METEOROLOGICAL AND CLIMATIC KNOWLEDGE THROUGHOUT HUMAN HISTORY AND THE CASE OF THE SEMIARID TROPICAL CLIMATE OF THE SEMIARID REGION OF BRAZIL: CONSIDERATIONS AND CHALLENGES FOR VULNERABILITY REDUCTION AND CLIMATE RISK MANAGEMENT

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ABSTRACT

This study discusses the relationship between the understanding of climatic conditions and social and human development, focusing on reflections and challenges in the Brazilian semiarid region, northeastern Brazil. The objective was to demonstrate how weather, climate, meteorological, and climatic phenomena were characterized and understood by different civilizations as well as to elucidate how the tropical environment, with a focus on the semiarid region, was understood over time. To do so, a narrative literature review was carried out, including academic research. The search did not have a defined period of time, allowing for all articles, regardless of year of publication. In order to understand the evolution of the topic over the years, the methodology did not define a specific time window of articles. The oldest manuscript was published in 1967 and the most recent in 2021. In total, a sample of 46 scientific articles was reviewed. The results showed that knowing the atmosphere of planet Earth has been one of the ambitions pursued by humanity for a long time. We concluded that the logical understanding of weather and climate phenomena can be one of the main tools to develop effective strategies to adapt to climatic anomalies.

Keywords: Histoy. Communication. Climate. Territoy. Hinterland.

CONHECIMENTOS METEOROLÓGICOS E CLIMÁTICOS AO LONGO DA HISTÓRIA HUMANA E O CASO DO CLIMA TROPICAL SEMIÁRIDO DA REGIÃO SEMIÁRIDA DO BRASIL: CONSIDERAÇÕES E DESAFIOS PARA A REDUÇÃO DA VULNERABILIDADE E GESTÃO DE RISCOS CLIMÁTICOS

RESUMO

Este trabalho discute a relação entre o entendimento das condições climáticas e o desenvolvimento social e humano, com enfoque para as reflexões e desafios no semiárido brasileiro. Objetivou-se demonstrar como o tempo atmosférico, o clima, os fenômenos meteorológicos e climáticos foram caracterizados e compreendidos por diferentes civilizações, bem como elucidar como o ambiente tropical, com foco no semiárido, foi compreendido ao longo do tempo. Para tanto, realizou-se uma revisão narrativa de literatura, contemplando pesquisas acadêmicas. A busca não teve um período de tempo definido, dando espaço a todos os artigos. No entanto, o artigo mais antigo foi publicado em 1967 e o trabalho mais recente em 2021. Selecionamos uma amostra de 46 trabalhos científicos. Os resultados demonstraram que conhecer a atmosfera do planeta Terra é uma das ambições perseguidas pela humanidade desde muito tempo. Conclui-se que a compreensão lógica dos fenômenos do tempo e do clima pode ser umas das principais ferramentas para desenvolver estratégias eficazes de adaptação às anomalias climáticas.

Palavras-chave: História. Comunicação. Clima. Território. Sertão.

INTRODUCTION

The study on climate is essential for understanding the processes and relationships of human beings with the environment surrounding them (GLASER, 1996). Climate and meteorological events influence human activities, such as agriculture and water resource management, as well as human beings' safety (STEINKE, 2012).

It is observed that, since a long time, human beings have been interested in weather, and its study is as old as the human curiosity about their environment (AYOADE, 2010). One of the first treatises written on meteorology and atmospheric conditions was Aristotle's work in 340 BC, and much of the content of this work — entitled *Meteorology* and which includes discourses on clouds, winds, lightning, hurricanes, and even climate change — derived from Egyptian and Babylonian works (NEVES *et al.* 2017).

This concern of humankind with the atmosphere is not fortuitous, as facts related to it caused repercussions on the lifestyle of different societies. Studies, ancient and contemporary, demonstrate how climatic and meteorological episodes influence the life of human beings, in its most diverse aspects (ALCOFORADO, 1997; NUNES, 1999; MENDONÇA and DANNI-OLIVEIRA, 2007; DINIZ, 2012; STEINKE, 2012; BARBATO, 2015; NUNES, 2019). There is evidence, for example, that throughout the eras, civilizations developed and thrived during the hot and humid periods, the so-called "optimal climates," with cold periods marked by famine, pandemics, and war (STEINKE, 2012).

Over time, human beings have acquired awareness of the inexorable interference of weather and climatic conditions in the environment, as well as the environmental risks arising from the impacts on nature, as essential factors for their quality of life.

