HNUE JOURNAL OF SCIENCE DOI: 10.18173/2354-1059.2021-0060
Natural Sciences 2021, Volume 66, Issue 3, pp. 195-206
This paper is available online at http://stdb.hnue.edu.vn

AN EVALUATION OF METEOROLOGICAL DROUGHT IN DAK LAK PROVINCE

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Abstract. Assessment of the degree of meteorological drought in Dak Lak province is carried out using the SPI index and the water balance index K in the period 1985 - 2019. The results show that: According to the SPI index, drought tends to occur more at the time of transition from the dry season to the rainy season, during the rainy season, and from the time of transition from the rainy season to the dry season. The K-index in the period 1985 - 2019 showed there was a dry period at the beginning of the year from January to April. The anomalous drought factor plays a very important role because its large influence can cause damages, and allows assessing the variability of rainfall and the impact of climate change on the region. The study and evaluation of meteorological drought have practical significance, supporting managers in making policies on water resource management, ensuring sustainable economic and social development in the context of global climate change.

Keywords: meteorological drought, SPI, K index, Dak Lak province.

1. Introduction

Drought is a natural disaster that greatly affects people's lives all over the world, causing great obstacles to socio-economic development and people's lives. Drought causes thousands of ponds, lakes, rivers, and streams to be exhausted, many residential areas are deprived of water for daily use, increases the possibility of saline intrusion, reduces crop yields, areas lose their ability to cultivate, leading to the risk of drought, desertification. In recent years, severe droughts have occurred in southeastern Brazil (2014 - 2017), California (2011 - 2017), the Caribbean (2013 - 2016), northern China (2010 - 2011), Europe (2011, 2015, 2018), India (2016, 2019), Horn of Africa (2011 - 2012), South Africa (2015 - 2016, 2018) and Vietnam (2016). These severe droughts have shown that the risk of impacts of Drought depends not only on the extent, frequency, and duration of droughts but also on the exposure, susceptibility, and response the capacity of the socio-ecological system [1].

Received October 11, 2021. Revised October 21, 2021. Accepted October 28, 2021.
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In recent years with the trend of global climate change, abnormal weather and drought have occurred in many localities across the country, especially in the Central Highlands and South Central region. In the Central Highlands, the amount of water on ponds, lakes, and irrigation works fell into a state of depletion and caused great damage to agriculture. In Dak Lak, drought occurs on an increasingly large scale, prolonged droughts have dried up the water sources in rivers, streams, ponds, and lakes in the area, causing damage to many crop areas in the province. Typically, the drought in the dry season of 2013, according to the report of the Department of Agriculture and Rural Development of Dak Lak province, the total area of crops under drought is more than 25,000 hectares, of which more than 7,000 hectares of rice, more than 17,000 hectares of coffee. In 2015 and early 2016, in Dak Lak, the drought and water shortage area included 11,811 hectares of rice, 457 hectares of maize, 47,835 hectares of coffee, and other crops; in which, the complete lost area was 4,364 ha (3,260 ha of rice, 274 ha of maize, 655 ha of coffee). Meteorological drought is considered a natural disaster because it causes a severe shortage of rainfall compared with the climate norm and occurs over a long period time.

Faced with this fact, the assessment of the level of drought types, especially meteorological droughts in Dak Lak province have practical significance for proposing solutions for natural disaster prevention and sustainable socio-economic development.

2. Content

2.1. Literature review, methodology, and data

2.1.1. Literature review

At present, the definitions of drought and the criteria for determining drought are not globally agreed upon due to the differences in the nature and impact of drought in each place. According to WMO, there are about 60 different definitions of arid conditions based on the relationship between hydro-meteorological conditions, but generally, the definitions are given based on the absence of rainfall throughout a long time. The world has developed and applied many different drought indices: Ivanov moisture index (1948), Budyko dry index (1950), Penman dry index, monsoon index GMI, standardized precipitation index (SPI), standardized precipitation-evaporation index (SPEI), and Palmer drought severity index (PDSI), Effective drought index (EDI), multivariable standard drought index (MSDI), crop moisture index (CMI), surface water supply index (SWSI), RDI (Reclamation Drought Index). However, experience from studies shows that no one indicator has superior advantages over others in all conditions. Therefore, the application of drought indicators depends on the specific conditions of each region as well as the available monitoring database system in that region. Below are presented a number of research works in the world and Vietnam that have used drought indicators to assess and forecast drought.

