

Drought intensity and frequency analysis using SPI for Tamil Nadu, India

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To assess the drought hazard for different agro-climatic zones of Tamil Nadu (TN), India, the present study deals with temporal trend and spatial pattern of drought over the period 1981–2019. Standardized Precipitation Index (SPI) has been used to detail the geographical variations of drought intensity, duration and frequency at multiple time steps. The spatial rainfall variability of the Southwest monsoon (SWM) ranged from 69.3 mm (Tuticorin) to 772.8 mm (the Nilgiris), and that for the Northeast monsoon (NEM) ranged from 277.8 mm (Krishnagiri) to 825.9 mm (Nagapattinam), while annual rainfall variability ranged from 558.8 mm (Tuticorin) to 1466.8 mm (the Nilgiris) for TN. Irrespective of all the regions, the frequency of moderate drought occurrence was higher compared to other drought nomenclature. The NEM season recorded on par and higher number of drought occurrences with respect to SWM season. Out of 39 years, TN experienced severely dry to extremely dry climate during 2002. The result underlines the potential of SPI in drought identification and also revealed that the rainfall is strongly linked to drought policies and measures implemented for the state.

Keywords: Northeast monsoon, rainfall, southwest monsoon, spatial variability, standardized precipitation index.

DROUGHT, an extreme event, exacerbated by water constraint and global warming have an impact on crop development and food-grain production^{1–3}. Meteorological drought is one among the drought categories, where the precipitation rates are below average for an area and period of time. Drought could be further grouped based on severity, duration, spread and consequent trend.

Drought has been linked to both natural and anthropogenic activity⁴, putting future crop yields at peril⁵. Since 1970s, there is a drying trend in the tropics and subtropics of northern latitudes⁶ and consistent shifts in drought regimes⁷. In India, as much as 50% area is considered as severely drought prone⁸ and drought events (1900–2016) in the country have affected nearly 1391 million people⁹.

Further, this risk is greater due to the vagaries in monsoon rainfall¹⁰.

Over the years, a number of indices have been used for drought depiction¹¹. Among the commonly employed indices that use rainfall data, Standardized Precipitation Index (SPI) is a universal index for drought assessment¹² and a standard drought-monitoring index¹³ of the World Meteorological Organization (WMO). SPI involves a probabilistic elucidation¹⁴ and helps quantify the rainfall deficit for multiple timescales of an area¹⁵. Drought characterization enables drought risk analysis, drought early warning¹⁶, and contingency planning¹⁷. From these perspectives, the present study examines the spatio-temporal nature of drought intensity and frequency for the different agro-climatic zones (ACZs) of Tamil Nadu (TN), India using SPI.

Materials and methods

Study area

The study area covers ACZs of TN, which lie between 8°–13°N lat. and 76°–80°E long. (Table 1).

Data source

District-wise historical rainfall data for the period 1981–2019 (39 years) were obtained from Agro Climate Research Centre and other Research Stations of Tamil Nadu Agricultural University, Coimbatore. The total area and food production data for the rainfall years were collected from a report of Directorate of Economics and Statistics, Government of TN.

Methodology

SPI is a probability index for monitoring drought, developed by fitting a gamma probability distribution for a station frequency distribution of precipitation totals¹⁸. The drought events identification was assessed using SPI for the southwest monsoon (SWM) and northeast monsoon (NEM). SPI allows for monitoring both dry and wet conditions¹⁹ (Table 2).

