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Understanding the Challenges and Opportunities in Cotton Crop Production in Kurnool District, Andhra Pradesh, India

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Abstract: Optimal site for locating borehole has been delineated on the basis of empirically derived aquifer hydraulic parameters. To that end, seventeen VES data were quantitatively interpreted via partial curve matching technique and the starting models refined by means of 1D Forward modelling with iteration to obtain geoelectric characteristics. The results indicted presence of varying geo-electric earth-layer models, ranging from 3- to 5- earth-layer models. Curve type analysis revealed that Htype and HA-type curves are predominant in the study area. The conceptual aquifer model showed a preponderance of Weathered/fractured aquifer systems archetypal to basement complex environments. The aquifer unit resistivity ranges from 5.6 – 751.6 ohm-m with low values symptomatic of clay materials. The aquifer layer thickness vary from 1.6 m to 48.3 m with an average of 13.6 m. Hydraulic conductivity values for the study area ranges from 0.005 – 11.99 m/day with most of the study area having low hydraulic conductivities. Transmissivity within the study area ranged from 0.03 - 141.6 m^2/day, corresponding to log transformed transmissivity ranging from 2.50 m^2/day to 6.20 m^2/day. The log transmissivity result was used to classify the study area into five zones based on Krasny Classification Scheme; Imperceptible (< 3 m^2/day), Very Low (3 m^2/day), Low (4 m^2/day), Intermediate (5 m^2/day) and High (6 m^2/day) groundwater potential zones. The findings showed that 80% of the study area falls within Very Low and Low transmissivity classification (3 – 4 m^2/day), correlating with zones of Low hydraulic conductivity and boreholes sited can only sustain small withdrawals for sequestered consumption. Optimal borehole site is limited to a small area (3.5 m^2) of high transmissivity where abstraction for regional purposes is supported.

Keywords: agriculture, Indian economy, cotton, commercial crops, growth rate, instability, production, Andhra Pradesh, Kurnool district, export, foreign exchange earnings

INTRODUCTION

Agriculture plays a vital role in the Indian economy, being the largest industry in the country, providing employment to around 65% of the total workforce, and contributing 19% to the national income (Kumar, 2014). Despite concerted industrialization in the last five decades, agriculture occupies a place of pride, and agriculture's share in GDP in 1951 was 55%, which fell to 25% by 2000 and now stands at 21% (Gulati et al., 2012). Indian agriculture dominates the economy to such an extent that a high proportion of working population in India is engaged in agriculture, with the number of people working on land increased to 235 million in 2001 from 97 million in 1951 (GOI, 2019). The contribution of agriculture to the economy, however, has been decreasing continuously, and the share of manufacturing and services sectors are increasing, but agriculture still provides a major share of the national income in India (Kumar, 2014).
Agriculture has been the source of supply of raw material to India's leading industries, and cotton and jute industries, sugar, vanaspathi, and plantations depend on agriculture directly (Joshi & Gulati, 2019). Many other industries also depend on agriculture in an indirect manner. Small scale and cottage industries like handloom weaving, oil crushing, rice husking, etc., depend on agriculture for their raw material, and together, they account for 50% of income generated in the manufacturing sector in India (Joshi & Gulati, 2019).

Commercial crops have contributed significantly to the growth of the Indian economy. Intensive commercial crops like sugarcane, groundnut, cotton, and potato generated 3,392.2 million man-days of employment in 1982-83 (Jha et al., 2013). India is a traditional exporter of oilseed cakes and meals, and jute was the largest exchange earner in the early seventies. Today, India not only produces one of the finest cotton varieties like Suvin but also is surplus in raw cotton, and commercial crops contribute significantly to the export sector (Gulati et al., 2012).

Cotton is the most important commercial crop in India, occupying an area of 5.4 million hectares under rainfed conditions. It generates employment for about 60 million people directly or indirectly, involving them in the agricultural and industrial sectors of cotton production, processing, textiles, and related activities (Kumar, 2014). Cotton crop occupies about 60% of the cotton on vertisols in Madhya Pradesh, Maharashtra, Andhra Pradesh, Karnataka, and Tamil Nadu (Jha et al., 2013). Cotton is a crop of prosperity, having a profound influence on men and matter, and is an industrial commodity of worldwide importance (Kumar, 2014). Cotton is the most vital crop of commerce, popularly known as the "White Gold," and foreign exchange earnings of cotton amount to about Rs.50,000 crores, nearly one-third of the total foreign exchange earnings of India (Kumar, 2014).