In the study "Indicators for drought characterization on a global scale", Niko Wanders et al (2010) analyzed the advantages and disadvantages of 18 drought indices including meteorological drought index, hydrological drought index, humidity index, and then selected appropriate index to analyze the characteristics of drought in five

different climate zones around the globe: equatorial region, polar arid region, warm temperature zone, snow zone, polar region. The results show that the SPI, EDI, and MAPVT indexes are not hindered by the physical basin structure, as they depend only on precipitation. A higher soil water storage capacity would increase the mean duration of drought as determined by TSDI, SVT, and QVT [2].

Michael J. Hayes (1999) in his study "Tracking 1996 Drought Using a Normalized Precipitation Index" used SPI to track the 1996 drought in the southern and southwestern plains of the United States. The results indicate that SPI is a tool that should be used as part of a state, regional or national drought monitoring system in the United States. During the 1996 drought, SPI detected the onset of a drought at least 1 month before PDSI. This timeliness will be invaluable to state and federal response and mitigation actions for future drought-affected areas [3].

G. Tsakiris and H. Vangelis (2004) in their study "Towards a Spatial SPI Based Drought Monitoring System" present a method based on SPI estimation over a geographical area and use it to model describe drought. Applications of the method are presented using geotechnical modeling and a simple computational procedure. It turns out that the proposed method can be easily applied and can support a drought monitoring system for a medium-sized area [4].

C. Mongkolsawat et al. (2001) in the study "Assessment of drought risk in Northeast Thailand using remote sensing and GIS data" used remote sensing and GIS to model drought-prone areas with a set of themes that have been studied and reviewed, including meteorological drought, hydrological drought, and physical drought. Research indicates that areas of high drought risk are located in the southwest and extend into the northwest of the region. Areas at low risk of drought are located along the Mekong River [5].

Mai Kim Lien et al (2016) assessed the meteorological drought in the Mekong Delta through the SPI index. The results show that the areas of Ca Mau, My Tho, and Chau Doc have a lower frequency of drought-free occurrence than other areas in the study area (72-75.4%), but this is the case. The areas with the frequency of occurrence of very severe drought are much higher than other areas (7.8 - 11.3%) [6].

Tran Van Ty et al (2015) [7] evaluated the current status of meteorological drought and the impact of climate change on drought in the Mekong Delta. Rain and temperature data simulated by SEA START (Scenario A2, B2) were checked for reliability and corrected. The SPI drought index is calculated for 1, 3, 6, and 12 months for the period 1980-2012 and 2015-2047. From there, the Degree-Time-Term Frequency (SDF) curve is established. The results are shown on maps for the Mekong Delta and the identified drought risk area [7].

2.1.2. Methodology

To classify droughts in Dak Lak province by different periods of the year, we used the normalized precipitation index SPI and the water balance index K. As shown in the overview, these two indicators have been used by many researchers to assess meteorological drought in Vietnam.

**** Standardized Precipitation Index SPI***

The SPI index was proposed by McKee et al. (1993) based on the difference between the actual precipitation R and the multi-year average R and divided by the standard deviation σ [8].

$$SPI = \frac{R - \bar{R}}{\sigma}$$

SPI can be calculated for different periods (1 month, 3 months, 6 months, 12 months). The calculation for different periods allows us to assess the impact of rainfall deficit on water resource characteristics such as runoff, groundwater, reservoir volume. Positive SPI values show that the actual amount of rainfall is larger than the mean and negative values indicate a shortfall from the mean. The threshold ranges of SPI are as follows:

Table 1. Classification of SPI value

SPI	Category
≥ 2	Extremely wet
1.5 to 1.99	Very wet
1.0 to 1.49	Moderately wet
-0.99 to 0.99	Near normal
-1 to -1.49	Moderate drought
-1.5 to -1.99	Severe drought
≤-2	Extremely drought

Drought occurs when SPI value reaches -1.0 and ends when SPI value returns to a positive value

**** Water balance drought index K***

K is the ratio between the main water resource and water use of the water balance. Drought index K is calculated as follows:

Monthly drought index: $K_{th} = \frac{E_{th}}{R_{th}}$,

E_{th}- mean monthly Piche evaporation (mm); R_{th}- mean monthly rainfall (mm)

Annual drought index: $K_n = \frac{E_n}{R_n}$,

E_n- mean annual Piche evaporation (mm); R_n- mean annual rainfall (mm)

Monthly droughts are divided on the basis of the monthly drought index in each area. We classify monthly drought into 5 levels.

