



TEMPORAL AND SPATIAL VARIABILITY OF DROUGHT IN KERALA

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Abstract: *The present study explores the spatial variability of drought over Kerala using standardized precipitation index. For all the stations considered for the study, the probability of near normal condition is more than 50% on annual basis and during southwest and northeast monsoon seasons. Highest probability for extreme dry cases is found in the station of southern most district Thiruvananthapuram. The highest probability for extremely dry condition during NEM season is observed in the chitoor station of Palakkad district.*

1. Introduction

Drought over a geographic area is a temporary condition caused by significantly less (deficient) rainfall for an extended period of time, usually during a season when substantial rainfall is normally expected over the area. Drought is generally viewed as periodically occurred mainly due to lower value of precipitation, soil moisture, river flow or ground water as compared to their normal values. When this phenomenon extends for the longer periods of time creates the significant effect to meets the need of human activities and for the environmental condition. Drought occurs in different parts of Indian sub-continent and other parts of the world in the form of meteorological drought, hydrological drought and agricultural drought with unpredictable frequencies due to variability of rainfall, delay in onset of monsoon and long dry spell during the cropping season.

Even though Kerala is bestowed with high annual rainfall, the variability of rain producing systems especially in the south west monsoon season gives rise to large water deficiencies in some years and increased water surpluses in others. These water deficiencies could result in droughts. The behavior of monsoon across Kerala, to a great extent, decides the total output of paddy during Virippu as it is grown under rain fed conditions through the technological trend in Kharif rice productivity was increasing. The intermittent breaks of monsoon may lead to low amount of rainfall, thus indicating a dry spell. The

recurrence of such dry spell coincides. There are many studies on the general characteristic of droughts over India (Sikka, 1999, Bhalme and Mooley, 1980, Parthasarathy et al., 1987 and Rao, 1981). But detailed studies on the spatial variability of drought over Kerala are not available. In this context, the spatial variability of the probability of occurrence of the drought over Kerala during different seasons, South west monsoon and northeast monsoon, has been studied here using standardized precipitation index.

2. Data and methodology

More than 20 years of monthly rainfall data of 54 stations (Appendix 1) collected from IMD and other research stations in Kerala have been used for the present analysis. A number of drought indices (Deciles, Per cent Normal, Palmer Drought Severity Index have been used world-wide. Effective drought Index has been suggested by Bhalme and Mooley (1981) to classify the severity of droughts. Amongst different methods, Standardized precipitation index (SPI) is widely used. McKee et al. (1993) developed the Standardized Precipitation Index (SPI) for the purpose of defining and monitoring drought. The nature of the SPI allows an analyst to determine the rarity of a drought or an anomalously wet event at a particular time scale for any location in the world that has a precipitation record [Edward and Mckee 1997]. The SPI calculation for any location is based on the long-term precipitation record for a desired period. This long-term record is fitted to a Gamma

probability distribution, which is then transformed into a normal distribution so that the mean SPI for the location and desired period is zero. Positive SPI values indicate greater than median precipitation, which represents wet conditions. Whereas negative values indicate less than median precipitation, which represents dry conditions.

Drought probabilities for different stations of Kerala based on SPI methodology were computed for three time scales (Annual - 12 months scale, Southwest monsoon - 4 months scale and Northeast monsoon - 3 months scale) for which daily rainfall data for 20 years or more is available. The criteria used in classifying drought severity using SPI values are given in Table 1. Drought event begins any time when the SPI is continuously negative and ends when the SPI gains a positive value.

Table 1: Categorization of climatic based on SPI

SPI	Category
More than +2.0	Severely wet
1.5 to 1.99	Very wet
1.0 to 1.49	Moderately wet
0.99 to +0.99	Near Normal
1.0 to -1.49	Moderately dry
1.5 to -1.99	Severely dry
Less than -2.0	Extremely dry

Thematic maps depicting probability levels for different drought severities for the selected three time scales are presented and discussed in the following sections.

3. Results and discussions

The probability of occurrences of near normal condition and various intensified drought conditions such as moderately dry, severely dry and extremely dry conditions on annual and seasonal (South west monsoon and northeast monsoon) is discussed below.

