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Drought in Sisal Territory: Study on the Standardized Precipitation Index (SPI) considering Climate Change Projections for Valente/BA

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***Abstract*—*This article aims to analyze the historical behavior and projections of precipitation and drought incidence for the municipality of Valente in Bahia, also associating climate variability with the variability of sisal production in the region. The research was characterized as exploratory descriptive, having been carried out through bibliographical and documentary survey. It should be noted that meteorological data were obtained through the platforms of the National Institute of Meteorology - INMET and Climate Change Projections for South America regionalized by the ETA - PROJETA model, which were analyzed using the Drought Index and Monitoring System - DIMES, to obtain the Standardized Precipitation Index – SPI and by CLIMAP to understand the trends and temporal distribution of rainfall and temperature for the location. The study concluded that in the 2010s there was one of the most severe and prolonged droughts today, which even influenced the low productivity of sisal in the region, and that, in view of future projections until 2030, the socioeconomic drought scenario tends to worsen.*

I. INTRODUCTION

Climate change and its effects are one of the themes that are at the heart of scientific discussions and global governance, due to the deleterious risks they can cause to society, the environment, and the economy. The breadth of extreme phenomena and climate variability can affect biodiversity, agricultural production, food security, access to quality water, health, employment, and the stability of socio-ecological systems [1].

Drought is one of the natural phenomena that has possibly been aggravated by climate change, presenting with greater constancy and intensity, and consequently increasing the susceptibility of desertification in arid climate regions [2]. Presented by the Pan American Health Organization/World Health Organization – PAHO/WHO [3] as a climatic event capable of permanently affecting several regions of the world, drought is characterized by its long duration and difficulty in stipulating its onset.

As a climatic phenomenon, drought is related to the existing hydrological balance between rainfall episodes, volume of reserves and evapotranspiration rate [3]. Fernandes et al [4] in turn, describe that the occurrence of drought in each region is due to lower levels of precipitation in a certain period when compared with the climatological estimates of the place.

Thus, drought refers to water scarcity on a temporal scale in eachterritoriality and can be classified into four types according to its severity, namely: meteorological, hydrological, agricultural, and socioeconomic. Meteorological drought is characterized as a deviation in the amount of rain expected on short scales, in response to more ephemeral atmospheric conditions. The hydrological drought is recognized by the temporal extension of rainfall deficits, which in turn end up affecting the volume of water available in reservoirs and water courses. Agricultural drought is understood as the insufficiency of moisture in the land to rehydrate the evapotranspiration losses of plants, thus impairing their productivity. Finally, the socioeconomic drought is related to the direct impacts on the daily lives of the populations, due to the lack of availability of water, as well as for the sanitary supply and for supply in the productive chains, among others [5].

One of the methods commonly used to measure the degree of humidity or dryness is the Standardized Precipitation Index - SPI (Standardized Precipitation Index). This is calculated using only the amount of monthly precipitation as a variable, returning values that correspond to categories between extremely dry and extremely humid. The SPI can be analyzed based on different temporal scales of precipitation rates, making it possible to examine meteorological or hydrological drought regimes, as well as their constancy, frequency, and severity within the analyzed period [5] [6].

A report presented by PAHO/WHO [3] points to drought as one of the main threats of natural disasters, with the poorest and developing regions being the most vulnerable to it. In fact, it is known that drought has been a bitter reality for many people across the globe for a long time, and that it manifests itself in various moments, such as poverty, hunger, malnutrition, and death, wherever it is present.

Campos and Studart [7] point out that between 1777 and 1779, Brazil experienced a great drought, with an estimated death of about 500,000 people in Ceará and adjacent areas. However, this reality is not limited to a remote past, the document Declaración de la OMM about the environment in the word in 2019, brings in its body relevant statements about the impacts that drought has brought to populations, whether environmental, social or economic, among which forest fires stand out, with the destruction of several ecosystems; promotion of migrations (eco-refugees); expansion of the exposure of the world population to health risks from heat and pollution; and slowing down of economic growth, especially in developing countries [8] [9].

The drought experienced between 2012 and 2015 was considered one of the worst in the recent period in the history of the semi-arid region, with the occurrence of El Niño and the abnormal position further north of the Intertropical Convergence Zone - ITCZ over the Atlantic being pointed out as aggravating factors, a fact characterized by the heating of these waters [1].

