REVISTA DE GEOCIÊNCIAS DO NORDESTE

Northeast Geosciences Journal

v. 7, nº 2 (2021)

https://doi.org/10.21680/2447-3359.2021v7n2ID20625

ISSN: 2447-3359

DROUGHTS, FLOODS AND SOCIO-NATURAL DISASTERS ASSOCIATED: A STATISTICAL ANALYSIS OF DRY AND RAINY PERIODS IN HIDROLÂNDIA-CE

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Abstract

In the municipality of Hidrolandia in inserted in the Brazilian Northeastern Semi-Arid it presents periods in which possible socio-natural disasters can occur associated with the absence of rain or excessive rain, resulting in droughts and floods. The article aimed to analyze the socio-natural disasters associated with droughts and floods in the municipality of Hidrolândia in the period 1989-2018. Initially, rainfall data were obtained from the Cearense Foundation of Meteorology and Water Resources - FUNCEME for application of the quantile technique, using the method of Pinkayan (1966). Then, disaster situations associated with dry and rainy periods in the municipality were identified, based on analyzes in the documents present in the Database of the Integrated Disaster Information System (S2iD), which present information on the number of people affected, decrees Emergency Situation (SE), State of Public Calamity (ECP) and recognition of socio-natural disasters. Concomitantly, atmospheric systems and teleconnections that interfered in the upper and lower accumulations were identified. The Intertropical Convergence Zone - ZCIT was the atmospheric system that most influenced the formation of rains. El Niño contributed considerably to the occurrence of droughts. At least twelve disaster situations were verified in Hidrolândia in the historical series analyzed.

Keywords: Hidrolândia; Socionatural Disasters; Quantile.

SECAS, INUNDAÇÕES E DESASTRES SOCIONATURAIS ASSOCIADOS: UMA ANÁLISE ESTATÍSTICA DE PERÍODOS SECOS E CHUVOSOS EM HIDROLÂNDIA-CE

Resumo

O município de Hidrolândia, inserido no Semiárido Nordestino Brasileiro (NEB), apresenta períodos em que podem ocorrer eventuais desastres socionaturais associados à ausência de chuva ou excesso da mesma, acarretando em estiagens e inundações. O artigo teve como objetivo analisar os desastres socionaturais associados às estiagens e inundações no município de Hidrolândia no período de 1989-2018. Inicialmente, foram obtidos dados pluviométricos na Fundação Cearense de Meteorologia e Recursos Hídricos – FUNCEME para aplicação da técnica dos quantis, através do método de Pinkayan (1966). Em seguida, identificaram-se situações de desastres associados aos períodos secos e chuvosos no município, a partir de análises nos documentos presentes no Banco de dados do Sistema Integrado de Informações sobre Desastres (S2iD), os quais apresentam informações sobre número de atingidos, decretos de Situação de Emergência (SE), Estado de Calamidade Pública (ECP) e reconhecimento de desastres socionaturais. De forma concomitante, foram identificados os sistemas atmosféricos e teleconexões que interferiram nos acumulados superiores e inferiores. A Zona de Convergência Intertropical - ZCIT foi o sistema atmosférico que mais influenciou na formação de chuvas. Já o El Niño contribuiu consideravelmente para a ocorrência de secas. Ao menos doze situações de desastre foram verificadas em Hidrolândia na série histórica analisada.

Palavras-chave: Hidrolândia; Desastres Socionaturais; Quantis.

SEQUIAS, INUNDACIONES Y DESASTRES SOCIONATURALES ASOCIADOS: UN ANÁLISIS ESTADÍSTICO DE PERÍODOS SECOS Y LLUVIOSOS EN HIDROLÂNDIA-CE