Table 2. Monthly drought classification based on K

Level	The upper limit of the monthly drought index
Very wet	< 0.5
Wet	0.5 ÷ 1
Relatively dry	1 ÷ 2
Dry	2 ÷ 4
Very dry	> 4

2.1.3. Data

To calculate the drought indices, data from 3 meteorological stations of Dak Lak province were used, including Buon Ho, Buon Ma Thuot, and M'Drak stations with the following factors:

- Monthly and annual rainfall data for the period 1985 - 2019.
- Monthly and annual Piche evaporation for the period 1985 - 2019.

2.2. Result and discussion

2.2.1. Assessing the degree of meteorological drought in Dak Lak province using SPI Standardized Precipitation Index

The SPI is calculated for the period 1985 - 2019 for 1 month (SPI-1), 3 months (SPI-3), and 12 months (SPI-12).

**** SPI-1***

The possibility of monthly drought occurrence in Dak Lak province in the period 1985 - 2019 is shown by the frequency of meteorological drought with SPI index ≤ -1 presented in Table 3. The results show that, according to the indicator, drought only occurs in the months of April-November, corresponding to the months of the rainy season, the beginning and the end of the dry season. Particularly in December and March, corresponding to the dry season in Dak Lak province, there is no drought. Thus, in the rainy season, the weather situation in Dak Lak province is quite complicated, with unusual dry spells. The most recent is the drought in the rainy season in 2021 when the weather in the province enters the rainy season, but the districts of Krong Bong, Ea Kar, and M'Drak in the eastern part of Dak Lak province have long-lasting heat causing many lakes, dams, rivers, streams in the province have gradually dried up, exhausted water sources, affecting the productivity and output of many crops. In contrast, in the dry season due to the occurrence of more and more unseasonal rains, reduces the risk of drought in the province. As in the dry season of 2018, in Dak Lak province, there were continuous unseasonal rains on a large scale, timely replenishing water for crops, especially coffee trees in areas at risk of water shortage.

Table 3. Frequency of meteorological drought by month in Dak Lak province with SPI ≤ -1 *(Unit: %)*

Station / Month	Buon Ho	Drought year	Buon Me Thuot	Drought year	M'Drak	Drought year
1	0		0		0	
2	0		0		0	
3	0		0		0	
4	20	1986, 1987, 1995, 2001, 2002, 2015, 2019	14.3	1987, 1995, 2008, 2015, 2016	0	

5	14.3	1985, 1991, 1992, 2010, 2012	14.3	1985, 1995, 2004, 2007, 2010	20	1986, 1988, 1990, 2005, 2010, 2016, 2018
6	17.1	1986, 1993, 1997, 2009, 2012, 2017	11.4	1997, 2004, 2005, 2012	17.1	1993, 1995, 1997, 2005, 2012, 2015
7	17.1	1998, 1999, 2001, 2007, 2008, 2016	14.3	1999, 2002, 2008, 2016, 2019	11.4	1987, 2001, 2003, 2019
8	5.7	1994, 1995	8.6	1995, 2012, 2017	11.4	1985, 1993, 1994, 2018
9	14.3	1989, 1998, 1999, 2001, 2004	20	1986, 1992, 1993, 2001, 2014, 2015, 2017	20	1990, 1992, 1998, 2004, 2011, 2016, 2017
10	14.3	1987, 2004, 2013, 2014, 2018	11.4	1997, 2004, 2014, 2018	17.1	1987, 2009, 2013, 2015, 2017, 2018
11	17.1	1991, 1992, 1994, 2004, 2006, 2012	14.3	1992, 1994, 2004, 2006, 2014	8.6	1997, 2006, 2014
12	0		0		0	

The probability of severe meteorological drought with SPI ≤ -1.5 in Dak Lak province is presented in Table 4.

