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ESTIMATION OF EFFECTIVE DROUGHT INDEX TO STUDY SPATIAL-TEMPORAL DISTRIBUTION OF DROUGHT CONDITIONS IN THE RAMANATHAPURAM DISTRICT, TAMIL NADU.

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ABSTRACT:

Prolonged water scarcity and monsoon failure lead to drought in that region. Geographical Information System (GIS) can be effectively utilized to assess the drought condition of an area. Drought can be estimated using the amount of rainfall received satellite images and through field visits etc. In this study, meteorological drought for 15 years (2006 – 2020) was estimated using rainfall data collected from Statistical Department for Ramanathapuram District. The meteorological drought was estimated using **Effective Drought Index** (EDI). The interpolation technique was used to estimate the level of drought in the district. The analysis was carried out season-wise and compared. The output reveals that the district was under wet condition in 2006, and in 2020, it was drastically changing towards a normal condition. Thus, it is moving towards drought conditions.

Keywords: GIS, EDI, Meteorological drought, interpolation.

INTRODUCTION:

Drought is a phenomenon often talked about all over the world. It is a period when an area or region only gets below normal precipitation. Simply saying, it is a severe shortage of water in a particular location. The lack of sufficient precipitation causes reduced soil moisture or groundwater, diminished streamflow, crop damage, and water shortage.

Drought can be a temporary and recurring meteorological event resulting from the lack of precipitation over an extended period. Though it is a regular

part of the climate, it is a severe natural hazard. Drought is called a slow-on, set disaster. It happens when total rainfall is well below average for a low period, and the result is arid soil, dying trees, and the weather is getting hotter and hotter. Drought condition develops slowly over some time and may not show a sudden impact on the environment.

Drought is a time of unusually dry weather that lasts long and causes crop damage, shortage of water supply, poverty etc. Its adverse impact on society is anxiety or depression about economic losses, conflicts due to lack of enough water, reduced income, fewer recreational activities, higher incidents of heat stroke, and even loss of human life. It also adversely affects wildlife. Apart from high temperature and lack of precipitation, a population can also lead to drought conditions.

The characteristic features of drought are dry land, no rainfall, crop failures, starvation, and poor living condition. Itcreates scarcity of water and food, employment, development actions, etc. In India, about 70% of cultivable land is badly affected.

The available moisture is not enough for crop cultivation. People and governments hesitate to react to drought due to other disasters like earthquakes, cyclones, floods, etc.

Mainly there are three types of droughts; when an area receives less rain than expected for that area is meteorological drought. It badly affects soil moisture, which has a severe effect on crop production. Changes in global atmospheric circulation result in significantly less rain in an area and also affect rainfall patterns. The second one is Hydrological drought. It is a change in water level that affects the eco-system sometimes that surface and groundwater are below expected ranges. The water shortage in rivers, lakes, reservoirs, and aquifers (water stored underground and naturally) can lead to drought. That mainly depends on rainfall, and surface water is more likely to be drought. The warm, dry conditions help the quick evaporation of surface water and thus cause drought. Hydrological drought takes more time to create an impact. The aquifers take months or even years to replenish is an example.

Agricultural drought is when the available moisture is not enough for crop cultivation. This type of drought does not depend only on the deficit of rain where is used carelessly

