Ever-since the beginning of the Five Year Plans in the country, considerable efforts have been made to improve the pattern of agriculture in general and to enhance the per hectare yield levels of important crops in particular. In this direction, 'Green Revolution' has brought about a substantial increase in agricultural production, particularly in foodgrains. Unfortunately, the fruits of agricultural modernisation have not been shared equally by all regions and by all crops. The high growth in agricultural production has been concentrated in a few pockets while large areas continue to wallow in stagnation. The concentration on the improvement of crop yield levels has also been laid on foodgrain crops especially paddy and wheat while the large number of crops viz., millets, oilseeds and fibres are still persisted with poor yield levels in many parts of the country. Consequently, the agricultural modernisation has
increased the disparities in both between regions and productivity of crops.

In this context it is pertinent to quote that "increase in the agricultural production in the recent Indian context is, to a great extent, linked with the problem of removal of disparity in yields both between crops and regions" (Swaminathan, 1977). The problems effectively boils down as how to enhance the per hectare yield levels of certain important food and commercial crops and areas which have so far lagged behind. The answer very often lies in the effective use of modern agrotechnological inputs and allied resources required and in overcoming the environmental or ecological problems that often plague them. Diagnostic regional inquiries focussing on the trends and disparities in the yield levels between the crops and their causes are an essential step in that direction.

Obviously, crop productivity is both dynamic and spatially variable. The spatio-temporal variations in crop productivity are the results of the combined interplay of physical, socio-economic, technological and organisational factors. Moonis Raz (1978, p. 19) opined that "the process of agricultural development in India, is essentially a function of differential doses of technological inputs interacting with environmental constraints of varying severity under the inhibiting influence of institutional factors of different intensities. While all the three operate together positively i.e., where institutions are less restrictive, environment more permissive and technological inputs high, it becomes possible to loosen the grip of inherited under development and a limited breakthrough is achieved in regional
agriculture. Where all the three mark together negatively - i.e., where the institutions are highly inhibitive, environment severe and technological inputs small-regional agriculture is unable to go beyond the stage of sub-marginal subsistence. Where the three operate in different directions or in the same direction with different degrees of intensity, regional agriculture plods along at an unsatisfactory pace."

Agricultural productivity is the composite index of the aggregate performance of various crops in regard to their output per hectare. It denotes the maximum average physical or monetary output per hectare in relation to the input under the prevailing physical socio-economic, technological and organisational conditions. Such a synthesised exercise may not be able to provide the insights in-depth to differentiate the crops whose performances and accomplishments are divergent, and also it is rather difficult to identify the yield gaps in the individual crops and between the crops as well as between the areas through the measurement of aggregate agricultural productivity. In view of spectacular spatio-temporal variations in the performances of certain crops due to differences in the intensities of agricultural modernisation, it is essential to focus on the study of changing patterns of crop yield levels and yield gaps. Such a study helps to design crop planning and to lessen both the yield gaps and regional disparities in crop yield levels. Study on the changing pattern of crop yield levels is of great importance in the drought prone areas like Cuddapah district where agriculture is the most important economic activity of the people.
The present study mainly focusses upon

i) the changing trends in the yield levels of important crops,

ii) to identify the yield gaps in individual crops and

iii) to assess the impact of rainfall especially on the yield levels of dry crops which are predominant in their spatial spread in this region.

Methodology

In the present study, the changing trends in the yield levels of important crops for the kharif and the rabi as well as for the total are examined with the help of linear regression equation. The 'goodness of fit' of the trend is measured by coefficient of determination. Trends in crop yields are also established by compound growth rates. For measuring the crop yield gap in percent, the yield difference between the district yield and the average State yield is measured in percent. The correlation analysis is made to assess the impact of rainfall on the crop yield levels especially for the dry crops.

The analysis is made at district level since the yield data is not available at taluk or mandal level. The study analyses the 11 important crops of the district and the span of the study period covers 18 years from 1967-68 to 1985-86.