The productivity of commercial crops is much lower in India than in many other countries. High yields of sugarcane, cotton, oilseeds, tobacco, and jute have been obtained where they are grown with adequate inputs and under efficient farm management (GOI, 2019). Among commercial crops, sugarcane and cotton enjoyed privileged positions in terms of allocation of research resources. The development of high-yielding hybrid cotton varieties and their rapid spread in the major cotton-producing states helped cotton cultivation to turn the corner in the seventies (Gulati et al., 2012)

Cotton is one of the most important commercial crops in India, contributing significantly to the country's economy and providing employment to millions of people. The history of cotton cultivation in India can be traced back to ancient times, with evidence of cotton fabrics dating back to 5000 BC. However, the production of cotton in India has been beset by numerous challenges, including pests, diseases, and low yields.

In the 1970s, a breakthrough in cotton cultivation occurred with the development and widespread adoption of high-yielding hybrid cotton varieties. According to Gulati et al. (2012), the development of high-yielding hybrid cotton varieties and their rapid spread in the major cotton-producing states helped cotton cultivation to turn the corner in the seventies. The hybrid varieties were developed through the use of advanced breeding techniques that combined desirable traits of different cotton varieties to produce hybrids with superior qualities such as higher yield potential, disease resistance, and tolerance to adverse weather conditions.

The impact of the introduction of high-yielding hybrid cotton varieties on cotton cultivation in India was significant. The new varieties allowed for higher yields per acre, reducing the pressure on farmers to expand their cultivation areas to meet market demand. As a result, the use of hybrid cotton varieties helped to reduce the environmental impact of cotton cultivation in India by limiting the need for expansion into forested areas and reducing pressure on water resources.

Moreover, the widespread adoption of hybrid cotton varieties brought about improvements in the livelihoods of farmers, particularly those in cotton-producing states like Gujarat, Maharashtra, and Punjab. The increased yields and improved quality of cotton resulted in higher profits for farmers, who could reinvest in their farms and communities, leading to improved economic and social development in these areas.

In conclusion, the development and adoption of high-yielding hybrid cotton varieties were a significant turning point in the history of cotton cultivation in India. These varieties have contributed to the increased production of cotton, improved the quality of cotton, and enhanced the livelihoods of cotton farmers in the country. The continued development of advanced breeding techniques and research into new varieties will be critical to sustainably meeting the growing demand for cotton in India and around the world.

REVIEW OF LITERATURE

Archana Singh and R.S.L. Srivastva[1] carried out empirical investigation that 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. A significant and positive growth in the production of sugarcane has emerged as a common feature. Sugarcane production instability is observed in this state with its varying magnitude across the regions. Area instability is the major source of production instability.

Daram Narain's[2] study is devoted to graphical comparison of year to year variations in acreage of six crops Cotton, Jute, Ground Nut, 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.

S.S.Grewal and P.S.Rangi[3] in their attempt, calculated compound growth rates of area, yield and production of important crops in Punjab State during the year 1966 – 67. to 1981 – 82. Cotton is one among the crops taken into consideration. American cotton was also recorded significant growth rate, in this entire increase in production has occurred as a result of increase in area. Desi cotton had shown negative growth rates of production in the study period. In case of American cotton, production has shown significant increase. Regarding the American cotton and Desi cotton there is absolutely decrease in productivity since the trend is on decline. They critically examine the growth pattern of agriculture in Punjab, particularly focusing on the factors associated with the growth process.

Konda Swamy[4] attempted to study the commercial crops in respect of labour intensive and total employed generated by the four major commercial crops: Sugar Cane, Ground Nut, Cotton and Potato. Among commercial crops Sugar Cane and Cotton enjoyed privileged position in terms of allocation of resources. The development of HYV Hybrid cotton varieties and their rapid spread in the major cotton productive states helped cotton cultivation to turn the corner in the seventies(70's). the cotton varieties H4,H6,MCU – 5, DCH – 32, Varalakshmi Deserve specific mention, while fertilizers use is now nearly universal and spread to all crops the extent to diffusion and the rates of application of fertilizers are far less in crops like oilseeds, cotton and tobacco and also less than the potential indicated by experiments. Hence, we have to make a break- through in technology and organization fronts to make the cotton crop sector an efficient one.

The link between growth and variability was first hypothesized by Sen[5] (1967) early in the post independence period when growth was largely based on area expansion.

Suresh Pal and A.S. Sirohi[6] used co-efficient of variation in their study to measure the magnitude of instability. The pattern of changes in the sources 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.

1. OBJECTIVE OF THE STUDY

The following are the objectives of the current study:

- To find out trends as well as growth rate and instability in production of Cotton crop in Kurnool District and Andhra Pradesh as a whole.
- To study the relationship between the Cotton output and prices and some important nonprice variables and the relative impact of different factors on Cotton output.