The more complex and sophisticated societies became, the greater the demand for knowledge of weather and climate (NEVES *et al*., 2017). As a result, human beings seek techniques and methods to improve their understanding and monitoring of atmospheric and climatic phenomena, whose main purpose is to reduce their vulnerability and control the risks of these phenomena (PFISTER, 2010). There is an increasingly broad interest of the scientific community in the importance of creating and expanding progressively sophisticated techniques, equipment, and methods to improve the accuracy of our understanding of the atmosphere and the natural episodes resulting from it (SAMPAIO and DIAS, 2014).

However, for the evolution of the understanding of climate processes, it is paramount to consider the studies and paradigms presented at different times by different researchers and actors of society, seeking to overcome the incomplete understanding of the atmosphere. The study on long periods of atmospheric weather culminates in climatology, which is one of the areas of atmospheric sciences in which past fluctuations are of great relevance to increase knowledge of current and future conditions (ARAKI, 2012, p.2). Corroborating Glaser (1996), Araki (2012) also points out that descriptive data provide detailed information on the climatic characteristics of times and can be determined by records obtained from different data sources as well as situations and processes that are affected by climate.

In this context, "historical climatology" emerges, which is a field of study situated between climatology and history, and deals mainly with documentary evidence using methods of climatology and history (PFISTER, 2010). From the discussions of Brázdil *et al*. (2005) and Araki (2012), it is understood that the study of historical climatology is relevant for the development of highly satisfactory climate models, not only aimed at the systematic monitoring of atmospheric and climatic conditions, but especially at providing bases that allow developing efficient mechanisms for the detection and temporal and spatial monitoring of meteorological and climatic risks.

The "historical climatology for the reconstruction of the past through consultation of direct records, containing details about the climate before the beginning of the systematization of measurement methods and records of climatological elements" (ARAKI, 2012, p.2, free translation), is extremely relevant for scientists who aim at studying climatic phenomena (CAICEDO, 2006; BOLÃNOS, 2008; PRIETO, 2012; ARAKI, 2012; MORA PACHECO, 2016; DIAZ BOLANOS, 2017). Therefore, historical climatology is the study of climate over time. For this climatic analysis, numerous documents are used, such as the written description of different environments and cave paintings, as well as utensils used in the crop (MENDONÇA and DANNI-OLIVEIRA, 2007). Based on these studies, it may be possible to perceive how the climate has been characterized throughout history.

In this study, we present how certain civilizations addressed meteorological and climatic events and discuss the case of the semiarid tropical climate, the climatic typology of the Brazilian semiarid region, and the main climatic phenomenon that occurs in this region. Over time, the poverty of this region has been attributed to the climate, long characterized as a problem for the social and economic development of the region.

Studying the narrative attributed to climate throughout time contributes to the evolution of improved understanding of climatic conditions, a fundamental condition for overcoming deterministic discourses that exclusively link poverty to natural causes. Furthermore, we deem that one of the important factors for the effective constitution of climate and meteorological risk management is how climate and weather phenomena are characterized and understood by different social actors, seeking from this perspective to broaden the understanding of these phenomena, which allows us to make right decisions and establish appropriate techniques for risk reduction.

Thus, it is understood that the inadequate characterization of the climate of a place excludes from the citizen the opportunity to effectively participate in public actions related to the management of climate risks that are configured in their daily lives. From the perspective of Conti (2011), it is from the knowledge of the numerous dimensions of climate phenomena that each citizen will develop the capacity to demand from government authorities, as well as from society in general, an action sufficiently adequate for the preservation of the environment and, consequently, of life.

Taking this into consideration, the objective was to demonstrate, from a narrative literature review, how atmospheric weather, climate, meteorological, and climatic phenomena were characterized and understood by different civilizations, ranging from the Greeks to the present day, with specific focus on the tropical climate and the specificities of the Brazilian semiarid. We also sought to highlight how the semiarid tropical climate, especially the drought phenomenon, was characterized throughout the history of the Brazilian semiarid. This study was based on the following guiding questions:

1- How have the facts related to weather and climate been understood by ancient civilizations over time?

2- What is the narrative created on the tropical environment?

3- In the case of the Brazilian semiarid tropical environment, what are the impacts of the narrative created on the climate and the drought phenomenon?

METHODOLOGY

The methodology used in this study was a narrative review of the literature. This presents a more open topic and does not require a rigid protocol for its composition (CORDEIRO et al., 2007). This type of review is well suited to describe and discuss the evolution of a particular scientific topic from a theoretical or contextual point of view (ROTHER, 2007; RIBEIRO, 2014). In this sense, some authors are critical of previous studies, while others prefer the neutrality of simply describing the information found (BATISTA and KUMADA, 2021, p.9).

