CHAPTER - II

Methodology
The agriculture sector is the biggest sector of the nation’s economy affording employment to majority of the population. A rise in income and living standards of the population through the improvement of yield and efficiency of agriculture not by mere shift away from agriculture but directly through investment of capital and improvement in technique bearing on the day-to-day operations of agriculture, was called for. Agriculture in developing economies was believed to be tradition-ridden and hence non-responsive to economic stimuli in developing economy, the growth of agricultural produce assumed critical importance due to rising demand for them generated by rapidly growing population and accelerated by rising levels of income. This way a wider problem and depended on the expanding potential of the agriculture sector as well as on increasing flow of resources into agriculture. In case of food, commercial and oil seeds crops, the demand for food products is increasing day-by-day with the growing population in the country. It is necessary to study about the price and production responses of Paddy, Groundnut and Sugarcane. It is also proposed to study the growth and instability of three selected major crops.

Agriculture being the predominant sector of its economy, the level and pace of economic development in Andhra Pradesh has been still continuing to be significantly influenced by the face of its agricultural development. The growing of area however had not being uniform or study there had
been considerable fluctuations in both area and production that led to the fluctuation in yield. Fluctuations in area of crops were caused by variation in price, whether conditions, availability of irrigation facilities, marketing etc. It is the fact that area of individual crops varying systematically in response to inter-crop price movement widely accepted on the basis of area response studies. Most of the studies, implicitly or explicitly assumed a close and direct relationship between area and output. An increase or decrease in area was regarded as a proxy for an increase or decrease in output of food crops. Although such assumption was generally valid it is worth pointing out that in subsistence agriculture, where yield could fall, an increasing area did not guarantee a raise in output. Hence, a direct test of relationship among output, area, price, and some non-price variables assumed to be both necessary and important to form a better Judgment about output response in under developed agriculture.

Statement of the problem:

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 population. Andhra Pradesh also not exempted from this. The growth of agricultural sector (area, production and productivity) 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 responceof selected crops’ (paddy, groundnut and sugarcane) in the regions of Andhra Pradesh state and the state as a whole. It helps to take appropriate policy decisions on cropped area, production and yield of the selected crops. It also helps to raise the national income.

**Schoolwork of Literature:**

Parthsarathy and John (1959) observed negative relationship in the case of sugarcane versus paddy. Both of them observed that changes in acreage are not included by changes in prices but by changes in profitability. The area under sugarcane increased even during the period when the prices of sugarcane were under decline.

Dhiarm Marian’s (1965) study is developed to a graphical comparison of year to year variations is acreage of six crops cotton, Jute, groundnut, sugarcane, rice and wheat. He concluded that the Indian farmers are significantly responsive to price. He has proved that in some specific regions, at least price exerts a significant influence on the variations of food grains area.

Rao (1965) attributed yield variability to be the cause for variability in the output. Analyzing the variability in Indian Agriculture, Mehra (1981)
has highlighted the association between increase in yield variability and the use of fertilizers per unit of land obviously the area and yield variability’s result in the variability in agricultural productions.

S.C. Gupta and A. Majid (1965) have examined the effectiveness of relative prices in bringing out the changes in acreage sown under A time lag of one year is allowed in the analysis of association of harvest prices and acreage under crop. The investigation has computed the link relatives of relative prices and the relative acreage on a year-to-year basis.

The link between growth and variability was first hypothesized by Sen (1967) early in the Post-independence period when growth was largely based on area expansion.

Minhas and Vidyanathan (1965) in their inter-state and inter-district analysis of output study decomposed the growth of crop output in India into four components for the period 1951-54 to 1958-61, the crop pattern, according to the authors, did not contribute significantly, while area and yield contributions turned out to be highly significant.

Sen (1966) in his study of foodgrains production and index number of agricultural production for undivided India from 1900-1901 to 1947-48 and for Indian union from 1936-37 to 1965-66 concluded that:

i. During the first 24 years, the country’s food grain production was at an annual rate of growth of 0.3 percent.
ii. A rising trend in food grain production was associated with increase in instability.

Thiruvenkatachari and Swami Nathan (1967) obtained a growth rate of 2 percent per annum for area under rice and 8 percent per annum for total output for the period 1955-56 to 1961-62. The growth rate in respect of yield of rice was 3 percent per year.

P.V. John (1968) has analyzed the impact of price variation on acreage and output of the crops in India. He used an exponential function of the form $y = ab^x$.