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Table 1. Agro-climate zones (ACZs) of Tamil Nadu, India

ACZs	District
Cauvery delta zone (CDZ)	Ariyalur, Karur, Nagapattinam, Perambalur, Thanjavur, Thiruvarur and Tiruchirapalli
High-altitude zone (HAZ)	The Nilgiris
High-rainfall zone (HRZ)	Kanayakumari
Northeastern zone (NEZ)	Chennai, Cuddalore, Kancheepuram, Thiruvallur, Thiruvannamalai, Vellore and Villupuram
Northwestern zone (NWZ)	Dharmapuri, Krishnagiri, Namakkal and Salem
Southern zone (SZ)	Dindigul, Madurai, Pudukkottai, Ramanad, Sivagangai, Theni, Tirunelveli, Tuticorin and Virudhunagar
Western zone (WZ)	Coimbatore, Erode and Tiruppur

Table 2. Classification of standardized precipitation index (SPI) values and intensities

SPI	Intensity
2.00 and more	Extremely wet
1.99–1.50	Very wet
1.49–1.00	Moderate wet
–0.99–0.99	Near normal
–1.00 to –1.49	Moderate drought
–1.50 to –1.99	Severe drought
–2.00 and less	Extremely drought

Results and discussion

Spatial variability of rainfall

Figure 1 *a*, *b* and *c* depicts the spatial variability of rainfall received in TN for SWM, NEM and annual period respectively. The rainfall variability of SWM/NEM/annual period ranged from 69.3 mm (Tutucorin)/277.8 mm (Krishnagiri)/558.8 mm (Tutucorin) to 772.8 mm (the Nilgiris)/825.9 mm (Nagapattinam)/1466.8 mm (the Nilgiris) respectively.

Out of 32 districts, wide variation in rainfall could be observed during SWM [(<100 mm: 1), (100–300 mm: 14), (300–500 mm: 15), (500–700 mm: 1) and (>700 mm: 1)]; NEM [(<300 mm: 2), (300–500 mm: 24), (500–700 mm: 4) and (>700 mm: 2)] and annual period [(<600 mm: 1), (600–800 mm: 9), (800–1000 mm: 14), (1000–1200 mm: 4), (1200–1400 mm: 3) and (>1400 mm: 1)]. This clearly indicates that the northeastern part of TN, especially along the coastal areas received more than 1000 mm of rainfall on an annual scale.

Per cent contribution of monsoonal rainfall to annual scale

During SWM, Tuticorin (12.4%) and Ramanathapuram (17.7%) districts contributed less than 20% to annual rainfall. Twenty-two districts contributed between 20% and 40%, and eight districts contributed above 40% to annual rainfall. During NEM, seven districts contributed less than 40%, 21 districts shared 40% to 60% and four districts contributed above 60% to annual rainfall (Table 3).

Drought frequency and magnitude for western ACZ

In Coimbatore, out of 39 years, moderate drought occurred for two years each during SWM (1987, 2012) and NEM (2009, 2017), while severe drought was recorded once in 2016 and extreme drought occurred twice (1988, 1991) during NEM (Table 4). In Erode, moderate drought occurred for one year each during SWM (1990) and NEM (2012), while severe drought was recorded twice (1988, 2009) in NEM. Extreme drought occurred twice each during SWM (2002, 2003) and NEM (2002, 2016). Similar consecutive drought intensity was observed for Coimbatore²⁰. The year 2002 was declared as the All India Severe Drought Year by India Meteorological Department (IMD), since the cropping area was reduced to 40% in the whole country.

In Tiruppur, moderate drought occurred for three years during SWM (2012, 2016, 2018) and one year during NEM (1985), while severe drought was recorded once (1988) and extreme drought occurred twice during SWM (1990, 2014) and once in NEM (1991). The frequency of drought occurrence was higher during NEM compared to SWM.

Drought frequency and magnitude for northwestern ACZ

For Dharmapuri, moderate drought occurred for seven years during SWM (1982, 1990, 1993, 1994, 2002, 2011, 2012) and twice during NEM (1988, 1989), while severe drought was recorded twice (2002, 2018) during NEM, and extreme drought occurred once (2018) during SWM and twice (1985, 2016) during NEM (Table 5). During 2002 and 2008, SWM, NEM and the whole year experienced drought with varied categorical scales as specified.

For Krishnagiri, moderate drought occurred for five years during SWM (1984, 1990, 1992, 1994, 2009) and three years during NEM (1984, 1988, 1990), while severe drought recorded for one year each during SWM (2002) and NEM (2002) and extreme drought occurred once during SWM (1982). During 2002, severe drought was observed in SWM, NEM and throughout the year.

