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Impact of climate change on agriculture in Karnataka

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ABSTARCT

Karnataka state is having the second largest rainfed agricultural area in the Country and food production is mainly depending on the south-west monsoon. The State's mean annual rainfall is found to be in decreasing trend along with its sixteen years cyclic periodicity. The State first half century's (1901-1950) normal of 1204 mm has been reduced to 1140 mm during second half of the century (1951-2000). Nevertheless, few districts like Bengaluru, Kolar and Tumkur are gaining in their mean annual rainfall and some traditionally heavy rainfall receiving districts like Kodagu, Chikmagalur and South Canara are loosing in their mean annual rainfall. The eastern districts of the state are tending to be more dependent on North East monsoon than terminal rains of the South West monsoon. Consequently individual crop growing area, growing period are changing. The normal sowing season rains are being delayed due to the shift of July rains to the August month and September peak rainfall is being shifted to October month. The maximum water available period for the grand growth period is shifting towards the end of September and beginning of October in many districts. Finger millet crop area (main food crop of southern Karnataka) in Chikmagalur district, Groundnut area in Chitradurga and Tumkur districts, Red gram in Bidar and Gulbarga districts is increasing. Where as, Groundnut area in Belgaum and Gulbarga districts and Red gram area in Belgam and Tumkur is decreasing.

Key words: Climate change, rainfall, productivity, global warming

The Karnataka State is located between 11.5º N and 18.5º N latitude and between 74º E and 78.5º E longitude. The mean elevation varies between 600 m to 900 m above mean sea level (Rajegowda 1990). The State comprises of ten Agro climatic zones. Global Climate change and its impact on agriculture is becoming an important issue even at the micro level. A slight change in the climate may lead to major changes in plant and animal life. Rainfall is one of the most important parameters that influence the agriculture of the region and food production. Therefore, a case study was taken up to analyze the rainfall pattern for few districts in Karnataka state where rainfall is showing definite trend to examine the cropped area variability for major crops. Sastri and Urkurkar (1996) observed a decrease in pre-monsoon rainfall in some parts of Chhattisgarh region in the months of May and June which has detrimental effect on the pre-sowing operations of rice crop. Saseendran *et.al*. (2000) showed that the plausible climate change scenario for the Indian subcontinent as expected by the middle of the present century. Kumar *et.al*. (2001) estimated the relationship between farm level net-revenue and climate variables in India using cross-sectional evidence. Sinha *et. al***.** (1988) indicated that food supplies in smaller nations would be affected more by climate change than those of larger nations.

MATERIALS AND METHODS

A case study has been taken up to analyze the rainfall pattern of few districts in Karnataka State where rainfall is showing definite trend and the cropped area variability trend for major crops. Published data of rainfall and cropped area of different districts were collected from Drought Monitoring Cell- Bangalore and Directorate of Economics and Statistics-Bangalore. Annual total rainfall for the years 1950 to 2006 is respect of several districts, zones and the state was analyzed and plotted on time series. Similarly the districtwise cropped area for the period from 1955-2006 was analyzed and with time series. The trend in rainfall and the area under different crops in several districts were examined and discussed.

RESULTS AND DISCUSSION

The time series of the mean annual rainfall of the State indicates a definite cycle of sixteen years starting 1950 to 1964 and so on. The first half of the cycle received less than the normal rainfall for the period from 1950 to 1958 and the second half of the cycle received more than the normal for the period from 1959 to 1964. During this half of the cycle, two or three of eight years have received the rainfall opposite to their trends. This cycle is repeated up to 2004 and the state is in the positive half of the cycle from 2004 and likely to continue till 2012 (Fig 1).