Research of scientific documents

This research was carried out from a literature review in the Scielo and Capes databases. The search in these databases was carried out by jointly selecting keywords such as: “climate history,” “atmosphere and ancient peoples,” “atmospheric knowledge,” and “historical climatology”. In order to understand the evolution of the topic over the years, the methodology did not set a specific time for the search of the articles. The oldest article was published in 1967 and the most recent in 2021.

Selection Criteria and Analysis of Documents

The first exclusion criterion was studies that were not directly and indirectly related to climatology and meteorology issues. After this initial search, a total of 583 articles were found in both databases.

However, it was observed, after reading the titles and abstracts, that some of them were repeated in the different databases and 93% of the total did not meet the criteria of this study. Thus, 40 articles were selected for reading and those that did not fit the purpose of the present study were excluded. The high percentage of exclusion is due to the fact that the manuscripts were not within the scope of atmospheric and climatic sciences.

From this total of 583 articles, a selection of 25% was made of those that met the criteria originally set. In order to increase the scope of the research, a search was also carried out directly in scientific journals from different fields of knowledge, such as: History and Geosciences, selecting a total of 16 articles that contemplated the discussion about atmospheric knowledge over chronological time, as well as on the history of the tropical climate and the case of the Brazilian semiarid. In addition, 15 books, three master’s theses, and one book chapter were consulted, as they met the aforementioned

criteria. Finally, the three guiding questions were used as a criterion for selection and exclusion of documents found during the bibliographic survey.Thus, 05 articles were selected from the Scielo database, 07 articles from the Capes database, 03 M.A. theses and 01 Ph.D. theses, in addition to 15 books and 16 articles through direct searches in journals in the field of interest, making a total of 46 works in the sample.

RESULTS AND DISCUSSION

Perspective of the facts related to atmosphere throughout history

Throughout human history, people who needed information about weather and climate have accumulated practical knowledge that allowed them to better understand how they varied (STEINKE, 2012, p.14). This fact demonstrates that “knowing the atmosphere of planet Earth has been one of the aspirations pursued by humanity for a long time” (MENDONÇA, DANNI-OLIVEIRA, 2007, p.11, free translation). For, according to these authors, to the extent that human beings began to observe their interdependence on climatic conditions, in addition to those resulting from their deliberate interference in the natural environment, as an inevitable condition for social development, they began developing and recording knowledge of the components of nature.

Nevertheless, it is worth highlighting that, throughout history, the atmosphere has not always been well understood by human beings, because they often gave rise to a misconception devoid of logic concerning the instigating phenomena arising from complex atmospheric processes. We can state that, in this context, “humankind’s understanding of weather phenomena was very small” (AYOADE, 2010, p.5, free translation). Thus, it was common to attribute certain phenomena to the condition of gods, for instance, “for thousands of years, lightning, thunder, torrential rain, intense drought were revered as mythological entities or linked to them” (MENDONÇA, DANNI-OLIVEIRA, 2007, p.11, free translation). Weather phenomena were deemed controlled by gods until around the fifth century BC, when the Greeks began making meteorological observations (AYOADE, 2010).

The relationship of these peoples regarding meteorological situations can be observed in their beliefs, considering that in Babylon (kingdom at southern Mesopotamia) the most important god was Marduk, who controlled the whole atmosphere; thus, from the observations of celestial stars, clouds, and optical phenomena (such as halos), this people sought to predict the conditions of atmospheric weather (NUNES, 2019). The author also points out that Crowder (1996) found these occurrences among the Assyrians. The Chinese, in turn, monitored the daily and seasonal changes in weather conditions, including the creation of a calendar, from the observation of the stars (CROWDER, 1996 *apud* NUNES, 2019).

Nunes (2019) argues that interest in the spatial and time patterns of weather was already observed around 300 BC, according to the texts written by Aratus (Phaenomena) and Virgil (Georgics, 37 BC).

Within this context, we can perceive that understanding the functioning and behavior of weather and climate has always drawn the attention of human beings, and civilizations have already organized their activities due to climate and geographical space (DINIZ, 2012). Indeed, according to Nunes (1999), an initial observation of the first human civilizations already demonstrated the relevance of this knowledge, especially the phenomena of rains and floods. This author also argues that it is impossible to speak of Egyptian civilizations or the Fertile Crescent without establishing relationships between them, the floods of the Nile River, and the importance of the Tigris and Euphrates Rivers.