For Namakkal, moderate drought occurred for three years during SWM (2002, 2003, 2011) and four years during NEM (2002, 2009, 2012, 2018), while severe

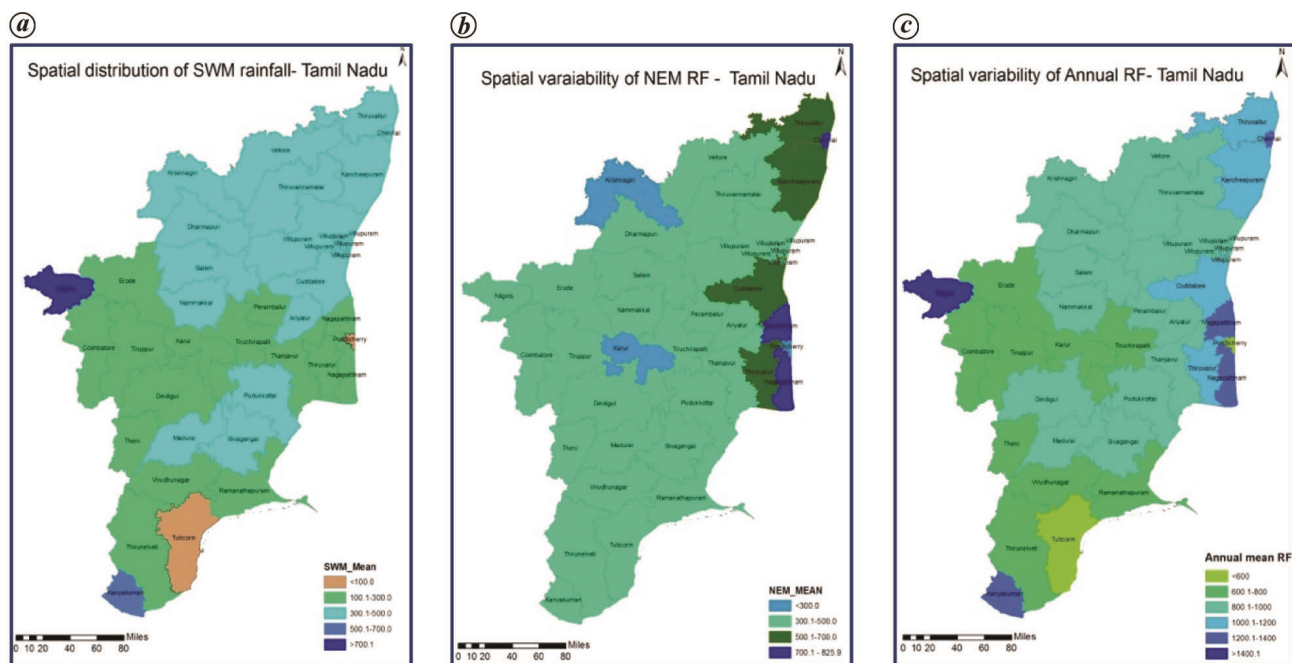


Figure 1. Spatial variability of rainfall over Tamil Nadu during (a) southwest monsoon, (b) northeast monsoon and (c) annual period.