Resumen

El municipio de Hidrolândia, inserido en el Nordeste Semiárido Brasileño (NEB), tiene períodos en que se puede ocurrir posibles desastres socionaturales asociados con la escasez de lluvia o lluvia excesiva, resultando en sequías e inundaciones. El artículo tuvo como objetivo analizar los desastres socionaturales asociados con sequías e inundaciones en el municipio de Hidrolândia en el período 1989-2018. Inicialmente, los datos de lluvia se obtuvieron de la Fundación Cearense de Meteorología y Recursos Hídricos (FUNCEME) para la aplicación de la técnica de los quantiles, utilizando el método de Pinkayan (1966). Luego, se identificaron situaciones de desastre asociadas con períodos secos y lluviosos en el municipio, con base en análisis en los documentos presentes en la Base de Datos del Sistema Integrado de Información de Desastres (S2iD), que presentan informaciones sobre el número de personas afectadas, Situaciones de Emergencia (SE), Estado de Calamidad Pública (ECP) y reconocimiento de desastres socionaturales. Concomitantemente, se identificaron sistemas atmosféricos y teleconexiones que interfirieron en los acumulados de lluvia superior e inferior. La Zona de Convergencia Intertropical - ZCIT fue el sistema atmosférico que más influyó en la formación de lluvias. Mientras que El Niño contribuyó considerablemente para la ocurrencia de sequías. Se verificaron al menos doce situaciones de desastre en Hidrolândia en la serie histórica analizada.

Palabras-clave: Hidrolândia; Desastres Socionaturales; Qauntiles.

1. INTRODUÇÃO

Socio-natural disasters are related to the very evolution of society and the condition in which itis shaped by nature and enjoys its resources. In times of awe, even with the presence of human agglomerations that were not as significant as those observed today, disasters were already taking place. However, in recent decades, apprehension of the impacts associated with socio-natural disasters has been significantly expanded, taking gradually more alarming proportions.

Thus, this alarmism may be associated with the social, environmental and economic damage and damage that socio-natural disasters have presented in recent decades, causingsuccessions of impacts and damage in large proportions to many contemporary societies. This perspective is particularly due to population growth, disorderly occupation and the intense process of urbanization and industrialization (KOBIYAMA et al., 2006).

In Brazil, the most common socio-natural disasters are floods, drought, erosion and landslides or landslides. Consequently, they are the main responsible for a high amount of human and material losses every year. For this reason, the processes are strongly linked to the degradation of unastable areas, enhanced by deforestation and irregular occupation (MAFFRA; MAZZOLA, 2007).

In northeastern Brazil, a region with the highest occurrence of socio-natural disasters (with about 40% of the country's events), a trend similar to the national scenario is pointed out, in other words, a higher occurrence of drought/drought-related disasters (presenting 78% of events in the region) and floods (around 21% of events in the region) (CEPED/UFSC, 2012; BRAZIL, 2014, 2016).

In this context, the State of Ceará is included, located in the northernmost part of the Northeast region, where droughts and floods are the socio-natural disasters that occur the most, that is, being correlated to the impacts arising from the precipitations, in the occurrence or not of these. Thus, studies associated with impacts from high rainfall or scarcity of rainfall increasinglyobtain an important meaning in the Brazilian territory, as well as in the State of Ceará.

In this context, the municipality of Hidrolândia-CE, as well as most of the inland municipalities that make up the Semi-arid Northeastern Brazil (NEB), presents dry and rainy periods in which possible socio-natural disasters may occur, associated with the absence of rain or excess of it, resulting in droughts and floods.

IN order to consider the behavior of rain from the observation of extreme episodes (droughts and floods) in the municipality of Hidrolândia, as well as the associated impacts, this article aimed to analyze the socio-natural disasters associated with droughts and floods in the municipality of Hidrolândia-CE, in the period 1989-2018.

As specific objectives, it sought to perform a statistical analysis to identify dry and rainy periods in the historical series under analysis using the quant technique; identify, in an operational way, possible disaster situations in the municipality of Hidrolândia, besidesanalyzing and pointing out which are the main atmospheric systems and teleconnections that influenced the occurrence of dry and rainy years in the municipality.

Located 227 km from the state capital (Fortaleza), the municipality of Hidrolândia is positioned in the Northwest region of the State of Ceará (Figure 1). Thepresents a Semi-arid Warm Tropical climate, with average annual temperatures around 26º to 28ºC, presentinganaverage rainfall of 800 mm annually, with more significant rainfall activities in the four-month period February-May. With a predominant vegetation of The Open Shrub By Caatinga and Spiny Deciduous Forest, quite thick in the territory, the municipality practically and found itself inserted in the geoenvironmental unit of the Sertaneja Depression and in the Acaraú River Hydrographic Basin (SOUZA, 2007).