Table 4. Frequency of severe drought by month with SPI ≤ -1.5

Station / Month	Buon Ho	Drought year	Buon Me Thuot	Drought year	M'Drak	Drought year
1	0		0		0	
2	0		0		0	
3	0		0		0	
4	2.9	2002	0		0	
5	2.9	1985	5.7	1985, 1995	5.7	1998, 2005
6	0		0		5.7	1997, 2005
7	0		5.7	2002, 2008	5.7	2001, 2019
8	0		0		0	
9	0		2.9	2001	8.6	1992, 2004, 2011
10	2.9	2004	0		0	
11	0		0		0	
12	0		0		0	

The results show that drought occurs in the period from April to October, but with a low frequency (2.9 - 5.7%). Particularly at M'Drak station, the frequency of severe drought in September is higher with 8.6% frequency. Notably, severe drought occurs mainly in the months of the rainy season (May, July, September).

The anomalous degree of meteorological drought in Dak Lak province is determined by the minimum ability of the SPI drought index values. When the SPI value ≤ -2 corresponds to a very severe drought, it is called anomalous drought. Table 5 presents the minimum values of the SPI index by months in the period 1985 - 2019.

Table 5. Minimum value of monthly SPI in Dak Lak province

Month / Station	1	2	3	4	5	6	7	8	9	10	11	12
Buon Ho	-0.6	-0.43	-0.78	-1.54	-2.12	-1.18	-1.46	-1.06	-1.48	-1.68	-1.33	-0.83
Buon Me Thuot	-0.42	-0.39	-0.92	-1.2	-1.69	-1.31	-1.74	-1.13	-1.54	-1.47	-1.14	-0.72
M'Drak	-0.92	-0.91	-0.95	-0.79	-1.65	-1.56	-1.6	-1.47	-1.89	-1.4	-1.25	-0.99

From Table 5, it can be said that in Dak Lak province, anomalous drought rarely occurs in January and December. Very severe drought only occurred in May at Buon Ho station with an SPI value of -2.12.

**** SPI-3***

According to the WMO Convention on short-term climates, a period of 3 months is considered a short season. The study and assessment of seasonal meteorological drought indicators play an important role. It reflects the severity of drought in the study area more accurately than the drought assessment every month because when the lack of rainfall lasts for multiple consecutive months, it will cause drought to become more severe. In the study, the author used a 3-month season - each year has 12 seasons, from season 1-2-3 to season 12-1-2.

Table 6. Frequency of seasonal meteorological drought in Dak Lak province with SPI ≤ -1 *(Unit: %)*

Station / Season	Buon Ho	Drought year	Buon Me Thuat	Drought year	M'Drak	Drought year
1-2-3	5.7	1993, 1998, 2003, 2004, 2014	17.1	1995, 2003, 2005, 2006, 2011, 2015	14.3	1993, 1998, 2003, 2004, 2014
2-3-4	17.1	1995, 2002, 2003, 2011, 2015, 2016	17.1	1995, 2003, 2005, 2010, 2015, 2016	5.7	1995, 2015,
3-4-5	14.3	1985, 2002, 2010, 2011, 2015	8.6	1995, 2010, 2015	14.3	1988, 2005, 2010, 2015, 2016
4-5-6	20.0	1986, 1991, 1993, 1995, 2002, 2011, 2012	11.4	1995, 2004, 2007, 2010	11.4	1986, 2005, 2015, 2018

5-6-7	11.4	1995, 1998, 2007, 2012	17.1	1993, 1995, 1997, 2002, 2007, 2012	14.3	1987, 1997, 2002, 2005, 2015
6-7-8	14.3	1995, 1998, 2008, 2012, 2016	17.1	1993, 1995, 1999, 2008, 2012, 2017	14.3	1991, 1993, 1997, 2003, 2012
7-8-9	11.4	1998, 1999, 2000, 2008,	20.0	1988, 1993, 1995, 1999, 2008, 2016, 2017	17.1	1993, 2003, 2004, 2011, 2016, 2017
8-9-10	14.3	1987, 1989, 1994, 2004, 2008	14.3	1987, 1994, 2004, 2014, 2017	20.0	1985, 1987, 1997, 2004, 2009, 2017, 2018
9-10-11	14.3	1989, 1994, 2001, 2004, 2014	20.0	1986, 1994, 1997, 2001, 2004, 2014, 2015	14.3	199, 1997, 2002, 2004, 2014
10-11-12	17.1	1989, 1994, 1997, 2004, 2012, 2014	14.3	1994, 1997, 2004, 2014, 2018	8.6	1991, 1997, 2006
11-12-1	17.1	1989, 1991, 1992, 2004, 2006, 2012	11.4	1992, 2004, 2006, 2014	5.7	1997, 2006
12-1-2	0		0		5.7	1989, 2013