Table 3. Per cent contribution (PC) of seasonal to annual rainfall

District	Southwest monsoon (SWM)	PC	Northeast monsoon (NEM)	PC	Annual
Ariyalur	364.8	38.8	472.5	50.3	939.1
Chennai	449.7	36.3	712.8	57.5	1240.6
Coimbatore	257.0	34.8	320.6	43.4	739.4
Cuddalore	373.0	33.7	623.4	56.3	1107.7
Dharmapuri	359.8	43.6	306.0	37.1	824.7
Dindigul	295.6	34.2	386.3	44.7	864.9
Erode	232.2	32.7	319.4	44.9	710.6
Kancheepuram	456.1	38.9	639.6	54.5	1172.5
Karur	204.6	32.7	295.8	47.3	625.4
Krishnagiri	381.7	46.1	277.8	33.6	827.6
Madurai	301.4	33.9	414.9	46.7	888.5
Nagapattinam	262.5	21.5	825.9	67.8	1218.6
Namakkal	360.7	43.3	317.0	38.1	832.8
The Nilgris	772.8	52.7	442.1	30.1	1466.8
Perambalur	271.7	33.3	414.8	50.9	815.3
Pudukkottai	327.1	39.2	395.8	47.5	834.2
Ramanathapuram	134.8	17.7	465.4	61.3	759.5
Salem	423.6	46.4	318.3	34.9	912.5
Sivaganga	317.8	36.8	394.9	45.7	864.4
Thanjavur	298.4	33.6	469.7	52.9	887.8
Theni	201.8	26.0	350.0	45.1	775.7
Thiruvallur	417.2	40.4	529.4	51.3	1031.5
Thiruvarur	277.9	26.6	632.8	60.5	1045.5
Thiruvannamalai	411.1	41.8	462.7	47.0	983.8
Tuticorin	69.3	12.4	387.5	69.3	558.8
Vellore	463.7	52.1	321.1	36.1	890.0
Villupuram	363.2	38.5	480.4	50.9	944.3
Virudhunagar	182.4	25.5	381.3	53.3	714.8
Kanyakumari	502.3	39.1	476.9	37.1	1285.4
Tirunelveli	161.0	20.9	418.5	54.4	769.4
Tiruppur	170.7	26.1	324.9	49.8	652.8
Trichy	274.3	35.9	380.4	49.8	764.0

drought was recorded for three years during SWM (2012, 2016, 2018) and extreme drought occurred once (2016) during NEM. During 2002, moderate dry condition was realized in both SWM and NEM. Severely dry SWM, extremely dry NEM was observed during 2016.

For Salem, moderate drought occurred for three years during SWM (1998, 1999, 2003) and two years during NEM (1985, 2018), while severe drought was recorded twice during SWM (2002, 2018) and once (2006) in NEM and extreme drought occurred twice during NEM (1988, 2016). The SWM, NEM and on annual scale, the year 2018 recorded. Severely dry condition during SWM and moderately dry condition during NEM and on annual scale respectively.

Drought frequency and magnitude for northeastern ACZ

For Cuddalore, moderate drought occurred for two years during SWM (1989, 2015) and five years during NEM (1981, 2003, 2013, 2014, 2016), while severe drought was recorded once each during SWM (1982) and NEM (2012) and extreme drought occurred for three years

Table 4. Frequency of drought events based on SPI for western ACZ

Drought	Coimbatore	Erode	Tiruppur
Moderate			
SWM	2	1	3
NEM	2	1	1
Annual	5	1	4
Severe			
SWM	0	0	0
NEM	1	2	1
Annual	1	0	3
Extreme			
SWM	0	2	2
NEM	2	2	1
Annual	0	2	0

Table 5. Frequency of drought events based on SPI for northwestern ACZ

Drought	Dharmapuri	Krishnagiri	Namakkal	Salem
Moderate				
SWM	7	5	3	3
NEM	2	3	4	2
Annual	5	5	4	1
Severe				
SWM	0	1	3	2
NEM	2	1	0	1
Annual	1	3	0	0
Extreme				
SWM	1	1	0	0
NEM	2	0	1	2
Annual	2	0	2	2

(2012, 2013, 2018) during SWM and once (1983) during NEM (Table 6). The consecutive years 2012 and 2013 recorded extremely dry condition during SWM and severely dry condition on annual time scale.

For Kancheepuram, moderate drought occurred for five years during SWM (1986, 1997, 1999, 2008, 2009) and three years during NEM (1984, 2009, 2018), while severe drought was recorded for one year during SWM (1992) and three years during NEM (2002, 2012, 2016), and extreme drought occurred twice during SWM (2003, 2018) and once during NEM (1982). Moderately dry SWM and NEM was observed during 2009. During 2018, SWM experienced extremely dry condition while NEM was observed to be moderately dry.

