

## RESEARCH ARTICLE

## District level drought assessment over Tamil Nadu

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### ABSTRACT

Received : 27<sup>th</sup> May, 2019 Revised : 10<sup>th</sup> June, 2019 Accepted : 10<sup>th</sup> June, 2019 Drought is one of the recurrent climate phenomenon that crippling the societal and economic development of the agrarian country. It occurs almost everywhere, although its features vary from region to region. The present study was undertaken to assess the drought in Tamil Nadu using the precipitation data of historic climatic period (1981-2017) with high spatial resolution (17 Km). Rainfall deviation from the long term mean during SWM, NEM and annual time scale was calculated at district level for identifying the drought prone districts in Tamil Nadu. The results showed that the frequency of the drought events was higher during the SWM as compared to NEM. Results indicated that Tirunelveli, Theni, Tiruppur, Karur, Tiruchirapalli districts were prone to the drought during SWM. As the NEM is the primary rainfall season and active crop growing period, suitable drought mitigation strategies need to be designed for the districts viz., Kanyakumari, Salem, Thiruvallur, which are highly affected due to deficit rainfall during NEM.

Keywords: Rainfall deviation, Drought frequency, Tamil Nadu.

## INTRODUCTION

Drought is the most complex but least understood of all natural hazards. In India, drought occurs more frequently in arid and semi-arid regions. The most single natural cause of Indian famines in the past had been occurrence of wide-spread droughts. Low rainfall has caused drought and a concomitant fall in agricultural production and the impact includes loss of life, human suffering and damage to the economy and environment (Muthumanickam et al., 2011). India has faced frequent and severe drought (once in every three years) in the last few decades (Mishra et al., 2016). Proper quantification of drought impacts and monitoring the sensitive areas are needed for formulating management plans. Therefore, it is critical to understand drought climatology better and to establish a comprehensive and integrated drought information system that incorporates climate, soil and water supply factors (Wilhite 2000). Numerous drought indices had been devised by meteorologist and agriculturist to suit the climatology of particular part of the word for periodic assessment of the current extend and severity of drought and for evaluating the drought hazards over an area. (Smakhtin and Hughes, 2007). The most commonly used indicator for drought monitoring is deviation of rainfall from long term mean. On the basis of rainfall deviations, categories were used in India for monitoring and evaluating the rainfall patterns across the country during the monsoon season (Naresh Kumar *et al.*, 2009). In this context, drought frequency assessment was done for Tamil Nadu at district level using long term rainfall data and presented in this paper.

## MATERIAL AND METHODS

## Study Area

Tamil Nadu is located in the Southern most tip of the Indian Peninsula between 8°5' and 13°35' North latitude and 76°15' and 80°20' East longitude. Tamil Nadu is generally characterized by a tropical climate and South West Monsoon season (SWM, June- September) and North East Monsoon (NEM, October- December) brings about 32 and 48 per cent of annual rainfall respectively.

#### Historic climate data

ECMWF reanalysis Interim (ERA-I) data available at a 0.75° horizontal resolution (Dee *et al.*, 2011) was used as initial and boundary conditions in WRF model. All available satellite and in-situ observations in the region were assimilated into WRF using the consecutive re-initialization method as described by (Langodan *et al.*, 2016; Viswanadhapalli *et al.*, 2016) to generate the data over 37-year period (1981-2017) at 17 Kilometer resolution. Validation of reanalysis data with observed data showed the acceptable range (-5 to 8 per cent).

#### **Drought frequency analysis**

Rainfall anomaly from long term mean was computed for drought frequency analysis at district scale during historical climate period (1981 to 2017) over Tamil Nadu.

Rainfall deviation (%) = (Actual rainfall – Normal rainfall) / Normal rainfall  $\times$  100

Rainfall deviation with < -20 per cent considered as a drought event (www.imd.gov.in). The lowest value of the rainfall deviation is -100 per cent, reflecting the occurrence of zero rainfall and the uppermost value cannot be defined. If the actual rainfall is twice the amount of normal rainfall, the rainfall deviation is 100 per cent and the actual rainfall is thrice the amount of normal, the rainfall deviation is 200 per cent and so on (Naresh Kumar *et al.*, 2009).