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2. METHODOLOGY

The following methodology is adopted to study the above objectives. To analyze the cotton cultivation in Andhra Pradesh and in Kurnool district, it is proposed to estimate the growth and instability in area, production and yield of cotton. There are two types of growth rates viz., linear and compound growth rates. In present study both linear and compound growth rates of cotton were estimated to determine the LGR, the linear function of the form Y = A+Bt-------------------------------------(1)

$$LGR = \frac{\hat{B}}{\bar{Y}} \times 100 \text{----------------------------(2)}$$

To determine the CGR, the exponential function of form is

$$Y = A.B^t \text{-----------------------------------(3)}$$

Where, Y= area/production/yield

t= time

A, B are the constants to be determined The % of CGR is

$$CGR = (B-1) \times 100 \text{---------------(4)}$$

The coefficient of time $\hat{B}$ was tested by t-test statistic

$$t = \frac{\hat{B}}{SE of \hat{B}}$$

$$S.E \text{ of } B = \sqrt{\frac{\sum (Y - \hat{Y})^2}{N}}$$

The instability measured by coefficient of variation (C.V.)

$$C.V. = \frac{\sigma}{\bar{Y}} \times 100 \text{---------------(5)}$$

To study the production responses of cotton crop, the adaptive expectations model was utilized. Traditionally the crop production has been assumed to be a linear function of area, lagged price and rainfall the functional relationship is

$$Y_t = a_0 + a_1 A_t + a_2 P_{t-1} + a_3 R_t + V_t \text{ --------------------(6)}$$

Where, Y_t = Quantity of cotton output (Bales)

A_t= Area under the cotton crop (hectares)

P_{t-1}= Lagged cotton price (Rs) R_t= Rainfall (m.m)

V_t= Random disturbance term

Generally farmers faced problems in making production decisions in response to changes in price and non-price factors. The agricultural output might be dependent on the expected prices (P_t^e), area under the crop, irrigation facilities etc. This Hypothesis suggests the necessity of adoptive expectation model in this study. Let the model be

$$Y_t = a_0 + a_1 A_t + a_2 P_t^e + a_3 R_t + V_t \text{ ----------------(7)}$$

Where P_t^e = Expected cotton price

Here P. Cagan's expectation coefficient is 'λ'. Therefore the adaptive expectation principle proposed by Cagan is

$P_t^e - P_{t-1}^e = \lambda [P_t - P_{t-1}^e], 0 \leq \lambda \leq 1$ -----------------------------(8)

Therefore $P_t^e = P_{t-1}^e (1-\lambda) + \lambda P_t$ --------------------------(9)

From 7

$P_t^e = \frac{1}{a_2} (Y_t - a_0 - a_1 A_t - a_3 R_t - V_t)$ ---------------------------(10)

Lagging one year, Equation (10) can be written as

$P_{t-1}^e = \frac{1}{a_2} (Y_{t-1} - a_0 - a_1 A_{t-1} - a_3 R_{t-1} - V_t)$-----------------------(11)

Substituting (9) in (7)

$Y_t = a_0 + a_1 t + a_2[P_{t-1}^e (1-\lambda)] + a_2 \lambda P_t + a_3 R_t + V_t$ ------(12) Substituting (11) in (12)

Yt = b0 + b1At + b2At-1 + b3Pt + b4Rt + b5Rt-1 + b6Yt-1 + Ut------------(13) Where $b_0 = a_0 \lambda$, $b_1 = a_1$,

$b_2 = -a_1(1-\lambda)$, $b_3 = a_2 \lambda$,

$b_4 = a_3$, $b_5 = -a_3(1-\lambda)$, $b_6 = (1-\lambda)$ $U_t = \lambda V_t$

Both the linear and log linear models were fitted to the data. The parameters were estimated by OLS (Ordinary Least Squares) method.

The time series data for the period 1985-86 to 2004-2005 has been used in the present study.

The relevant data was collected from various issues of "Seasons and Crop Report of A.P." and "Statistical Abstract of Andhra Pradesh" issued by the Director of Bureau of Economics and Statistics, Andhra Pradesh and the "Chief Planning Officer, Kurnool".

3. FINDINGS

The growth and instability in cotton cultivation is the first objective of the present study. To fulfill this objective, it is proposed to estimate the linear and compound growth rates of area, production and yield of cotton in Kurnool district as well as Andhra Pradesh as a whole. Along with the growth rates, the Coefficient of Variation was calculated to identify the stability in cotton cultivation. The collected data on cotton area, production and yield for the period of 20 years that is from 1985-86 to 2004-05 was fed with the equations 1 and 2 given in the methodology. Estimated equations are given below and analyzed accordingly.

Area (Andhra Pradesh)

The estimated linear equation for area under cotton cultivation is

$Y = 555499.75 + 25874.3^* t$

(4.330)

LGR= 3.1280 C.V= 8.7

* Significant at 5% probability level

Figures in the parenthesis are 't' value

From the above linear regression equation the coefficient of time is 25874.3. It is positive and significant at 5% level of probability. It expresses that every year 25874 hectares of Cotton area is increasing in Andhra Pradesh. It is noticed that this increase in cotton area is significant, proved by't' – test Statistic. The estimated linear growth in cotton area is nearly 3.13%. It reveals every year on an average 3.13% of cotton area is increasing. The value of co efficient of variation is 0.087, which indicates that 8.7% variation in cotton area was recorded in entire state of Andhra Pradesh. Therefore the instability of cotton area is very less that is nearly 9%. Hence it may be inferred that stability in cotton cultivation is 91.3%.