For Thiruvallur, moderate drought occurred for two years during SWM (1992, 2003) and four years during NEM (1987, 1989, 2004, 2012), while severe drought was recorded once during SWM (1986) and twice during NEM (2013, 2016). During SWM, 2002 and 2018 extreme drought was observed. In 2003, NEM experienced extremely dry, SWM realized moderately dry whereas throughout the year it was severely dry.

For Tiruvannamalai, moderate drought occurred for three years during SWM (1984, 1989, 2009) and two years during NEM (2013, 2018), while severe drought was recorded twice during SWM (2002, 2018) and once (2012) in NEM, and extreme drought occurred once each during SWM (2012) and NEM (2016). Drought severity with varied time scales was observed during 2012 and 2018.

For Vellore, moderate drought occurred for two years during SWM (2008, 2009) and three years during NEM (2003, 2014, 2018), while severe drought was recorded once during SWM (2012) and twice (1983, 2016) during NEM, and extreme drought occurred thrice during SWM (2002, 2003, 2018) and once during NEM (2002). Drought severity in different time scales, viz. moderately dry, severely dry and extremely dry categories were prevailed in both SWM, NEM along with annual period during 2002, 2003 and 2018.

For Villupuram, moderate drought occurred for two years during SWM (1994, 2003) and five years during NEM (1981, 1982, 1984, 1988, 2000), while severe drought was recorded thrice during SWM (1982, 2002, 2018) and once (2016) in NEM, and extreme drought occurred once each during SWM (2012) and NEM (1995). The SWM, NEM and on annual scale for the year 1982 recorded severely dry condition during SWM and on annual scale and moderately dry condition during NEM.

Drought frequency and magnitude for Cauvery delta zone

For Thanjavur, moderate drought occurred for three years during SWM (1991, 2002, 2015) and five years during

Table 6. Frequency of drought events based on standardized precipitation index for northeastern ACZ

Drought	Cuddalore	Kancheepuram	Thiruvallur	Tiruvannamalai	Vellore	Villupuram
Moderate						
SWM	2	5	2	3	2	2
NEM	5	3	4	2	3	5
Annual	6	0	7	3	4	3
Severe						
SWM	1	1	1	2	1	3
NEM	1	3	2	1	2	1
Annual	3	2	3	2	1	2
Extreme						
SWM	3	2	2	1	3	1
NEM	1	1	1	1	1	1
Annual	0	2	0	1	2	1

Table 7. Frequency of drought events based on SPI for CDZ

Drought	Thanjavur	Nagapattinam	Thiruvarur	Karur	Perambalur	Ariyalur	Trichy
Moderate							
SWM	3	2	0	3	5	7	2
NEM	5	2	4	4	3	5	6
Annual	3	1	4	6	4	2	4
Severe							
SWM	3	0	3	0	1	0	2
NEM	0	0	2	1	0	2	3
Annual	2	3	1	0	2	5	4
Extreme							
SWM	1	3	1	1	1	1	3
NEM	2	4	1	1	4	2	0
Annual	1	2	1	1	1	0	0

NEM (1988, 1995, 2012, 2014, 2019), while severe drought was recorded thrice during SWM (1982, 1994, 1999), and extreme drought occurred once (2018) during SWM and twice (1983, 2002) during NEM (Table 7). During 2002, moderately dry and extremely dry condition was observed in SWM, NEM and on annual time scale.

For Nagapattinam, moderate drought occurred for two years each during SWM (2008, 2009) and NEM (2003, 2013), while extreme drought occurred thrice (1994, 1999, 2018) during SWM and four times (2002, 2009, 2012, 2016) during NEM. During 2009, moderately dry SWM, extremely dry NEM and severely dry condition for the whole year was observed.

For Thiruvarur, moderate drought occurred for four years during NEM (1983, 2003, 2012, 2017), while severe drought occurred thrice in SWM (1999, 2001, 2013) and twice in NEM (2002, 2019), and extreme drought occurred once each during SWM (1994) and NEM (2018).

