



GROWTH, INSTABILITY AND SUPPLY RESPONSE OF PADDY CROP (A Study in Costal Andhra Region of Andhra Pradesh)

ABSTRACT

Indian agriculture playing 2nd rank in worldwide in forming output, while development occurs, the population grows and per capita income rises. Though the agriculture sector is the largest sector of the nation's economy and offered employment above fifty percent of the total population, the demand for agricultural products is increasing day-to-day in India due to enormous growth of population. Andhra Pradesh also no exempted from this. The growth of agricultural sector (area, production and yield) had not been uniform or steady. There were considerable fluctuations observed in the sector by the post studies. The fluctuations were caused by many reasons. An increased in cropped area may not raise the output of the crop. It is able to raise the production through the raising of productivity to meet the demand for agriculture produce. Hence, it is necessary to study 'growth and instability and supply response of selected paddy crop in Coastal Andhra region of Andhra Pradesh state. To find out growth and instability simple linear regression model and co-efficient of variation used and tested by F-test statistics and to examine the supply response of crop hectareage Nerlovian partial adjustment adaptive expectation model was used. It helps to take appropriate policy decisions on cropped area, production and yield. It also helps to raise the national income.

J. Siva Sankaramma¹

*Research Scholar
Department of Economics
Sri Krishnadevaraya University
Anantapuramu
Andhrapradesh
India*

**Prof. K. Satyanarayana
Reddy²**

*Professor
Department of Economics
Yogi Vemana University
Kadapa
Andhrapradesh
India*

KEYWORDS: Agriculture, Population, Production, Economic Development, Income.

INTRODUCTION

Economic development is continuous and dynamic process involving constant change in the structure and behaviour of the economy. In relatively high income countries where a large and complex administrative structure and a high rate of capital formation are more readily available, growth trends to proceed more rapidly than in low income countries. Most of the people in India depended mainly on agriculture. Agricultural production pre-supposes not only an

increasing per capita demand for food but also large supply of other commodities. For rapid economic development, expansion of non-agriculture sectors is necessity in low-income countries. Expansion of non-agriculture sectors requires vast quantities of capital.

The pace of economic transformation has an important implication to both the role and the strategy of agricultural development. On the one hand, the pace of transformation is the key-determinant of the size and rate of transformation and the specific nature of the

agriculture sector determine the extent to which economic development depends on capital formation in agriculture and transfer of capital from agriculture to other sectors. It is likely that production in the non-agricultural sector can be expanded at least in proportion to the increase of capital and labour. The production expands more than proportionately with increased capital and labour input in these sectors.

Agriculture is to play a dynamic role in economic development sources of capital for economic developments are classified into two categories- domestic savings, foreign aid and foreign commercial investment. A low income country depend more on foreign aid and foreign commercial investment and less on domestic savings. Agriculture may make significant contributions to net foreign exchange earnings through displacement of current and potential imports and through expanded exports. The contribution from import displacement may represent a direct displacement of imports of agricultural commodities through expanded domestic production and through a shift in consumption patterns toward domestically produced agricultural commodities.

Agricultural development programmes normally increase the welfare of a large population of low income countries. Agricultural development programmes will have at best an indirect welfare effect on two groups (land and labour) of the rural population. The land less labourers derive benefits of the agricultural development only in so far as technological change creates greater employment opportunities for hired labour. The improved welfare for this group will depend to a large extent on creation of non-farm Job opportunities.

REPUTATION OF AGRICULTURE IN INDIAN ECONOMY

Agriculture farms are the back bone of the Indian economy and despite concerted industrialization in the recent past, agriculture continues to occupy a place of pride. Being the largest industry in the country, agriculture is the source of livelihood for over seventy percent of population in the country. The significance of agriculture in national economy can be the best explained by considering the role of agriculture under different heads.