The estimated exponential form of cotton area is

$$Y = (13.2323)\ (0.0343)^{*t}$$

(4.753)

C.G.R= 3.486

In the above estimated exponential form the coefficient of time is 0.0343. It is observed that the annual average increase over the previous year is 3.43%. It is significant at 5% probability level. The estimated compound growth rate of cotton area in Andhra Pradesh is 3.48%.

Production (Andhra Pradesh)

The estimated linear regression equation of cotton production in Andhra Pradesh is

$$Y = 766751.38+43766.57^{*}t$$

(3.509)

LGR = 3.569 C.V. = 11.9

It is evident from the above linear regression equation that the coefficient of time is 43766.57. It is positive and significant at 5% level of probability. It expresses that every year 43766 bales of cotton production is increasing in Andhra Pradesh. It is noticed that this increase in cotton production is significant, proved by't' –test Statistic.

The estimated linear growth rate in cotton production is nearly 3.57%. It reveals that on an average 3.57% of cotton production is increasing every year. The value of coefficient is 0.119, which indicates that there is 11.9% of variation in cotton production was recorded in the entire state. Therefore the instability of cotton production is moderate i.e., nearly 12%, which indicates that stability in cotton production in Andhra Pradesh is 88%.

The estimated exponential form of cotton production in Andhra Pradesh is

$$Y = (13.5050)\ (0.0431)^{*t}$$

(3.842)

CGR = 4.404

In the above estimated exponential equation the coefficient of time is 0.0431. It is observed that the annual average increase over the previous year is 4.31%. It is significant at 5% level of probability. The estimated compound growth rate in cotton production in the state is 4.404%.

Yield (Andhra Pradesh)

The estimated linear regression equation for cotton yield in Andhra Pradesh is

$$Y = 231+1.8t$$

(1.005)

LGR = 0.7203 C.V. = 16.8

From the linear regression equation the coefficient of time is 1.8kgs. It is positive and significant at 5% probability level. It shows that every year 1.8kgs of cotton yield is increasing in Andhra Pradesh. It is noticed that this increase in cotton yield is a significance increase proved by't' – test statistic. The estimated linear growth rate in cotton yield is nearly 0.72%. It reveals that every year on an average 0.72% cotton yield is increasing. The value of Coefficient of Variation in cotton yield is 0.16, which shows that 16% of variation in cotton yield was recorded in Andhra Pradesh. Therefore instability of cotton yield is moderate and stability in cotton yield is 84%.

The estimated exponential form of cotton yield in Andhra Pradesh is $Y = (5.4048)\ (0.0093)^{t}$

(1.211)

CGR = 0.939

From the above estimated exponential form, the coefficient of time is 0.0093. It is observed that annual average increase over the previous year is 0.09%. It is not significant at 5% probability level. The estimated compound growth rate in cotton yield in the state is 0.94%. **Area (Kurnool)**

The estimated linear regression equation for cotton Area in Kurnool District is

$$Y = 68584.711+1484.675t$$

(1.224)

LGR = 1.7638 C.V. = 15.2

From the above linear regression equation the coefficient of time is 1484.675. It is positive but not significant at 5% probability level. It expresses that every year 1484 hectares of Cotton Area is increasing in Kurnool District. It is noticed that this increase in cotton area is not a significant increase, proved by'‘t’- test statistic. The estimated linear growth rate in cotton area is nearly 1.76%. It reveals every year, on an average, 1.76% of cotton area is increasing. The value of Coefficient of Variation is 0.152. That is there is 15.2% of variation was recorded in cotton area in Kurnool district. Hence the instability of cotton area is around 15% and stability of cotton area is 84.8%

The estimated exponential form of cotton area in Kurnool District is

$$Y = (11.0868)\ (0.0175)^t$$

(1.162) CGR = 1.766

In the above estimated exponential form, the coefficient of time is 0.0175. It is observed that the annual average increase over previous year is 1.75%. It is not significant at 5% probability level. The estimated compound growth rate in cotton area in Kurnool District is 1.766.