For Karur, moderate drought occurred for three years during SWM (1982, 1987, 2002) and four years during NEM (1985, 1986, 2002, 2018), while severe drought occurred once during NEM (2012), and extreme drought occurred once each during SWM (2003) and NEM (1988). During 2002, moderately dry condition was observed in both monsoons and extremely dry condition prevailed on annual scale.

For Perambalur, moderate drought occurred for five years during SWM (1986, 1989, 1996, 2002, 2018) and three years during NEM (2003, 2016, 2018), while severe drought occurred once during SWM (1993), and extreme drought occurred once during SWM (1990) and four times during NEM (1983, 2002, 2009, 2012). During SWM, moderately dry condition was experienced in 2002 and 2018. The other drought categories were experienced during NEM and on annual basis.

For Ariyalur, moderate drought occurred for seven years during SWM (1982, 1983, 1997, 2002, 2003, 2014, 2015) and five years during NEM (1983, 2006, 2009, 2013, 2014), while severe drought occurred twice during NEM (2002, 2003), and extreme drought occurred once during SWM (2018) and twice during NEM (2012, 2016). The varied drought time scale was experienced in both SWM, NEM and on annual basis during 1983, 2002, 2003 and 2014.

For Trichy, moderate drought occurred for two years during SWM (2002, 2015) and six years during NEM (1989, 2001, 2013, 2014, 2017, 2019), while severe drought occurred twice during SWM (1994, 2012) and thrice during NEM (1983, 1985, 2002), and extreme drought occurred thrice during SWM (1997, 1999, 2018). Moderately dry SWM, severely dry condition during NEM and on annual scale respectively was experienced during 2002.

Table 8. Frequency of drought events based on SPI for southern ACZ

Drought	Dindigul	Madurai	Pudukkottai	Theni	Tirunelveli	Tuticorin	Sivaganga	Ramnathapuram	Virudhunagar
Moderate									
SWM	7	1	4	3	1	2	5	1	3
NEM	4	5	1	5	2	2	5	5	3
Annual	2	4	5	5	2	1	4	1	2
Severe									
SWM	0	3	3	2	3	1	1	2	3
NEM	0	3	2	3	1	1	1	2	0
Annual	1	2	2	1	1	2	1	3	1
Extreme									
SWM	1	0	1	1	1	2	1	1	0
NEM	2	0	2	0	2	2	1	1	2
Annual	3	1	1	1	2	1	1	1	2

Drought frequency and magnitude for southern ACZ

For Dindigul, moderate drought occurred for seven years during SWM (1981, 1984, 1994, 2002, 2012, 2014, 2016) and four years during NEM (2002, 2009, 2014, 2016), and extreme drought occurred once (1990) during SWM and twice (1988, 2012) during NEM (Table 8). Moderately dry SWM was realized during 2002, 2013, 2014 and 2016. The other drought scales, viz. severely dry and extremely dry conditions were observed in rest of the seasons.

For Madurai, moderate drought occurred once during SWM (1987) and five times during NEM (1983, 1991, 2017, 2018, 2019), while severe drought was recorded thrice each during SWM (1982, 2002, 2014) and NEM (1987, 2002, 2003). Severely dry NEM was observed during 1987 and 2002.

For Pudukkottai, moderate drought occurred for four years during SWM (1999, 2002, 2016, 2018) and once during NEM (1983), while severe drought was recorded thrice during SWM (2003, 2009, 2015) and twice during NEM (2013, 2017), and extreme drought occurred once in SWM (1981) and twice in NEM (1989, 2014).

For Theni, moderate drought occurred for three years during SWM (1982, 2002, 2006) and five years during NEM (1984, 1985, 2000, 2012, 2013), while severe drought was recorded twice during SWM (2003, 2012) and thrice NEM (1988, 1996, 2016), and extreme drought occurred once during SWM (2013). Moderately dry NEM was realized during 2012 and 2013. The consecutive moderately dry NEM had a critical impact on major crop production in their district.