Ancient peoples, such as Egyptians, Greeks, Arabs, and Chinese, established an empirical basis for knowledge of weather and climatic conditions by observation, which constituted a substantial element in the organization of their lives and activities (ALCOFORADO, 1997 *apud* NUNES, 2019). The Egyptians, in particular, left an important legacy for environmental knowledge, exceptionally because they reported the floods and droughts in detail, consisting in information of extreme relevance for the knowledge of past conditions (NUNES, 2019).

“In fact, we can observe that the climate has always played some decisive role in all the peoples who inhabit or have inhabited our planet. From the earliest prehistoric men to our contemporary societies, the climate has always been a cause of interest” (BARBATO, 2015, p.69, free translation).

For this reason, as Mendonça and Danni-Oliveira (2007, p. 11, free translation) demonstrated, clarifying the dynamics of natural phenomena and the behavior of the atmosphere was crucial for social groups to overcome the condition of mere individuals subject to the bad weather of nature “and to achieve not only the understanding of the functioning of some phenomena, but also the condition of users and manipulators of these phenomena at different scales.”

However, “the Greeks were the first to produce and record more directly their reflections on the behavior of the atmosphere, resulting from observations about the differentiation of places and navigations through the Mediterranean Sea” (MENDONÇA and DANNI-OLIVEIRA, 2007, p. 11, free translation). “The works *On Airs, Waters, and Places,* by Hippocrates*; Histories*, by Herodotus; and *Meteorology*, by Aristotle, are examples of the advances that the Greeks produced in climate studies” (BARBATO, 2015, p.69-70, free translation). It is assumed, then, that “many of the principles that govern the current knowledge of the atmosphere emerged among the Greek thinkers of that time, who formulated concepts valid for the Earth as a whole” (MENDONÇA And DANNI-OLIVEIRA, 2007, p. 12, free translation).

Hence, according to these authors, the knowledge produced by human beings who were able to develop and demonstrate logical explanations for those natural phenomena constituted the first basis for the origin of the scientific study on the atmosphere, and the Greeks were the pioneers. Nonetheless, it should be noted that the Greeks initiated erroneous discussions, especially about the relationship between climates and different peoples, and were responsible for spreading the distorted image of the tropical climate (BARBATO, 2015).

Tropical Climate: an overview

During the 18th and 19th centuries, European and North American naturalists spent some time in tropical environments, referring to their museums and research centers new “specimens,” classified and organized in an order that disregarded connections with their home environments (NUNES, 2019, p.11). This author adds that “tropical areas were (and still are, to some extent) called and treated as ‘exotic’ — a term that holds negative connotation, although the linguistic root of the word shows that in its origin the term is defined as something excitingly different, unusual” (p.11, free translation). Moreover, she argues that, in fact, by appropriating the meaning of the unusual term and from the perspective that the most important biodiversity lies within the tropics, it is evident that what can be considered exotic is the extratropical environment and not the tropical environment, an approach that demonstrates “the prejudice in force at the historical moment and that has contaminated science” (p.11, free translation).

“Overall, this negative image of the tropical climate, propagated by the Greeks, lasted until the beginning of the 20th century.” European elites mostly believed in a “climate determinism,” that is, that those born in warm regions were bound to inferiority in relation to those born in colder regions. “This is because they believed that the climate was responsible for numerous diseases, besides generating apathetic, lazy, and ignorant men” (BARBATO, 2015, p.72, free translation).

An entire series of representations has been produced about the tropical environment relating it to backwardness, and “extensive literature, produced by great names of European sciences and philosophy, such as Montesquieu, Buffon, Raynal, among others, showed that the tropical climate, with all its benevolence, exerted harmful effects in terms of civilizational potentialities on those who lived under it” (BARBATO, 2016, p.218, free translation), as, according to this author, the tropical climate was accused of forming frail, weak, lazy, lascivious, and unpredictable individuals, therefore inferior to the peoples of Europe.

Only in the third decade of the 20th century was environmental determinism — based on false scientific statements of atmospheric sciences — rejected, because it was devoid of a real scientific basis (NUNES, 2019, p.12).

Scientific knowledge of the tropical zone of the Planet was pursued late when compared with the temperate zone, an area where the countries with the greatest socioeconomic development are located (MENDONÇA and DANNI-OLIVEIRA, 2007, p.16). These authors associate this backwardness with the fact that the tropical part of the globe has been incorporated into the global production process in a recent context. Moreover, they argue that the colonization process of this area (of exploratory nature) explains the lack of interest in capital investment for the production of scientific knowledge of the tropical world, focused on its development.