Changing Pattern of Crop Yield Levels (1967-85):

An attempt is made here to examine the changing trend of yield levels of 11 important crops of Cuddapah district during the
period 1967-85 so as to ascertain whether there is any increasing trend in the productivity of crops. The crops chosen for the purpose of study include paddy, jowar, bajra, ragi, korra, redgram, greengram, horsegram, groundnut, cotton and turmeric.

**Yield Level of Paddy:**

Paddy is an important cereal and intensively cultivated crop under irrigation in the district. The per hectare yield level of paddy in Cuddapah district has shown significant positive trend both in kharif and rabi seasons as well for the gross cropped area. The per hectare yield level of paddy in kharif season has increased by 588 kgs. i.e. from 1511 kgs. in 1967-70 triennium to 2099 kgs. in 1983-86 triennium. Rabi paddy yield level too was increased by 1000 kgs. On an average the total paddy yield level was increased by 686 kgs. per hectare. It reveals that the growth in the paddy yield level is high in rabi season than kharif. It is also evident from the fact that the growth rate in rabi paddy yield level is high which accounted 3.4 per cent per annum and it is 2.1 per cent growth in kharif paddy yield and the average is 2.6 per cent for the total paddy yield level.

The regression line has also revealed that there has been a steep increase in the yield level of rabi paddy than kharif paddy. In rabi season the gradual improvement in the paddy yield with high positive trend has been accounted by 82 per cent of coefficient of determination when compared to 38 per cent $r^2$ value for the trend of kharif paddy yield level. It indicates that there has not been a steady improvement year by year in the kharif paddy yield level.
CUDDAPAH DISTRICT
Trend in the Yield Level of Paddy

Kharif

scale
y 1 cm 400 Kgs
x 1 cm 2 Years

Rabi

Total

Fig: 91

Yield per Hectare (Kgs)
because there are many other factors which influenced more and thereby caused significant yearly deviations in the yield level of kharif paddy as it is clearly seen in the figure 9.1. Here, it is worth while to mention that the productivity of paddy may generally be high in rabi season because paddy is intensively cultivated in a limited area with full assured water facilities and agro-technological inputs. Though paddy is an irrigated crop even during kharif season but its cultivation is extensive and sometimes the failure of monsoon and occurrence of droughts may seriously affect the crop at the maturity stage. Consequently the yield levels would be declined and fluctuations may be occurred.

It is interesting to note here that the hectare yield of paddy in Cuddapah district is higher than the average yield of paddy in the State both in the first triennium (1967-70) and in the last triennium (1983-86). In the last triennium the yield gap was marginal 0.9 per cent or 19 kgs.

Since paddy is an irrigated crop, generally the impact of rainfall on paddy yield may not be found and this was found correct from the coefficient of correlation between rainfall and paddy yield i.e. 0.08 in the case of kharif paddy yield. 0.1 in rabi paddy yield.

Evidently from the above analysis, the agricultural modernisation has considerably brought about a spectacular change which has dividends in the scenario of paddy culture in the district. If the new agro-technology equally succeeds in extensive kharif paddy
cultivation as in the case of rabi paddy, this process would certainly brings a greater prosperity to this district.

**Yield Level of Jowar:**

The current yield level of jowar is somewhat respectable in Cuddapah district (1017 kgs. in 1983-86) when compared with the state's average (624 kgs/hectare in 1983-86). There has been a striking increase in the yield levels of jowar both in kharif and rabi seasons. In the kharif season, the jowar yield was increased by 500 kgs. (from 513 kgs. in 1967-70 to 1013 kgs. in 1986-89) in the district as against to only 57 kgs. increase in the State's average (494 kgs. in 1967-70 to 551 kgs. in 1983-86). In the rabi season, the increase was by 682 kgs. (i.e. from 474 kgs. in 1967-70 to 1156 kgs. in 1983-86) in the district as against to 237 kgs increase in the state's average value (i.e. from 460 kgs. to 697 kgs). On an average the yield of jowar was increased by 513 kgs. in the last 18 year period. It is observed that the high increase in the yield of rabi jowar is at the rate of 5.9 per cent per annum, while kharif jowar yield has registered 4.7 per cent increase. On an average the compound growth rate is 5 per cent increase per annum in the district.