He has considered three types of responsiveness,

1) Changes in the area and output of a crop in response to change in its prices

2) Change in the area and output of a commodity in response to change in the relative prices of its substitute crops

3) Changes in the area and output of a commodity in response to changes in the price of that commodity relative to changes in the average price of a composite group of commodities that can be grown as its substitute.

He has adopted the congenital approach of relative prices prevailing the previous year to area and output in the current year. He found in the majority of cases a positive relationship of one kind or another between price and area output and relative price and relative area/relative output.
Minhas and Srinivasan (1968) from their study claimed that the growth rate of food grains had remained constant.

Vidyanathan (1977) while analyzing growth trends for food grain production for the period 1950-51 to 1975-76 observed that although the rate of growth of food grain production had remained constant, the rate of growth of agriculture as a whole had shown a slight tendency to decelerate.

Alagh and Sharma (1980): Studied the growth rates of food grains and a few selected cash crops at the national level during the periods 1960-61 to 1969-70, 1969-70 to 1978-79. The growth rates of all crops were higher in most of the states during the second period. The rate was 1.85, 2.74 & 2.77 percent per annum during the three phases respectively. Andhra Pradesh had a recovery during phase-II.

Subramaniam (1980) used compound growth rate functions to find out growth rates of area, production and productivity of fruits and vegetables for the period 1949-1950 to 1980-1981. The author suggested education, introduction crop rotation and adoption of new technology to the growers for rapid growth of horticultural crops as remedial measures.

Hazel (1982) observed that “the substantial growth in world production of the past two and half decades has been accompanied by a widening band of variability around the trend. Although each through in production has been consistently higher than in an previous downturns, the probability that
aggregate production can fall substantially below trend has increased since the 1960’s.

Suresh Pal and A.S. Sirobi in their study used co-efficient of variations, to measure the magnitude of instability. The pattern of changes in the source of growth and instability was examined using Hazel’s (1982) decomposition scheme. The growth and stability in the production of commercial crops were complementary rather than competitive process in intensively irrigated regions.

Anita Ghatak and Subrata Chatak, (1985) Studied output Response in under developed agriculture, a case study in West Bengal district: They concluded that the output is significantly influenced by area under cultivation. The impact of acreage on output seems to be stronger than that of price. They used the Adaptive Expectation Model in their study.

The studies of Sangawan revealed that he cash are more elastic to price movements than food crops. But the impact of the yield in their proportionate acreage at the cost of competing crops shows only insignificant results than the price. It is not worthy to mention that rapeseed or mustard seed, gram is positively and significantly related with the yield.

According to the study of Cummings, the farmers all over the country are fully aware of both potential prices and prevailing market conditions.
This is true not only in the case of cash crops but also cereals crops. Cummings stressed that analytic efforts should be made in strengthening the supply response of the formers.

The inference drawn by DayanathJha were equally relevant to Mellor who had mention that the agriculture price only was not a direct stimuli of output. He pointed that the increase or the stimulant output would be the acreage responsiveness. But during the times of modernisation and technological change it can be accepted that the price policy may have a direct response to the yield.

The study of Kaul and Siddu revealed that the elasticities in long-run were higher than the short-run period. They have quoted that the elasticities were more than one in case of cash crops namely, groundnut and desi-cotton. They have also said about the risk abiding crop. They said that the maize, groundnut and desi cotton were high risk crops compared to the low risk crops like paddy and wheat.

Krishna has confirmed that the economic forces influence acreage response in both developed and under-developed countries. His work was confined to areas of undivided Punjab region. He adopted Nerlov’s lagged adjustment model in the Indian context. His findings were proved positive in case of cotton and maize. It may be worth mentioning that his model has found certain refinements in Nerlov’s lagged adjustment model.
The model applied by Madhavan showed better results than that of Raj Krishna. The results show that, the formers response to variations in price and yield were just equal to or greater than the acreage elasticities which were recorded in the previous studies. The findings of Madhavan go to show that the acreage elasticity estimate with respect to price were high for commercial crops and low for cereal crops.

During the post-independence phase, the food grain output increased at an annual rate of 2.51 percent with yield increase being the major source of growth (1.47 percent). Growth rate of area was only 0.68 percent.

Ashok Parkh and Pravin Trivedi study concerns the estimation of Production Function for regions; they used the Cobb-Douglas production function and number of linear regression equation for time series / cross-section data. The study reveals that cross section estimates are likely to be cross to long run co-efficient than the time-series estimation.