Production (Kurnool District)

The estimated linear equation for production of cotton crop in Kurnool district is

$$Y = 86054.602+1644.519t$$

(0.806)

LGR = 1.5916 C.V. = 20.8

From the above linear regression equation the coefficient of time is 1644.519. It is positive but not significant at 5% level of probability. It expresses that every year around 1644 bales of cotton production is increasing in Kurnool district. It is noticed that this increase in cotton production is not a significant one, proved by‘t’ – test statistic. The estimated linear growth rate in cotton production is nearly 1.6%. It reveals that every year on an average 1.6% increase is found in cotton production in Kurnool district. The value of coefficient of variation is 0.208, which shows 20.8% of variation was recorded in cotton production in Kurnool district. Therefore the instability in cotton production is moderate at 21% and it may be inferred that stability in cotton production is 79.2%. The estimated exponential form of cotton production in Kurnool is

$$Y = (11.2125)\ (0.0192)^t$$

(0.901)

CGR = 1.935

In the above estimated exponential form the coefficient of time is 0.0192. It is observed that the annual average increase over the previous year is 1.92%. It is not significant at 5% level of probability. The estimated compound growth rate in cotton production in Kurnool district is 1.935.

Yield (Kurnool District)

The estimated linear equation for yield of cotton crop in Kurnool district is

$$Y = 199.537+0.192t$$

(0.100)

LGR = 0.0951 C.V. = 19.8

From the above linear regression equation, coefficient of time is 0.192. It is positive and insignificant at 5% level of probability. It expresses that every year around 0.192kgs of yield of cotton is increasing in Kurnool district. It is noticed that this increase in cotton yield is insignificant, proved by't' – test statistic. The estimated linear growth rate in cotton yield is nearly 0.0951%. It reveals that every year on an average 0.095% of cotton yield is increasing. The value of Coefficient of Variation is 0.198, which indicates 19.8% variation in cotton yield was recorded in Kurnool district. Therefore the instability in cotton yield is 20% and stability in cotton yield is at 80.2%.

The estimated exponential form of cotton yield in Kurnool district is $Y = (5.2612)$
$(0.0017)^t$
(0.176) CGR = 0.168

In the above estimated exponential form the coefficient of time is 0.0017. It is observed that the annual average increase over the previous year is 0.17%. It is insignificant at 5% probability level. The estimated compound growth rate in cotton yield in Kurnool district is 0.168%.

Compound Growth Rates in Cotton Irrigated Area Area

The estimated exponential form as irrigated area of cotton in Kurnool district is

$$Y = (0.0413)\ (1.7706)^t$$

(0.1914)

CGR = 77.0607   C. V = 58.3952

From the above mentioned equation the value of b, i.e. the coefficient of t is 1.7706. It expresses the average annual increase over the previous year in irrigated area under cotton crop. The compound growth rate of irrigated area is 77.0607. It reveals that the average annual growth in cotton crop area over the previous year is 77.0607. The value of intercept term is 0.0413. The annual growth in irrigated area under crop is not significant. It is inferred that the growth in irrigated area of cotton crop is Kurnool district is positive because cotton crop is favourable than other irrigated crops. So the farmers shifted their attitudes from other crops to cotton. It is proved by't' – test statistic.

Production

The estimated exponential form of the cotton production in Kurnool district is

$$Y = 0.1071\ (2.2713)^t$$

(1.0737)

CGR = 127.1330   C. V = 64.5880

From the above estimated equation the value of b is 2.2713. It expresses the average annual increase in cotton production. The compound growth rate of cotton production is 127.1330. It reveals that the average annual growth rate in cotton production on the previous year is 127.1330. The value of intercept term is 0.1071. The annual growth in cotton production under irrigated area is positive level not significant. It is proved by 't' – test statistic. The instability in Cotton production is 64.50 percent. **Yield**

The estimated exponential form of the cotton yield in Kurnool district is

$$Y = 0.1360\ (1.7085)^t$$

(0.1795)

CGR = 70.8529   C. V = 16.8424

From the above equation the value of b i.e. coefficient of t is 1.7085. It expresses that the average annual increase in cotton yield. The compound growth rate of cotton yield is
70.8529. It reveals the average annual growth rate in cotton yield over the previous year is 70.8529. The value of intercept terms is 0.1360. The annual growth in cotton yield is insignificant. It is noticed that the cotton

yield in Kurnool district is significant and also better than the other remaining crops. It is proved by't' – test statistic.

Table - 1

Growth Rates and Coefficient of Variation

Item	Kurnool					Andhra Pradesh		
	Total Area			Irrigated Area				
	LGR	CGR	C V	CGR	C V	LGR	CGR	C V
Area	1.7638	1.766	15.2	77.0607	58.395	3.128	3.486	8.7
Production	1.5916	1.935	20.8	127.1330	64.5830	3.569	4.404	11.9
Yield	0.0951	0.168	19.8	70.8529	16.8424	0.720	0.939	16.8

From Table - 1, the linear and compound growth rates of area in production of cotton crop is positive and greater than one where as growth rates of cotton yield with respect to total area is less than one. From the values of coefficient of variation, maximum stability (84.8%) was recorded in cotton area, followed by cotton yield (80.2%) and production (79.2%). With respect to irrigated area under cotton crop in Kurnool District, highest growth rate (127.13%) was recorded in case of cotton production, followed by cotton area (77.06%) and in case of yield, it is 70.85%. With regard to the variation in cotton crop, maximum instability (64.58%) was observed in cotton production, followed by cotton area (58.40%) and cotton yield (16.84%).

