



E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; SP2: 850-852

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Assessment of occurrence and frequency of drought by percent normal precipitation index (PNPI) for western zone of Tamil Nadu

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DOI: <https://doi.org/10.22271/phyto.2019.v8.i2Sv.7692>

Abstract

Drought is a climatic variance, categorized by deficiency of rainfall, and high evaporation which cause negative consequences to environmental and human life. Understanding the drought is a significant process considering the current erratic rainfall situation. Nowadays monitoring the drought is a crucial factor for risk management and providing impact assessments to overcome from such drought events. A numerous drought index has been developed in many countries but they are not unique to all the region. This study examined Percent Normal Precipitation Index (PNPI) for Coimbatore and Erode district in western zone of Tamil Nadu. A rainfall data was collected from 1971 to 2015 (45 years) for Coimbatore and Erode district and the Assessment of PNPI drought index was analyzed and result shows that both the district have slightly decreasing trends in drought events with increasing trends in heavy rainfall event. When analyzed agricultural drought it was occurred between 40 and 51 standard week in Coimbatore likewise for Erode agricultural drought occurs in 45 and 50 standard weeks. This indicates effective real time contingency plans need to be formulated for managing the extreme weather conditions in western zone of Tamil Nadu.

Keywords: Percent Normal Precipitation Index (PNPI), Drought Index and frequency of drought

Introduction

Drought is a natural calamity happens in all climates with severe socio-economic and harmful consequences in a wide range that result in scarcity of water, groundwater table reduction and failure of crop. It is generally described as a temporary meteorological occurrence due to lack of rainfall over a specific region for a certain time. Based on the specific definition drought can be grouped as meteorological drought, agricultural drought and hydrological drought (Wilhite and Glantz, 1985; Hayes *et al.*, 2010) [4, 1] they are not much easy to predict. According to India Meteorological Department the initiation of rainfall lesser than 10 percent to long term mean value is called meteorological drought (Krishnamurthy and Shukla, 2000) [3] if meteorological drought continued for long term resulted in hydrological drought with low recharge rate in rivers, lakes reservoirs and streams when rainfall and soil moisture are insufficient during the growing season of crop is called agricultural drought

Drought assessment is very important key for effective mitigation and makes adaptation strategies in order to reduce risk in all the sectors. The success of drought events and alertness is attained by using different drought indices and till date many drought indices have been developed that are Palmer Modified Drought Index (PMDI), Rainfall Anomaly Index (RAI), Decile Index (DI), Percent Normal Precipitation Index (PNPI), Standardized Precipitation Index (SPI), Effective Drought Index (EFI), Reconnaissance Drought Index (RDI), Drought Severity Index (DSI) Z- Index, Bhalme and Mooly Drought Index (BMDI) Keetch-Byram Drought Index (KBDI) etc (Zargar *et al.*, 2011) [5]. No index is universally suitable based on quantity of climate data available for the particular region makes index to detect drought event.

Methods

Historical observed weather data for 45 years (1971–2015) was used for agro climatic analysis over western Zone of Tamil Nadu. Percent Normal Precipitation Index (PNPI) one of forthright method used to assess drought event in western zone of Tamil Nadu and this method is effective when used for a single region or single season. This index calculates amount of precipitation from long term in area which represents in percent.

Formulae for PNPI = $P_i/P \times 100$

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Where P_i = actual precipitation and P = Long term average precipitation

Categorization of PNPI

Table 1:

Class	Index Range
Moderately wet	≥ 110
Normal	80 to 110
Moderate dry	55 to 80
Severe dry	40 to 55
Extreme dry	≤ 40

Result

The Frequency of drought was indicated in figure1 and 2. PNPI moderate drought occurred consecutively three times (1985, 1986 / 1990, 1991 / 2000, 2001) in Coimbatore and one consecutively moderate drought (1991, 1992, 1993) and two consecutive moderate drought (1981, 1982 / 1985, 1986) condition was indicated for erode district. During study period Coimbatore has moderate drought event in 1976, 1985, 1986, 1988, 1989, 1990, 1991, 1995, 2000, 2002 and 2013 the year 2012 as severely drought and 1974 as extremely drought. Likewise, in erode 1974, 1981, 1982, 1985, 1986, 1990, 1991, 1992, 1993, 2002 and 2013 are moderate drought year and 1995 was extremely drought event occurred. In figure 3 and 4 the annual PNPI index shows slightly decreasing trends in drought event at that same time both the district of western zones shows increasing trends of maximum rainfall events over past 30 years in figure 5. The year 1988, 1991, 2000 and 2002 were agricultural drought years and drought weeks fell between 40 and 51 standard weeks for rabi seasons. In Erode 1982, 1989, 1994, 1995, 2002, 2004 and 2007 were drought years and drought occurred between 45 and 50 standard weeks.