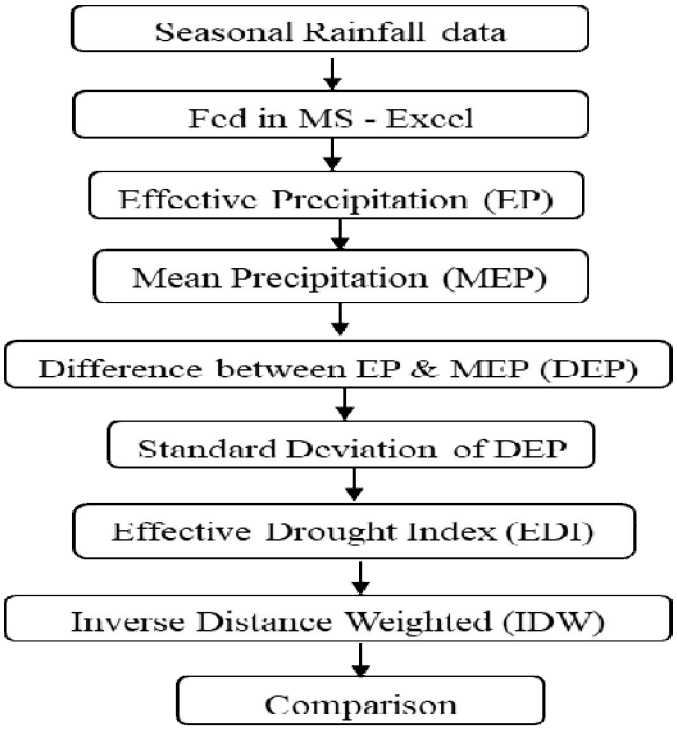
Considering the meteorological drought, we have standard precipitation index (SPI), Effective drought index (EDI), Rainfall anomaly index (RAT), Drought Index (DI), and finally, percent of the normal index (PNI).The SPI is based on the chance of precipitation observed for any time scale and thereafter transformed into an index. Many research institutions and national meteorological and hydrological services in the world use SPI as part of their drought monitoring and early warning efforts. The effective drought index has a better time scale of this index and can monitor drought early. The daily time scale of this index makes EDI hold an upper hand over the others. Their concept of adequate precipitation is essential for a better analysis of drought.

Daily MEP is calculated by the average of the EP values of the same day for months in the period. Using this equation DEP= EP – MEP, the difference between EP and MEP for a day is calculated.

The study's main aim is to estimate Effective Drought Index in Ramanathapuram District using GIS. The primary objectives of the study are to collect rainfall data for the rain gauge stations in Ramanathapuram district, calculate finally to Effective Drought Index and Estimate the drought condition in different seasons in Ramanathapuram District

METHODOLOGY:

A multitier methodology has been adopted to carry out this research work.



The collected rainfall data were fed into MS-Excel for 15 years from 2006 to 2020. The Effective precipitation, Mean Precipitation, Difference inadequate precipitation, Standard Deviation of (DEP), and Effective Drought Index for five consecutive years were calculated in MS Excel. The values of EDI (season-wise) were converted into point data in ArcGIS. The IDW for point data was executed. The output was reclassified based on the threshold values for drought conditions. Finally, the changes in drought level were detected between 5 years seasonal-wise.

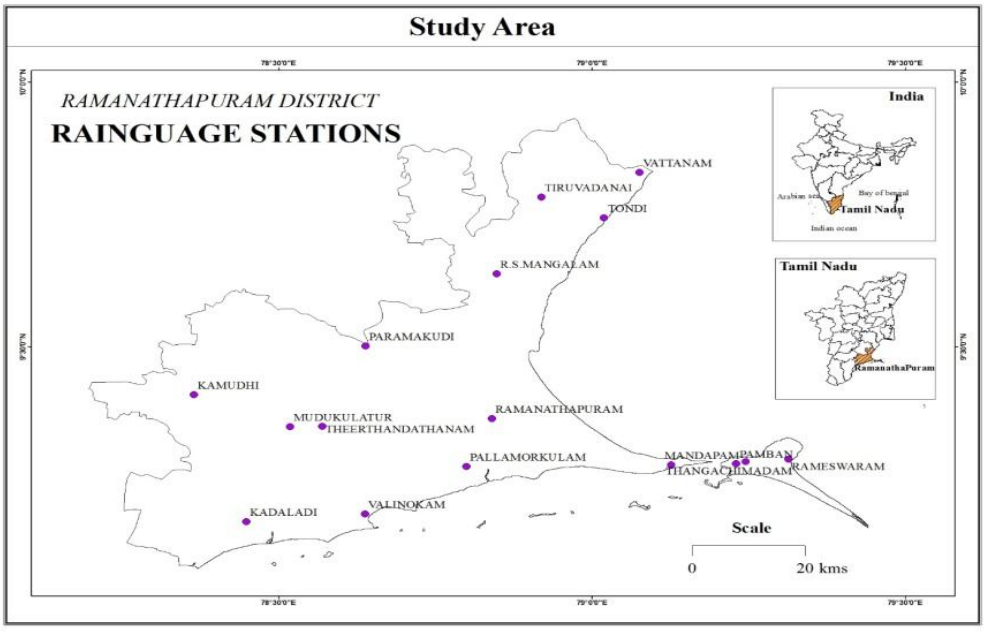
$$Effective\ Preciptation\ (EP) = m1 + \left(\frac{m1+m2}{2}\right) + \left(\frac{m1+m2+m3}{3}\right) \ldots. (1)$$

