CHAPTER – II

METHODOLOGY
The agriculture sector is the largest sector of the Nation’s economy affording employment to two-thirds 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-riddin 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 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 production responses of food crops. It is also proposed to study the growth and instability of three major food crops Paddy, Jowar and Bajra.

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 was 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.

**Review of Literature:**

Dharm Narain'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.

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.

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.

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.

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

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.

The study of K.R. Shanmugam, (2003) 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 or 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.

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.

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 coefficient 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.

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.

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 $y = a \cdot b^x$.

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.

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
variabilities and the use of fertilizers per unit of land obviously the area and yield variability’s result in the variability in agricultural productions.

Hazell (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.

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 foodgrain 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 foodgrain production was at an annual rate of growth of 0.3 percent (ii) a rising trend in foodgrain production was associated with increase in instability.

Minhas and Srinivasan (1968) from their study claimed that the growth rate of food grains had remained constant.

Thiruvenkatachari and Swaminathan (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 annum.

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 foodgrain 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 foodgrains 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 and 2.77 percent per annum during the three phases respectively. Andhra Pradesh had a recovery during phase-II.

During the past 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.

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.

**Design of the study:**

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

In the Second Chapter, 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.

The linear growth rates and instability in area production and yield of major food crops, namely, paddy, Jowar and Bajra in three regions, i.e., Coastal Andhra, Rayalaseema and Telangana and the state of Andhra Pradesh as a whole was studied in Third Chapter.

In the Fourth Chapter, the output responses of three major food crops was analyzed for the period of 25 years, i.e., 1980-81 To 2004-05, by
adopting Cagon's adoptive expectation model. A region-wise study was carried out for the three regions and entire state.

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

Objectives:-

The following are the objectives of the present study.

1) To determine the trend as well as growth rates of area, production and yield of selected food crops, in three regions of Andhra Pradesh.

2) To estimate the instability in selected food crops.

3) To study the relationship between agricultural output and price and some important non-price variables.

4) To study the relative impact of different factors on crop output and to identify weather, there is any particular pattern in planting procedure of crops.

Methodology:-

To fulfill the first objective of the study, i.e., growth rates of selected the simple linear regression model was

\[ Y = A + B_t \]  \hspace{1cm} (1)

Here: \( Y = \text{Area} / \text{Production} / \text{Yield} \).

\( t = \text{Time point.} \)

\( A, B \) are the constants to be determined.

The percentage of linear growth rate is calculated by the formula

\[ \text{L.G.R.} = \frac{\hat{B}}{\bar{y}} \times 100 \]  \hspace{1cm} (2)

\( \hat{B} \) is tested by 't'-test statistic

\[ t = \frac{\hat{B}}{S.E(\hat{B})} \]  \hspace{1cm} (3)

\[ \text{SE} (\hat{B}) = \sqrt{\frac{\varepsilon(y - \hat{y})^2}{N}} \]  \hspace{1cm} (4)
To study the second objective i.e., to determine the instability in the crops, the co-efficient of variation was calculated.

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

(5)

Where:

- \(\sigma\) = Standard deviation
- \(\bar{Y}\) = Mean of area / Production / Yield

To study the third objective of the study the following traditional model was used

\[
Y_t = a_0 + a_1 A_t + a_2 P_{t-1} + a_3 R_t + U_t
\]

(6)

Where:

- \(Y_t\) = Quantity of output (in tonnes)
- \(A_t\) = Area under the crop (in hectors)
- \(P_{t-1}\) = lagged own price (in rupees)
- \(R_t\) = Rainfall (in millimeters)
- \(U_t\) = Random disturbance term.

\(a_0\) and \(a_i\) are intercept and the coefficients of variables. The constant or intercept term indicates the net effect of variables which are not included in the model. Both the linear and log-linear models were estimated. When the logarithms are taken, the equation (6) may be converted into

\[
Y^*_t = b_0 + b_1 A^*_t + b_2 P^*_{t-1} + b_3 R^*_t + U_t
\]

(7)

Where “*” denotes the logarithmic values of corresponding observations of respective variables.

