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# Impact of Climate Change in the Area of Cultivation and Cropping Pattern in Tamil Nadu – A Micro Analysis

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**ABSTRACT**

India is a developing nation with majority of agricultural population and high cultivation area when compared to the other developing countries. According to 2011 census 71 percent of the Indian people are living in rural areas and mostly they are employed in agriculture and related activities. It is a primary source available for generation of income and employment in rural area. The growth rate of agriculture has come down to 1.1 percent from 4.69 percent in contrast to the 6 percent growth rate of Indian economy for the last ten years. Around 93 percent of the farmers are small farmers having land holdings of less than 4 hectare but the average farm size is only 1.57 hectares and they cultivate nearly 55 percent of the available land and the reasons are as follows, due to Industrial growth in India more number of industrial units was started in the past decades. In recent years, the climate changes have been a complex issue due to foreign climate policy. The climate changes affect the existing cultivating areas due to unscheduled rainfall, high temperature, and high tensed cyclones and so on. This micro level study made on attempt to make an assessment about the level of changes occurred in the cultivation area, temperature and rainfall and its effects on the area of cultivation and cropping pattern in study region.

## 1. Introduction

India is a developing nation with majority of agricultural population and high cultivation area when compared to the other developing countries. According to 2011 census 71 percent of the Indian people are living in rural areas and mostly they are employed in agriculture and related activities. It is a primary source available for generation of income and employment in rural area. The growth rate of agriculture has come down to 1.1 percent from 4.69 percent in contrast to the 6 percent growth rate of Indian economy for the last ten years. Around 93 percent of the farmers are small farmers having land holdings of less than 4 hectare but the average farm size is only 1.57 hectares and they cultivate nearly 55 percent of the available land and the reasons are as follows, due to Industrial growth in India more number of industrial units was started in the past decades. In recent years, the climate changes have been a complex issue due to foreign climate policy. The climate changes affect the existing cultivating areas due to unscheduled rainfall, high temperature, high tensed cyclones and so on. This micro level study made on attempt to make an assessment about the level of changes occurred in the cultivation area, temperature and rainfall and its effects on the area of cultivation and cropping pattern in study region.

## 2. Statement of the Problem

Climate has focused largely on changes in atmospheric composition. A large body of work has demonstrated that a change in area of cultivation provides an additional major forcing of climate, through changes in the physical properties of the land surface. Surface albedo change can be compared with greenhouse-gas emissions through the concept of radiative forcing (Betts 2000), but changes in vegetation cover can also modify the surface heat fluxes directly. Long-term weather conditions, regional-scale land-cover change can impact on the global climate system through tele connections (Avissar 1995; Pielke 2001a; Claussen 2002). Atmospheric and ocean circulation patterns and their subsequent involvement within the planets climate are dynamic, variable and difficult to predict. These limit our ability to predict the impact of changes of area in the cultivation and landscape dynamics on climate patterns. A more complete indication of human contributions to climate change will require the climatic influences on the cultivation pattern and other processes to be factored into climate-change-mitigation strategies. Area of cultivation has changes due to global warming; cropping pattern has change highly in the recent decades.

## 3. Need and Importance of the Study

India is a large agricultural country with a high population. During the historic development of several thousand years, large areas of forest and grassland have been converted into arable lands. At present, a number of bioclimatic models have been used to assess the potential impacts of climate change on the distribution of major ecosystem complexes on a global scale (Holdridge, 1967; Budyko, 1974; Emanuel, Shugart & Stevenson, 1985; Prentice et al., 1992). However, all these global models have significant limitations for recognizing important seasonal and local aspects of vegetation and climate. Changes in temperature and precipitation will alter the hydrological cycle, which influences runoff, moisture availability, sedimentation and erosion and, furthermore, the recycling of organic matter and nutrients of the soil. Thus, it is necessary to develop and then to apply the regional bioclimatic model for investigating and estimating the potential scale, such as in the extent of cropping pattern and cultivation areas in the study area.

## 4. Objectives of the Study

- To study the climate changes and problems of global warming in the study area.
- To analyses the rainfall and cropping pattern in the study area.
- To suggest the suitable measures to reduce the global warming and improve the cropping pattern.

## 5. Climate Change and Rainfall

**Table-1 Climate Change and Rainfall**

| Year | Changes in Temperature (+increase, -decrease) in °C | Rainfall (+increase, -decrease) in mm |
|---|---|---|
| 2001-02 | 0.52 | -88.3 |
| 2002-03 | 0.71 | -17.7 |
| 2003-04 | -0.11 | 129.6 |
| 2004-05 | -0.68 | -6.4 |
| 2005-06 | 0.20 | 296.8 |
| 2006-07 | 0.21 | -112.1 |
| 2007-08 | -0.95 | 82.3 |
| 2008-09 | 0.68 | -106.2 |
| 2009-10 | 0.76 | -385.0 |
| **Overall changes** | **1.34** | **-207** |

***Source:*** *Computed Data from Assistant Director of Statistics, Madurai*

Climatical weather condition is important determinant for the rainfall of the area. Many studies prove that there is a adverse relationship will be there between the changes in temperature condition and rainfall of the study area. Here, we use the computed data set of changes in climate condition (temperature) and rainfall of the Madurai District from Assistant Director of Statistics, Madurai.