Faced with the problem of climate change and the phenomenon of drought, this study aims to analyze the historical behavior and projections of the Standardized Precipitation Index - SPI, from the survey of official secondary data measured and simulated for future scenarios considering changes in the climate for the city of Valente - located in the sisal territory of the semi-arid region of Bahia, as well as associating climate variability with the production of sisal in the region.

In an article reported by the news portal G1, Mendes [10] portrayed what would become in the mid-2010s, the worst drought since 1960 experienced by the municipality of Valente, making it possible to ascertain the occurrence of a prolonged and severe drought, characterized, therefore, as a hydrological, agricultural and socioeconomic drought, as it seriously affected agricultural productivity and the entire chain of processing of sisal fibers in the region, bringing financial and social losses to the local population.

Valente's economy is based on commerce, the sisal industry, agriculture, and livestock. According to Cerqueira [11], Valente is among the three largest producers of sisal in the territory, but cassava, beans and corn can be found in the locality, the latter two of which have low productivity in the region. In livestock terms, the practice of grazing for sheep, goats and cattle is observed, so that agropastoral activities are identified as those promote greater occupation of land in the sisal territory.

In view of the above, the present study intends to analyze the historical behavior and projections of precipitation and drought incidence for the municipality of Valente in Bahia, also associating climate variability with the variability of sisal production in the region.

II. MATERIAL AND METHODS

The present study is characterized as exploratory descriptive research, having been carried out through a bibliographic and documentary survey, with consultations to primary and secondary sources. In this way, scientific articles extracted from platforms such as the Scientific Electronic Library Online – SciELO, Google Scholar and Lens.Org.AcademicProductions made available in university repositories; reports and publications from representative organizations and data obtained from platforms that provide climatological information such as the National Institute of Meteorology – INMET [12], National Institute for Space Research - INPE.

Daily historical information on rainfall and temperature variables were downloaded from the INMET Database (https://portal.inmet.gov.br/), observing a time interval of 39 years, corresponding to the 1980s. to 2019. As a reference to obtain the data, the conventional weather station of the municipality of Serrinha/BA was used, located at geographic coordinate's latitude-11.67 and longitude-39, which is also located in the territory of Sisal and is approximately 60km from the administrative headquarters of Valente/BA, being the closest station to the city object of this study.

The data from the climatic variables were first processed in the free software Climap 3.0, which made it possible to carry out statistical, analyzes of the daily meteorological data with consequent inference of trends in the temporal distribution of rainfall and the temperature curve for the location [13].

Precipitation forecasts, considering climate change, were obtained from CPTEC/INPE, through the Climate Change Projections for South America platform regionalized by the ETA - PROJETA model (https://projeta.cptec.inpe.br/#/dashboard).Monthly data with a 10-year interval between the years 2020 to 2030 were sought, using the 20km option, RCP8.5, continental HadGEM2-ES as a reference, using the same geographic coordinates as the INMET meteorological station.

The choice for the RCP8.5 scenario was based on the arguments of Schwalm, Glendon and Duffy [14], who communicate that in this model the accumulation of CO_2 in the atmosphere in a shorter temporal analysis is what is most likely to align with the conventional policies adopted, as well as global efforts aimed at mitigating greenhouse gas emissions, as in the Paris Agreement (Figure 1). Nevertheless, the authors still see that, although the future scenario may seem more pessimistic regarding the fight against climate change, the choice to overestimate, rather than underestimate future scenarios, can serve as a foundation to advise decision makers.

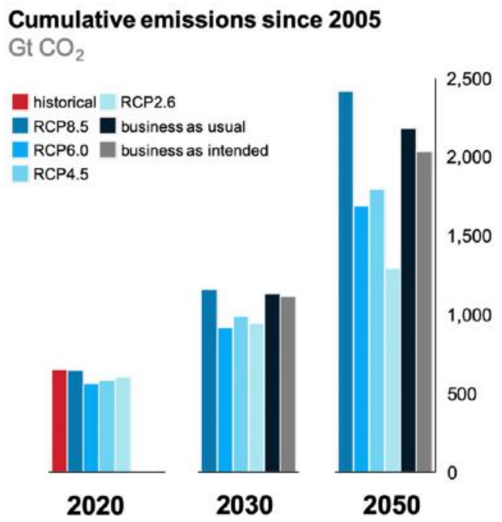


Figure 01: Expected accumulation of CO_2 in the atmosphere according to climate projection models.