3.1. Drought probability on annual scale

Probability for near normal condition of rain is above 50% for all the stations considered for the analysis. Highest probability is observed in Nedumangad station (82%) in Thiruvananthapuram district followed by Kunnankulam station (74%) in Thrissur district. Probability for near normal

condition is more than 70% in Thiruvananthapuram, Kottayam, Ernakulam, Kannur and Kasargod. Probability of 70% and above has been considered generally as benchmark for making decisions on agricultural operations and this is observed 33% of the stations considered across the state for near normal condition. Lowest probability for normal condition is noted in Kollengode station (52%) in Palakkad district followed by Vellayini station (56%) in Thiruvananthapuram district.

Highest probability of occurrence for moderately dry condition is seen in Parambikulam station (19%) in Palakkad district followed by Thrithala station (17%) which is also in Palakkad district. Moderately dry condition does not occur in Pampadumpara station in Idukki district. Central zone shows 10% of moderately dry probability. Probability of Severe drought condition in the highest form in Emackal station and Chengannur station (13%) followed by Kannara (12%). Emackal and Kannara stations are in Thrissur district. 27% of the stations don't show any probability for severe drought conditions as indicated figure. In the case of extreme drought, Neyattinkara shows highest probability (11%) of Thiruvananthapuram district followed by Aluva station (9%) in Ernakulam district. 47% of stations in Kerala do not showing any probability for extreme droughts. (Fig 1(a) to 1(d)).

3.2. Drought probability during SWM season

Probability for near normal condition during Southwest monsoon is above 50% for all the stations. The highest probability for near normal condition is observed in Nilambur (Malappuram) and Peerumed (Idukki) station (81%) followed by Irikkur of Wayanad (77%). In the case of moderately dry category, probability more than 15% is found in Pathanamthitta district and some parts of Idukki, Thrissur, Ernakulam, Palakkad and Wayanad. The highest probability is noted at Kannara station (24%) in Thrissur district followed by Aluva station (23%) in Ernakulam district. In the case of severe dry condition, 30% of the stations don't show any probability for severe dry conditions during SWM

season in Kerala state. Vythiri station of Wayanad district shows highest probability for severe drought condition (18%). In the case of extreme dry condition 63% of the stations do not show any probability values. However, highest probability is found in Neyatinkara station (11%) followed by Nedumangad (9%), both are in Thiruvananthapuram district (Fig 2(a) to 2(d)).

3.3. Drought probability during NEM monsoon season

Probability for near normal conditions is above 60% during the NEM season for all the stations. Highest probability 93% for near normal condition has been noted in Pattambi station in Palakkad district followed by Manjeri station (81%) of Malappuram district and lowest probability for near normal condition shows Piravam station (59%) in Ernakulam district, Chengannur of Alappuzha district and Munnar of Idukki district. Highest probability for moderate dry condition is seen in Piravam and Munnar (23%). In the case of severe drought conditions, 27% of stations don't show any probability for severe dry condition during NEM season. Ottappalam and Thrithala show highest probability (13%) for severe drought condition in this season. In the case of extreme drought condition, 48% of available stations do not show any probability and Chittur station in Palakkad district shows 9% probability which is highest probability observed as compared all other stations (Fig 3(a) to 3(d)).

Conclusions

From the present analysis it is found that on annual scale, the probability of near normal condition is above 50% for all the stations and the probability for moderate drought is 5-10% in majority of the districts of Kerala. The probability is high (more than 10%) in the southern zone district Thiruvananthapuram and some parts of Palakkad and Wayanad.

Probability for near normal condition during Southwest monsoon is above 50% for all the stations (59) considered for the study. In the case of moderately dry category, probability more than 15% is found in Pathanamthitta district and some parts of Idukki, Thrissur, Ernakulam, Palakkad and Wayanad. In the case of severe dry condition, 30% of the stations don't show any probability for severe dry conditions during SWM season in Kerala state. In the case of Extreme dry condition 63% of the stations do not show any probability values. However, highest probability is found in Neyatinkara station (11%) followed by Nedumangad (9%), both are in Thiruvananthapuram district.

