3	20.2	16.2	68.1

Conclusions and policy implications :

From the present study, it could be concluded that area, production, and productivity of major oilseed crops declined.

Productivity was noted to be more or less stagnant which could be attributed to poor adoption of technology.

During 1970s, area of most of the oilseeds crops like groundnut, gingelly had increased in Tamil Nadu and

Table 5: Acreage response function of groundnut in Tamil Nadu

Particulars	Co-efficients	*t Stat*
Constant	3.88	1.95
Lagged area of Groundnut	0.03	0.29
Lagged yield of Groundnut	0.64**	10.22
Lagged price of Groundnut	-0.26**	5.90
Rainfall	0.30	1.86
R2	0.81	
Adjusted R2	0.78	

** denotes significance at 1% levels of probability.

Table 6: Short run and long run price elasticity

Crop	Adjustment co-efficient	Price elasticity of supply	
		Short run	Long run
Groundnut	0.97	-0.2600	-0.26804

Table 7 : Final fesults of cointegration Mumbai =f (Chennai)

Variable	Label DF	Estimate	Standard Error	t Value	Pr > ItI
Intercept	Intercept 1	476.74131	126.24245	3.78	<.0002
Chennai	Chennai 1	1.10304	0.07575	14.56	<.0001

Table 8 : Final results of co-integration analysis Chennai =f (Mumbai)

Variable	Label DF	Parameter Estimate	Standard Error	t Value	Pr > ItI
Intercept	Intercept 1	485.02578	80.50008	6.03	<.0001
Mumbai	Mumbai 1	0.50187	0.03446	14.56	<.0001

Appendix 1 : Augmented dickey-fuller unit root tests for Chennai (Non-stationary condition)

Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero mean	1	0.7492	0.8642	0.89	0.8994		
	2	0.8052	0.8759	1.07	0.9256		
	3	0.8113	0.8771	1.25	0.9463		
	4	0.7580	0.8661	1.10	0.9288		
	5	0.7795	0.8706	1.28	0.9490		
Single mean	1	-3.9966	0.5359	-1.03	0.7424	1.18	0.7692
	2	-2.5743	0.7067	-0.72	0.8376	1.05	0.8038
	3	-0.5733	0.9209	-0.18	0.9368	0.89	0.8451
	4	-0.9512	0.8896	-0.28	0.9241	0.73	0.8840
	5	0.1285	0.9627	0.04	0.9603	0.84	0.8572
Trend	1	-20.8971	0.0508	-2.92	0.1601	4.49	0.2792
	2	-17.7790	0.0986	-2.55	0.3050	3.56	0.4660
	3	-13.2821	0.2394	-2.10	0.5409	2.84	0.6092
	4	-18.1145	0.0918	-2.41	0.3736	3.60	0.4575
	5	-13.9971	0.2091	-2.07	0.5612	3.02	0.5743

this recorded the positive growth than production as well productivity. The high co-efficient of variation during the 1970's implies a great variation in productivity for groundnut crop during this period, which reduced during the subsequent decades (Table 3).

During 1980s, oilseeds crops like gingelly recorded more positive growth than groundnut both in area as well as production.

During 1990s, only the major oilseeds crops like gingelly, groundnut has recorded the enormous growth in productivity than area as well as production.

During the recent past years (2000-01 to2005-06), the major oilseeds crops like gingelly, groundnut had less negative growth in production than area as well productivity.

When 1970-71to2005-06 period was analyzed as a whole, the oilseeds crops had enormous growth in production as well productivity.

The supply response function describes factors considered by farmer while deciding about area to be allotted for different crops. Lagged price and lagged yield of groundnut crop were the significant factors affecting

Appendix 2: Augmented dickey-fuller unit root tests for Mumbai (Non-stationary condition)

Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	1	-0.0203	0.6773	-0.02	0.6757		
	2	0.0577	0.6952	0.06	0.7010		
	3	0.1043	0.7061	0.12	0.7182		
	4	0.1454	0.7159	0.17	0.7353		
	5	0.1471	0.7163	0.17	0.7359		
Single Mean	1	-11.2476	0.0949	-2.49	0.1192	3.28	0.2352
	2	-9.9022	0.1327	-2.31	0.1712	2.85	0.3451
	3	-9.0065	0.1655	-2.17	0.2178	2.56	0.4197
	4	-8.0523	0.2091	-2.03	0.2739	2.27	0.4919
	5	-8.3394	0.1949	-2.04	0.2704	2.29	0.4878
Trend	1	-30.9544	0.0050	-3.87	0.0155	7.54	0.0190
	2	-29.9653	0.0063	-3.63	0.0305	6.64	0.0418
	3	-30.0420	0.0062	-3.47	0.0460	6.08	0.0638
	4	-29.4234	0.0072	-3.30	0.0705	5.48	0.0951
	5	-34.9975	0.0018	-3.38	0.0581	5.75	0.0808