The probability of seasonal meteorological drought in Dak Lak province is shown by the frequency of meteorological drought (SPI≤-1) presented in Table 6. The results show that drought can occur in any season of the year. Notably, in the rainy season months, the possibility of seasonal drought is higher than in the winter months. Typically, at Buon Ho station in season 4-5-6, Buon Ma Thuot station in season 7-8-9, season 9-10-11, M'Drak station in season 8-9-10, the frequency of drought is up to 20%. Particularly for season 12-1-2, the probability of drought is very low, only about 5.7%.

The probability of seasonal severe drought in Dak Lak province is presented in Table 7. The results show that the frequency of seasonal severe drought in Binh Dinh province ranges from 2.9 - 8.6%, corresponding to 1 - 3 drought years in the period 1985 - 2019. Severe drought occurs mainly in seasons during the rainy season, such as the season 6-7-8, and the season 9-10-11. The probability of severe drought is 8.6%. Particularly the season 11-12-1, season 12-1-2, season 1-2-3 correspond to seasons in the dry season without severe drought.

Table 7. Frequency of seasonal severe drought in Dak Lak province with SPI ≤ -1.5 *(Unit: %)*

Station / Season	Buon Ho	Drought year	Buon Me Thuot	Drought year	M'Drak	Drought year
1-2-3	0		0		0	
2-3-4	5.7	2002, 2015	2.9	1995	0	
3-4-5	2.9	2002	5.7	1995, 2010	2.9	20.2
4-5-6	0		2.9	1995	2.9	2005
5-6-7	2.9	20.1	0		5.7	1987, 2005
6-7-8	8.6	1995, 2008, 2012	5.7	2008, 2012	2.9	1993
7-8-9	2.9	1998	5.7	1993, 2017	2.9	2011
8-9-10	0		5.7	2014, 2017	2.9	2004
9-10-11	8.6	1989, 1994, 2004	5.7	2004, 2014	0	
10-11-12	2.9	2004	2.9	2004	0	
11-12-1	0		0		0	
12-1-2-3	0		0		0	

The anomalous degree of seasonal meteorological drought in Dak Lak province is shown by the minimum values of the SPI index shown in Table 8. When SPI value ≤ -2, anomalous drought occurs, corresponding to very severe drought on the SPI scale. From Table 8, it can be said that seasonal anomalies can occur at the end of the dry season, the beginning of the rainy season (season 3-4-5), the middle of the rainy season (season 7-8-9), the end of the rainy season, the beginning of the dry season (season 9-10-11). The anomaly value is in (-2, -2.5) range. Particularly at Buon Ho station, the SPI value is up to -2.45 in the season 9-10-11.

Table 8. The minimum seasonal SPI value of Dak Lak province

Season / Station	1-2-3	2-3-4	3-4-5	4-5-6	5-6-7	6-7-8	7-8-9	8-9-10	9-10-11	10-11-12	11-12-1	12-1-2
Buon Ho	-1.03	-1.7	-1.6	-1.36	-1.76	-1.65	-1.96	-1.41	-2.45	-1.78	-1.26	-0.83
Buon Me Thuot	-1.15	-1.51	-2.01	-1.57	-1.47	-1.71	-1.82	-1.89	-1.85	-1.62	-1.12	-0.72
M'Drak	-1.21	-1.07	-1.55	-1.93	-1.78	-1.74	-2.05	-1.75	-1.29	-1.29	-1.17	-0.99

**** SPI-12***

To assess the possibility of drought by year, the study used annual rainfall to assess the deficiency of annual rainfall compared to the long-term mean (period 1985 - 2019). The probability of meteorological and severe drought by year in Dak Lak province is presented in Table 9 and the change of SPI value during the period 1985 - 2019 is shown in Figure 1.