The regression analysis also revealed that there has been a positive trend in the yield levels of jowar both in the kharif and the rabi seasons. The slope of the positive trend of rabi jowar yield is confirmed by a high value of 70 per cent of coefficient of
CUDDAPAH DISTRICT
Trend In The Yield Levels Of Jowar

**Scale**
Y 1cm 200 Kgs
X 1cm 2 years

**Kharif**

**Rabi**

**Total**

Fig: 92
determination indicating that the yearly fluctuations in the yield are not so vivid and the improvement in the yield is rather gradual. While in kharif jowar yield, the trend of increase is accounted by 45 per cent $r^2$ value which indicates that increase in the yield has not been accounted by time factor i.e. improvement in the yield year by year is not constantly occurred but influenced by other factors especially rainfall. As a result, the fluctuations in the observed values of kharif jowar yield are more and can clearly be seen in the figure 9.2. Since jowar is a rainfed crop in the kharif season, these striking fluctuations may be occurred on account of fluctuations in rainfall conditions.

The impact of rainfall on the yield level of kharif jowar is very high as is clear from the coefficient of correlation value of 0.9. In kharif season jowar is almost cultivated as a rainfed crop and hence the yield of jowar is being determined by rainfall. While in rabi season the low coefficient of correlation value 0.2 has indicated that the impact of rainfall on rabi jowar yield is insignificant because the rabi crop is grown depending on irrigation.

Jowar is the leading crop in the district next to groundnut. The current yield level of jowar is somewhat respectable compared to the State. But what is more required at present is to reduce the fluctuations in the yield levels especially in the kharif jowar and it may possible by adopting dry farming technology.
Yield Levels of Bajra, Ragi and Korra:

These millet crops are not that much of important as paddy, jowar or groundnut to cultivate extensively in both kharif and rabi seasons in the district. In one way or other the cultivation of these coarse millet crops have been confined to seasonal cropping either as a kharif crop or rabi crop. In view of this reason and also their meagre contribution to the total production, the yield levels of these crops are analysed for the gross cropped area.

The yield levels in bajra, ragi and korra are increased during the period 1967-85. The bajra yield was increased by 422 kgs./hectare, (from 601 kgs. in 1967-70 to 1023 kgs. in 1983-86) as against 142 kgs. increase in the State's average yield (472 kgs. to 624 kgs.). It shows that the yield gap and the rate of increase between the district and the State's average figure are positive. The compound growth rate also indicated that the bajra yield has increased at the rate of 2.7 per cent per annum. The regression equation has also shown positive trend and this trend line is accounted by 40 per cent coefficient of determination. It reveals that the fluctuations in the yield of bajra are significant caused by other factors than the time factor. The relationship between rainfall and the yield of bajra is positive but moderate as it inferred from the coefficient of correlation value of 0.5. It may be stated that bajra cultivation has not been receiving much attention in terms of technological input application and in effect, the yield level has been fluctuating quite significantly.
CUDDAPAH DISTRICT