Appendix 3 : Results of augmented dickey-fuller unit root tests. The non-stationarity regression results are integrated *i.e.*, It changed become the stationarity condition

Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	1	-253.005	0.0001	-11.17	<.0001		
	2	-434.487	0.0001-	9.73	<.0001		
	3	-280.406	0.0001	-7.23	<.0001		
	4	-1049.59	0.0001	-7.04	<.0001		
	5	572.8809	572.8809	-6.89	<.0001		
Single Mean	1	-258.419	0.0001	-11.26	<.0001	63.38	0.0010
	2	-466.108	0.0001	-9.84	<.0001	48.45	0.0010
	3	-310.530	0.0001	-7.33	<.0001	26.89	0.0010
	4	-1951.92	0.0001	-7.17	<.0001	25.71	0.0010
	5	435.0579	0.9999	-7.06	<.0001	24.91	0.0010
Trend	1	-260.436	0.0001	-11.27	<.0001	63.53	0.0010
	2	-483.213	0.0001	-9.91	<.0001	49.14	0.0010
	3	-331.962	0.0001	-7.43	<.0001	27.63	0.0010
	4	-4032.38	0.0001	-7.30	<.0001	26.69	0.0010
	5	376.8139	0.9999	-7.24	<.0001	26.28	0.0010

the decision of farmers to allocate the area under crops.

The Cointegration analysis describes the two market prices were in non-stationarity condition, hence, this two markets were two way cointegrated. If the price of groundnut increased by Rs.1/qtl Chennai will result in price of increase of groundnut in Mumbai by Rs.1.10/Qtl (Table 7). If Price of groundnut increased by Rs.1/qtl Mumbai will result in price of increase of groundnut in chennai by Rs.0.50/Qtl (Table 8).

Policies, therefore, need to focus on enhancing the major oilseeds production in Tamil Nadu.

To maintain acreage at desire levels, appropriate price policy measures should be adopted so that the oilseed crops growers obtain remunerative prices for their produce in Tamil Nadu.

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REFERENCES

Davidson, R. and MacKinnon, J.G. (1993). Estimation and Inference in Econometrics. Oxford University Press, NEW YORK, U.S.A.

Engle, R.F. and Granger, C.W.J. (1987). Co-integration and Error Correction. Representation estimation and Testing. *Econometrics*, **55**(2): 251-276.

Granger, C.W.J. (1986). Developments in the study of co-integrated economic variable. *Oxford Bulletin of Economics Statistics*, **34**(1): 213-228.

Granger, C.W.J. and Bold, P. New (1977). *Forecasting Economic Time Series*. Academic Press, NEW YORK, U.S.A.

Gujarati, Damodar N. (2004). Basic Econometrics, Fourth Edition, McGraw-Hill International Editions, Singapore.

In and B. Indler (1997). Long run relationship between world vegetables oil prices. *Australian J. Agril. & Res. Econ.*, **41**(4): 455-470.

Johansen, S. and Juselius, K. (1990). Maximum likelihood estimation and inference on cointegration- with application to the demand for money. *Oxford Bulletin of Economics Statistics*, **52**(2):169-210.

Johansen, S. (1988). Statistical analysis of co-integration vectors. *J. Econ. Dynamics & Control*, **12**: 231-254.

Narasimhan, N.V., Rao, P.P.I. and M. Von Oppen (1988). Relationship between prices of oils and oilseeds in India. *Artha Vijnana*, **30**(3) : 257-276.

Nasurudeen, P. and Subramanian, S.R. (1995). Price integration of oils and oilseeds. *Indian J. Agril. Econ.*, **50**(4): 624-633.

Nayyar, Deepal and Abhijit Sen (1994). International Trade and Agricultural Sector in India. In: G.S. Bhalla (Ed). Economic Liberalization and Indian Agriculture. Institute for Studies in Industrial Development. NEW DELHI, INDIA.

Ravallion, M. (1986). Testing market integration. *American J. Agril. Econ.*, **29**(4) : 61-65.

Rao, C.H. (1995). Liberalization of Agriculture in India some Major Issues. *Indian J. Agril. Econ.*, **50**(3) : 468-472.

Srinivasan P.V. (2004). Managing price volatility in an Open Economy Environment: The Case of Edible Oils and Oilseeds in India.", Discussion Paper No. 69, MTID, International Food Policy Research Institute, Washington, May.