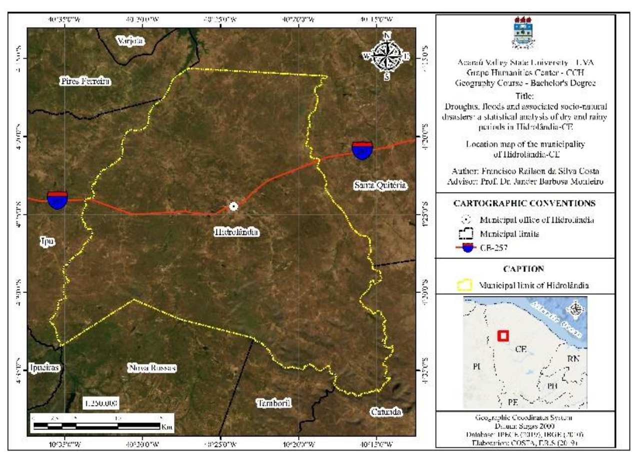

Figure 1 - Location Map of the municipality of Hidrolândia-CE.. Source: author (2019)

This investigation allowed, in addition to a statistical analysis on the behavior of rain in the municipality, the identification of situations of socio-natural disasters, information that can be used in future investigations, as well as for knowledge of the municipality, especially in public management, with regard to decision-making that provide preventive and mitigating measures.

2. THE SOCIONATURAL DISASTER IN ITS CONCEPTUAL PERSPECTIVE.

Disasters can be understood as the consequence of adverse events that cause impacts on society and are differentiated according to their origin, that is, the nature of the phenomenon that causes it (TOBIN; MONTZ, 1997).

From the perspective of Romero and Maskrey (1993), a natural disaster can be understood from the parallelism between a dangerous natural phenomenon (torrential rain, for example) and vulnerable socioeconomic and physical conditions.

However, it should be noted that, in many cases, either by the media or by common sense, what sometimes occurs is a mistaken interpretation that the 'natural' disaster comes from powerful natural or supernatural forces, as if nature or a supreme being (connection with a deity) acted on society by rematch.

Mas o pensamento natural ou sobrenatural foi, aos poucos, cedendo lugar a um pensamento mais social e integral dos desastres naturais. O desastre natural deixou de ser visto como uma expressão que se aproxima do conceito de fenômeno natural e aspectos relacionados à forma como as sociedades se organizam e contribuem para o incremento dos desastres passaram a ser considerados. Ora, a propria vulnerabilidade torna-se um componente importante nesta equação complexa. Assim, alguns autores passaram até a utilizar um outra terminologia: desastre socionatural (MONTEIRO; ZANELLA, 2019).

3. THE DROUGHTS-FLOODS BINOMIUM IN THE STATE OF CEARÁ AND IN NORTHEASTERN BRAZIL.

Talking about the Brazilian Northeast from a climatic perspective can mean, at first and roughly speaking, mentioning the high temperatures and scarcity of rain. However, it is not always this "image" that we observe when analyzing the behavior of rain in this region, which is concentrated in a short period (a few months) and poorly distributed in time and space.

Moreover, to understand drought in its essence, it is also necessary to understand the occupation itself and the economic development of the region. That is, it is not just a scarcity of rain (MONTEIRO, 2016). There is a strong social component that should be considered, since vulnerability is a major element in the analysis. In addition, the state's own role, especially in the implementation of preventive measures and public policies, represents a real tipping point, contributing to minimize the damage. Otherwise, if negligence occurs on the part of the public authorities, the effects associated with the occurrence of droughts and floods end up having even more significant impacts on vulnerable and unassisted populations.

The reports of important droughts permeate the historical documents (ALVES, 2003) and even the literature that brings as a background the Northeast region. Droughts like the one in 1777-78, 1790-93, 1915, among others that occurred in more recent periods, such as the droughts of 1983, 1993, 2012-2016 etc. bring to light a recurrent situation that has an impact on losses, damages and even the adoption of strategies by the government (usually after major droughts) and communities in order to adapt, to live with this adverse situation.