Trend In The Yield Levels Of Bajra, Ragi, Korra

**Bajra**

- Scale: Y 1 cm 200 Kgs
- X 1 cm 2 Years

**Ragi**

- Scale: Y 1 cm 400 Kgs
- X 1 cm 2 Years

**Korra**

- Scale: Y 1 cm 100 Kgs
- X 1 cm 2 Years

Fig. 9.3
The yield level of ragi has registered a positive increase of 2.3 per cent per annum. In terms of actual figures, ragi yield was increased by 364 kgs./hectare (from 1133 kgs. in 1967-70 to 1497 kgs. in 1983-86) as against an increase of 139 kgs. in the State's average ragi yield. When compared with other millet crops, ragi yield level is somewhat considerable and respectable due to its cultivation more under irrigation. The regression trend too has shown a positive trend of increase but with a low coefficient of determination value of 30 per cent. The relationship between rainfall and yield level of ragi is positive with a moderate coefficient value of 0.5. On account of this relationship with rainfall the yield levels of ragi certain times may be affected considerably and striking fluctuations are to be occurred.

Korra, an inferior millet has not registered significant current yield level as in the case of other millet crops. This crop is raised mostly unirrigated and it is being pushed to poor marginal lands. But any how, korra yield level in the last 18 year period was increased by 448 kgs. i.e. from 210 kgs./hectare in 1967-70 to 658 kgs in 1983-86 compared to a small increase of 59 kgs./hectare in the state's average yield of korra. The compound growth rate has shown high increase in the yield level of korra at the rate of 6.5 per cent per annum. The regression equation too has shown a significant positive trend with steep slope. This positive trend is accounted by 42 per cent coefficient of determination. It is observed that the differences between trend values and observed values are more due to its cultivation depending upon rainfall conditions. The correlation analysis has revealed that there is a high relationship
between rainfall and yield level of korra which is indicated from the coefficient value of 0.7.

From the above discussion, it is observed that the current yield level is considerable in the case of ragi than bajra and korra crops. In this situation, the current yield levels of bajra and korra are to be raised because these two crops are significant in spatial spread than ragi. Especially the bajra yield could be increased substantially by raising the input application and by adopting the dry farming technology. Another important observation which is to be seriously considered is the fluctuations in the yield levels of these millet crops. These fluctuations in the yield levels are to be minimised through varietal improvement programmes for the enhancement of total sustainable agricultural production.

Yield Levels of Pulses and Grams:

The situation in the yield levels of pulses and grams is not encouraging. They are raised mostly unirrigated on inferior soils and often as interculture crops. Their current yields are low and they remain neglected in input application. The important grams cultivated in the district and considered here are horsegram, redgram and greengram.

The yield level of horsegram has registered a small increase at the rate of 1.4 per cent per annum. In terms of actual values, yield of horsegram has increased from 129 kgs. per hectare in 1967-70 to 258 kgs./hectare in 1983-86, showing a net increase of 129 kgs. compared to 140 kgs. increase in the State's average yield. Regression analysis has also shown the positive trend in the yield
CUDDAPAH DISTRICT
Trend In The Yield Levels Of Pulses And Grams

**Green Gram**

Yield per Hectares (kgs)

Years: 1957 to 1986
Scale: 100,000 Kgs
Y 1 cm = 100,000
X 1 cm = 2 Years

**Red Gram**

Yield per Hectares (kgs)

Years: 1957 to 1984

**Horse Gram**

Yield per Hectares (kgs)

Years: 1957 to 1986

Fig 94
level of horsegram. The trend line is accounted by 9 per cent of coefficient of determination. From the figure 9.4, it is observed that the differences between the observed values and the trend values are high indicating the marked fluctuations in the yield of horsegram. These differences are due to fluctuations in the rainfall conditions. Because the relationship between rainfall and the yield level of horsegram is high amounted to 0.6 per cent coefficient value. It is worthwhile to mention here that there is a negative yield gap between the horsegram yield in the district and in the state as a whole. The yield gap amounted to -23 kgs. or -8.9 per cent.