The share of agriculture in national income is often taken as an indicator of economic development. Normally, developed economies are less depends on agriculture when compared to under developed countries. But in India the share of agriculture has persistently declined on account of the development at the secondary and tertiary sector of the economy. In 1950-51 the share of agriculture in net domestic product was roughly fifty percent. It has declined steadily to 15.7 percent in 2010-11.

With rapid increase in population, the absolute number of people engaged in agriculture and allied activities has become exceedingly large. Development of the other sectors of the economy has not been sufficient to provide employment to the increase additions to working population who are, therefore, forced to fall back upon agriculture even if their marginal productivity on land is zero or nearly so. This gives rise to the familiar problem of under employment and disguised unemployment. According to Indian census, nearly 52.1 percent of India's working population is engaged in agriculture in 2010-11.

In India, as in other developing countries agriculture plays an important role in industrial development. Agriculture provides raw material to the cotton textiles, Jute, Sugar and Vanaspati and plantation- all these depend on agriculture, which are of basic importance of the growth of national income. But then in recent years, the significance of agriculture to industries is going down as many new industries have been coming up which are not dependent on agriculture. Despite this, as agriculture develops in India and as the incomes occurring to the rural people increase the size of the market for industrial products in rural areas will also increase.

REVIEW OF LITERATURE

The study of K.R. Shanmugam (2003) reveals the farm-specific technical efficiency of raising major principal crops. He employs the stochastic frontier production function technique to measure the technical efficiency of rice, paddy and cotton farm in Tamil Nadu. The technical efficiency of raising irrigated groundnut is relatively high in own land cultivation as compared with that of leased land cultivation. Farmers having a high promotion of family members with middle school education are more efficient in raising groundnut.

Rahji and Adewunmi (2008) conducted a study on the market supply response and demand for local rice in Nigeria with implications for self-sufficiency policy. The main objective of the study was to apply a supply response model to rice production in Nigeria. This study examined the supply response and demand for local rice in Nigeria between 1960 and 2004. A system of equations using secondary data was estimated by OLS and 2 Stage Least Square techniques. The short run response elasticity is 0.077. The implied long run response elasticity is 1.578. The partial adjustment measure is 0.49 thereby indicating some difficulties in the supply response to changing economic conditions. The price elasticity of demand obtained is 0.841. The demand for local rice is thus price inelastic. Rice income inelasticity is 0.3378, that is, it is also

inelastic. The ban on rice importation could be said to be a step in the right direction. This policy should be continued and policed. However, price, output and non-price incentives that can exert significant influence on rice supply response and demand are required if the self-sufficiency goal is to be achieved.

K. SubbaramaRaju and P.B.Parthasarthy study is related to supply response and influence of growth on supply response and adjustment mechanisms were assessed for major oilseed crops by regions in Andhra Pradesh. The adjustment mechanism indicates less

number of years required to realize the price effect, when compared with the low growth districts in each region of Andhra Pradesh. The growth concept can be better utilized in the location-specific and crop specific research schemes and in the growth oriented development programmes.

OBJECTIVES

The following are the core objectives of the present study,

1. To study the growth and instability in area, production and yield and
2. To examine the supply response of paddy crop in Coastal Andhra region, Andhra Pradesh.

METHODOLOGY

To fulfil the first objective of the study both the linear and log-linear models were estimated with the graphs were shown along with the original trend for paddy crop. But analysis was carried out only for linear model.