In the state of Andhra Pradesh, the growth rates of cotton area, production and yield are positive. But the highest growth rate was recorded in case of production, followed by cotton area and cotton yield. The growth rates of cotton yield in A.P are less than one percent. The maximum stability was recorded in case of cotton area (91.3%) followed by cotton production (88.1%) and cotton yield (83.2%).

To study the relative impact of different input factors on cotton production, the adaptive expectation model was used it is based on the behavioral hypothesis of farmers which stated the present level of output depends not on the present price level, but also the expected price level. The analysis is based on log-linear model.

Multiple Linear Regression:

$$Y_t = 15961.1797+1.6454^*A_t - 23.2374\, P_{t-1} – 16.53544\, R_t$$

(5.9839) (1.0416) (0.3605) R^2= 0.78983* F = 20.0434

Cobb – Douglas model :

$$Y_t= 1.124+1.4155^*\, A_t - 0.3636\, P_{t-1}- 0.1101\, R_t$$

(3.2414) (1.1394) (0.4404)

R^2 = 0.8621* F = 33.3301

In the above estimated log linear model the coefficient of area is positive (1.4155). This positive coefficient express a positive relationship between area and cotton output. For every one hectare increase in cotton area will increase cotton production by nearly 1.42 bales. This increase in cotton production is a significant increase. It is proved by the t – test statistic, therefore the cotton production in Kurnool district was significantly responded by its current area under cultivation. The estimated coefficient of lagged price is negative (-0.3636). An inverse relationship was noticed by the price variable; therefore the price effect is negative on cotton production. It reveals that in Kurnool district the prevailing prices are not encouraging the cotton growers to raise the cotton production. A unit increase in lagged price will decrease the current cotton output. Therefore the lagged cotton prices influencing the cotton growers negatively, but this lagged price effect is not a significant effect. The coefficient of rainfall is negative (-0.1101). It is observed that there exists an inverse relationship between rainfall and cotton production. A unit increase in rainfall will decrease the cotton output by 0.11 bales. But this decrease is not a significant decrease. Therefore, an adverse effect of rainfall was noticed on cotton production in Kurnool district. It is inferred that cotton production was negatively influenced by excess rainfall or lack of rainfall or untimely rainfall. Finally, it may be concluded that the cotton growers in Kurnool district are not responded by its market prices. It may be suggested that by providing better marketing conditions and attractive prices the cotton growers are motivated to raise the cotton production in Kurnool district.

The aggregate effect of three independent variables, area under cotton crop, lagged price and rainfall on cotton production was estimated by Multiple Correlation Coefficient (R^2). The estimated value of R^2 is 0.8621. The significance of aggregate effect of selected three variables was tested for its significance. F- test statistic was adopted and it is found to be that the combined effect of three independent variables on cotton production in Kurnool is significant at 5 percent probability level.

To study the relative impact of input factors on cotton production, the adaptive expectation model was used. This model is based on behaviour hypothesis of farmers which states that present level of output depends not on the present price level but on expected price level. After incorporation of expected prices, the modified regression model (Equation No.23) is given in the methodology. The time series data was fed to the equation and the parameters were estimated. The estimated results were expressed in functional form. Both the linear and log-linear models were estimated. The analysis is based on log-linear model only.

Multiple Linear Regression:

$$Y_t = 0.4913 + 0.01164^* A_t - 0.00304 A_{t-1} + 0.1311 P_t$$
$$(4.2147) \quad (0.7432) \quad (0.8065)$$
$$-0.15156 R_t - 0.50862 R_{t-1} - 0.49282^* Y_{t-1}$$
$$(0.4074) \quad (1.4119) \quad (2.1630)$$
$$R^2 = 0.97181^* \quad F = 74.6979$$

Cobb – Douglas Model:

$$Y_t = 5.059 + 1.649^* A_t - 0.0856 A_{t-1} + 0.0794 P_t - 0.0649 R_t - 0.2431 R_{t-1} + 0.3274 Y_{t-1}$$
$$(4.9659) \quad (0.2372) \quad (0.2577) \quad (0.2258) \quad (0.8772) \quad (1.1913) \quad R^2 = 0.8919^* \quad F = 17.8766$$

From the above estimated log-linear model the coefficient of area under cotton crop is positive and significant at 5 percent probability level. It indicates that there is direct relationship between the quantity of cotton production is positively and significantly influenced by its area. For every one hectare increase in area, 1.649 bales of cotton output may be increased. This increase in cotton production is a significant increase observed by ttest statistic.