The yield level of redgram was very low in 1983-86 triennium in the district amounted to 179 kgs./hectare compared to 274 kgs. for the State as a whole. In the last 18 year period redgram yield has shown a decrease of 268 kgs./hectare in the district which was higher than the decrease of 133 kgs./hectare in the average yield of redgram in the State. The yield rate of redgram has recorded a negative growth rate of 5 per cent per annum. The regression analysis has also revealed a trend of decrease in the yield and this regression accounted for 42 per cent of the variation in the observed values of the dependent variable. It indicates that there are conspicuous fluctuations in the yield level of redgram between 1967-70 and 1983-86 period. These high fluctuations in the redgram yield caused due to rainfall impact, low input condition and very less attention about its cultivation. Because redgram is generally cultivated as an interculture crop in groundnut and jowar cultivating areas. In such a situation, farmers show much interest on main crop rather
than the secondary crop. So the cultivation of redgram has lost the attention of the farmer. The relationship between rainfall and the yield of redgram is positive and accounted high degree of coefficient of correlation of 0.6. The yield gap between the district's yield value and the State is negative and amounted to -95 kgs. or -79 per cent.

The yield level of greengram recorded an increase of 4.2 per cent per annum. In terms of actual yield, it was increased by 259 kgs./hectare (from 184 kgs./hectare in 1967-70 to 443 kgs. in 1983-86) in the district compared to 267 kgs. increase per hectare in the average yield of State. The current yield level of greengram in the district is quite higher than the average yield level of the state and the yield gap is 36 kgs. or 8.1 per cent. The regression equation has also shown that the increase in the yield level of greengram is positive and this positive trend line is accounted by 35 per cent of coefficient of determination. The relationship between rainfall and the yield level of greengram is positive but the low coefficient value 0.4 indicates that the impact of rainfall on the yield levels of greengram is not significantly high.

From the above analysis it is inferred that the current yield levels of pulses and grams are not significantly high. This is due to (i) rainfed cultivation of these crops incurred high fluctuations in the yield levels, (ii) lack of varietal programmes to boost up the production of grams, (iii) attention and care given to the cultivation of these crops is comparatively less, and (iv) cultivation of grams as inter-mixed crops has given only secondary importance
to pulses. There is sufficient scope for improvement of yield levels of pulses and grams by suitably using input conditions and adopting dry farming technology.

Yield Level of Groundnut:

Groundnut is the most leading crop cultivated in the district. The agricultural productivity of this district heavily depends upon the contribution of groundnut yield and production. But it is very unfortunate to note that there was a complete negligence on the improvement of the yield level of groundnut in the last 18 year period. This negligence is apparent if the average yield of groundnut when compared to the State's average yield. The average yield of groundnut in the district was 688 kgs./hectare in 1983-86 triennium compared to 856 kgs. in the State as a whole. Another debilitating effect was the decline in the average yield level of groundnut from 840 kgs./hectare in 1967-70 to 688 kgs./hectare in 1983-86, thus showing a net decrease of 152 kgs./per hectare in the last 18 year period. But of the average yield level of the State, groundnut yield was increased by 94 kgs. per hectare. The decrease in the yield of kharif groundnut was very much about 216 kgs./hectare in the district. In kharif season, groundnut is mostly cultivated as a rainfed crop with low input application resulted into poor yield levels. While in rabi season, groundnut cultivated as an irrigated crop, as a result, the rabi yield is moderately high (1500 kgs./hectare in 1983-86 also showed an increase of 324 kgs./hectare during 1967-85.
CUDDAPAH DISTRICT
Trend in the Yield Level of Groundnut

Kharif

Y 1 cm 400 Kgs
X 1 cm 2 Years

Scale

Yield per Hectares (Kgs)

1967 1976 1986

Years

Rabi

1967 1976 1986

Years

Total

1967 1976 1986

Years

Fig 9.5
The compound growth rates showed that there is a decline in the yield levels of groundnut at the rate of -2 per cent per annum in the kharif groundnut and -1 per cent per annum in the case of average yield. While in rabi groundnut the yield rate was positive with 1.5 per cent per annum. From 1967-68 onwards, the trend of average groundnut yield in the district has been marginally negative trend. The goodness of fitness of the regression trend i.e., coefficient of determination states that the present negative trend is to the tune of 2.5 per cent only. It means that the present negative trend is not exactly perfect and true. There are many other factors which are playing major role in determining the yield levels and thus giving rise to significant fluctuations in the yield of groundnut. The regression trend for the kharif groundnut yield was negative and this negative trend was accounted by 8.5 per cent coefficient of determination. The linear trend for rabi groundnut yield was positive and it accounted by 15 per cent of coefficient of determination.