To study the fourth objective of the study, Cagan’s adaptive expectation model was used. Most of the economists have assumed a direct relationship between area and output, it is valid in subsistence agriculture. Formers facing problems in making production decisions in response to changing price and non-price factors. It leads to utilization of Cagan’s adoptive expectation model. The farmers output decisions are depending on their future price expectations. The agricultural output might depend on the
expected future prices area under the crop, irrigation facilities etc. Hence, the distributed lag models was utilized in the present study. Let the model be

\[ Y_t = a_0 + a_1 A_t + a_2 P_t^e + a_3 R_t + \epsilon_t \]  \hspace{1cm} (8)

Where, \( P_t^e \) = Expected price of the crop.

In the above model the expected price, instead of normal (or) actual price was used as an independent variable with the belief that the crop output in particular year is governed by the prices, that the farmers expect to get in that year, rather than by the fast years price. This suggest the use of adaptive expectation model.

Since, the expected price was not directly observable, the following hypothesis was formulated about price expectations.

\[ P_t^e - P_{t-1}^e = \lambda [P_t^e - P_{t-1}^e] \hspace{0.5cm} 0 < \lambda \leq 1 \]  \hspace{1cm} (9)

This hypothesis was the rationalization of Koyek’s estimation of distributed lag model. Here ‘\( \lambda \)’ was the coefficient of expectation, this hypothesis known as adaptive expectation (or) progressive expectation or error learning hypothesis. It was popularized by P.Cagan and M. Friedman.

\[ P_t^e = (1 - \lambda) P_{t-1}^e + \lambda P_t \]  \hspace{1cm} (10)

From equation (8)

\[ P_t^e = \frac{1}{a_2} (y_t - a_0 - a_1 A_t - a_3 R_t - \epsilon_t) \]  \hspace{1cm} (11)

Lagging one year to this equation :

\[ P_{t-1}^e = \frac{1}{a_2} (y_{t-1} - a_0 - a_1 A_{t-1} - a_3 R_{t-1} - \epsilon_{t-1}) \]  \hspace{1cm} (12)

Substituting equation (10) in equation (8)

\[ Y_t = a_0 + a_1 A_t + a_2 [(1-\lambda) P_t^e + \lambda P_t^e] + a_3 R_t + \epsilon_t \]  \hspace{1cm} (13)

Again substituting equation (12) in (13), we may get the equation (14)
Simplifying equation (14) we get the equation

\[ Y_t = \lambda a_0 + (1-\lambda) y_{t-1} + a A_t - a_1 (1-\lambda) A_{t-1} + a_2 \lambda P_t + a_3 \\
R_t - a_3 (1-\lambda) R_{t-1} + v_t \]  

(15)

Put

\[ \begin{align*}
 b_0 &= \lambda a_0 \\
 b_1 &= 1 - \lambda \\
 b_2 &= a_1 \\
 b_3 &= -a_1 (1-\lambda) \\
 b_4 &= a_2 \lambda \\
 b_5 &= a_3 \\
 b_6 &= -a_3 (1-\lambda) \\
 v_t &= \text{disturbance.}
\end{align*} \]

(16)

Taking the logarithms to the values of selected variables in the equation (16), we get the equation (17). The log-linear model which is used in the study is as follows:

\[ y_t^* = c_0 + c_1 y_{t-1}^* + c_2 A_t^* + c_3 A_{t-1}^* + c_4 P_t^* + c_5 R_t^* + c_6 R_{t-1}^* + V_t \]  

(17)

To avoid the price risk, it is proposed to consider the co-efficient of variations of prices instead of actual prices ($P_t, P_{t-1}, P_{t-2}$).

**DATA:** The time series data for the period of 25 years that is 1980-81 to 2004-05 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. The data related to the variables, output, price, rainfall, area, yield was collected for the selected food crops paddy, Jowar and Bajra in three regions of Andhra Pradesh and the state as a whole. The collected data was given in the tables from 2.1 to 2.12 with appendix.

**Limitations:**

The study is confined to three regions, namely, Coastal Andhra, Rayalaseema, and Telangana regions. The data related to the present study was used for the period – 1980-81 to 2004-05. The data was collected from the published books of Bureau of Economics and Statistics, Hyderabad.