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Short Communication

Evaluating precipitation patterns of Vellanikkara, Kerala using SPI approach under future climatic scenarios

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Rainfall is a crucial weather parameter affecting agricultural production. Due to erratic distribution of monsoon rainfall, there exist a large uncertainty is agricultural production, water resources planning, and the economy of the country like India. Understanding of rainfall characteristics is essential in the changing environment due to climate change. The Standardized Precipitation Index (SPI) is an important parameter in studying precipitation characteristics (McKee *et al.*, 1993). SPI has widely used as an effective indicator for analyzing precipitation characteristics and drought analysis in various parts of the world (Lee *et al.,* 2018; Kamble *et al*., 2019). Vysakh *et al*., (2019) used SPI for drought analysis of Kerala state. This study attempts to compare the present and future precipitation characteristics using standardized precipitation index (SPI).

Long-term precipitation data (1989–2020) for the Vellanikkara station was collected from the agrometeorological observatory in Vellanikkara. The station is located at 10°32' N latitude and 76°20' E longitude, at an altitude of 22 meters above mean sea level, which comes under the Central Zone of Kerala. Daily rainfall projections from 2020 to 2080 were obtained using the MarkSim DSSAT weather file generator and simulated with the NorESM1-M global climate model under the RCP 4.5 and RCP 8.5 scenarios (http://gisweb.ciat.cgiar.org/MarkSimGCM/).

The dryness or wetness of the present and future climate was quantified using the SPI as specified by McKee *et al*., (1993). In this study, daily rainfall data was converted to monthly data, and the SPI was calculated on a monthly and annual time scale using R statistical software. Based on the SPI values, different classes of wetness and dryness were defined (Table 1).

Table 1: SPI values and their respective classes

SPI values	Class
≥2	Extremely wet
1.5 to 1.99	Very wet
1.00 to 1.49	Moderately wet
0.99 to -0.99	Near normal
-1.00 to -1.49	Moderately dry
-1.50 to -1.99	Severely dry
≤ -2	Extremely dry

Variation of SPI during 1990 to 2020

The rainfall data was collected from 1989 to 2020 to calculate SPI over a 12-monthy time scale. But to get the results for the first year (1990), we needed the data from the previous year (1989) as well. Hence the results start from 1990, even though we began collecting data in 1989 which is presented in Fig. 1. In most of the years the 12 monthly SPI values showed a near normal value. Extremely dry conditions were seen in 2016 with an SPI of -2.3. Moderately dry conditions were noticed in 1996, 2000, 2003, and 2012. Mildly dry conditions were recorded in 1993, 2001, 2002, 2008, and 2017. Moderately wet conditions occurred in 1998, 2006, 2011, and 2018. Severely wet conditions were recorded in 1992 (SPI of 1.6) and 1994 (SPI of 1.5), while extremely wet conditions were seen in 2007 with an SPI of 2.1. This findings indicates the region's susceptibility to both drought and excessive rainfall, which emphasizes the importance of continuous monitoring and adaptive measures to address this type of climatic challenges.

Monthly standardized precipitation index (SPI) for future period

Monthly values of SPI calculated for 2020 and future

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Table 2: Monthly values of SPI calculated for 2020 and future time periods under RCP 4.5 and RCP 8.5

Months	2020	RCP 4.5			RCP 8.5		
		2030	**2050**	**2080**	**2030**	**2050**	**2080**
Jan	0.708	-0.243	-0.244	-0.242	-0.239	-0.222	-0.247
Feb	0.711	-0.224	-0.231	-0.235	-0.218	-0.210	-0.234
Mar	0.757	-0.217	-0.213	-0.236	-0.245	-0.230	-0.248
Apr	0.692	-0.167	-0.176	-0.168	-0.276	-0.259	-0.297
May	0.706	0.397	0.325	0.416	0.283	0.420	0.229
Jun	1.041	1.037	0.920	1.185	1.649	1.848	1.722
Jul	0.829	1.431	1.355	1.593	2.370	2.615	2.534
Aug	0.053	1.221	1.221	1.427	2.150	2.274	2.299
Sep	0.382	0.629	0.549	0.841	1.232	1.464	1.620
Oct	0.147	0.692	0.543	0.813	1.252	1.389	1.558
Nov	-0.252	0.943	0.773	0.999	1.235	1.369	1.567
Dec	-0.250	1.039	0.861	1.068	1.296	1.425	1.666