$$Mean\ Effective\ Precipitation\ (MEP) = \frac{m1+m2+m3}{3} \ldots. (2)$$

$$Difference\ Effective\ Precipitation\ (DEP) = EP - MEP \ldots . (3)$$

$$Effective\ Drought\ Index\ (EDI) = \frac{DEP}{Std\ (DEP)} \ldots. (4).$$

STUDY AREA:



The area chosen for the present study is Ramanathapuram in Tamil Nadu, India. "Ramnad" is another name of Ramanathapuram. The total geographical area of the district is 4123 sq. Km. It consists of 16 blocks. It lies between the geographic coordinate of 9.07` N to 9.95` N latitudes and 78.19' E to 79.44' E longitudes. Ramanathapuram is bounded by Sivagangai on the north part, Puthukottai on the northeast, Palk strait on the east, Gulf of Mannar on

the south, Thoothukudi district which contains Pamban bridge on the west and chain of low islands extended between India and Sri Lanka on the east west side.

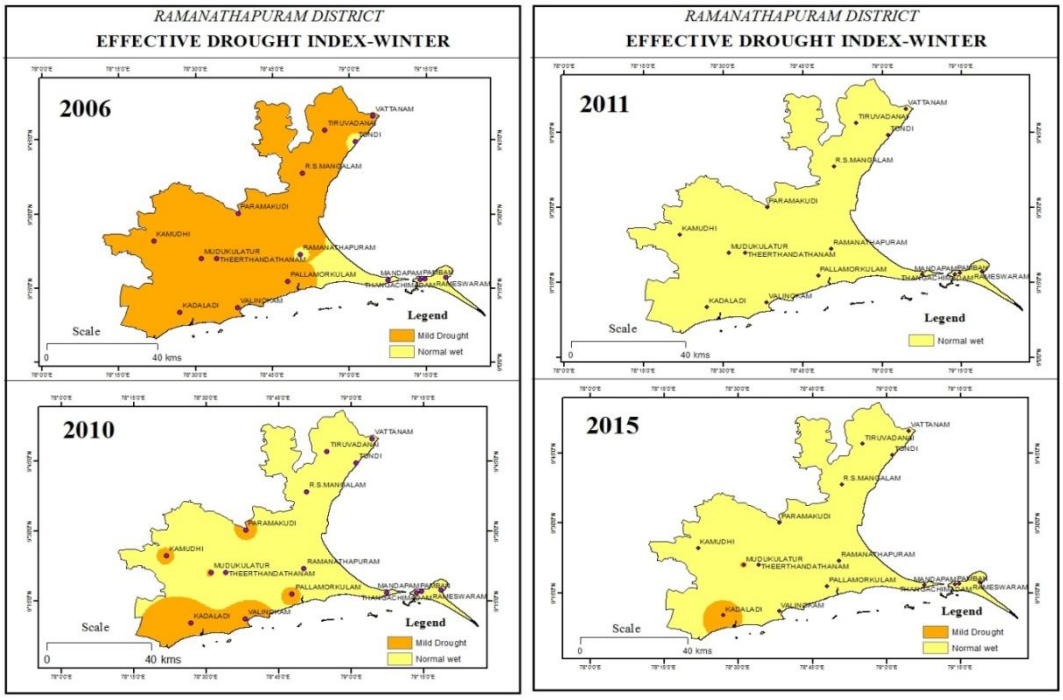
MATERIALS AND METHODS:

The rainfall data for 16 rain gauge stations were collected from "The Statistical Department,"Ramanathapuram, for 15 years.