Probability for near normal conditions is above 60% during the NEM season for all the stations. In the case of severe drought conditions, 27% of stations don't show any probability for severe dry condition during NEM season. In the case of extreme drought condition, 48% of available stations do not show any probability and Chittur station in Palakkad district shows 9% probability which is highest probability observed as compared all other stations.

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Figure 1: Probability of occurrences drought in near normal and various drought conditions on annual scale

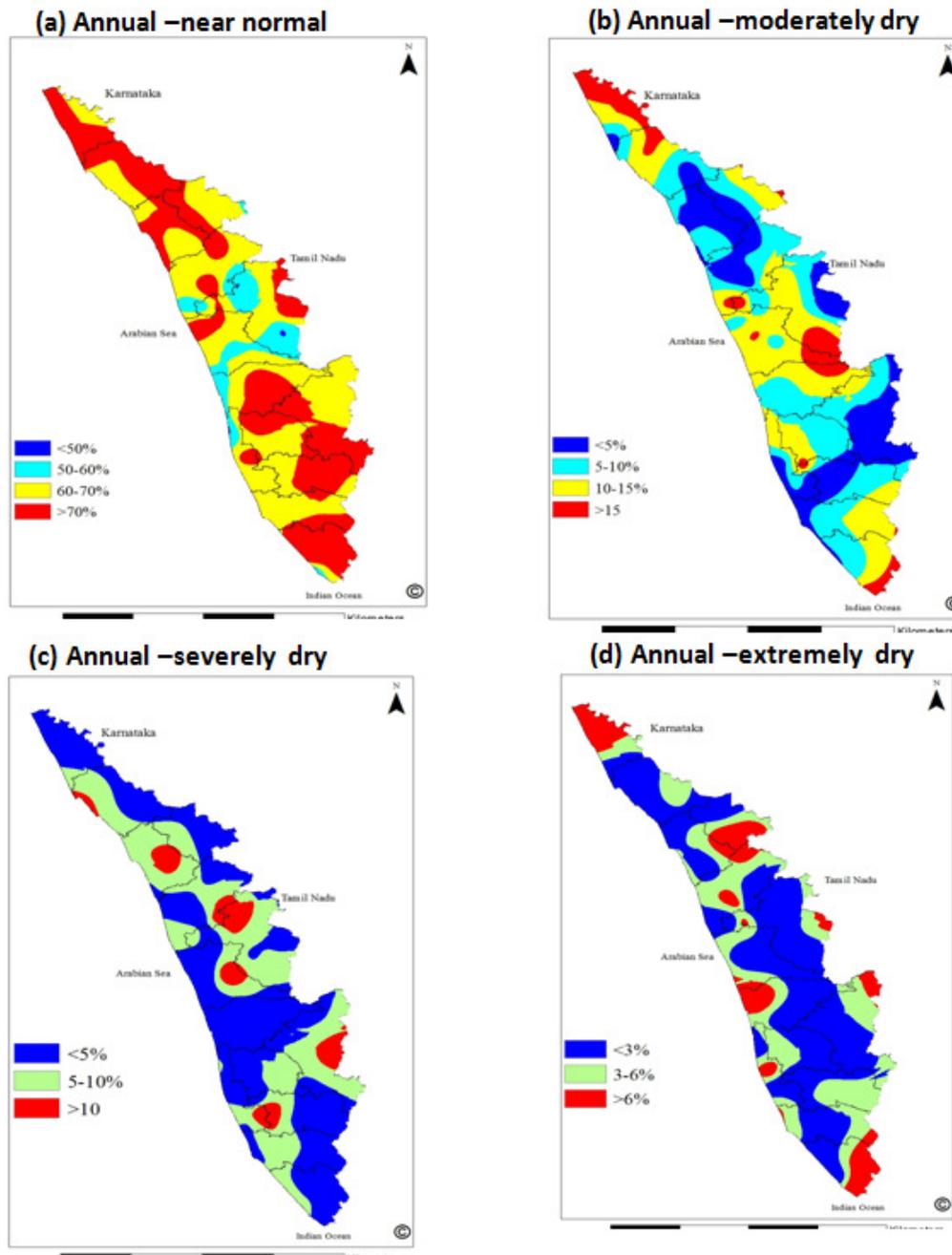


Figure 2: Probability of occurrences drought in near normal and various drought conditions during SWM season

