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Area and Production of Peanuts in Tamil Nadu: The Granger Causality Approach

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Abstract

This paper has examined the possibility of granger causality between the area and production of peanuts in Tamil Nadu during 1990-91 to 2020-21. The study findings suggest that area and production of peanuts are co-integrated, so there is the long run relationship between area and production of peanuts. Moreover, the granger causality result indicates that there is one way causal relationship running from production to area of peanuts in short run. Most of the soils in Tamil Nadu are deficient in zinc, boron, and iron (micronutrients). In addition to the basic use of essential nutrients, especially nitrogen, phosphorus, and potassium, the peanut crop also needs some micronutrients on a minimum dose. Technology has been developed by the oilseed research station, Tindivanam (TNAU) to provide micronutrient mixture as a foliar application during the flowering stage to increase yield. The agriculture development unit of every state has subsidy schemes outlined for various crops with different percentages. It is advisable to visit the nearest agricultural office to know more about these schemes as they keep changing every year. NABARD is one such organization which provides assistance to farmers in different ways through various subsidy schemes.

Key Words: Area, Production, Peanuts, Granger, subsidy.

Introduction

Peanut is called as the 'King' of oilseeds. It is also called as wonder nut and poor men's cashew nut. Peanut is believed to be a native of Brazil (South America), since many closely related species are found there. The crop spread from Brazil to Peru, Argentina and Ghana from where it was introduced into Jamaica, Cuba and other West Indies islands. The plant was introduced by the Portuguese into Africa from where it found a way to North America. It came to India during the first half of the 16th Century from one of the Pacific islands of China, where it was introduced earlier from either Central America or South America. The oil content of the seed varies from 44 to 50 per cent, depending on the varieties and agronomic conditions. Peanut oil is edible oil. It finds extensive use as a cooking medium, both as refined oil and vanaspati ghee. It is also used in soap making, and in manufacturing cosmetics and lubricants, olein, strearin and their salts. Kernels are also eaten raw, roasted or sweetened. They are rich in protein and Vitamins A, B and some members of the B_2 group. Their calorific value is 349 per 100 grammes. The H.P.S. types of Peanut kernels contain 7 to 8 per cent of N.1.5 per cent of P_2 O_5 and 1.2 per cent of K_2 O and are used as a fertilizer. Peanut is an important protein supplement in cattle and poultry rations. It is also consumed as a confectionery product. The cake can be used for manufacturing artificial fibre. The haulms are fed to livestock. Peanut shell is used as fuel for manufacturing coarse boards, cork substitutes. Peanut is also valued as a rotation crop. Being a legume with root nodules, it can synthesize with atmospheric nitrogen and thereby improve soil fertility.

As of 2021, China was the largest producer of peanuts worldwide, producing over 18.3 million metric tons of peanuts. India ranked second that year, producing just over ten million metric tons. The top three exporters of peanuts are India with 87851 shipments followed by United States with 65268 and China at the third spot with 18616 shipments. Seventy per cent of the area and 70 per cent of the production are concentrated in the four states of Gujarat, Tamil Nadu, Madhya Pradesh and Andhra Pradesh. Moreover, Gujarat produced 45.02 quantity in lakh tones, Tamil Nadu 9.49 quantity in lakh tons, Madhya Pradesh 6.45 quantity in lakh tons and Andhra Pradesh 5.77 quantity in lakh tons of peanut during the year 2021-22.

Methodology

The study is based on secondary data only. The secondary data have been collected from Hand Book of Statistics on Indian Economy and Published by RBI.

Tools for Analysis

The secondary data is meaningfully analyzed by using econometrical tools such as Granger Causality Test. Two methods are Unit Root Test and Johansen's Co-integration Test. Analysis has been done by using E-views 10.

Period of the Study

The period of the study taken up for the analysis was a period of 31 years, from the year 1990-91 to that of the year 2020-21.

Hypotheses

The study is based on three hypotheses for testing the causality and co-integration for Tamil Nadu, which are as follows:

1. H_0: There is no bidirectional causality between area and production of peanut in Tamil Nadu.
2. H_o: There is no unidirectional causality between area and production of peanut in Tamil Nadu.
3. H_0: There exists no long run relationship between area and production of peanut in Tamil Nadu.

Mathematical Background and Overview of Techniques

Test for Stationarity

Unit Root Test

Time series analysis is about the identification, estimation and diagnostic checking of stationary time series.

Definition: The sequence y_t is said to be covariance stationary if for all t and t - s

$$E\,(y_t) = E\,(y_s) = \mu$$

$$E\,(y_t - \mu)^2 = E\,(y_{t-s} - \mu)^2 = \sigma$$

$$E\,(y_t - \mu)\,(y_{t-s} - \mu) = E\,(y_{t-j} - \mu)\,(y_{t-j-s} - \mu) = \Upsilon^2$$

The Augmented Dickey-Fuller Test for Unit Roots

Dickey and Fuller (1979, 1981) devised a procedure to formally test for the presence of a unit root. The Augmented Dickey-Fuller test simply includes AR (p) terms of the Xt term in the three alternative models.