The ArcGIS is Geospatial software for working with maps and Geographic information. It comprises four key parts: creating, editing,and analyzing geographic data, the application of mapping, analyzing, calculating raster and vector data, spatial and attribute data information, Geo-processing, Queries, data manipulation, etc.

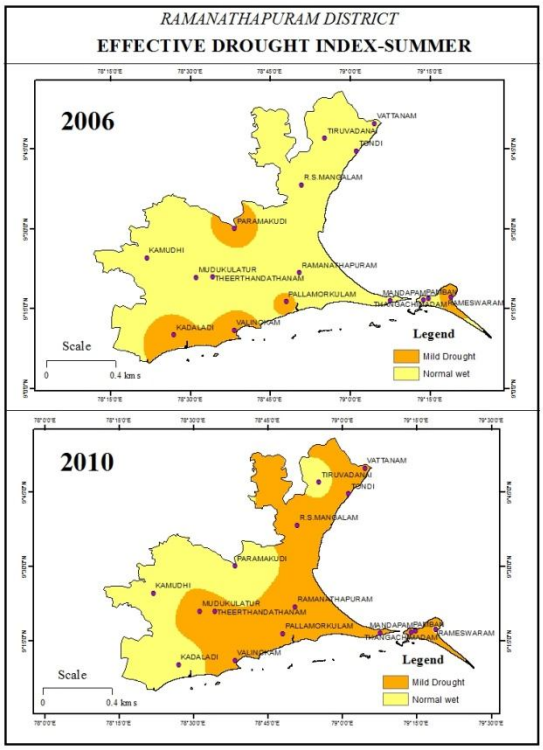
RESULT AND DISCUSSION:

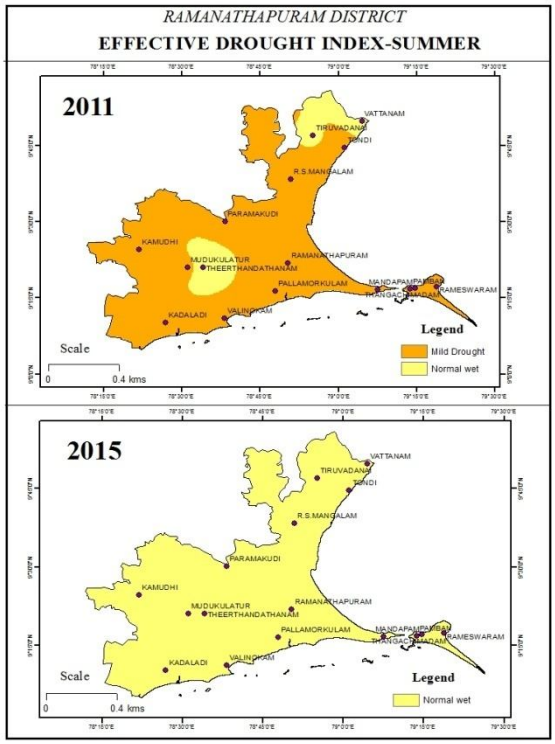
In 2006 and 2010, during the winter season, the droughts were classified into two classes Mild drought, Normal wet. In 2006 and 2010, no severe drought conditions prevailed in the Ramanathapuram district during the winter season. Most of the region was the Mild drought condition in 2006 and the average level in the south-eastern part. Compared to 2006 and 2010, most of the region in 2010 occupies the normal wet condition and massive places, changed as mild drought. Kadaladi, Kamudhi, Paramakudi, and Pallamorkulam areas have faced the condition of mild drought.



When we compared 2011 and 2015, the whole place in Ramanathapuram District was covered by Normal wet in 2011; nothing area comes under drought conditions. In 2015 very tiny part of the south region was covered by Mild drought. Mainly in the Kadaladi region. Comparing the data of 2016 and 2020, there are No seasonal changes that occurred in this area. The entire study area was covered with normal wet conditions.