The coefficient of lagged area is negative (-0.0856) but not significant. An insignificant negative effect on lagged area on cotton production was noticed in Kurnool district. For every one hectare increase in lagged area, the cotton production will decrease by 0.0856 bales. The coefficient of price is 0.794. An insignificant positive effect of price on cotton production was noticed by the estimated coefficient of price. A unit increase in price will increase the cotton production by 0.08 units. This increase in production is an insignificant increase. The coefficients of rainfall and lagged rainfall variables are negative and insignificant. They are –0.0649 and -0.2431 respectively. It is observed that an increase in these rainfall variables will decrease the cotton production. The coefficient of lagged output is positive (0.3274) and insignificant. A direct relationship was recorded between current and lagged outputs. This relationship is not a significant relationship.

The aggregate effect of these six variables on cotton production was estimated and denoted by R^2. The value of multiple correlation coefficient (R^2) is 0.8919. It indicates that nearly 89.2 percent of production variation was observed by the collective effect of these selected independent variables. From 'F' test statistic, the combined effect of these six variables on cotton production is significant at 5 percent probability level.

Production responses of cotton in Andhra Pradesh

Time series data for the period 1985 – 2005 has been used in the present study. The data related to Andhra Pradesh as a whole was fed to the equation. The parameters were estimated by OLS method and results are expressed in the equation form. Both linear and log linear models were estimated and it is observed that log-linear model yields the better estimates comparing to linear models. The analysis is based on log-linear model only.

$Y_t = 3.689 + 0.334^* A_t + 0.508^* P_{t-1} + 0.314 R_t$

(3.729) (4.132) (1.634) $R^2 = 0.5769^*$ F = 9.545

In the above equation, coefficients of area and lagged price are positive and significant at 5 percent probability level in Andhra Pradesh state. It indicates that the cotton production is directly and significantly influenced by its area and its lagged price. A unit increase in area and lagged price may raise the cotton output by 0.334 and 0.508 units respectively. The coefficient of rainfall is positive. This means the cotton output is directly responded by rainfall. For every one unit increase in rainfall will raise the cotton output by 0.314 units. The combined effect of all independent variables on cotton output is expressed by the multiple correlation coefficient (R^2). The value of R^2 is 0.5769. This shows that all independent variables explained more than 57 percent of variation in total output. F-test was carried out for the significance of R^2. it is noticed that the combined effect is significant on cotton output. Hence, it is concluded that the cotton output is significantly responded by area and lagged price but it is insignificantly responded by rainfall. The value of intercept term is 3.689.

The price and non price factors are influencing the farmer's decision in allocating the area to the cotton crop. Among these factors expected prices will motivate the growers more than the other factors. The expected price may be used as an explanatory variable in the model with the belief that they may get more profits. This suggests the use of adoptive expectation model. The adoptive expectation model which is used in the study is given in the methodology. The estimated results for cotton crop in Andhra Pradesh are given in the equation form.

$Y_t = -1.241 + 0.378^* A_t + 0.030 A_{t-1} + 0.369 P_t$

(4.3245) (0.1321) (0.1652)

$+ 0.481 R_t + 0.153 R_{t-1} + 0.197 Y_{t-1}$

(0.2277) (0.4356) (1.1513)

$R^2 = 0.5623^*$ F = 3.853

From the above equation, the estimated coefficient of area under the cotton crop is positive and significant. The coefficient of lagged area, price rainfall, lagged rainfall, and lagged output are positive but not significant. This states that all independent variables directly influencing the cotton production in Andhra Pradesh. For every one unit increase in each of these variables may raise cotton output by 0.378, 0.030, 0.369, 0.481, 0.153, and 0.197 units respectively. The combined effect of all independent variables on cotton output, i.e., the value of R^2, is 0.5623. It shows that all independent variables effect on dependent variable is 56.23 percent. More than 56 percent of variation in total output of cotton was noticed by these variables. F-test was carried out and it is found to be significant. It is inferred that the combined effect of all variables is significant on cotton output. Hence, it is concluded that cotton output is responded positively by all independent variables. The value of intercept term is negative i.e., -1.241.

Co-efficient of Expectation:

The term 'Expectation' itself relates to the future events. To some extent, this expectation depends on past events. In our present study, λ is the coefficient of expectation of cotton prices. If the value of λ is sufficiently high, there is a greater possibility of the expected prices to be accurate. Since only the prices of recent years' will be considered and the value of earlier years' prices be negligible, shall be ignored. Contrary to this, if the value of the λ is low, the value of expected prices of earlier years' can be included in computing expected prices and they will possess greater accuracy. In the case of higher values of λ, more importance is to be attached to the recent years' prices than the earlier years' prices. Thus, lower the value of λ, greater is the memory concerning the prices of earlier years'. In short, the expectation coefficient indicates only the psychological behaviour of producer. If the value of λ is greater than 1, the over expectation takes place in future prices of the output. If $\lambda = 0$, the expectation of future prices are static i.e. the expected value adjusts period by period to the current observation and all previous history is irrelevant. If $\lambda = 1$, the expectations are realized immediately and fully, i.e. in the same period. In other words, an expectation once formed continuously unchanged, irrespective of current or earlier observations. The positive fraction of λ means that the expectations are get adjusted each period by same proportions of the discrepancy between the latest observations and expectation for that period.