## **RESULTS AND DISCUSSION**

#### Annual drought frequency

The analysis showed that out of 37 years, high frequency (> 5 years) of drought events occurred in Kanyakumari, Tirunelveli, Tiruppur, Karur, Tiruchirappalli, The Nilgiris, Salem districts of Tamil Nadu while rest of the districts experienced drought for less than five years (Fig. 1a).



## Figure. 1a. District wise number of drought years based on annual rainfall over Tamil Nadu (1981 - 2017)

More number of drought years (20 to 25 per cent) were observed in Tirunelveli, Tiruppur, Karur, and Tiruchirapalli whereas less number of years (5 to 10 per cent) were drought in Ramanathapuram, Pudukottai, Thanjavur, Namakkal, Perambalur, Cuddalore, Vilippuram, Tiruvannamalai, Krishnagiri, Kancheepuram and Thiruvallur.



# Figure. 1b. Annual drought occurrence (per cent of years) in 1981 - 2017 over Tamil Nadu

In rest of the districts, the incidence of drought

ranged between 10 and 20 per cent (Fig. 1b). Dheebakaran *et al.* (2019) carried out the drought analysis over Tamil Nadu using 60 years weather data and they found that Ariyalur, Dindigul, Madurai, Pudukottai, Theni, Tiruppur were experienced less than 20 per cent of drought years and Thanjavur had more than 50 per cent of drought years.



Figure. 2. District wise number of drought years based on NEM rainfall over Tamil Nadu (1981 -2017)

#### Seasonal drought frequency

## Drought during North East Monsoon (NEM)

Out of 37 years, high frequency (9-12 years, 25-30 per cent) of drought events occurred in kanyakumari, Ramanathapuram, Thiruvarur, Coimbatore, Thanjavur, Tiruppur, Tiruchirappalli, The Nilgiris, karur, Namakkal, Cuddalore, Chennai, Salem and Thiruvallur. Majority of the districts in Tamil Nadu had the drought frequency between 5 and 9 years (Fig. 2). These observations are in line with the findings of (Nathan, 1998) who found that Coimbatore, Dharmapuri, Kanyakumari, Madurai, Ramanathapuram, Salem, Tirunelveli, and Tiruchchirappalli districts were drought prone districts in Tamil Nadu.



Figure. 3. District wise number of drought years based on SWM rainfall over Tamil Nadu (1981 -2017)

#### Drought during South West Monsoon (SWM)

Frequency of drought was higher in SWM compared to NEM. High frequency (12-15 years, 30-40 per cent) was observed in Tirunelveli, Thoothukkudi, Theni, Tiruppur, Karur, Tiruchirappalli, The Nilgiris and Salem districts. The drought frequency ranged from 8 to 11 (20-30 per cent) in Madurai, Dindugal, Thiruvarur, Nagapattinam, Erode, Namakkal and Krishnagiri districts. The frequency was less than four in Cuddalore, Kancheepuram,

Vellore, Chennai and Thiruvallur while 4 to 8 drought events (10-20 per cent) were observed in Kanniyakumari, Ramanathapuram, Virudhunagar, Sivagangai, Pudukkottai, Coimbatore, Thanjavur, Ariyalur, Perambalur, Vilippuram, Tiruvannamalai districts (Fig. 3).

## CONCLUSION

Frequency of drought was higher in SWM compared to NEM in Tamil Nadu. Tirunelveli, Tiruppur, Tiruchirapalli and Karur districts become drought prone areas as the annual drought occurrences exceed 20 per cent in these districts over 37 years (1981 – 2017). The incidence of drought events during SWM was about 40 per cent in Tirunelveli, Theni, Tiruppur, Karur, Tiruchirapalli districts and Kanyakumari, Salem, Thiruvallur districts had experienced the maximum of 30 per cent drought years during NEM.

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