The State's mean annual rainfall for the period from 1901 to 1950 was 1204 mm (Rajegowda *et. al.* 1990) and it during the period 1951 to 2000 is reduced to 1140 mm (Annual Report 2003. Drought -2002). The mean annual rainfall of the State for the period from 1901 to 2000 was reported to be in declining (Panduranga *et. al***.** 2006). There is s definite declining trend in rainfall in Kodagu (Guruprasanna *et. al***.** 2006), Chikmagalur and South Canara districts. In Kodagu district, the mean annual rainfall for the period 1901-1950 was reduced from 2725 mm to 2625 mm during the period 1951-2006. Chikmagalur district's mean annual rainfall of 1927 mm declined to 1872 mm and

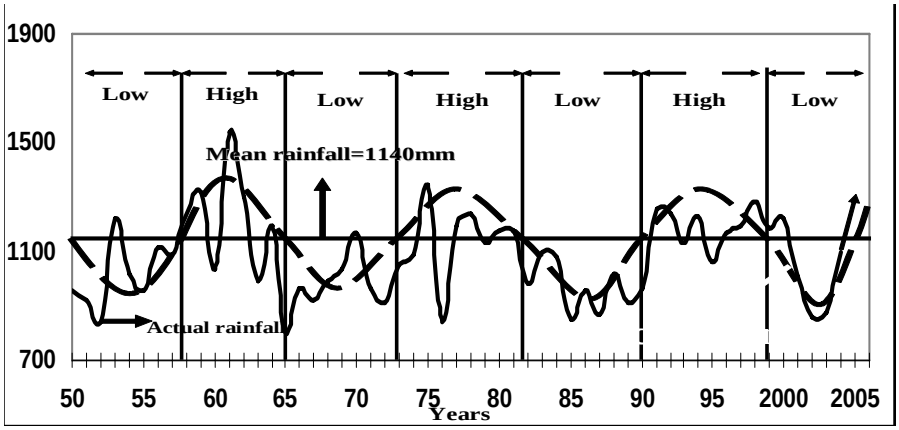

Fig 1: Cyclical trend of Karnataka State mean annual rainfall for the period from 1950 to 2006

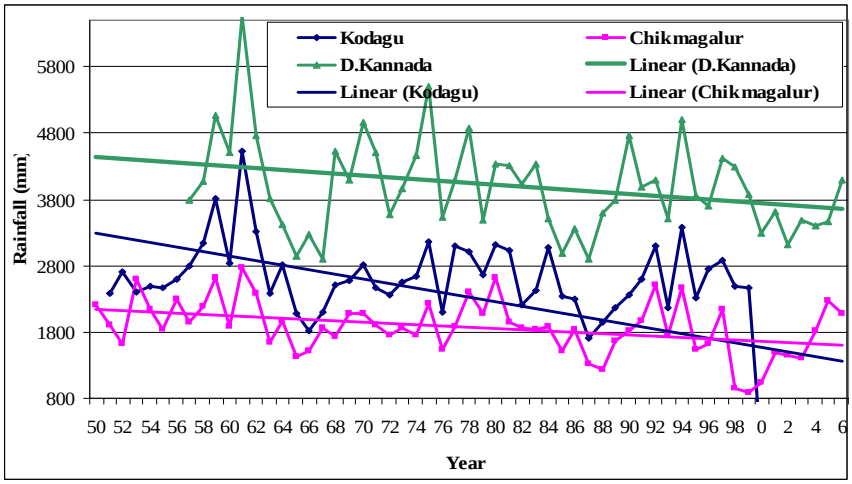

Fig 2: Declining trend of rainfall in Kodagu, Chikmagalur and South Canara districts.