The State of Ceará, which has the vast majority of its territory in a semi-arid environment, experiences drought on a recurring basis. However, between one episode and another of drought, the heavy rains show a curious contrast in the State, once again triggering major human and material damage, especially in densely urbanized areas.

While the print media provided cover in local newspapers because of the damage associated with the torrential rains of 1974, the country watched perplexed television headlines in 2009 that presented a chaotic scenario in many municipalities of Ceará, due to heavy rains.

Although the northeastern people eagerly await the rainy season, such extreme events, when they occur, trigger major disasters. And so the dry-flood binomial becomes so striking in this region and necessary to be understood in its essence.

This rainfall behavior is largely the result of the fluctuation and intensity of the main atmospheric system that causes important rainfall in the northern portion of northeastern Brazil: the Intertropical Convergence Zone - ITIC, especially in the rainy four months february-May for the State of Ceará. In addition, other mechanisms such as El Niño Southern Oscillation – ENOS and the TSM Dipole of the Intertropical Atlantic are important predictors to define how abundant the rains will be in the period (FERREIRA; MELLO, 2005; XAVIER, 2001; MONTEIRO, 2016).

Some atmospheric systems can also contribute to important accumulators and even work together with THE ITH, such as the Cyclonic Vortexes at High Levels – VCAN, East Wave Disturbances – DOLs, Mesoscale Convective Complexes, among others.

4. METHODOLOGY

In order to promote the analyses and discussions developed, it was necessary a bibliographic survey on the theme addressed, from authors who explain natural/socio-natural disasters from a theoretical perspective, including those more recurrent in the State of Ceará (droughts and floods), in addition to authorswho evidence and analyze the main atmospheric systems and teleconnections that can offer a significant influence on the behavior of rain.

Subsequently, rainfall data were obtained through the Cearense Foundation of Meteorology and Water Resources - FUNCEME, using rainfall data from the Hidrolândia rainfall station, Posto 55, in order to analyze the behavior of rain in the period 1989-2018.

In order to define and classify, in a clear and objective way, dry and rainy years, after tabulating the information on the accumulated rain of the post, it wasapplied to the technique of the quantis, through the method that Pinkayan (1966) used in his research, a division into 5 classes: Very Dry, Dry, Normal, Rainy and Very Rainy, from the historical series of 30 years (1989 to 2018).

These classes were represented from the interval between the Q(0.15), Q(0.35), Q(0.65) and Q(0.85) quants. The extreme classes (Very Dry and Very Rainy), in this sense, present a relatively shorter interval (only 15%), which allows a more understandable and correct statistical approach that takes into account a normal distribution, since the Normal class presents the largest interval (30%).

An understandable analysis for quantile Qp is as follows: believing that probability p is expressed in percentages, it is expected that in p(%) of the years the amount of rain "X" should not extrapolate the value of this qp quantile, in millimeters, as for (100 – p) % of the years such a value will be exceeded. By way of example, for quantile orders p = 0.15; 0,35; 0,65; and 0.85 (15%, 35%, 65% and 85%), the referring quants are Q(0.15), Q(0.35), Q(0.65) and Q(0.85). Thus, we would have a division into 5 classes (MONTEIRO, 2011; XAVIER, 2001).

In this way, the totality of rain stored in each month of each year of the historical series are placed together in a table and, soon after, the values are reunidos to obtainthe total rainfallaccumulated during each year. Then, the annual values are ordered, that is, from the smallest to the largest, in order to apply the technique of the quants.

In order to simplify the understanding of the normal distribution of quants for the years observed in the historical series, the accumulated were arranged from the driest year to the wettest of the series, in order to better understand, in essence, the application of the technique (Figure 2).