Venkataramanan and his co-author estimated three different equations, relative prices, absolute prices and standard deviation of prices in addition to be observed value of prices. It is observed a negative relationship between supply and the standard deviation of prices. This is the evidence of the existence of the phenomenon of risk aversion among farmers.

According to Singh and Singh (1991) the area under Rice in Haryana increased at the rate of 9.28 percent per annum during 1966-67 to 1988-89.
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, groundnut 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.

Archanan Singh and R.S.L Srivastava (2003) carryout empirical investigation than can reveal the growth rate and instabilities in sugarcane producers in different regions of Uttar Pradesh. Semi log equations were fitted to estimate compound growth rates in area, production, and yield was measured through co-efficient of variation. Though significant and positive growth in the production of sugarcane has emerged as a common feature, sugarcane production instability is observed in the state with its varying magnitude across the regions. Area instability is the major cause of production instability.

Satyanarayana studied the problem of supply response in terms of changes in acreage under sugarcane. An important feature of this study is that besides that usual variable of relative price, he takes into account the installed capacity of the sugar factories and sugar prices. The study
suggests that the installed capacity of the factories have significant influences on the acreage of sugarcane. The influence of other variables differed from state to state.

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.

The study of J.R. Behrman, “The supply responsiveness in Thailand” suggests that, he studied in detail, the general delete over the supply responsiveness of under developed agriculture. The study, concentrates the response to price change. The results strongly support that farmers in economically under developed countries responded significantly and substantially to economic incentives.

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.

**Design of the study:**

The following is the design of present study. The first chapter deals with the importance of agriculture in Indian economy, role of food, commercial and oilseed crops, economic review and agriculture and allied activities as well as growth of food, commercial and oilseed crops in Andhra Pradesh.

The statement of the problem, review of literature, design of the study, objectives, methodology which adopted in the study, data and limitations of the study was given in the second chapter. The growth and instability in
area, production and yield of three selected crops are analysed in the chapter three.

In the fourth, fifth and sixth chapters, supply (area) responses were analyzed for area, production and yield of one of the selected crops i.e., Paddy (food crop), Groundnut (oilseeds crop) and Sugarcane (commercial crop) respectively in three regions i.e., Rayalaseema, Coastal Andhra and Telangana and the state of Andhra Pradesh as a whole.

The summary and conclusions of the study were given in the seventh and last chapter.

Objectives:
The following are the core objectives of the present study.

1. To study the growth and instability in selected crops (paddy, groundnut and sugarcane).

2. To examine the supply responses of the selected crops i.e., paddy, groundnut and sugarcane.

3. To determine the short-run and long-run elasticities of prices of the selected crops in three regions and Andhra Pradesh state as a whole.

Methodology:
To fulfill the first objective of the study both the linear and log-linear models were estimated. The analysis was carried out for only linear model. Both the graphs were shown along with the original trend for selected crops.

The simple linear regression model was used. The model was

\[ Y = a + bt \]
Here:

\[ Y = \text{area} / \text{production} / \text{yield}. \]
\[ a, b \text{ are the constants to be determined.} \]
\[ t = \text{time point} \]

The percentage of linear growth rate is calculated by the formula

\[ \text{L.G. R} = \frac{\hat{b}}{\bar{Y}} \times 100 \]

\( \hat{b} \) is tested by ‘t’-test statistic

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

Where,

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

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

\[ \text{C.V.} = \frac{\sigma}{\bar{Y}} \times 100 \]

Where:

\[ \sigma = \text{standard deviation} \]
\[ \bar{Y} = \text{mean of area} / \text{production} / \text{yield} \]

To fulfill the second objective, i.e., to examine the supply responses of the selected crops hectareage 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 crops 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:

$$A_t^* = a_0 + a_1 p_{t-1} + V_t \quad (1)$$

Where,

$$A_t^* = \text{desired long-run hectareage}$$

$$p_{t-1} = \text{lagged farm harvest price}$$

$$V_t = \text{error term}$$

$$a_0, a_1 \text{ are constant and price coefficients respectively}$$

The actual area under the crop was adjusted in proportion to the difference between the long-run desired level of area and actual area under the crop.