The table 1 discuss about the overall changes in temperature and rainfall in the Madurai district. The result reveals that there are a lot of fluctuations in the rainfall and temperature. The results clearly pointed that when are the temperature has increase in the environment there is a gradual decrease of rainfall overall the study period indicates the temperature has increased at 1.34° due to temperature increase the rainfall has reduced to 207mm. This result has proven that the change of temperature in the atmosphere have the inverse relationship in the rainfall of the study area.

### *5.1. Changes in Cropping Pattern of the Madurai D*

**Table 2 Changes in Cropping Pattern of the Madurai District**

*(in Hectares)*

| S.No | Varity of Crops | 2001-02 | 2010-11 | Changes |
|---|---|---|---|---|
| 1 | Cereals | 81898 | 80105 | -1793 |
| 2 | Pulses | 8578 | 6076 | -2506 |
| 3 | Oil Seeds | 8892 | 3653 | -5239 |
| 4 | Commercial Crops | 19070 | 12832 | -6238 |
| | Total | 118438 | 102666 | -15772 |

***Source:*** *Department of Economics and Statistics, Chennai*

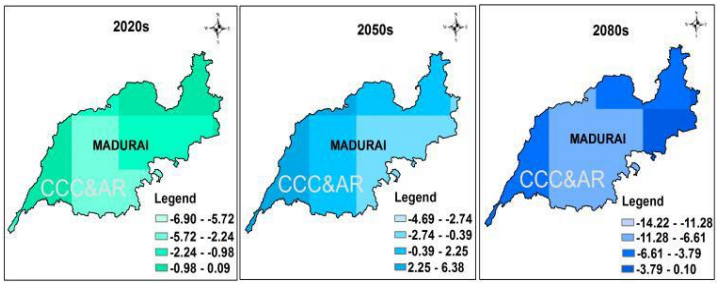
Cropping pattern of the land may depend upon the climate condition and quantum of rainfall in the localities. Here, the table was discussed about the changes in cropping pattern in the Madurai district. The crop cultivation has divided into four major categories namely cereals, pulses, oil seeds and commercial crops. Paddy, cholam, cumbu, ragi, varagu, samai, maize are comes under cereals. Redgram, bengalgram, greengram, blackgram are the crops of pulses. Groundnut and gingelly are the components of oil seeds and remain cotton; sugarcane and banana are the commercial crops of the Madurai district. The grouping of crops is depends on the major cropping pattern of the study area and the availability of data.

The set of data for area of crops cultivation used for the years 2001-02 and 2010-11 are obtained from the official website of the department of economics and statistics, Chennai. During the study period, there is a downward trend in the area of cultivation in the study area. The above statistics reports that totally 15772 hectares of cultivational land were used for other agricultural purposes and left with unused due to lack of irrigation facility in the area of cultivation. During the past decade, the temperature was increased in Madurai district and amount of rainfall also reduced in this juncture rainfall and climate condition of the locality has severely affected the cropping pattern and area of cultivation.

### *5.2. Rainfall Projections for Madurai*

The annual rainfall normal (1970-2000) of Madurai district is 840 mm. Projections of rainfall over Madurai for the periods 2010-2040 (2020s) and 2070-2100 (2080s) show a general decrease of 1.0% and 4.0% with reference to the baseline (1970-2000) but for 2040-2070 (2050s) it indicate an increase of 1.0% respectively.

**Figure 1 Projected Rainfall**




Percent change in Annual Rainfall for the period 2020s, 2050s and 2080s

### *5.3. Percent change in Annual Rainfall*

**Table 3 Projected Rainfall**

| Parameter | 2020s | 2050s | 20180s |
|---|---|---|---|
| **Annual Rainfall** | -1% | +1% | -4% |

The projected rainfall will be about 4 percent will be reduce in the 2080s and it will be hardly going to affect the environment of the Madurai district.

## 6. Major Findings

- Totally, 1.34°C temperature was increased for the last ten year (2001-02 to 2010-11) period.
- Overall change in rainfall level was 207mm in the last ten years period.
- Regarding the crop cultivation, overall 15772 hectares of crop cultivation area were reduced in past ten years.

- The annual rainfall for Madurai district may reduce by 4.0% by the end of the century as per the emission scenario of A1B.

## 7. Conclusion

The advance researches are needed to study the extreme events and their consequences of collecting evidence on their effects from long-term observations and experimental studies in various ecosystems. The present study concludes that there is a direct, adverse relationship is there between the climate change and rainfall, and these two factors are affecting the cropping pattern of the study area. It is essential to take into account information on historical or projected extremes of simulated events (i.e, relative magnitude compared to mean conditions) though this is lacking in many event-based experiments like climate change and cropping pattern of the different regions. Otherwise, the predictive power of the results will be limited in agricultural sector. Event-based research on weather extremes will contribute substantially to the debate as to whether local weather extremes are relevant to the rainfall and cropping pattern with long-term ecological impacts. Collaborative scientific efforts will contribute to our understanding of the role of climate change and its impacts into the agricultural areas and improve the rainfall.

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