Years	Total accumulated in mm (from the smallest to the largest)
2015	314
1998	414
2012	438
2014	471
2001	479,8
1993	482,6
2013	484
1992	555,8
2006	556
2016	618
1997	684,8
1990	692,4
2010	695
2007	727,6
2000	730
1991	751,2
2017	760
2002	775
2005	780
1999	796
2011	891
2004	960
2008	1025,3
2003	1055,5
1995	1065
2018	1136,8
1989	1170,4
2009	1198
1996	1250,6
1994	1268,7

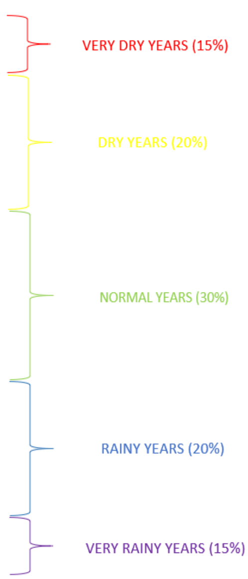

Figure 2 – Rainfall values accumulated in the years of the historical series and their *probable classifications according to the division proposed in the research. Source: adapted from Monteiro (2011).*

The consultationwas carried outwith the Integrated Disaster Information System (S2iD), based on the reports that present the various damages and damage caused by disastersituations in the wettest and driest years in Hidrolândia (considering the 1989-2018 time frame), as well as digital files containing documents that consolidate a history of disasters associated with adverse phenomena.

It should be noted that the Integrated Disaster Information System (S2iD) distinguishes between the terms dry and dry. It considers dry, based on the meteorological concept, where drought would be a prolonged drought, characterized by causing a drastic reduction in existing water reservoirs. In turn, the drought is characterized by presenting a reduction in rainfall activities, in this case, the absence of rain during the given rainy season.

Concomitantly, atmospheric systems and teleconnections that had an important influence on the accumulated rainfall in Hidrolândia in each year of the analysis period were identified and analyzed.

5. RESULTS AND DISCUSSIONS

In Hidrolândia, the rains intensify in the rainy quarter, that is, in the period between February and May. In the other months, the dry season is usually observed, especially in the second half of the year.

Thus, the annual accumulated of the historical series analyzed during the thirty years (1989-2018), considering the rainfall station 55 (posto located in the head of Hidrolândia), were placed in ascending order (Figure 3) for later application of the quant technique, thus defining the q(0.15), Q(0.35), Q(0.50), Q(65) and Q(0.85).

i	1	2	3	4	5	6	7	8	9	10
y (mm)	314	414	438	471	479,8	482,6	484	555,8	556	618
P_i=i/(N+1)	1/31	2/31	3/31	4/31	5/31	6/31	7/31	8/31	9/31	10/31
	0.032	0.064	0.096	0.129	0.161	0.193	0.225	0.258	0.290	0.322
i	11	12	13	14	15	16	17	18	19	20
y (mm)	684,8	692,4	695	727,6	730	751,2	760	775	780	796
P_i=i/(N+1)	11/31	12/31	13/31	14/31	15/31	16/31	17/31	18/31	19/31	20/31
	0.354	0.387	0.419	0.451	0.483	0.516	0.548	0.580	0.612	0.645
i	21	22	23	24	25	26	27	28	29	30
y (mm)	891	960	1025,3	1055,5	1065	1136,8	1170,4	1198	1250,6	1268,7
P_i=i/(N+1)	21/31	22/31	23/31	24/31	25/31	26/31	27/31	28/31	29/31	30/31
	0.677	0.709	0.741	0.774	0.806	0.838	0.870	0.903	0.935	0.967

Figure 3 - Values ordered for the application of *the quant technique in Hydroland.. Source: adapted from Monteiro (2011).*

Thepost-application of the statistical technique of the quants, the thresholds in millimeters (mm) predicted were identified, thus determining the five classes propostas (Figure 4).

Thus, the annual accumulated ones below the Q threshold (0.15) were classified as very dry, whereas between Q(0.15) and Q(0.35) nthedry class, between Q(0.35) and Q(0.65) nthenormal class, between Q(0.65) and Q(0.85) ntherainy class, and the annual accumulated above Q(0.85) n thevery rainy class.

Then, the annual accumulated, after their due classification, were organized in order to facilitate visualization (Table 1).

Table 1 - Classification of the values established for each quantile class of the hydroland historical series (1989-2018). Source: author (2021).