The coefficient of expectation with respect to cotton crop was calculated with the help of the estimated coefficient of the variable, lagged output in the equation (13), i.e. $b_6 = 1 - \lambda$, $\lambda = 1 - b_6$.

The calculated value of λ are given in the table - 2.

Table No. – 2

The Co-efficient of Expectation of Cotton Output

Kurnool	**Andhra Pradesh**
1.4928	0.80

From the table - 2, it is observed that the value of λ is greater than 1 in Kurnool District. It indicates that over expectation of cotton crop growers about future prices of cotton output in Kurnool District.

In Andhra Pradesh state, the value of λ is 0.80. It is sufficiently high. The cotton growers in the state are influenced by very recent years' prices for their future cotton price expectation.

4. CONCLUSIONS

Commercial crops play a significant role in Indian Agriculture. Commercial crops account for 25 percent of cropped area in the country. The value of production is 40 percent in the total value of agricultural production in India. Cotton is one of the important commercial crop in Andhra Pradesh. One of the major commercial crops in Kurnool District is cotton. To analyse the performance of cotton cultivation, the growth and instability of cotton cultivation was studied and also the production responses of cotton crop was analysed with a traditional functional relationship, cotton production is a function of area, lagged price and rainfall. In a subsistence economy, crop production is determined by a number of input factors. Here, the Cagan's Adoptive Expectation Model was utilized to study the production responses of cotton. From the estimated equation, the following conclusions are made.

Observing the estimates of the traditional model, almost same results were observed in both linear and log linear models. The coefficient of area, established a positive and significant relationship with cotton production in Kurnool District. The remaining two variables - lagged price and rainfall are having negative relation with production. These two variables express that a unit increase will decrease the cotton production. Therefore, the effect of price and rainfall is not observed on cotton production. From the coefficient of rainfall, cotton is cultivated more under irrigated area than the rainfed area. Finally, it is infer that the cotton production was responded by its area only. Market prices are not encouraging the cotton growers to rise the production.

The estimated coefficient of the equation (13), both the models gave the same results. Only the coefficient of the area expresses the significant and positive relation with the cotton production. Price factor reveals an insignificant positive relationship and the remaining variables lagged area, rainfall and lagged output having inverse relationship with the cotton production. Hence, the cotton production in Kurnool was responded by area only but not the prices. Therefore, the area is the major output determinant factor. A negligible price effect was noticed. More than 90 percent of cotton variation was recorded by these explanatory variables. The aggregate effect of the variables on cotton production is significant.

The cotton production in Kurnool District was mainly area responsive but not price responsive. Similarly, rainfall's effect on production is negative. The cotton output is mainly responded by irrigation factor. It may be suggested to rise the production in Kurnool by providing minimum support price, better marketing conditions, etc.

Considering Andhra Pradesh as a whole, it is observed that the cotton production was mainly affected by area only. But, in traditional relationship, cotton production in Andhra Pradesh was responded by its area and price. The remaining variables establish an insignificant positive relationship with cotton production. 57 percent of production variation was recorded by these variables and this variation is found to be significant.

5. REFERENCES

Archana Singh, and Srivastava, R.S.L. (2003). Growth and Instability in Sugarcane production in Uttar Pradesh: A Regional Study. *Indian Journal of Agricultural Economics,* Vol.58, No.2, April – June, pp. 279-282.

Daram Narain. (1965). Impact of Price Movements on Areas Under Selected Crops in India. 1900-1930, *Cambridge University press*, London.

Grewal, S.S., and Rangi, P.S. (1983). An Analytical Study of Growth of Punjab Agriculture. *Indian Journal of Agriculture Economics*, Vol.XXXVIII, No.4, OctoberDecember, p.509.

Konda Swamy, A. (1985). Commercial Crops in India. *Indian Journal of Agriculture Economics*, Vol.43, No.3, July-September, pp.185-198.

Sen, S.R. (1969). Growth and instability of Indian Agriculture. *An address to the twentieth conference of the Indian Society of Agriculture Statistics*, Jan 10-12.

Suresh Pal., and Sirohi, A.S. (1988). Source of Growth and Instability in the Production of Commercial Crops in India. *Indian Journal of Agriculture Economics*, Vol.43, No.3, JulySeptember, pp.456-463.