Source: [14]

In this way, it should be noted that both INMET's historical data and PROJETA's forecasts were configured to present monthly precipitation values to be able to run in the Drought Index and Monitoring System -DIMES tool, in the Microsoft Excel environment, to verify the occurrence and forecasts of water deficits through the Standardized Precipitation Index - SPI. As for the time scale to calculate the SPI, the 12-month interval was chosen, where the graph curve responds better if there was a drought of the hydrological and agricultural type in the studied territory [5]. The SPI values and their qualification regarding the degree of drought or humidity are presented in Table 01.

Table 01: Dryness or humidity categories according to the SPI value.

SPI	CATEGORY
≥ 2,00	Extremely humid
1,50 a 1,99	Severely Wet
1,00 a 1,49	Moderately Moist
0.01 a 0,99	Incipient Moisture
0 a -0,99	Incipient Drought
-1,00 a-1,49	Moderately Dry
-1,50 a -1,99	Severely Dry
≤ - 2,00	Extremely Dry

Source: [5].

Nevertheless, the research also collected quantitative data on the production of sisal in Valente/BA between the years 2010 to 2019 to verify if the water variability is associated with the amount of sisal produced in the municipality. Thus, such information was obtained from the digital repository of the Brazilian Institute of Geography and Statistics - IBGE, through economic statistical studies on agriculture, livestock, and others, and more specifically in the product: Municipal Agricultural Production (PAM) (Agricultural Production Municipality - PAM | IBGE).

Finally, the image projection process (desertification map) was performed using the GIMP publishing software version 2.10.8.

The Brazilian semiarid and the territory of Sisal

Covering an area of approximately 1,128,697 km2, the Brazilian semi-arid region comprises almost the entire northeastern territory and a part of northern Minas Gerais. Included in this space are 1,262 municipalities, with a population of about 24 million people, equivalent to 13% of the country's total population. It is also noteworthy that the semi-arid region encompasses 64% of the northeastern territory and 12% of the national territory [15] [16] [17] [18].

The Brazilian semi-arid region is recognized for its low rainfall and high temperatures, which associated with high evapotranspiration rates, constitute a climate with great aridity. Although there is a statement that there is no rainfall in the semi-arid region, the fact is that it occurs at an annual average of 400mm to 800mm, and it is worth noting that it can be concentrated in a period or in a certain location, thus characterizing a dispersion that does not cover the entire territory in a linear fashion [17] [19].

The semiarid vegetation is characterized by xerophilous and tropophilous, which, due to their generally thorny constitution, have high adaptability to the scarcity of rainfall. In addition, deciduous tree and shrub species can be glimpsed, and in some cases, they can store water and nutrients in their root system [18] [19] [20].

As part of the morphoclimatic domain of the semiarid region, the sisal territory according to Cunha et al [21] is characterized by irregular annual rainfall; annual average temperatures of 24ºC, being 29.2ºC maximum temperature and 20.2ºC minimum temperature; and water deficit between -20% and -40%. Based on such information, it is possible to state that the risk of drought in the territory is high, so that annual rainfall averages of about 400mm to 650mm are recorded. The authors also observe that the intertropical geographic location, associated with the characteristics of climate and temperature, as well as the atmospheric clarity verified in the region for most of the year, favor the process of potential evapotranspiration, being estimated at 3,000 mm per year.

It is worth mentioning that the sisal territory also has high levels of insolation and low relative humidity, so it is also possible to say that the dry period is predominant in the area, corresponding to about 6 to 8 months, although it can be reaching the 11-month mark in areas with greater aridity. It should be noted that the high insolation observed in the locality makes it therefore present a high frequency of droughts, as well as torrential rains. That said, these characteristics project 100% of the territory's areas into the drought polygon [21] [22].

The sisal territory corresponds to an area of 20,292.70 km^2, about 3.6% of the area of the state of Bahia, with a population of about 582,329 habitants, spread over 20 municipalities, namely: Monte Santo, Nordestina, Queimadas, Quijingue, Serrinha, Teofilândia, Barrocas, Biritinga, Conceição do Coité, Ichu, Lamarão, Retirolândia, Santaluz, São Domingos, Tucano, Araci, Candeal, Cansanção, Itiúba and Valente [22]. The latter being the focus of analysis in more depth. The geographical delimitation of the territory can be seen in Figure 02.