The simple linear regression model was used. The model was

$$Y = a + bt$$

Here,

- Y = area / production / yield
- a, b are the constants to be determined
- t = time point

The percentage of linear growth rate is calculated by the formula

$$L. G. R = \frac{\hat{b}}{\bar{Y}} * 100$$

\hat{b} is tested by 't'-test statistic

$$t = \frac{\hat{b}}{S.E(\hat{b})}$$

Where,

$$S.E(\hat{b}) = \sqrt{\frac{\sum(Y - \bar{Y})^2}{N}}$$

To determine the instability in area, output and yield of the paddy crop, the co-efficient of variation was calculated by the formula

$$C. V. = \frac{\sigma}{\bar{Y}} * 100$$

Where,

- σ = standard deviation
- \bar{Y} = mean of area / production / yield

To fulfil the second objective, supply equations have been estimated with the help of Nerlovian partial adjustment adaptive expectation model. The farmer decides the hectareage to be planted under different crop on the basis of expected future prices. The farmer adjusted the current planted area to the desired area in the current production year due to techno-economic and instructional constraints. Nerlove introduced the element of dynamism by introducing the concept of distributed lags in the analysis of the hectareage of the agricultural commodities. He defined the long-run supply response function as follows:

$$A_t = C_0 + C_1 P_{t-1} + C_2 A_{t-1} + U_t \dots\dots\dots (1)$$

Where,

$$C_0 = a_0 B, C_1 = a_1 B, C_2 = (1-B)U_t = B V_t$$

The equation (1) is helpful in the estimation of short-run and long-run price elasticity and they can be obtained by using the relations:

$$SRE = C_1 \frac{\bar{P}_{t-1}}{\bar{A}_t} \dots\dots\dots (2)$$

$$LRE = \frac{C_1}{1-C_2} \frac{\bar{P}_{t-1}}{\bar{A}_t}$$

Where,

\bar{P}_{t-1} and \bar{A}_t are the means (averages) of P_{t-1} and A_t respectively.

$$A_t^* = B[a_0 + a_1 P_{t-1} + a_2 Y_{t-1} + a_3 C V_p + a_4 C V_y + a_5 R_t + a_6 I_t + a_7 D + V_t]A_{t-1}(1-B) + Z_t$$

$$A_t^* = C_0 + C_1 P_{t-1} + C_2 Y_{t-1} + C_3 C V_p + C_4 C V_y + C_5 R_t + C_6 I_t + C_7 D + C_8 A_{t-1} + U_t \dots (3)$$

Where,

$$C_0 = a_0 B; C_1 = a_1 B; C_2 = a_2 B; C_3 = a_3 B; C_4 = a_4 B;$$

$$C_5 = a_5 B; C_6 = a_6 B; C_7 = a_7 B; C_8 = a_8 B; U_t = B V_t + Z_t$$

Variables are denoted as follows -

A = actual area planted in 1,000 hectares under the crop.

t = 'tth' production period.

P_{t-1} = farm harvest price of the crop (/ Quintal) lagged by one year.

Y_{t-1} = yield of the crop by one year (Kilograms /Hectares).

$C V_p$ = co-efficient of variations of the prices of the crop connected for the yearst-1, t-2, t-3 used as a measure of price risk.

$C V_y$ = co-efficient of variation of yields of the crop concerned for the years t-1, t-2, t-3 used as a measure of yield risk.

R_t = rainfall for the sowing season for the crop concerned in millimetres.

D = dummy variable to pick up the effect of the left out variables of new technology. Thus the dummy variable will specify the constant terms for the period of 1985-86 to 2010-11.

I_t = irrigated area under all crops in 1,000 hectares.

U_t = stochastic disturbance term.

C_1 's = regression co-efficients.

Bothe the linear and log linear models for the equation (1) and (3) were fitted to the data and the results discussed to evolve a better model.