Years	Accumulated (in millimeters)	Classification
1989	1170,4	Very Rainy
1990	692,4	Normal
1991	751,2	Normal
1992	555,8	Dry
1993	482,6	Dry
1994	1268,7	Very Rainy
1995	1065	Rainy
1996	1250,6	Very Rainy
1997	684,8	Normal
1998	414	Very Dry
1999	796	Normal
2000	730	Normal
2001	479,8	Dry
2002	775	Normal
2003	1055,5	Rainy
2004	960	Rainy
2005	780	Normal
2006	556	Dry
2007	727,6	Normal
2008	1025,3	Rainy
2009	1198	Very Rainy
2010	695	Normal
2011	891	Rainy
2012	438	Very Dry
2013	484	Dry
2014	471	Very Dry
2015	314	Very Dry
2016	618	Dry
2017	760	Normal
2018	1136,8	Rainy

In order to identify the occurrence of socio-natural disasters in Hidrolândia, information from the State Civil Defense wasused through the Database of the Integrated Disaster Information System (S2iD), which contain documents that point to the occurrence of possible disaster situations. These present information on the number of affected and decrees of Emergency

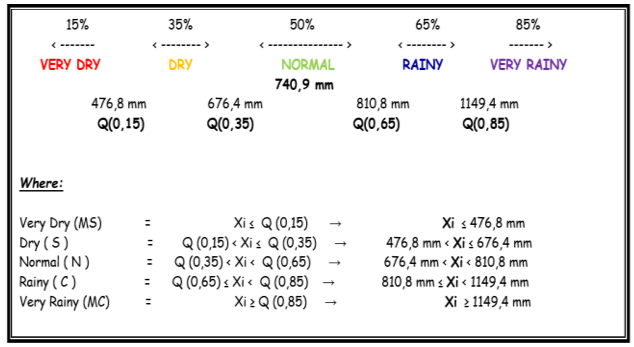

Figure 4 - Values established for hydroland quants. Source: adapted from Monteiro (2011)

Situation (SE) and State of Public Calamity (PCE), which are important indicators of disaster situations associated with drought, drought and floods (Table 2).

Table 2 - History of associated disasters: droughts, droughts and floods in Hydroland. Source: Integrated Disaster Information System (S2iD).

History of associated disasters: droughts, droughts and floods - Hidrolândia				
Year	**Document**	**Event**	**Type of Decree**	**Hit Numbers**
1993	Concierge	Drought	ECP	-
2001	Concierge	Drought	ECP	-
2005	Avadan	Drought	SE	8565
2007	Avadan	Drought	SE	8843
2008	Avadan	Flooding	-	18116
2009	Avadan	Flooding	SE	3302
2010	Avadan	Drought	SE	5156
2012	Nopred	Drought	SE	4660
2013	Concierge	Drought	SE	-
2014	Fide	Drought	SE	572
2015	Fide	Drought	SE	572
2016	Fide	Drought	-	5720

However, it should be noted that the initial years of the historical series analyzed did not present sufficient information regarding the number of affected, for example. Only access was obtained to ordinances that recognized drought and drought situations, as well as possible decrees of Emergency Situation - SE and State of Public Calamity - ECP issued by the Government of the State of Ceará.

Hidrolândia presented, considering the historical series under analysis, a greater number of emergency situation decrees (SE), which occurred in eight years (2005, 2007, 2009, 2010, 2012, 2013, 2014, 2015). In these years, the disasters associated with drought and drought weremore recurrent. Among them, consecutive years (2014 and 2015) were considered very dry years.

Even in 2015, the lowest rainfall accumulated was identified in the historical series analyzed and, as a result, there was a loss in agricultural production, resulting in the sale of cattle, sheep, goats and other livestock products.

It was mainly recorded the drastic reduction of the water intake of the Paulo Sarasate dam (Araras), reaching an alarming level, with about 3.46% of its capacity (Figure5), culminating in supply problems in the municipality. However, Decretos of Estado de Calamity Pública (ECP), occurredonly in two years (1993 and 2001). They were pointed out as dry years of the historical series.