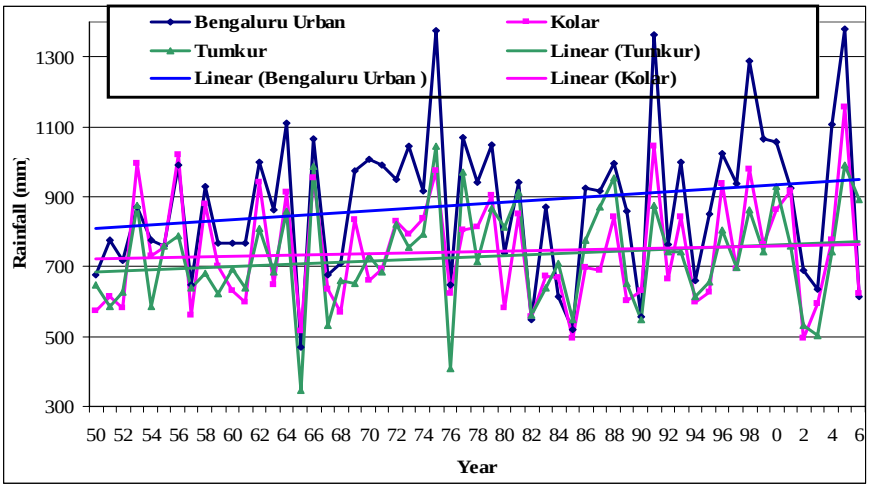

Fig 3: Increasing trend of rainfall in Bengaluru, Kolar and Tumkur districts.