ANALYSIS

Growth and Instability:-

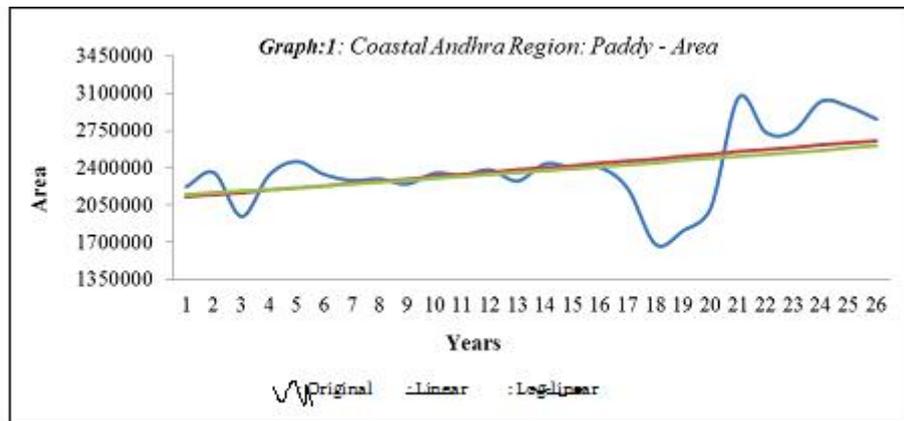
Trends, growth rates and instability were analysed with three views i.e., area, production and yield for selected food crop (paddy) with the help of the lineal equations, co-efficient of variation and also given graphical representation in Coastal Andhra region, Andhra Pradesh.

1. **Area;** Linear regression equation for area under paddy crop is

$Y=2105423.98+21143.844*t$	L.G.R = 0.8843 %	C.V =14.12 %
----------------------------	------------------	--------------

From the above equation, the estimated value of 'b' is 21143.844. It reveals that there is increasing trend in paddy (area) in Coastal Andhra region. This is noticed that on average, 21143.8 hectares are increasing every year during the study period. It is significant at 5 per cent probability level. The linear growth rate (LGR) is estimated and found as 0.8843 per cent. It shows that the average

annual increase in growth of area of paddy in the region is 0.88 per cent. It may infer that the paddy cultivation is not profitable to its growers. The value of the intercept term i.e., 'a' is 2105423.98. The coefficient of variation is 14.12 per cent and it reveals that 14 per cent of variation is in area of paddy during the study period as shown with the following graph-1.

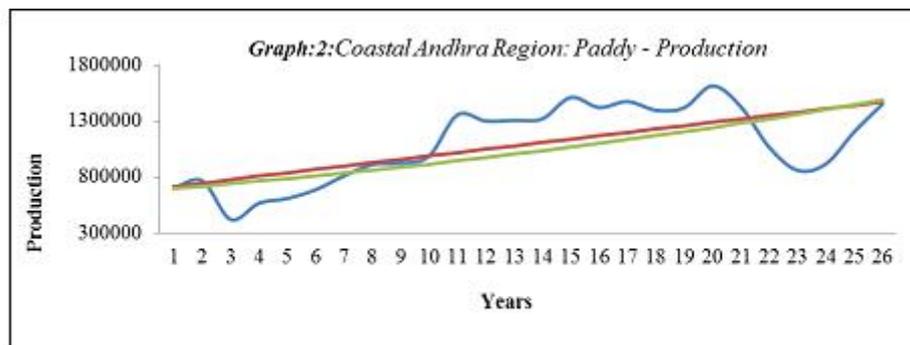


2. **Production;** the fitted equation of linear regression for paddy production is

$Y=684295.27+30332.92*t$	L.G.R=2.7732 %	C.V =31.98 %
--------------------------	----------------	--------------

The linear growth rate is 2.7732 per cent. This rate shows that the average annual increase in growth of production of paddy in Coastal Andhra region is 2.77 per cent. The value of the intercept is 684295.27. The estimated value of 'b' is 30332.92. This positive and significant value

reveals that there is an increasing trend in paddy production in Coastal Andhra region. It shows that on average, 30333 tons of paddy output is increasing every year during the study period. The coefficient of variation is 31.98 per cent.