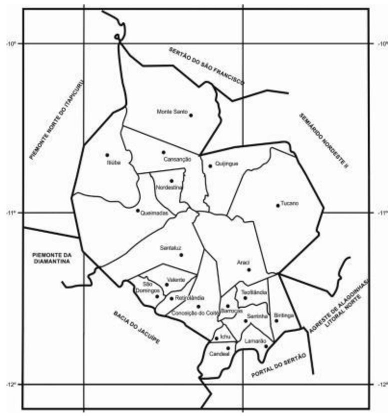


Fig.2: Delimitation of the Sisal Territory – Bahia.

Source:[20].

Lima et al [23] draw attention to the fact that, since 1970, the municipalities that make up the sisal region have undergone marked landscape transformations, a fact mainly attributed to the suppression of native vegetation, especially the caatinga, to make way for agricultural activities, so that an accelerated process of environmental deterioration has been established, which tends to promote desertification processes, which are pointed out as aggravating climate change.

Problematizing drought in the Sisal Territory

According to the World Meteorological Organization - WMO [24], droughts can be characterized according to severity, location, duration, and chronological development, and it is possible to say that it has as its primary cause, hydrometeorological processes that cause rainfall suppression, as well as they limit the availability of water in surface or underground mode.

Thus, it is stated that drought is mainly related to climatic phenomena related to low and/or irregular rainfall associated with high rates of evapotranspiration and may be closely linked to desertification processes. Silva [25] states that 41% of land cover is in dry regions, and between 10% and 20% of this total is in the process of desertification.

Considered extensive natural disasters, the occurrence of droughts affects not only the Brazilian semi-arid regions, but the entire world, so that of the total of 10,603 environmental disasters recorded across the globe between 1970 and 2014, 577 were drought-related, and more, 21% of deaths resulting from disasters are attributed to events of this nature [3] [26]. In Table 02, a comparison of the impacts of drought in the world and in America can be seen over forty-four years.

Table 02: Comparison of drought impacts in the world and in America between 1970 and 2014.

	World			Americas		
	total of disasters	drought disaster	% drought disaster	total of disaster	drought disaster	% drought disaster
Events	10.603	577	5,4	2737	128	4,68
Deaths	3330568	700.869	21,0	496.170	77	0,02
Affected	6680448	2067368	30,9	237.232	70.397	29,6
Costs	2687169.357	132809588	4,94	971.986.750	59.457.639	6,12

Source: [3].

According to the United Nations - UN [27], the process of environmental degradation is so increasing that two billion hectares of destroyed land have been identified, a fact that impacts 3.2 billion people worldwide.

When carrying out a more focused analysis on the sisal territory, there is a marked erosion of the vegetation cover, and such circumstances are attributed to the forms of land use in the region (agriculture, livestock, and mining), indicating an imbalance between the natural and anthropic exploitation [11].Understanding the natural and social environment, as a socio-ecological system, it is possible to perceive the relationship established between human action and the occurrence of drought, even if it comes from climatological phenomena.

The above statement is based on several studies that demonstrate that deforestation, the lack of vegetation cover on the soil, favors erosion, as well as an increase in the surface runoff of rainwater, consequently reducing the infiltration capacity of the same on the ground. As a result of this process, there is a higher rate of evapotranspiration, which, associated with issues of rainfall irregularity, leads to a situation of drought, in which the water availability of water courses - surface and underground is affected, impacting natural elements (fauna and flora) and human beings, with the deprivation of the use of this important resource in domestic, subsistence and economic activities [18] [28] [29] [30] [31].

Faced with such placements, it is important to highlight that the sisal region has a geophysical structure that favors the occurrence of drought, its soil types are considered fragile, with high susceptibility to erosion and desertification processes. Dourado [32], conducting research on areas at risk of desertification in Bahia, identified that the central region of the state, where the semi-arid region is located, presented areas that ranged from very high to low risk. It should be noted, however, that the north of the semiarid region is constituted almost entirely by areas of very high risk, and it is precisely in this area of higher prevalence of risk that the territory of sisal is inserted and therefore the municipality of Valente, as can be seen in figures 03 and 04, where the greater the prevalence of reddish tones, the greater the incidence/propensity to desertification.