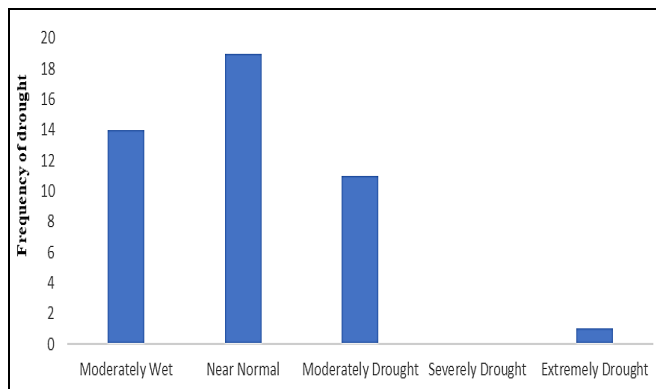


Fig 2: Frequency of drought – Erode –Annual (1971- 2015)

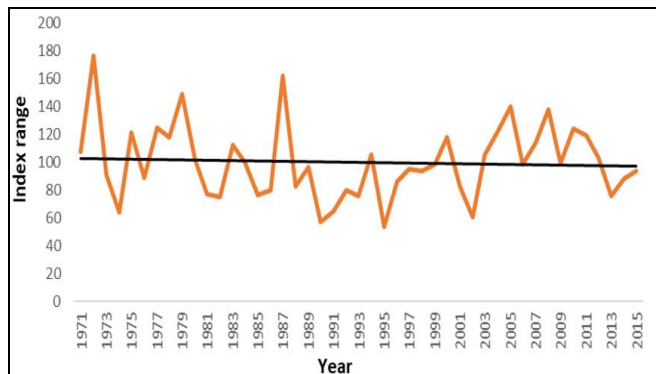


Fig 3: Annual PNP Index for Erode District of Tamil Nadu (1971- 2015)

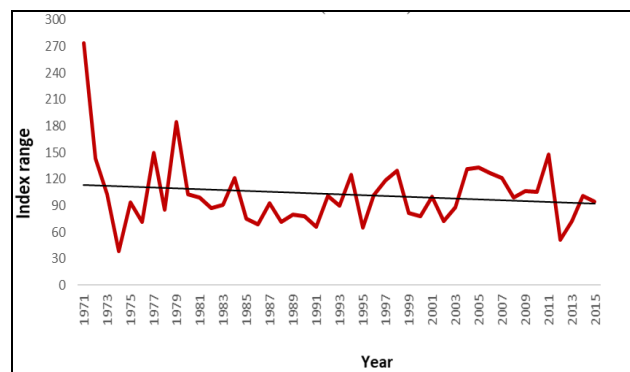


Fig 4: Annual PNP Index For Coimbatore District of Tamil Nadu (1971-2015)

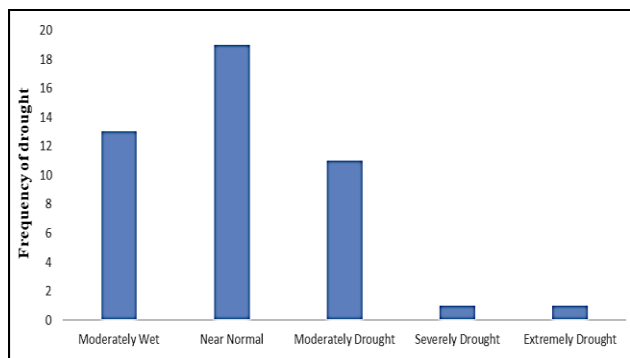


Fig 1: Frequency of drought – Coimbatore –Annual (1971- 2015)

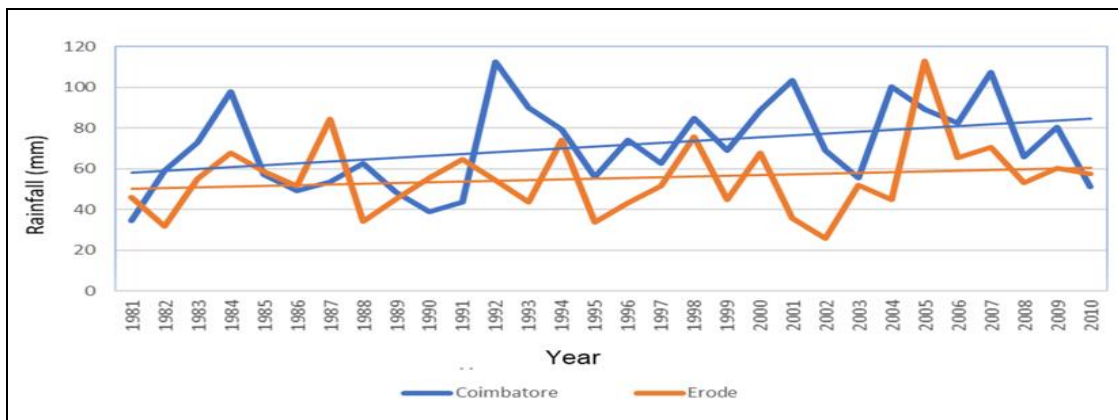


Fig 5: Maximum Heavy rainfall events Over Western Zone of Tamil Nadu

Conclusion

Drought analysis based on 45 years (1971-2015) showed that one consecutive moderate drought and three consecutive moderate drought years occurred in Coimbatore and Erode district and it also shows increase in heavy rainfall events which indicates the need for formulation of efficient real time contingency plans in agricultural planning and during heavy rainfall water should be efficiently harvested to utilize for agricultural and domestic usage at same time during water scarcity periods supplementary irrigation can be provided for agricultural areas.

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