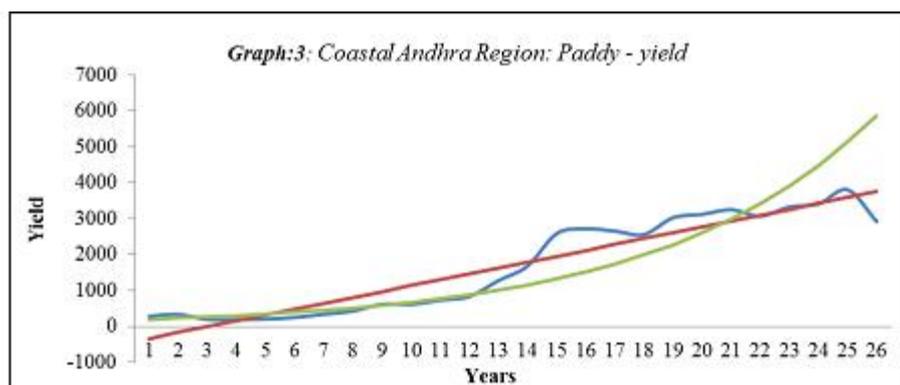


3. Yield; the estimated equation of regression for paddy yield is

$Y = -497.75 + 163.525 * t$	L.G.R = 9.5637 %	C.V = 75.56 %
-----------------------------	------------------	---------------

From the above equation, the estimated value of 'b' is 163.252. It reveals that there is an increasing trend in the yield of paddy in Coastal Andhra region. This value reveals that an average, 163.5 kilograms are increasing every year during the study period. The linear growth rate is found as 9.5637 per cent. This rate shows that the

average annual increase in yield of paddy is 9.5 per cent. The value of the intercept term is -497.75. The coefficient of variation is 75.56 per cent and it reveals that 75.5 per cent of variation is in yield of paddy during the study period as shown with the following graph-3.



SUPPLY RESPONSE

Equation -1:-

Coefficients	Estimated Values
b_0	11.0296 (2.8741)
P_{t-1}	0.1010* (0.0704)
A_{t-1}	0.2071* (0.2033)
R^2	0.1647
\bar{R}^2	0.0921
F	2.2686*
Note: Figures in parentheses are standard errors of the estimates. * Significant at five per cent probability level.	

It was best fitted the log-linear regression models to study the supply response of paddy (selected food crop). The analysis was carried out for the region of Coastal Andhra in Andhra Pradesh state. In the present study, the dependent variable was the area under paddy crop in current year (A_t), and the independent variables are lagged farm harvest price (P_{t-1}) and lagged year area (A_{t-1}). The results are drawn to study the combined and individual effect of both lagged price (P_{t-1}) and lagged area (A_{t-1}) on current year cropping area of paddy. The data was fed to equation -1 which is supply area response function and the results were shown in the following table-1.

The multiple correlation coefficient (R^2) indicates the collective effect of both independent variables on dependent variable i.e., area under the paddy crop is to be 16 per cent. From F-test statistic, this collective effect (R^2) of independent variables is found to be significant (2.2686). The coefficient of \bar{R}^2 is 0.0921. The factor figure of the lagged price (P_{t-1}) is 0.1010. It shows that the area under the paddy crop is positive and significant. It means as the price of paddy increases the area under paddy crop may be raised significantly by its growers. So, it is drawn that area under paddy crop is suggestively price responsive.

The coefficient of lagged area (A_{t-1}) is 0.2071. This figure indicates that if there was any increase in independent variable the dependent variable also will increase insignificantly. So, it was found that in the view

of the equation-1 both the independent variables are affecting significantly with its progressive nature in the study area. The value of coefficient of constant term i.e., b_0 is 11.0296.

Equation – 3:-

Coefficients	Estimated Values
b_0	0.1602 (0.0064)
P_{t-1}	-0.0003 (0.0002)
Y_{t-1}	0.0006 (0.0005)
CV_p	-1.3981 (0.0001)
CV_y	-0.0001 (0.0001)
R_t	-0.0011 (0.0003)
I_t	0.9907* (0.0005)
D	0.0001 (6.5683)
A_{t-1}	-0.0006 (0.0003)
R^2	0.9499
\bar{R}^2	0.9099
F	13.1315*

Note: Figures in parentheses are standard errors of the estimates. * Significant at five per cent probability level.