For Tirunelveli, moderate drought occurred once during SWM (1997) and twice during NEM (1984, 2003), while severe drought was recorded thrice during SWM (1986, 2002, 2003) and once in NEM (2002), and extreme drought occurred once during SWM (1990) and twice in NEM (2012, 2016). Severely dry SWM was experienced during 2002 and 2003. The other drought scales were realized in the rest of the season and on annual basis.

For Tuticorin, moderate drought occurred twice during SWM (1986, 2012) and once during NEM (1989), while

severe drought was recorded once in SWM (2016) and twice in NEM (2002, 2012) and extreme drought occurred twice each during SWM (1990, 2014) and NEM (2009, 2016). The SWM, NEM and annual periods were severely affected by drought during 2012 (moderately dry – SWM/severely dry – NEM/annual), 2016 (severely dry – SWM/extremely dry – NEM/annual).

For Sivaganga, moderate drought occurred five times each during SWM (1982, 1984, 1990, 2003, 2004) and NEM (1985, 2003, 2013, 2014, 2017), while severe drought was recorded once each in SWM (2012) and NEM (2007), and extreme drought occurred once each during SWM (1983) and NEM (2016). The SWM, NEM and annual periods were severely affected by drought during 2003 (moderately dry – SWM/NEM/annual).

For Ramnad, moderate drought occurred once during SWM (1982) and five times during NEM (2003, 2009, 2012, 2014, 2019), while severe drought was recorded twice each in SWM (1994, 2002) and NEM (2002, 2017), and extreme drought occurred once each during SWM (2012) and NEM (2016). The SWM, NEM and annual periods were severely affected by drought during 2002 (severely dry – SWM/NEM/annual), 2012 (extremely dry – SWM and annual/moderately dry – NEM).

For Virudhunagar, moderate drought occurred thrice each during SWM (1994, 1997, 2016), and NEM (1986, 2003, 2016), while severe drought was recorded thrice in SWM (2002, 2006, 2009) and extreme drought occurred twice during NEM (2002, 2009). Severely dry SWM, extremely dry condition during NEM and on annual scale was observed in 2002 and 2009. In 2016, moderately dry SWM and NEM was realized. Similar considerable moderate dry events occurrence was reported over southern Agro Climatic Zone of Tamil Nadu²¹.

Drought frequency and magnitude for hilly and high-rainfall zones

For Kanyakumari, moderate drought occurred for three years during SWM (2009, 2014, 2016) and two years