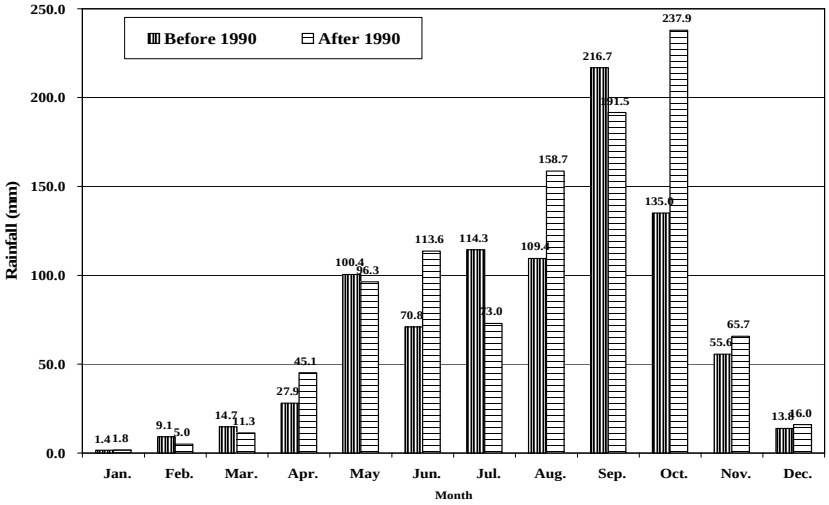

Fig 4: Rainfall shift in the Eastern Dry zone of Karnataka

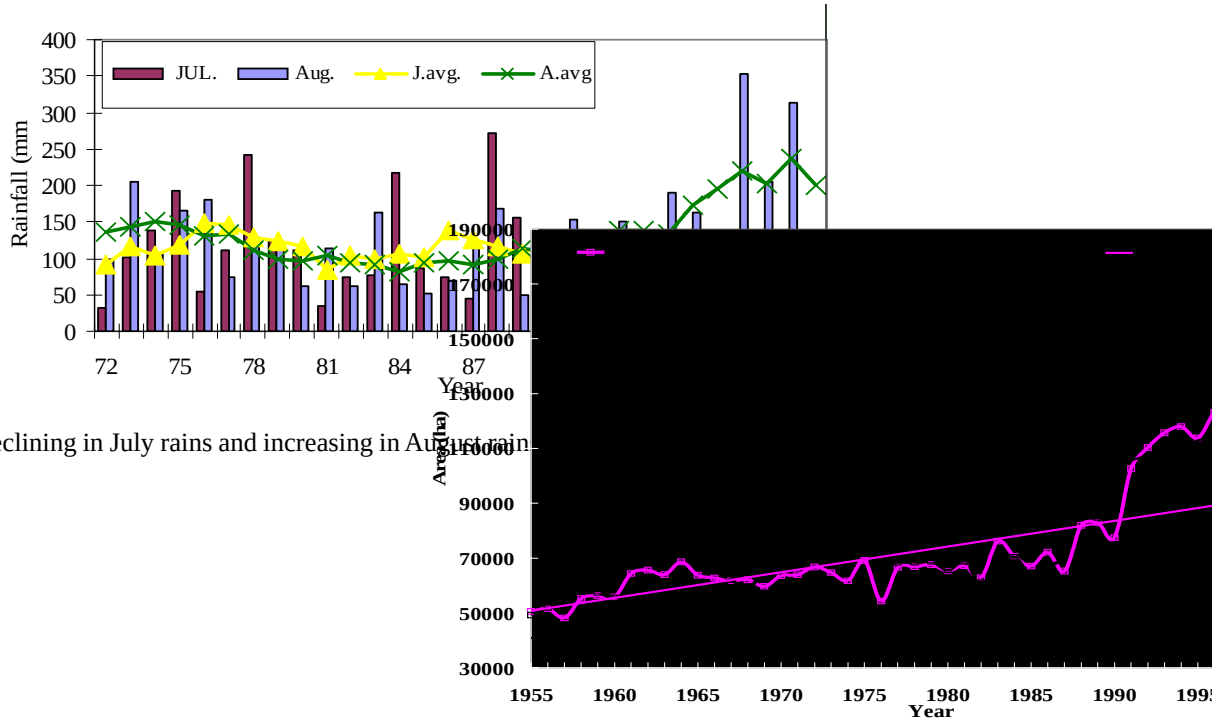

Fig 5: Declining in July rains and increasing in August rain

Fig 6: Increase in rice area in Mandya and Mysore districts and their trends

South Canara district's mean annual rainfall of 3976 mm has been reduced to 3960 mm for the corresponding periods which clearly indicates declining trend and the same is shown in figure.2. Further few districts of the state have shown increasing trend in the annual rainfall. Bengaluru, Kolar and Tumkur districts have shown the considerable increasing trend in the annual rainfall. Their mean annual for the period from 1901 to 1950 are 867 mm, 745 mm and 688 mm respectively and compared to are 883 mm, 767 mm and 730 mm respectively for the period from 1951 to 2006. (Fig 2).

The Eastern Dry zone of Karnataka consists of Bengaluru and Kolar districts and parts of Tumkur district. This Zone is also called as the Tank fed region and constitutes 9.42 per cent of the State's geographical area. Eighty per cent of the area is at an altitude of 800 -900 m above mean sea level (Rajegowda 1990). 47 per cent of its area is under agriculture/horticulture crops. Rajegowda *et. al*. (2000) have shown that there is a predominant shift in the initiation and termination of rainfall to supply adequate moisture for crop growing period. This shift was observed after 1990 and their mean monthly values also have changed. Before 1990, the annual rainfall ranged from 619 to 1119 mm with a mean of 869 mm. After 1990, the annual rainfall ranged between 611 and 1311 mm with a mean of 1011 mm. During the first period, on the average the peaks were observed during the months May, July and September (Fig 4). During the second period, the peaks were observed during the months May, August and October months.

Consequently growing area under different is varying. Crop growing period is changing and crop productivity is also varying. The normal sowing season gets delayed due to the shift of July rains to the month of August (Fig.5).The peak normally occurring during September shifted to October The maximum water available period for the grand growth period is shifting towards the end of September and beginning of October in many eastern districts.

The changes in cropped area under different crops in various districts was examined for the period from 1950 to 2006. It is observed that area under some crops is increasing while it is decreasing in some districts over years. A definite was observed for the following crops. The area under rice in Mysore and Mandya districts, finger millet (Ragi) in Chikmagalur district, Red gram in Bidar district and Groundnut in Chitradurga and Tumkur districts is increasing (Figs 6 to 9). The decline of area of in red gram area in Belgaum and Tumkur districts, Groundnut in Belgaum and Gulbarga districts are shown in figures 10 and 11 respectively. Such change in the cropped area is found to be influenced mainly due to the availability of the rain water during the cropping season.