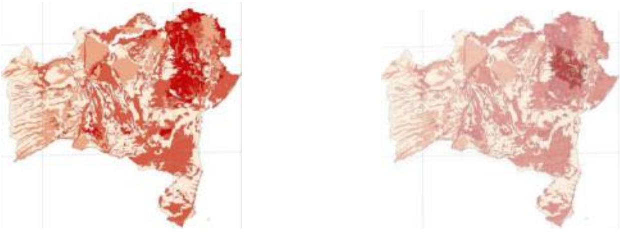


Fig. 3 and 4: Representative scheme of soil fragility and susceptibility to erosion in Bahia.

Source: [33].

The effects of climate change can worsen droughts and consequently intensify desertification processes, especially in more vulnerable regions. Marengo, Cunha and Alves [1] state that the prospect of an increase in both the frequency and duration of drought is worrying, as such factors associated with increased temperature, consequently incur greater environmental degradation and establish a vicious cycle of the socio-ecological system [32], in which the environment, in an attempt to recover, ends up aggravating climate change and these respond in such a way that they end up accentuating drought conditions .

Faced with such concerns, it is relevant to highlight that the state of Bahia currently has 417 municipalities, 97 with a declared state of emergency due to drought and/or drought, twenty of them in southwest Bahia and thirteen in the sisal territory. So that 1,003,975 people suffer directly from this situation, being in the territory of sisal, 164,361 people and in Valente 1,547 people [34].

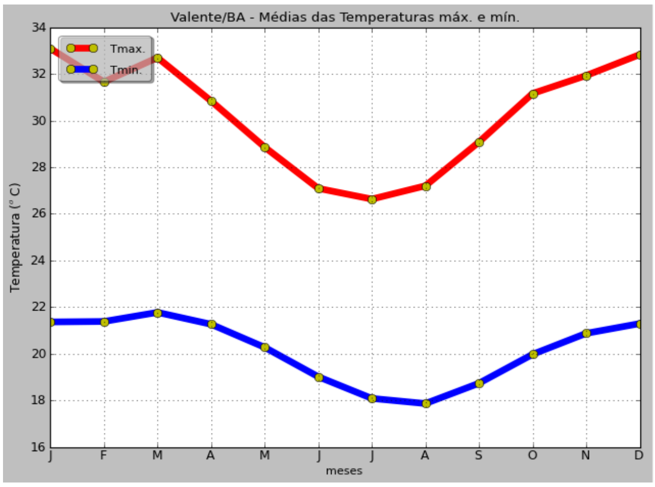
Therefore, this study seeks to verify the occurrence of droughts, as well as to make predictions about the possibility of droughts in Valente/BA considering a possible scenario on the horizon of climate change, as well as to investigate the association between sisal production and water availability.

The drought in Valente - BA

The municipality of Valente/BA is located in the territory of Sisal, which is part of the Brazilian semi-arid region, at an altitude of 358 meters above sea level, with geographic coordinates latitude -11°41'66" and longitude -39°45'51". With a territorial extension of 394.877 km², its estimated population in 2020 was 28,800 inhabitants, and it has a Human Development Index - HDI considered average, at the mark of 0.637 [35]. According to information from CLIMATE-DATA.ORG, the climate in Valente/BA is classified by Köppen and Geiger as BSh, ie hot semi-arid climate.

Based on an analysis carried out by Climap on daily temperature and precipitation data from 1980 to 2019 in the region, monthly meteorological trends and distributions were investigated.Thus, as observed in Graph 01, the average monthly maximum temperature for the municipality ranged from 26.63ºC to 33.09ºC and the average minimum temperature ranged from 17.86º to 21.77ºC, with the months between October and April , those that recorded the highest temperatures, with maximums above 30ºC, and the months between June and August, as those that marked the lowest temperatures, with minimums between 26º and 28ºC.

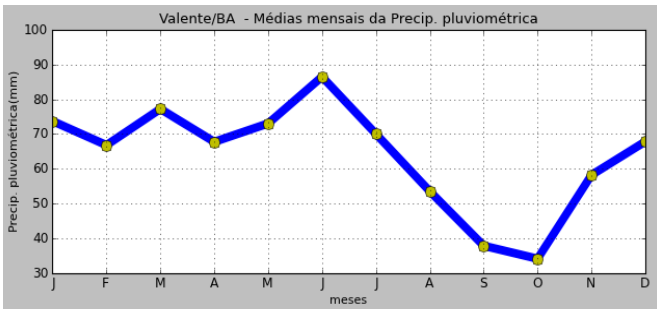
Graph 01: Monthly averages of maximum and minimum temperatures.