Table 9. Frequency of drought and severe drought (with SPI ≤ -1 and SPI ≤ -1.5) in Dak Lak province

Place	Frequency of meteorological drought/Frequency of severe drought (%)	Drought year
Buon Ho	17.1	1995, 2004, 2008, 2011, 2012, 2015
	11.4	1995, 2004, 2011, 2012
Buon Me Thuot	14.3	1991, 1995, 1997, 2004, 2015
	8.6	1991, 1995, 2004
M'Drak	11.4	1991, 1997, 2002, 2004
	0.0	

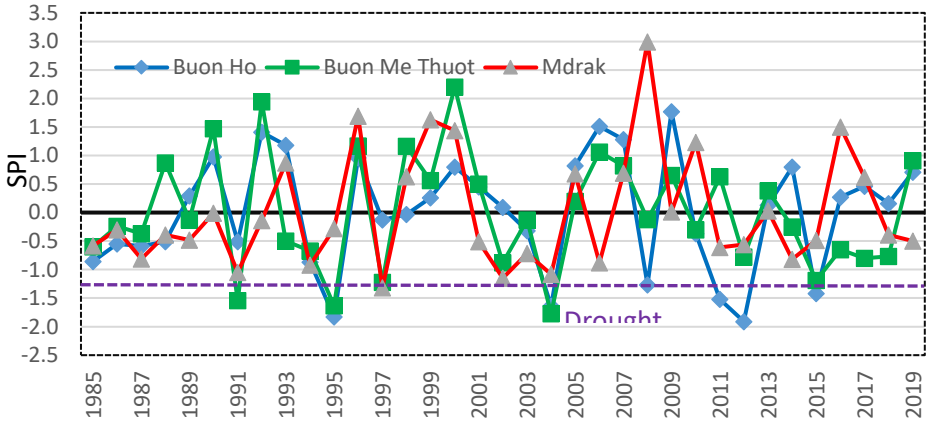

Figure 1. SPI-12 value change from 1985 - 2019

The results show that the frequency of meteorological droughts in Dak Lak province ranges from 11.4 - 17.1% and severe droughts with a frequency of 8.6 - 11.4%. Figure 1 shows that in the period 1985 - 2019, in Dak Lak province only severe drought occurred, no anomalous drought occurred. Particularly in Buon Ho station in 2002, the SPI value reached -1.91, nearly touching the very heavy limit.

In summary, according to the SPI index, in the period 1985 - 2019, Dak Lak province experienced moderate to severe drought. The possibility of monthly drought in the province only occurs in the months of April-November, corresponding to the months of the rainy season, the beginning and the end of the dry season with the degree of moderate to very severe drought. Severe drought occurs mainly in the months of the rainy season (May, July, September). Very severe drought occurs only in May in Buon Ho area with an SPI value of -2.12. The possibility of seasonal drought can occur in any season of the year. In the rainy season months, the probability of seasonal drought is higher than in the winter months with the frequency of drought up to 20%. Seasonal drought occurs with the degree of moderate to very severe drought. Severe drought mainly occurs in the rainy season with a frequency of 8.6%. Very severe drought can occur in the last months of the dry season - the beginning of the rainy season, the middle of the rainy season, the end of the rainy season - the beginning of the dry season with SPI values in the (-2, -2.5) range.

2.2.2. Assessing the degree of meteorological drought in Dak Lak province using K water balance index

Calculation results of monthly and annual drought indexes for the whole period of 1985-2019 in Dak Lak province are presented in Table 10. The results show that drought in Dak Lak province occurs mainly in the first months of the year (1-4). In Buon Ho, Buon Ma Thuot, anomalous drought with K > 6 occurs in the months 1-3, the K index value was up to 24.8 - 36.7. Particularly in M'Drak, it is slightly dry in the middle months of the rainy season (6-8).