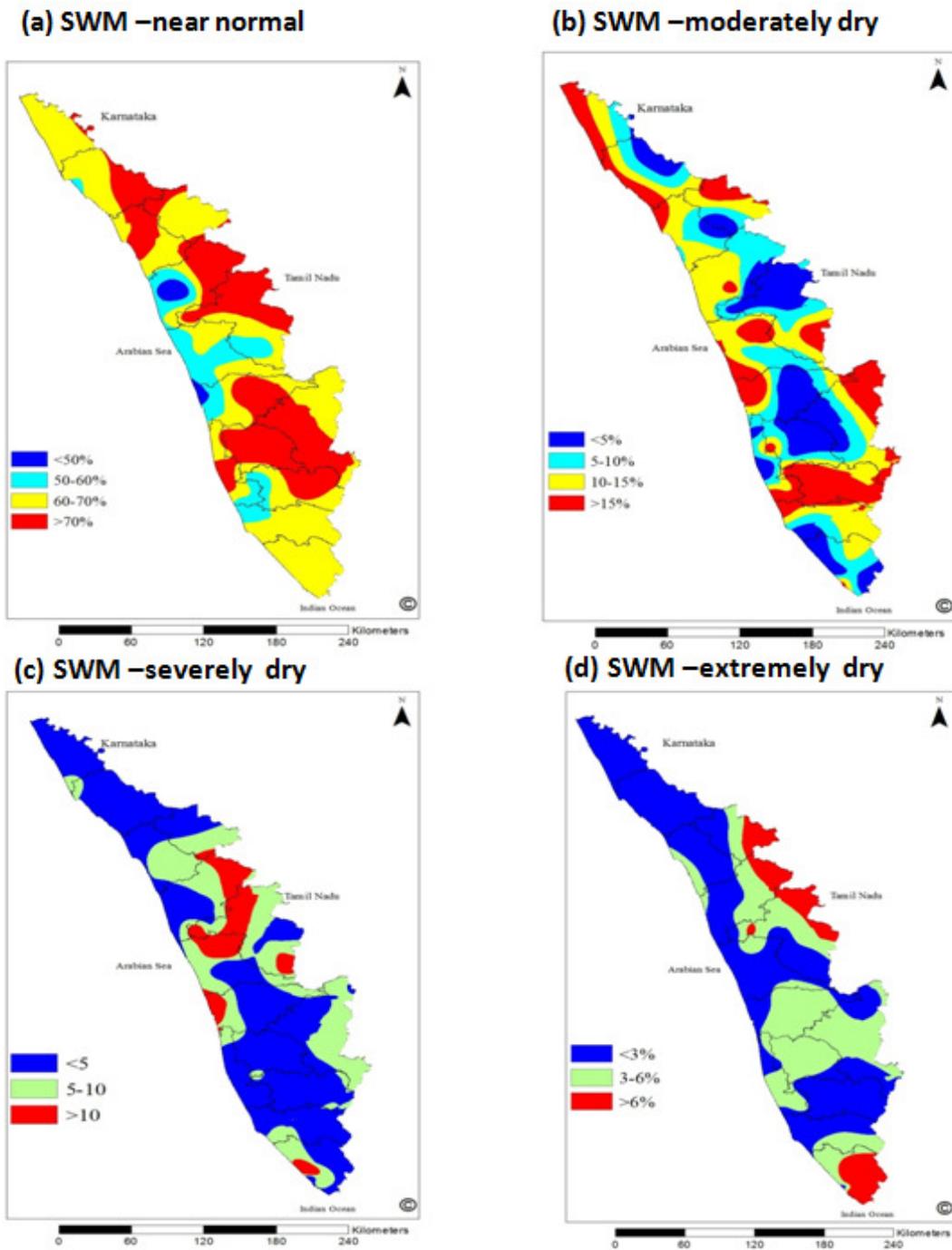


Figure 3: Probability of occurrences drought in near normal and various drought conditions during NEM season