Source: Prepared by the authors (2021).

It was also found that the month of June had the highest monthly average of rainfall with 86.43mm, while the months of September and October were the driest, with rates of 37.99mm and 34.24mm, respectively (Graph 02).

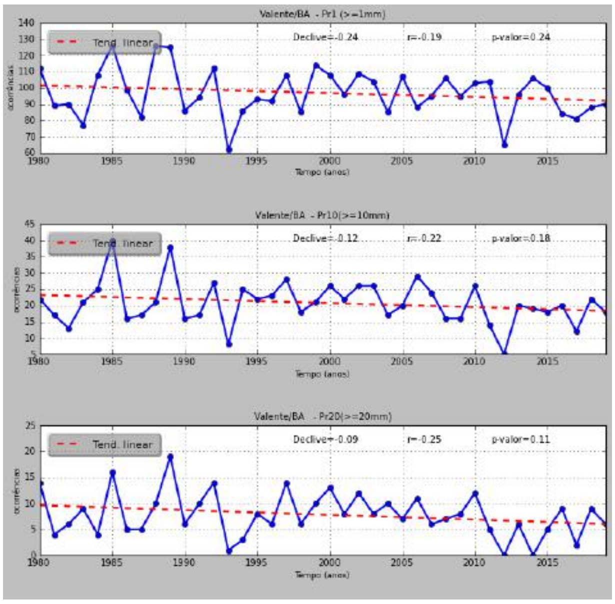
Graph 02. Monthly averages of precipitation



Source: Prepared by the authors (2021).

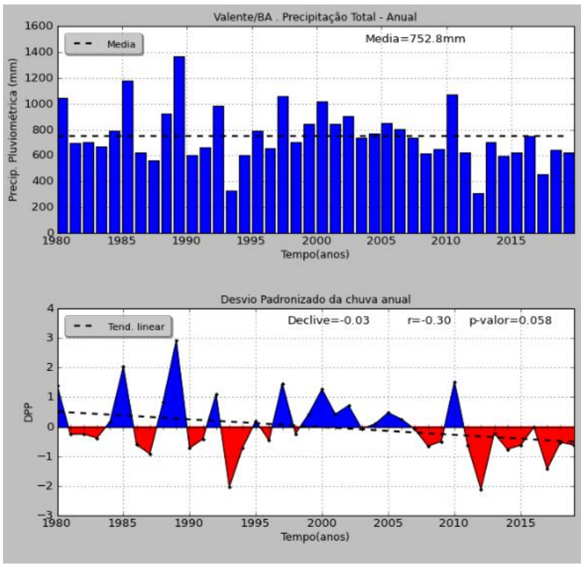
When observing within the delimited historical range, it appears that the average rainfall in days per year, equal to or above 1mm, was 97 days; with precipitation equal to or greater than 10mm were 21 days; and with rains equal to or above 20 mm, it took 8 days (graph 03).

Graph 03: Number of days per year with precipitation ≥ 1 mm/day, ≥ 10 mm, ≥ 20 mm.



Source: Prepared by the authors (2021).

Graph 04: Averages of precipitation and standarddeviation in the historical range between 1980 and 2019

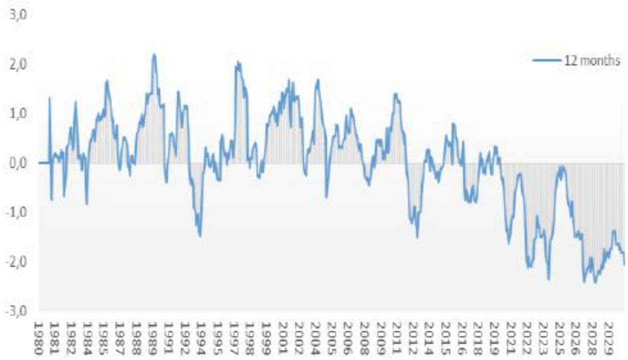


Source: Prepared by the authors (2021).