The declining trend of annual rainfall in Kodagu, Chikmagalur and South Canara districts in is The increasing trend of annual rainfall in Bengaluru, Kolar and Tumkur districts indicates better water availability to the for getting higher yield.

The distribution of rainfall during the cropping season has high influence on the cropping area and crop selection. In both the periods considered for this study, the quantum of May rains received during both the periods more or less remain same. The rainfall received during the south-west monsoon, i.e., starting from June to October which is the crucial period for the growth of the crop apart from the hydrological utility is much more important. The quantum of rain received during June is low and it remains unchanged more or less in both the periods. The average rainfall during July, which was 114.3 mm during 1972-90, decreased to 73.0 mm during 1991-99. This reduction in July rains seems to be compensated by an increase in August rains (158.7 mm) during 1991-99 compared to the period 1972-90 (109.4 mm). This clearly shows that there is a perceptible shift in rainfall pattern from July to August and also from September to October in this Agroclimatic zone. A distinguished peak was observed in the month of September (216.7 mm) during 1972-90 and October was the next highest rainfall-receiving month. The analysis of monthly rainfall beyond 1991 showed that the highest rains are now received during October i.e. (237.9 mm) and the next highest rainfall is received during September (191.5 mm). This implies that the peak, which was being observed during 1972-90, has shifted to October during 1991-99. There is a marginal increase even in the rainfall of November month after 1990.

The crop sown during July rains would reach the grand growth period i.e., flowering to grain formation stage (long duration crops of about 115 days) during September month which was receiving the highest rainfall till 1990, so that there was no moisture stress during the grand growth period. After 1990, as a result of reduction in July and September rains, the crops can not be sown during July, though the land preparation could be done using June rains. Even with scanty rains, if the sowing is done during July, the crop would suffer from moisture stress due to the reduction in rainfall during September and also the crop grown would be caught in the October rains causing considerable loss in the grain yield at the harvest. The change in the mean monthly rainfall pattern beyond 1990 does not favour the sowing of crops during July month. This analysis reveals that the sowing of the crops (medium duration variety crops of about 115 days) could be done during August preparing the land using June and July rains. In the years of early onset of south-west monsoon, sowing can be recommended during last week of July also. The crop sown during August would reach the grand growth period during October. As the October month receives higher rainfall the crop in its grand growth period would not suffer for want of moisture. The crop sown beyond August