In 2016 most of the regions were covered by Mild drought in southern-western. When compared to 2006, most of the place was occupied by mild drought. only huge area accoutred by average wet. In 2006 most of the area was covered with normal wet and southwest part and the Pallamorkulam region only mainly showing mild drought conditions .other everywhere has the normal wet conditions. In 2010 the climate was entirely changed because most of the area was covered with mild drought. Moreover, the western part of the district and the Thiruvadanai area only showed normal wet conditions.

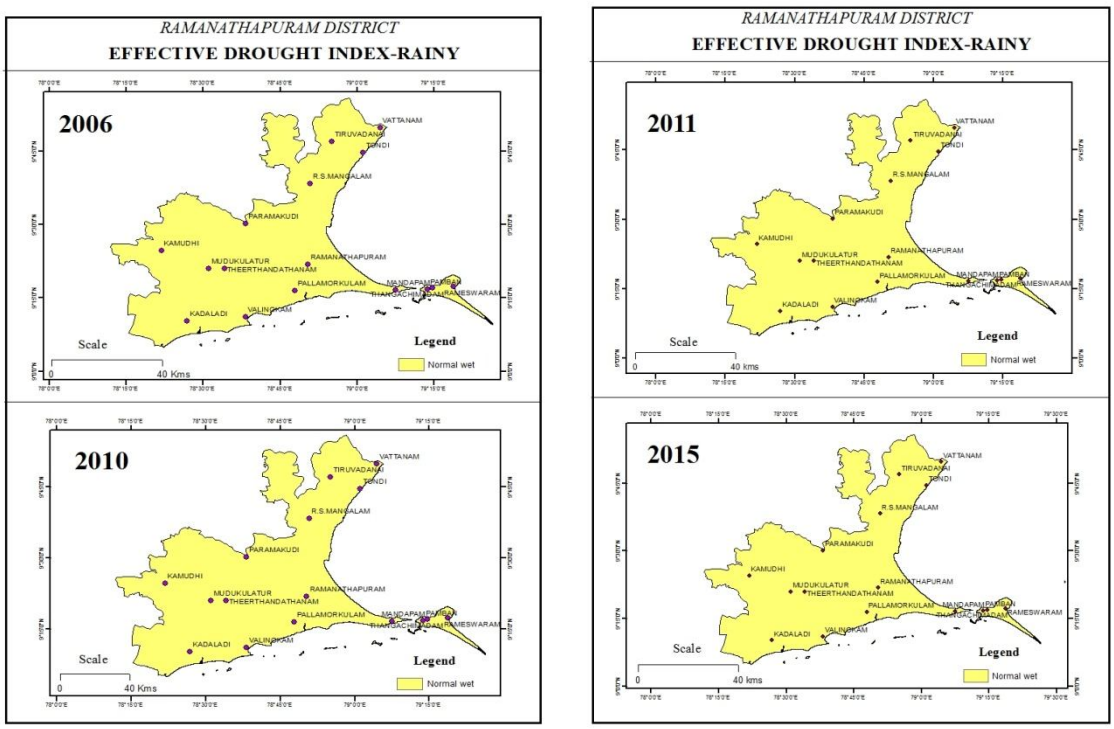




In 2011 the EDI shown in the map was most of the area covered with mild drought and the central part (Mudakulatur, Theerthandathanam) and top left part (Thiruvadanai, Vattanam) occupied by normal wet conditions. Only a tiny part of the area is covered with normal wet. Other regions are Mild drought.

2015 only occupied by Normal wet conditions throughout the study area in the summer season.

The rainy season comparing the climatic condition of Ramanathapuram district 2006 and 2010 changed because the rainy season throughout the study area comes under normal wet conditions.



In 2006, 2010, 2011,and 2015, no changes, only normal wet in the entire district in the rainy season. Nothing changes founded

CONCLUSION:

The rainfall data collected from the Statistical department was fed in MS-Excel. The Drought Index for Ramanathapuram District was calculated using the Effective Drought Index method in GIS.

Because of climatic changes and global warming, the amount of rainfall received in Ramanathapuram District gradually decreases. So, the Normal wet region is converted into Mild drought. If this condition prevails or extends for the next few years, the district will face a metrological drought.

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