Therefore we have:

$$\Delta X_t = \gamma Y_{t-1} + \sum_{I=1}^{P} \beta_I \Delta X_{t-1} + \varepsilon_t$$

Co-integration Tests

Johansen Test

This test permits more than one co-integrating relationship so is more generally applicable than the Engle Granger test which is based on the Dickey Fuller (or the augmented) test for unit roots in the residuals from a single (estimated) co-integrating relationship. In fact, Johansens procedure is nothing more than a multivariate generalisation of the Dickey-Fuller test. Consequently, he proposes two different likelihood ratio tests namely

- The trace test
- Maximum eigenvalue test

Johansen's method takes as a starting point the vector auto regression (VAR) of order p given by

$X_t = \Pi_1 X_{t-1} + \Pi_2 X_{t-1} + u_t$

where

Xt is an n * 1 vector of variables that are integrated of order one.

u_t is an n * 1 vector of innovations while$\Pi_1$through Πp are m*n coefficient matrices.

Trace Test

The trace test tests the null hypothesis of r co-integrating vectors against the alternative hypothesis of n co-integrating vectors. The test statistic is given by

$$\tau_{trace} = -T \sum_{i=r+1}^{k} ln(1 - \lambda_i)$$

Maximum Eigenvalue Test

The maximum eigenvalue test, on the other hand, tests the null hypothesis of r co-integrating vectors against the alternative hypothesis of (r + 1) co-integrating vectors. Its test statistic is given by

$$\tau_{trace} = -T(1-\lambda r)+1$$

Where T is the sample size, and λ_i is the i^{th} largest canonical correlation.

Granger Causality Test

Granger pointed out that if a pair of time series is co-integrated, and then there must be causation in at least one direction. According to the Granger causality (Granger, 1969) approach a variable Y is caused by X, if Y can be predicted better from past values of Y and X, than from past values of Y alone. Moreover X 'Granger causes' Y if past values of X can help explain Y. If Granger causality holds this does not guarantee that X causes Y. But, it suggests that X might be causing Y. Four patterns of causality can be distinguished:

- Unidirectional causality from X to Y;
- Unidirectional causality from Y to X;
- Feedback or bi-directional causality; and
- No causality.

For a simple bivariate model, the pattern of causality can be identified by estimating regression of Y and X on all the relevant variables including the current and past values of X and Y respectively and by testing the appropriate hypothesis. The causal relations between stationary series xt and yt can be established based on the following equations:

$$\Delta X_t = \alpha_0 + \lambda_1 EC^1{}_{t-1} + \sum_{i-1}^{m} \alpha_i \Delta X_{t-i} + \sum_{j=1}^{n} \alpha_j \, \Delta Y_{t-j} + \varepsilon_{1t}$$

$$\Delta Y_t = \beta_0 + \lambda_2 EC^2{}_{t-1} + \sum_{i-1}^{m} \beta_i \Delta Y_{t-i} + \sum_{j=1}^{n} \beta_j \, \Delta X_{t-j} + \varepsilon_{2t}$$

Where Δ is the first difference operator; EC_{t-1} is the error correction term lagged one period; λ is the short-run coefficient of the error correction term (-1 <λ<0); and ε is the white noise. The error correction coefficient (λ) is very vital in this error correction estimation as the greater coefficient indicates higher speed of adjustment of the model from the short-run to the long-run. Sometimes we check for Granger causality simply (albeit imperfectly) using only t-tests. The P-values for the t-states on individual coefficients can be used to determine whether Granger causality is present.

Results and Discussions

Unit Root Tests

It was felt that prior to causality testing, it is essential to examine the time series properties of the given variables in levels or in differences. Now, it is required to determine the order of integration for each of the two variables used in the analysis along with their stationarity tests. Stationarity of the area and production of peanuts in Tamil Nadu series is examined using ADF tests and the results are presented in Table. 1, 2, 3 & 4.

Table – 1

Augmented Dickey-Fuller Test for Area of Peanuts

Null Hypothesis: D (Area) has a unit root Exogenous: Constant Lag Length: 0 (Automatic – based on SIC, Maximum lag = 7)			
	t - statistic		Probability*
Augmented Dickey-Fuller test statistic	-10.270		0.000
Test critical values	1% level	-3.679	
	5% level	-2.968	
	10% level	-2.623	

Source: Calculated by Authors.