The correlation analysis has revealed a moderate positive correlation between the rainfall and the average yield of groundnut and the coefficient value is 0.5 per cent in the district. This positive relation is somewhat high 0.7 with kharif groundnut yield than the rabi groundnut yield (0.2). Since the large area is under kharif groundnut and that too groundnut is the single largest contributor to the overall productivity of the district and negative yield gap between the district and the state's average, it is imperative to improve the yield levels of groundnut with the help of suitable fertiliser responsive HYVs for the low rainfall and low
irrigation environments of this district.

Yield Level of Cotton:

The per hectare yield level of cotton has raised at the rate of 2.8 per cent per annum. The actual yield was increased by 36 kgs./hectare (from 95 kgs. in 1967-70 to 131 kgs. in 1983-86). The regression trend has also shown the positive trend. This trend of increase was accounted by 12 per cent of coefficient of determination. From the figure 9.6 it is observed that there are considerable fluctuations in the actual yield levels of cotton in the district indicates the precarious condition of cotton cultivation. This is mainly because of its rainfed cultivation as well as the prevalence of plant diseases. The relationship between rainfall and cotton yield is positive and the coefficient of correlation value is 0.4.

Yield Level of Turmeric:

Turmeric is an important spices cultivated intensively in the irrigated tracts of K.C. canal irrigation system. Though the location of its cultivation is confined to few segments but it is an important cash crop. The per hectare yield of turmeric in the district has increased by 1.7 per cent per annum or 2545 kgs. increase per hectare (from 3720 kgs./hectare in 1967-70 to 6265 kgs. hectare in 1983-86) during 1968-86. The regression trend too has shown the trend of increase and it is accounted by 10 per cent coefficient of determination. From the figure 9.6 it is observed that the difference between the observed values and the trend values are more conspicuous
CUDDAPAH DISTRICT

Trend In The Yield Levels Of Cotton & Turmeric

Cotton

Scale
Y 1 cm = 20 tonnes
X 1 cm = 2 Years

Turmeric

Scale
Y 1 cm = 1000 Tonnes
X 1 cm = 2 Years
Conclusion

From the present study, it is inferred that the yields are moderate to high in the cereal crops but yields are deplorably poor in oilseeds and pulses crops in the district. This situation mainly obtains due to disparity in the use of physical resource base and input application. Many parts of the district are plagued with problems of low rainfall with greater degree of uncertainty and variability, drought, prolonged dry spells, scanty irrigation facilities, poor red soils and soil erosion in the valleys and upland areas. The technological input application is also very insignificant in the cultivation of dry crops. Consequently, the yield levels of many crops in the district have not been found with constant rise and the fluctuations are more vivid. This highly fluctuating increase of the yield levels can not be shown the stable performance of agriculture. The first and foremost problem to be solved in this region is to reduction in the fluctuation of yield levels and so as to bring normal and stability in the production process. Secondly, attempts are to be made to enhance the yield levels of important crops especially groundnut, jowar and paddy which accounted for three-fourths of area and production. Until and unless these crops are not raised with spectacular yield levels the overall productivity and prosperity of agriculture may not be achieved. This, however, is not easy but much greater efforts will have to be made than attempted
so far. In this endeavour, the illiterate and orthodox farmers of this region must be trained in the new methods of cultivation and dry farming technology for strengthening the present rainfed farming and for improving the productivity of dry crops.