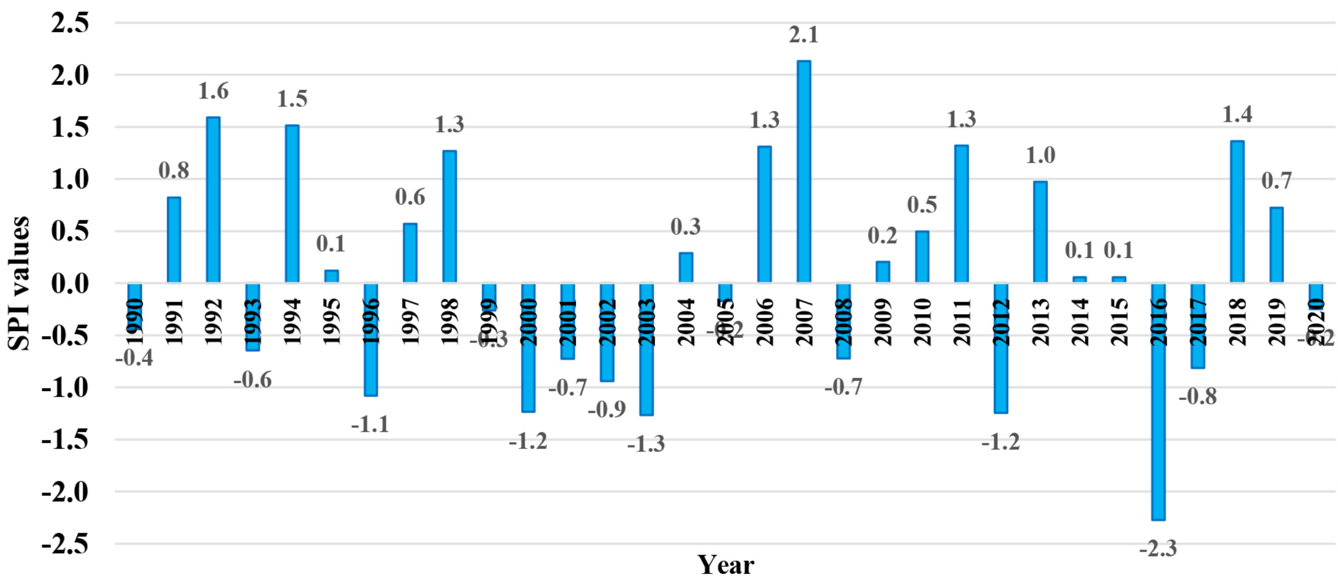

Fig. 1: 12 monthly SPI values calculated for Vellanikkara during the period of 1983 to 2020

time periods under RCP 4.5 and RCP 8.5 was represented in Table 2. In January, February, March, April, October, November, and December, the SPI values for 2030, 2050, and 2080 generally showed a consistent pattern across both RCP 4.5 and RCP 8.5 scenarios, with slight differences between the two scenarios. These months was expected to exhibit SPI values that generally range from slightly negative to neutral, indicating predominantly near-average precipitation conditions throughout the future periods compared to the baseline of 2020. However, notable differences can be expected in May, June, July, August, and September. In May, June, and July, SPI values consistently showed positive deviations from the baseline across all future periods under both scenarios, suggesting wetter conditions compared to 2020. Especially in June and July, SPI values were expected to increase significantly, indicating potentially very wet conditions by 2080, especially under RCP 8.5. August and September also show a trend towards increasing SPI values in the future, with more differences between scenarios, indicating a potential shift towards wetter conditions. April, October and December was expected to exhibit mixed patterns with varying SPI values across scenarios and future periods, reflecting uncertainties in precipitation projections for these months. Overall, the findings revealed a possibility for a potential future shift towards wetter conditions in months like May, June and July, particularly under the higher emission scenario (RCP 8.5). This analysis underscores the importance of understanding how climate change can influence regional precipitation patterns, crucial for adapting agricultural practices and water resource management strategies to future climate conditions. The crop planning has to be done in such a way that the planting and other cultural practices must be in tune with the shifting precipitation pattern.

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