*MacKinnon (1996) one-side p-values

Table – 2

Least Square Test for Area of Peanuts

Augmented Dickey-Fuller Test Equation Dependent Variable: D (Area,2) Method: Least Squares				
Variable	Co-efficient	Standard Error	t - Statistic	Probability
D (Area (-1))	-1.434	0.140	-10.270	0.000
C	-5010.028	32286.75	-0.155	0.878

Source: Calculated by Authors.

*MacKinnon (1996) one-side p-values

Table – 3

Augmented Dickey-Fuller Test for Production of Peanuts

Null Hypothesis: D (Production) has a unit root Exogenous: Constant Lag Length: 0 (Automatic – based on SIC, Maximum lag = 7)			
	t - statistic		Probability*
Augmented Dickey-Fuller test statistic	-6.519		0.000
Test critical values	1% level	-3.679	
	5% level	-2.968	
	10% level	-2.623	

Source: Calculated by Authors.

*MacKinnon (1996) one-side p-values

Table - 4

Least Square Test for Production of Peanuts

Augmented Dickey-Fuller Test Equation Dependent Variable: D (Production,2) Method: Least Squares				
Variable	Co-efficient	Standard Error	t - Statistic	Probability
D (Production (-1))	-1.183	0.181	-6.519	0.000
C	-17962.72	42222.93	-0.425	0.674

Source: Calculated by Authors.

*MacKinnon (1996) one-side p-values

Above tables presents the calculated t-values from ADF tests on each variable in first differences. Although we have included trend in levels, we exclude it in first differences. Since the calculated values are greater than the critical value at five per cent level for Area and Production of Peanut in Tamil Nadu, none of them have unit root, when their first differences are taken. The results of the ADF tests indicate that the variables are integrated of order one, i.e., I(1).

Johansen's Co-integration Test

Johansen's Co-integration test is performed to examine the long-run relationship between area and production of groundnut in India and its results are presented in Table-5&6.

Table 5

Unrestricted Co-integration Rank Test (Trace)

Co-integration Equation	Eigen-value	Trace statistics	5% critical value	Prob. **
None*	0.386	15.985	15.495	0.042
At Most 1	0.061	1.835	3.842	0.176

Trace test indicates one co-integrating equations at the 0.05 level.

*denotes rejection of the hypothesis at the 0.05 level.

**Mackinnon – Haug – Michelis (1999) p – values.

Table 6

Unrestricted Co-integration Rank Test (Maximum Eigen)

Co-integration Equation	Eigen-value	Max-Eigen statistics	5% critical value	Prob. **
None	0.386	14.150	14.265	0.052
At Most 1	0.061	1.835	3.842	0.176

Source: Author's own calculation.

Max-Eigen value test indicates no co-integrating equations at the 0.05 level.

*denotes rejection of the hypothesis at the 0.05 level.

**Mackinnon – Haug – Michelis (1999) p – values.

Table-5 shows that we can reject the hypothesis of 'no co-integrated equations (trace)' at 5 per cent level of significance but table-6 demonstrates that we cannot reject the hypothesis of 'no co-integration equation (maximum eigen) at 5 per cent level of significance. So we can conclude that area of peanut is co-integrated with production peanut in Tamil Nadu, in other words there is long run relationship between two variables.

Granger Causality Test

The results of Granger Causality test have been presented in table-7.

Table 7

Granger Causality Test

Null Hypothesis	F Statistic	Probability	Decision
Production does not Granger Cause of Area	16.767	0.000	Rejected
Area does not Granger Cause of Production	1.069	0.310	Accepted

Source: Author's own calculation.

There are two ways in which causality can express itself: through the F-test of joint significance of the lagged differenced terms. It can be seen that in this case of Tamil Nadu F-statistics are significant at 95 per cent level of confidence. Thus, the data suggest that there is causality in one way direction from production to area of peanuts in Tamil Nadu.

Conclusion

This paper has examined the possibility of granger causality between the area and production of peanuts in Tamil Nadu during 1990-91 to 2020-21. The study findings suggest that area and production of peanuts are co-integrated, so there is the long run relationship between area and production of peanuts. Moreover, the granger causality result indicates that there is one way causal relationship running from production to area of peanuts in short run. Most of the soils in Tamil Nadu are deficient in zinc, boron, and iron (micronutrients). In addition to the basic use of essential nutrients, especially nitrogen, phosphorus, and potassium, the peanut crop also needs some micronutrients on a minimum dose. Technology has been developed by the oilseed research station, Tindivanam (TNAU) to provide micronutrient mixture as a foliar application during the flowering stage to increase yield. The agriculture development unit of every state has subsidy schemes outlined for various crops with different percentages. It is advisable to visit the nearest agricultural office to know more about these schemes as they keep changing every year. NABARD is one such organization which provides assistance to farmers in different ways through various subsidy schemes. There are certain schemes organized by public sector firms to promote the use of improved varieties of the seed for peanut farming in India and the schemes are Seed village program Beej swavlambanYojna Contract seed production.

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