Figure 5 - Comparison of the *water intake of the Paulo Sarasate reservoir (Araras): maximum amount reached in 2009 (a) and minimum amount reached in 2015 (b). Source: Portal Hidrolândia 24 horas (2015).*

Considering the floods, weobserved decree Emergency Situation (SE) only in 2009, considered very rainy in Hidrolândia, presenting one of the largest accumulated in the historical series worked, approximately 1198.0 mm. The high water supply of the Batoque stream, for example, caused flooding in the urban state of Hidrolândia, specifically in the Neighborhoods Progresso, Nova Hidrolândia and Vila Freitas (Figure 6).

Figure 6 - Occurrence of flooding in the urban state of Hidrolândia in 2009. Source: Portal Hidrolândia 24 horas (2011).

The year 2008 also presented an important accumulated (1025.3 mm) and stands out for the number of people affected by floods (more than 18,000 affected, according to civil defense information).

The documents made available in The S2iD draw attention to the damage mentioned, such as bleeding and weir break-ins, damage to roads and compromise of basic services (suchas health andeducation), directly affecting families in the rural area of Hidrolândia, especially the districts Betânia and Conceição.

As for economic losses, subsistence agriculture was the mostaffected. Corn and bean crops showed significant losses. During this period, initial productionof 10935 tons was expected, because of heavy rains. However, there was a final production of about 6665 tons, obtaining an average loss of 39.14% of the crop planned for harvest. As a result, the income of many families has been impacted.

Regarding the number of people affected by the socio-natural disasters that occurred in Hidrolândia, these were more expressive when associated with droughts, together with droughts.

According to civil defense data, the years 2014, 2015 and 2016 were notified through the Disaster Information Form - FIDE. The form is used to designate the recognition ofThe Situations of Emergence (SE) or Estado de Calamity Pública (ECP) referring to disasters.

In these years, the most affected populationis living in the countryside, mainly in the districts of Irajá, Betânia and Conceição. As a result of the drought situation, there was a significant loss in agricultural production, as well as in livestock activity, including the decrease in water intake of the Paulo Sarasate reservoir (Araras) that supplies the municipality (Figure 7).

Figure 7 – Water scarcity of the Paulo Sarasate reservoir *(Macaws) in 2015. Source: Paiva (2015).*

It is noteworthy that eighteen years of the historical series under analysis (1989, 1990, 1991, 1992, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2002, 2003, 2004, 2006, 2011, 2017 and 2018) were even mentioned here. This does not mean that disaster situations have not been exterminated by the population. It is believed that some damages were not properly recorded/identified in the System or were not reported by the municipality/Civil Defense, which may result in a deficiency of information.

Regarding the influence of atmospheric systems in the years of the historical seriesanalyzed, the Intertropical Convergence Zone - ITIC was the atmospheric system that most influenced the accumulated rainfall during the rainy four-month (February, March, April and May). This is considered a system of wide proportion, formed through the meeting of the trade winds of the northern hemisphere and the southern hemisphere, where the Temperaturas of the Superficie of the Air (TSM) is one of the determining conditions for its positioning and, aboveall, its intensity.

As for ocean-atmosphere teleconnections, there is an important influence of El Niño in dry years,which is nothing more than the warming ofsea surface temperatures in the Ocean Pacycical Equatorial, interfering in the formation of rain clouds in the rainy quarter and triggering smaller accumulated in the State and, consequently, in Hidrolândia. In turn, the opposite phenomenon, called "La Niña", in reference to the cooling of the waters of theaciduous Pacycical Equatorial, may have contributed to expressive accumulated in the rainy quarter, a situation verified in 1989, 2008 and 2009, for example.

El Niño acted in the analyzed period, ranging from weak (in 2015), in transition from neutral to weak in the years 1991, 1997 and 2002, moderate in only one year (1992) and strong in the years 1998 and 2016 (Table 3). La Niña varied weakly in three years (2009, 2017 and 2018), moderate in two years (2008 and 2011) and strong in the years 1989 and 2010. In addition, years considered neutral were observed: 1990, 1993, 1994, 2004, 2013 and 2014.

Table 3 - ENOS and Atlantic Dipole in the four-month period February-May. Source: Author (2021), based on information from FUNCEME and NOAA.