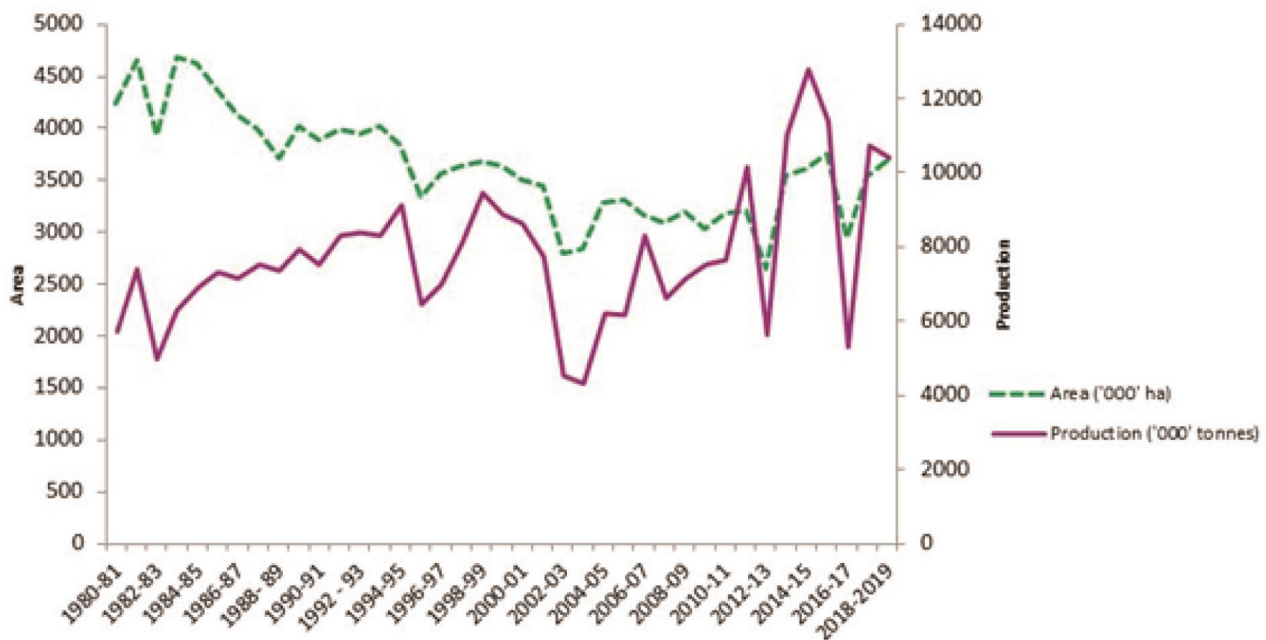


Figure 2. Area and production details for TN.

Table 9. Frequency of drought events based on SPI for high-rainfall and hilly zones

Drought	Kanyakumari	The Nilgiris
Moderate		
SWM	3	0
NEM	2	5
Annual	2	2
Severe		
SWM	1	1
NEM	4	5
Annual	1	2
Extreme		
SWM	1	2
NEM	0	1
Annual	1	2

during NEM (1986, 2002), while severe drought occurred once in SWM (2002) and four times during NEM (2001, 2003, 2013, 2016), and extreme drought occurred once (2003) during SWM (Table 9). The SWM, NEM and annual periods were severely affected by drought during 2002 (severely dry – SWM and annual/moderately dry – NEM), 2003 (extremely dry – SWM and annual/severely dry – NEM), 2016 (moderately dry – SWM and annual/severely dry – NEM).

For the Nilgiris, moderate drought occurred for five years during NEM (1981, 1986, 1989, 2003, 2009), while severe drought occurred once each in SWM (2003) and NEM (1983), and extreme drought occurred twice (2002, 2009) during SWM and once in NEM (2002). The SWM, NEM and annual periods were severely affected by drought during 2002 (extremely dry – SWM/NEM/annual),

2003 (severely dry – SWM and annual/moderately dry – NEM) and 2009 (extremely dry – SWM/moderately dry – NEM/severely dry – annual).

Area and production details for Tamil Nadu

From the analysis of area and production over TN with respect to drought intensity, the area ('000 ha) showed a declining trend (<3000) during 2002–03 (2792), 2003–04 (2837), 2012–13 (2648) and 2016–17 (2946). Similarly, the reduction in food grain production reduction was noticed for the corresponding years as mentioned above (Figure 2). The present study clearly relates the magnitude of severe extreme drought events to a significant reduction in total food grain area and production.

Conclusion

The spatial rainfall variability of SWM ranged from 69.3 mm (Tuticorin) to 772.8 mm (the Nilgiris), while for NEM it ranged from 277.8 mm (Krishnagiri) to 825.9 mm (Nagapattinam) and for annual period from 558.8 mm (Tuticorin) to 1466.8 mm (the Nilgiris) in TN. Irrespective of all the zones, the frequency of moderate drought occurrence was higher compared to other drought nomenclature. NEM recorded on par and a higher number of drought occurrences with respect to SWM. Temporal drought patterns were examined, which revealed several interesting results on the variability in the occurrence of drought in the region. The consecutive cropping seasons for both SWM and NEM were severely affected by

drought in almost all the ACZs of TN. Thus, SPI acts as a potential indication assessing the drought categories in different time scale.

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Received 26 August 2020; revised accepted 14 July 2021

doi: 10.18520/cs/v121/i6/781-788