Table 10. Monthly and annual drought index K of Dak Lak province in the period 1985 - 2019

No.	Station	1	2	3	4	5	6	7	8	9	10	11	12	Year	Drought period
1	Buon Ho	10.4	16.1	6.5	1.5	0.5	0.4	0.3	0.2	0.2	0.3	0.4	1.5	0.6	12-4
2	Buon Me Thuot	24.8	36.7	6.0	1.7	0.4	0.3	0.3	0.3	0.2	0.4	0.9	4.2	0.7	1-4
3	M'Drak	1.1	3.0	2.7	1.3	0.6	1.1	1.2	1.0	0.4	0.1	0.1	0.2	0.5	1-4, 6-8

Results of the K index for each year at Dak Lak meteorological stations in the period 1985 - 2019 are presented in Figure 2. In the period 1985 - 2019, in the Buon Ho and M'Drak area, the annual drought did not occur. In the Buon Ma Thuot area, a drought condition occurs with a frequency of 8.6%. On average for the whole period of 1985 - 2019, the K-index of stations in Dak Lak province is in the range of 0.5 - 0.7.

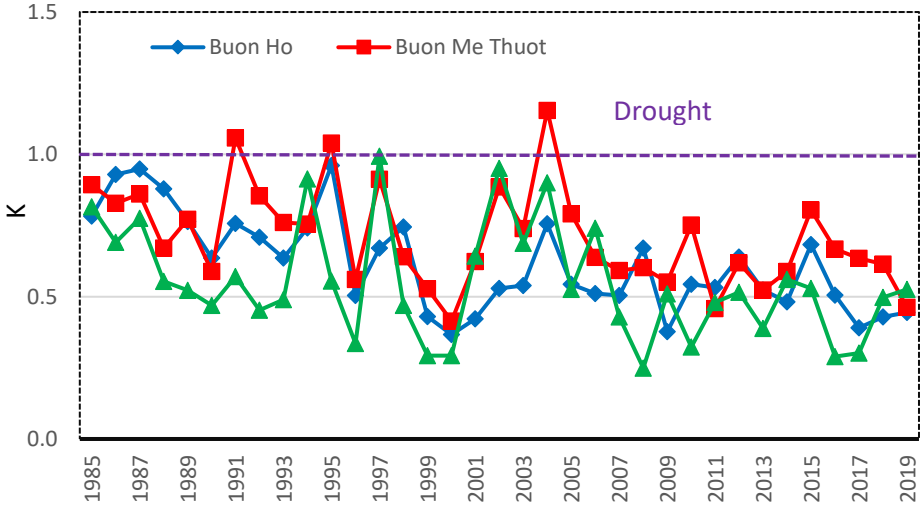

Figure 2. Calculation of K-index by year at meteorological stations of Dak Lak province

In summary, according to the water balance index K, in the period 1985 - 2019, the monthly drought in Dak Lak province occurred mainly in the first months of the year (1-4) with the degree from slightly drought to very drought. Anomalous drought with K > 6 occurred in Buon Ho, Buon Ma Thuot in the months 1-3 (K index values up to 24.8 - 36.7). In the M'Drak area, it is slightly drought in the middle months of the rainy season (6-8). By year, drought occurs only in Buon Ma Thuot with a frequency of 8.6%.

3. Conclusions

Meteorological drought in Dak Lak province is assessed by the SPI drought index and the water balance index K at 3 meteorological stations of the province, including Buon Ho, Buon Me Thuot, and M'Drak stations.

- SPI index is calculated by month, by season (1 season with 3 months), by year (12 months) in the period 1985 - 2019. According to the SPI index, drought tends to occur more at the time of transition from the dry season to the rainy season, during the rainy season, and from the time of transition from the rainy season to the dry season. Anomalous drought rarely occurs in the months January-December. Very severe drought occurs only in May at Buon Ho station. Seasonal anomalous drought can occur at the end of the dry season, the beginning of the rainy season (season 3-4-5), the middle of the rainy season (season 7-8-9), the end of the rainy season, and the beginning of the dry season (season 9-10-11).

- The K-index is averaged monthly for both the period 1985 - 2019 and each year during this period. According to the K-index, in Dak Lak, a dry period occurs at the beginning of the year, from I-IV. Anomalous drought occurs in the months 1-3.

Acknowledgment. This article is supported by the Vietnam - Belgium protocol project: "Monitoring climate Impact and disaster Resilience of Vietnamese Agro-ecosystems" (MINERVA). Vietnam code: NDT.96.BE/20; Belgium code: BL/67/VT44.

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