ENOS e Dipolo of the Atlantic in the four-month period February-May		
Year	**Enos in the Quarterly February-May**	**Dipolo of the Atlantic**
1989	La Niña Strong	Favorable (negative)
1990	Neuter	Neuter
1991	Transition Neuter/El Niño Weak	Favorable (negative)
1992	El Niño Moderate	Unfavorable (positive)
1993	Neuter	Neuter
1994	Neuter	Favorable (negative)
1995	Transition El Niño Weak/Neutral	Favorable (negative)
1996	Transition La Niña Weak/Neutral	Favorable (negative)
1997	Transition Neuter/El Niño Weak	Unfavorable (positive)
1998	El Niño Strong	Neuter
1999	La Niña Moderate	Favorable (negative)
2000	La Niña Moderate	Favorable (negative)
2001	Transition La Niña Weak/Neutral	Neuter
2002	Transition Neuter/El Niño Weak	Favorable (negative)
2003	Transition El Niño Weak/Neutral	Neuter
2004	Neuter	Neuter
2005	Transition El Niño Weak/Neutral	Unfavorable (positive)
2006	Transition La Niña Weak/Neutral	Neuter
2007	Transition El Niño Weak/Neutral	Unfavorable (positive)
2008	La Niña Moderate	Favorable (negative)
2009	La Niña Weak	Favorable (negative)
2010	La Niña Strong	Neuter
2011	La Niña Moderate	Favorable (negative
2012	Transition La Niña Weak/Neutral	Unfavorable (positive)
2013	Neuter	Neuter
2014	Neuter	Favorable (negative)
2015	El Niño Weak	Unfavorable (positive)
2016	El Niño Strong	Favorable (negative)
2017	La Niña Weak	Favorable (negative)
2018	La Niña Weak	Unfavorable (positive)

6. FINAL CONSIDERATIONS

In recent years, the impacts resulting from socio-natural disasters related to precipitation (upper and lower accumulated) have intensified in Brazil. With regard to the State of Ceará, the city of Hidrolândia presented some phenomena of droughts, droughts and floods that during the period under analysis contributed to the triggering of economic and material losses, directly impacting society and which were characterized as Socio-natural disasters.

In accordance with the results obtained from this investigation, it was possible to verify the important influence that the action of the Intertropical Convergence Zone - ITH exerts to obtain expressive accumulated in rainy years. Otherwise, drought/drought ends up presenting itself as the disaster that triggers significant damage in that respective year under analysis.

In "La Niña" years,the scenario usually points to a favorable positioning of the ITH. However, it is also necessary to observe the important role of Tropical Atlantic TSMs, which, when they are more heated near the northeast coast and cooled in more northern parts of the Atlantic, present favorable conditions for the intensification/performance of the ITH. However, this changing pattern can modify the expected scenario quickly.

As for dry periods, the occurrence of El Niño, especially if it is of strong or moderate intensity, seems to offer the region an important prediction that another yearof 'drought' will be exworked. Moreover, more heated temperatures far from the coast, in northern parts of the Intertropical Atlantic Ocean end up interfering in the positioning of the ITIC, not bringing enough moisture in the rainy quarter long awaited by the population of this semi-arid environment.

The application of the quantis technique demonstrated to the municipality of Hidrolândia, in aclear and objective way, a methodological and systematic relevance for the climatic study in the determination of dry and rainy periods in a long historical series. In addition, it contributed to the analysis of possible influences (ocean-atmosphere teleconnections and atmospheric systems) that interfered in the behavior of rain in the locality.

Finally, trying to understand the behaviorof rain in Hidrolândia represents a first step to learn how to deal with situations of socio-natural disaster, enabling decision makers resources to 'think' and develop mitigating measures, minimizing impacts and establishing a culture of coexistence.

However, such measures are part of a very sensitive system, involving various social actors, responsibilities and change of attitude. That is, more than understanding rain and exposure to risks associated with floods and droughts, it is necessary to analyze the vulnerability of populations, resilience, among other components that configure this complex equation.

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Received in: 30/04/2020
Accepted for publication in: 30/09/2021