Through graph 04, in turn, it can be seen that the average annual precipitation between 1980 and 2019 was 752.8 mm. In this way, there is a trend in the decrease of rainfall in the region, verifying that since 2011 the averages of precipitation are below average. Of the entire sample, 60% of the years recorded negative deviations from rainfall and 40% positive deviations from the average. In 75% of the years, rainfall was within plus or minus 1 standard deviation, that is, with rainfall of 210mm more or less compared to the historical average. The years with the most extreme cases were 1985 (1177.4mm) and 1989 (1364.8mm) with the highest rainfall accumulations, and the years 1993 (326mm) and 2012 (309.9mm) with the worst precipitation levels.

After tabulating the daily rainfall data recorded by INMET in monthly values and grouping them with those of simulated projections in the context of climate change in the RCP8.5 scenario by PROJETA, the time series between 1980 and 2030 was worked on in DIMES to obtain the Standardized Precipitation Index - SPI, on a 12-month scale for past and future years, which resulted in the curve shown in Chart 05 and in the records shown in Chart 03.

Graph 05. SPI curve in the range between 1980 and 2030.



Source: Prepared by the authors (2021).

Table.3. Categorization, amount and percentage of SPI of the historical and future series (1980-2030).

Values of SPI	Category	1980-2019		2020-2030		Total	
		Qt	%	Qt	%	Qt	%
≥ 2,00	Extremely humid	5	1%	0	0%	5	1%
1,50 a 1,99	Severely Wet	19	4%	0	0%	19	3%
1,00 a 1,49	Moderately Moist	75	16%	0	0%	75	12%
0.01 a 0,99	Incipient Moisture	238	51%	2	2%	240	40%

0 a -0,99	Incipient Drought	120	25%	34	26%	154	26%
-1,00 a-1,49	Moderately Dry	13	3%	30	23%	43	7%
-1,50 a -1,99	Severely Dry	1	0%	38	29%	39	6%
≤ - 2,00	Extremely Dry	0	0%	28	21%	28	5%

Source: Prepared by the authors (2021).

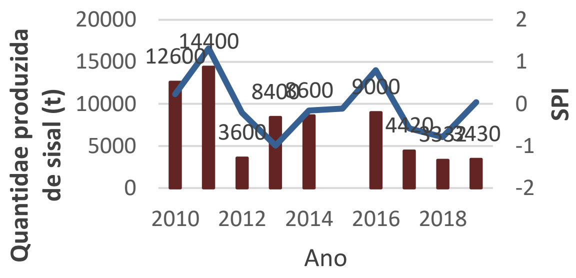
From the information seen in Graph 05, as well as in Table 03, it appears that historically, incipient humidity prevailed in the region (51% of the months), with the SPI fluctuating most of the time between values 0 and 1. It should be noted that there were short passages with a lot of water availability, with 16% of the months reaching SPI considered moderately humid, 4% severely humid and 1% extremely humid, many in response to greater rainfall accumulations, especially in 1985, 1989 and 1997.

In turn, the drought was present in 28% of the time, 25% as incipient drought, 3% as moderate drought and only 1 record of severe drought at the end of 2012. However, the curve shows the occurrence of hydrological drought more accentuated and prolonged between the years 1993 to 1995, 2011 to 2014 and 2017 to 2018. Corroborating the above analysis, Marengo, Cunha and Alves [1], highlight that in the 2010s one of the biggest droughts occurred today.

When analyzing the SPI of this decade, comparing it with the amount of sisal produced in the municipality of Valente/BA, according to Graph 06 , it is possible to infer the association of the influence of the drought climatological phenomenon on agricultural production, so that it is observed that the years of 2012, 2017 to 2019, were those that showed lower sisal productivity, a fact that confirms the hypothesis raised by this research that the water deficit may be linked to the decrease in sisal production in the region [5] [9]. In addition, the data is consistent with the article by Mendes [10], which depicts a scenario of socioeconomic drought in Valente/BA, causing serious socio-environmental, economic, and daily impacts on the local population.

When analyzing the relationship between the SPI and the production of Sisal, through regression, no significance (5%) was found for the analysis of variance, with the "p-value" at the threshold, 0.0577 (Table 4). However, the data suggest a downward trend in Sisal production around 3,547.7 t for each unit in SP (Graph 7).

Graph 06: SPI curve and amount of sisal produced between 2010 and 2019 in Valente/BA.