$$A_t - A_{t-1} = B(A_t^* - A_{t-1}), \quad 0 < B \leq 1 \quad (2)$$

B is the coefficient of the adjustment which accounts for the forces which causes the differences between the short-run and long-run supply and price elasticities substituting equation (1) in equation (2) we get

$$A_t = C_0 + C_1 p_{t-1} + C_2 A_{t-1} + U_t \quad (3)$$

Where,

$$C_0 = a_0 B, \quad C_1 = a_1 B, \quad C_2 = (1-B)U_t = BV_t$$

The equation (3) is helpful in the estimation of short-run and long-run price elasticities and they can be obtained by using the relations:
\[ SRE = C_1 \frac{\bar{P}_{t-1}}{A_t} \] \hspace{0.5cm} \{ \text{.........(4)} \}

\[ LRE = \frac{c_1}{1-c_2} \frac{\bar{P}_{t-1}}{A_t} \]

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

Along with the above model, we have used another model by using some other variables like risk which also have some effect on area under the particular crop under the study. The model is as follows-:

\[ A_t^* = a_0 + a_1 P_t^* + a_2 Y_{t-1} + a_3 C V_P + a_4 C V_Y + a_5 R_t + a_6 I_t + a_7 D + V_t \] \hspace{0.5cm} \{ \text{.........(5)} \}

Substituting \( P_t^* = P_{t-1} \) in equation (5), we obtain
\[ A_t^* = a_0 + a_1 P_{t-1} + a_2 Y_{t-1} + a_3 C V_P + a_4 C V_Y + a_5 R_t + a_6 I_t + a_7 D + V_t \]

\[ A_t - A_{t-1} = B(A_t^* - A_{t-1}) + Z_t \]
\[ A_t - A_{t-1} = B A_t^* - B A_{t-1} + Z_t \]
\[ A_t = B_t^* - B A_{t-1} + Z_t + A_{t-1} \]
\[ A_t = B_t^* - B A_{t-1} + A_{t-1} + Z_t \]
\[ A_t = A B_t^* + A_{t-1} - B A_{t-1} + Z_t \]
\[ A_t = B A_t^* + A_{t-1}(1-B) + Z_t \]

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

(or)

\[ A_t^* = C_0 + C_1 P_{t-1} + C_2 Y_{t-1} + C_3 C V_p + C_4 C V_y + C_5 R_t \\
+ C_6 I_t + C_7 D + C_8 A_{t-1} \\
+ U_t \] … (6)

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 fallows –

\[ A = \text{actual area planted in 1,000 hectares under the crop.} \]
\[ t = \text{'t'\textsuperscript{th} production period.} \]
\[ P_{t-1} = \text{farm harvest price of the crop (` / Quintal) lagged by one year.} \]
\[ Y_{t-1} = \text{yield of the crop by one year (Kilograms /Hectares).} \]
\[ C V_p = \text{co-efficient of variations of the prices of the crop connected for the} \]
\[ \text{yearst-1, t-2, t-3 used as a measure of price risk.} \]
\[ C V_y = \text{co-efficient of variation of yields of the crop concerned for the} \]
\[ \text{years t-1, t-2, t-3 used as a measure of yield risk.} \]
\[ R_t = \text{rainfall for the sowing season for the crop concerned in millimeters.} \]
\[ I_t = \text{irrigated area under all crops in 1,000 hectares.} \]
\[ D = \text{dummy variable to pick up the effect of the left out variables of new} \]
\[ \text{technology. Thus the dummy variable will specify the constant} \]
\[ \text{terms for the period of 1985-86 to 2010-11.} \]
\[ U_t = \text{stochastic disturbance term.} \]
\[ C_1 \text{'}s = \text{regression co-efficients.} \]
Both the linear and log linear models for the equation (3) and (6) were fitted to the data and the results discussed to evolve a better model.

**Data and Limitations:**

The study was totally depended on the secondary data. The study is confined to three revenue regions, namely, Rayalaseema, Coastal Andhra and Telangana. The time series data for the period of 25 years that is from 1986-87 to 2010-11 was collected from various issues of ‘Seasons and Crop Report’ of Andhra Pradesh, ‘Statistical Abstract of Andhra Pradesh’ issued by the Director, Bureau of Economics and Statistics, Government of Andhra Pradesh and Central Statistical Organisation, New Delhi. The data related to the variables area, output, yield, price and rainfall was collected for the selected crops paddy (food crop), groundnut (oil seeds) and sugarcane (commercial crop) in three regions of Andhra Pradesh and the state as a whole and given with **appendix.**