To study the combined effect of all independent variables namely, lagged price (P_{t-1}), lagged yield (Y_{t-1}), the coefficient of variation of preceding three years price (CV_p), the coefficient of variation of preceding three years yield (CV_y), current year rainfall (R_t) current irrigated area (I_t), dummy variable (D) (the effect of the left out variables like new technology, HYV, use of fertilisers and chemicals etc.) and lagged area (A_{t-1}) on dependent variable (current cropping area of paddy (A_t)) it is adopted the equation-3, shown in methodology. The findings of all variables are given in table-2.

The coefficient of lagged area (A_{t-1} ; -0.0006), the coefficient of lagged price (P_{t-1} ; -0.0003), current year rainfall (R_t ; -0.0011), the coefficient of variation of preceding three years yield (CV_y ; -0.0001) and the coefficient of variation of preceding three years price (CV_p ; -1.3981) are having negative relationship with dependent variable but not significant at 5 per cent probability level. It means the dependent variable is affecting damagingly by independent variables of the coefficient of lagged area (A_{t-1}), the coefficient of lagged price (P_{t-1}), current year rainfall (R_t), the coefficient of variation of preceding three years yield (CV_y) and the coefficient of variation of preceding three years price (CV_p).

So, there is no scope to improve the cropping area (A_t) by increasing the above said variables. Contradictorily, the coefficient of lagged yield (Y_{t-1} ; 0.0006) and the coefficient of irrigated area (I_t ; 0.9907) are showing its positive and significant effect on current year cropped area (A_t) except the coefficient of lagged yield. It indicates as the irrigated area of paddy increases the area under the paddy crop raised 99 per cent by its growers i.e. the area under paddy is perfectly irrigated area responsive in study area and this growth is significant at 5 per cent probability levels. The value of coefficient of b_0 (constant) is 0.1602.

The collective effect of all independent variables on dependent variable i.e., current year cropping area of paddy is 95 per cent. This collective effect of independent variables on dependent variable is tested by F-test statistic as significant (13.1315) during the study period. The value of adjusted multiple correlation (R^2) is 0.9099.

FINDINGS AND SUGGESTIONS

The linear growth rate is estimated and found as positive trend 0.8843, 2.7732 and 9.5673 percent regarding to *area, production* and *yield* of paddy crop in Coastal Andhra region in the study period. But towards area this positive growth rate is insignificant by t-test statistic at 5 percent probability level.

The coefficient of variation is 14.12, 31.98 and 75.56 per cent of instability is in the view of *area, production* and *yield* of paddy crop during the study period.

Accordance with the equation-1, the effect of lagged price (P_{t-1}) on cropped area (A_t) is positive and the effect of lagged area (A_{t-1}) on cropped area (A_t) of paddy is positive and significant in Coastal Andhra region

The combined effect of both independent variables on dependent variable is calculated by the multiple regressions coefficient (R^2) and is similar in all regions including state as a whole. It is tested by F-test statistic as significant at 95 per cent of confidence.

There is no scope to improve the cropping are (A_t) by increasing the above said variables in Coastal Andhra region. Contradictorily, the coefficient of lagged yield (Y_{t-1} ; 0.0006) and the coefficient of irrigated area (I_t ; 0.9907) are showing its positive and significant effect on current year cropped area (A_t) except the coefficient of lagged yield. It indicates as the irrigated area of paddy increases the area under the paddy crop raised 99 per cent by its growers i.e. the area under paddy is perfectly irrigated area responsive in Coastal Andhra region and this growth is significant at 5 per cent probability levels. The value of coefficient of b_0 (constant) is 0.1602.