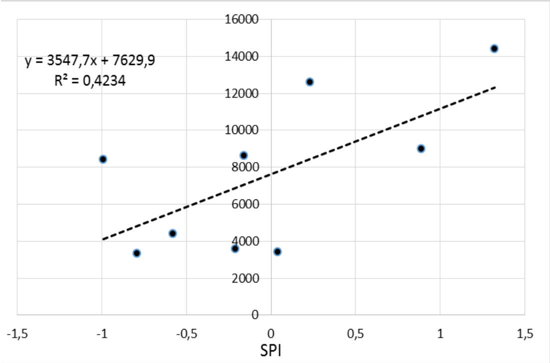
Source: Prepared by the authors (2021).

Table 4. Analysis of Variance of the Sisal Production x SPI Regression.

	gl	*SQ*	*MQ*	*F*	*F de signif.*
Regressão	1	57799153	57799153	5,13995	0,0577
Resíduo	7	78715535	11245076		
Total	8	1,37E+08			

Source: Prepared by the authors (2021).

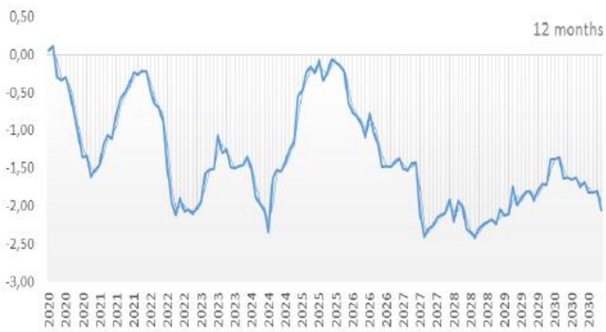
Graph 07: Regression between Sisal production and API (Valente - BA).



Source: Prepared by the authors (2021).

Cutting out Graph 5 and narrowing the SPI analysis for projections between 2020 and 2030 considering the RCP8.5 scenario of climate change, Graph 8 and the notes in Table 3 are the result. The climatological drought tends to be significantly prolonged and worsened in Valente/BA by climate change, since 98% of the simulated SPI values were below zero. By projections, it is estimated that 26% of the months will have SPI categorized as incipient drought, 23% as moderate drought, 29% as severely dry and 21% as extremely dry.

Graph 08: SPI curve in the range between 2020 and 2030.



Source: Prepared by the authors (2021).

In view of the measured, the scenario predicted for the 2020s to 2030s is worrying, so that there is a prospect of more intense and dramatic socioeconomic droughts than the events experienced in the 2010s, such as the episode portrayed in 2017. in Valente/BA by Mendes [10]. From now on, projections in the face of climate change may have repercussions on the increase in socio-environmental vulnerability of socio-ecological systems in the region, translating into greater losses in the production and processing of sisal, impacts on the economy and food security. Nevertheless, Seyffarth and Rodrigues [37] also point out that the effects of climate change, such as drought and desertification, put at risk even the biodiversity of the caatinga, which, although normally adapted to the semiarid region, may not withstand more intense events.

III. FINAL CONSIDERATIONS

Although identified as a climatological event, drought can be aggravated by human action, through different forms, among which are the population density and inadequate use of natural resources, mainly resulting from economic exploitation, therefore including in this list, practices agricultural and extractive activities, which end up having a huge impact on the soil, water and unbalancing entire ecosystems.

It can be seen from this study that the sisal region and especially the municipality of Valente often suffers from meteorological drought and its derivations, and that future perspectives considering the most accentuated scenarios of climate change tend to provide more severe and prolonged droughts. , since 98% of the simulated SPI values were below zero, ranging between incipient drought (26%), moderate drought (23%), severe drought (29%) and extreme drought (21%), which may translate in socioeconomic droughts, increasing the susceptibility to desertification and socio-environmental vulnerability in the region. It is reiterated that, if the simulated SPI projections for the 2020s to 2030s materialize, Valente/BA will suffer one of the worst droughts in its history.

It is noteworthy that, based on the analyzes proposed by the research, there was a relationship between the decrease in rainfall, verified through the SPI, and the fall in the production of sisal in the municipality.Given this narrative, the horizons of climate change must be present in science and in governance decision-making, with a view to mitigating its causes and effects, seeking to increase the resilience of socio-ecological systems.

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