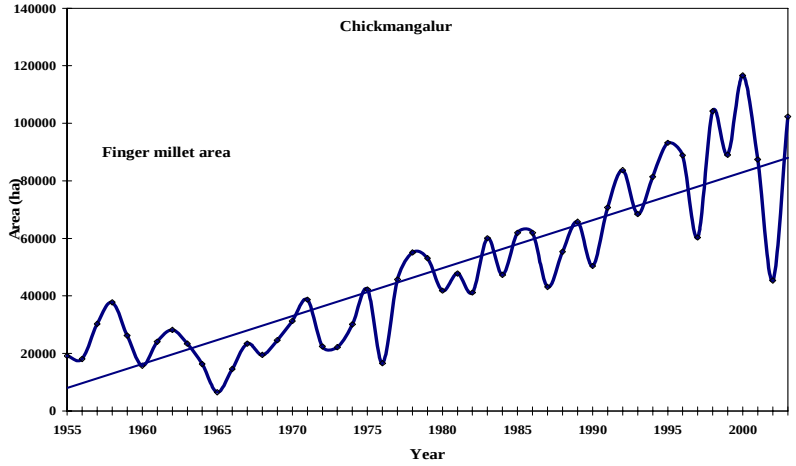

Fig 7: Increase in finger millet area in Chikmagalur district and its trend

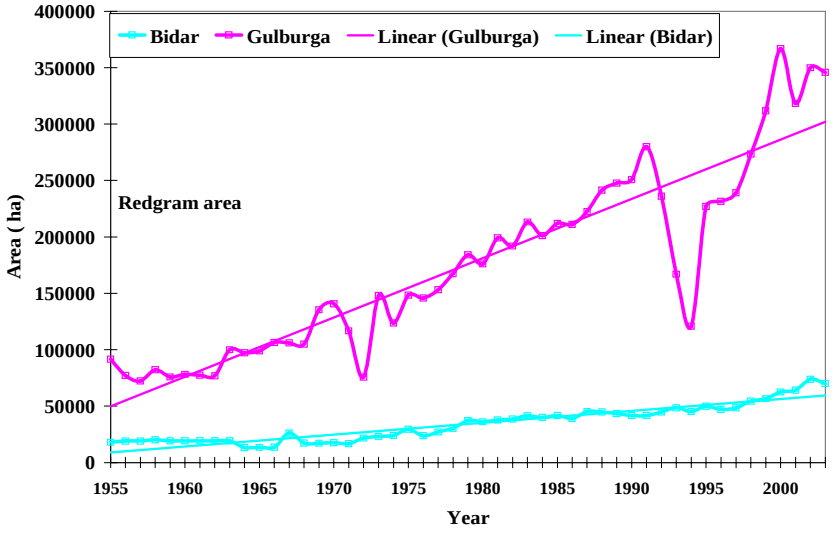

Fig. 8: Increase in red gram area in Bidar and Gulbarga districts and their trends

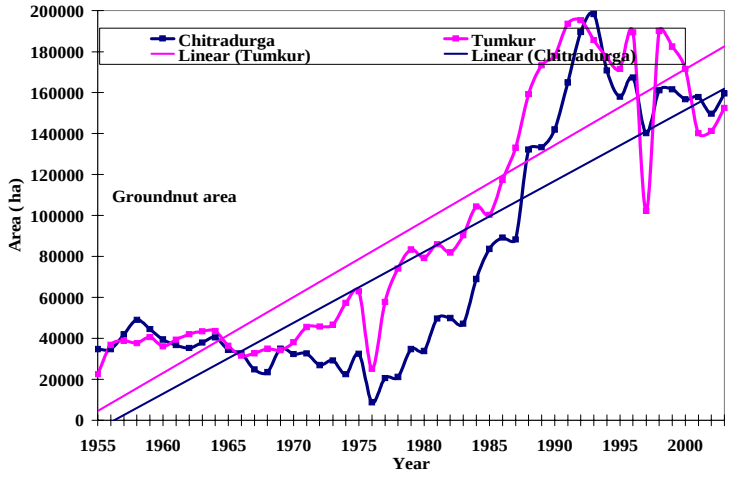

Fig 9: Increase in groundnut area in Chitradurga and Tumkur districts and their trends

Fig. 10: Decrease in red gram area in Belgaum and Tumkur districts and their trends