MEASURES TO IMPROVE CROPPING AREA, PRODUCTION AND PRODUCTIVITY OF PADDY

Major constraints to rice production that India faces are land, water, labour and other inputs such as fertilizers, pesticides and insecticides, and even high quality germ plasma, without affecting the already degraded and stressed agricultural environment. The problems of flash floods, water logging/submergence due to poor drainage are very common in South India. Due to the non-availability of seeds farmers are using continuous of traditional varieties, lack of awareness of farmers about high yielding varieties is the major constraint low soil fertility, due to soil erosion resulting in loss of plant nutrients and moisture. Low and imbalanced use of fertilizers, low use efficiency of applied fertilizers particularly in the South Indian States.

1. Need of stabilizing policies towards area and production of paddy crop, in Coastal Andhra.
2. To improve location specific technology through research, development and extension efforts and also ensured input supply mechanism.
3. It is possible that most of the fluctuations are due do to price and payment polices. This is an area that needs to be investigated.

4. There is more scope to raise the area under these food crops by enhancing or offering the more prices and providing better irrigation and marketing facilities to its producers.
5. To get best results in production and productivity by enhancing the consumption of bio-fertilizers.
6. The introduction of new seed-irrigation-fertilizer technology supported by remunerative pricing policy encouraged the farmers to put more and more area under these two crops.
7. Adequate number of improved/high yielding varieties may be evolved for rain fed eco-system, which constitutes nearly 60% of the cultivated rice area.
8. Rice area in Eastern region is 59% of total area but productivity is very poor. Hence, suitable technology and varieties may be developed for this state so that productivity could be increased.
9. More number of cold tolerant high yielding varieties are required to be developed and popularized for different altitudes of hill regions.
10. Leguminous crops may be included in the cropping system in order to improve the soil fertility.
11. Saline, alkaline and acidic soils may be reclaimed by application of soil ameliorants.
12. To encourage the Integrated Pest Management approach for effective control of pests and diseases by emphasizing the need based application of pesticides.
13. Another green revolution should be needed towards accelerate production and yield of food crops in the state.
14. Abolish role of mediators at the time of selling crops by farmers.
15. Provide interest-free loans to farmers at cropping time sufficiently.
16. Provide guaranteed crop-insurance for all type of crops overall the state.

REFERENCES

1. Ray. S.K. "Growth and instability in Indian Agriculture", June Research Report (unpublished), Institute of Economic growth Delhi.
2. Mahendradev. S., "Growth and instability in Food Grains production. In *Interstate Analysis*", Economic & political weekly, Review of Agriculture Vol. 22, No. 39, 1987, pp. A 82-92.
3. Surespal and Sirohi, A.S. "Source of Growth and instability in production of Commercial crops in India", Indian Journal of Agricultural Economics Vol. 4; No-3, July-September 1988, Pp – 456 – 463.

4. Maji C.C; and L.S. Venkataramanan, "Dynamic Supply and Demand models for Better Estimations and Projections; An econometric study for Major Food grains in the Punjab Region", *Indian Journal of Agricultural Economics*, Vol. 26, No. 1, January – March 1971, Pp. 21 – 34.
5. SS. 2003. Disease management factors influencing yield and quality of sorghum and groundnut crop residues. *Field Crops Research* 84:89-103.
6. Gupta, S.C. and Majid. A. "producer's Response to change in prices and marketing polices; A case study of Sugarcane and paddy in Eastern Uttar Pradesh", *Agro-Economic Research centre, University of Delhi*, 1965.
7. Suryanarayana, K.S, (1980) "Economic Aspects of yield increasing Technology in producing Food grains in A.P. ", *Final Technical Report Pp. 236. USDA Dunded Scheme; Dept. of Agri-Economics APAU, Hyderabad.*
8. M. Lathika and C.E. Ajith Kumar, "Growth trends in area, production and productivity of coconut in India ", *Indian Journal of Agricultural Economics*, Vol. 60 No.4 October – December 2005, P.P. 686-697.