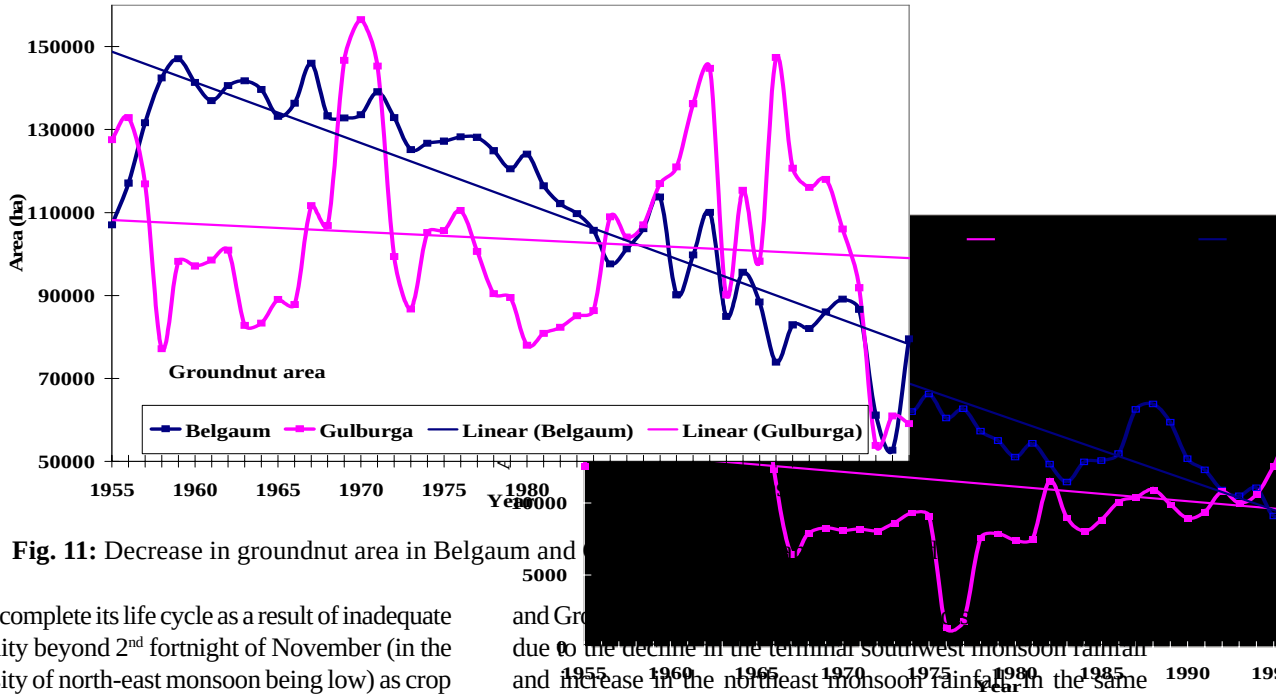

Fig. 11: Decrease in groundnut area in Belgaum and [illegible]

may not be able to complete its life cycle as a result of inadequate moisture availability beyond 2nd fortnight of November (in the event of the intensity of north-east monsoon being low) as crop maturity coincides during this period. Under such circumstances, the short duration variety crops have to be preferred. Further micro level studies in quantum of rainfall shift are needed.

The increasing in rice area in Mysore and Mandya districts is due to increase in irrigation area and also reduction in rainfed agriculture. In case of Chikmagalur district, the fingermillet area s increasing due to the declining trend in rainfall. The farmers are changing their crops to raise better crops based on the available water through rain water. Hence, the area under finger millet is increasing. Red gram in Bidar and Gulbarga districts and Gr[illegible] due to the decline in the terminal southwest monsoon rainfall and increase in the northeast monsoon rainfall. In the same districts the groundnut area is decreasing as the water requirement is not met during the pod filling and pod maturity of the crops as the September month rainfall is decreasing. During this period, the redgram will not be affected as the crop is in vegetative stage and does not demand more water and hence the red gram area is increasing in these districts and groundnut area is decreasing.

CONCLUSION

The state's mean annual rainfall is found to be in decreasing trend along with its sixteen years cyclic periodicity.

The State's normal of 1204 mm is reduced to 1140 mm. Bengaluru, Kolar and Tumkur are gaining in their mean annual rainfall and some traditionally heavy rainfall receiving districts like Kodagu, Chikmagalur and South Canara are loosing in their mean annual rainfall. The eastern districts of the State are tending to be more dependent on North East monsoon than terminal rains of the South West monsoon. The predominant shift in initiation and termination of rainfall to supply the adequate moisture for crop growth has been observed in many agro climatic zones of the state retaining the same length of rainy period. Consequently to this, individual crop growing area is varying, crop growing period is changing and crop productivity is also varying. The normal sowing season rains are being delayed due to the shift of July rains to the August month and September peak rainfall is being shifted to October month. The maximum water available period for the grand growth period is shifting towards the end of September and beginning of October in many districts.

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