For many decades, in the exploratory initial phase, the meteorological and climatic observation of the tropical atmosphere was extensively marked by misunderstandings and inaccuracies, which resulted in widespread discredit (MENDONÇA and DANNI-OLIVEIRA, 2007). This fact can be explained, according to these authors, by the incipient knowledge of the composition and dynamism of the atmosphere, as well as the lack of technical preparation on the part of the first explorers, who knew the atmospheric conditions of the temperate zone; however, the tropical area is an environment with many particularities.

"The regions located between the tropics have, from the astronomical point of view, strict limits, established by latitudes of 23º27'33", north and south of the equator, composing a ring around the globe, which covers 46% of its surface" (CONTI, 2002, p.119, free translation). However, the meaning of these lines is quite relative; hence, it is observed that the characteristics of tropicality often manifest beyond these lines or, as often happens, such characteristics may be absent in the interior of these lines and, therefore, one should consider the fact that tropical regions are far from being homogeneous (CONTI, 2002). Thus, "the intertropical zone has a huge variety of environments, from the superhumid to the hyperarid, and all transitional types such as humid, subhumid, semiarid, and arid" (CONTI, 2010, p.52, free translation).

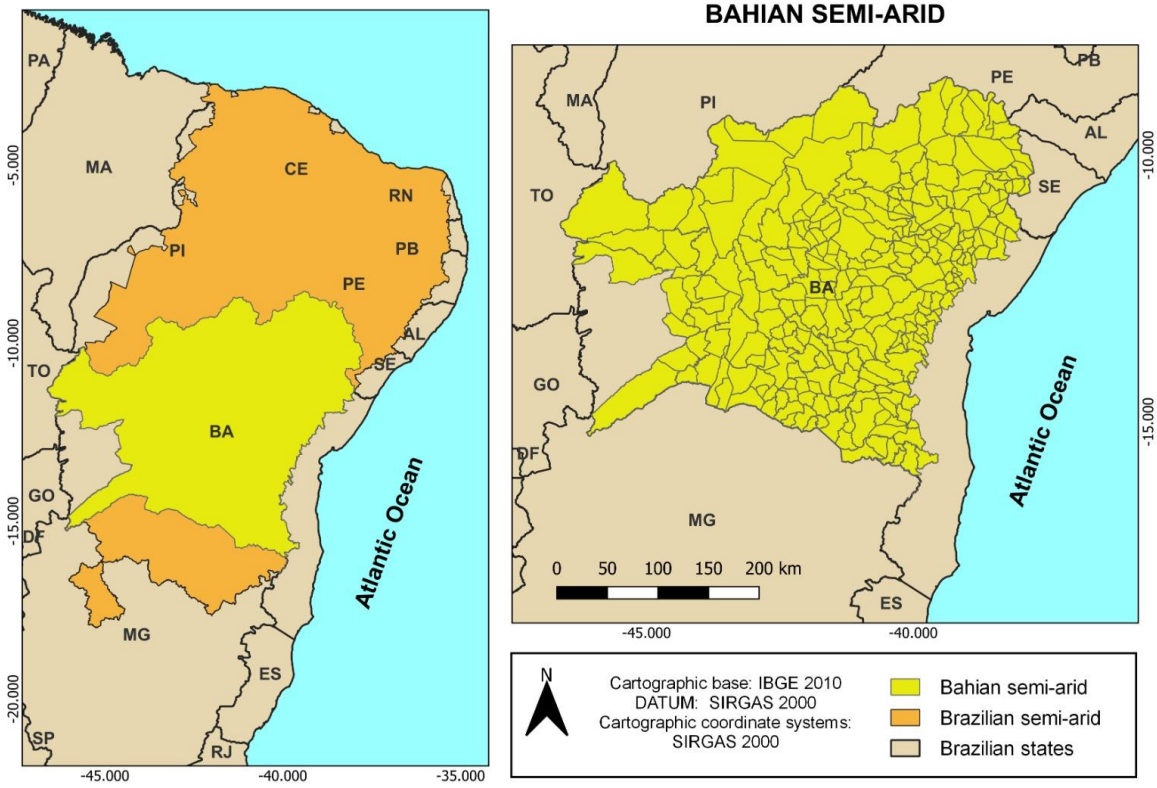
The evolution of the geographical concept of tropical region, described in Mendonça and Danni-Oliveira (2007) and Conti (2009), allows us to assume that this environment has important peculiarities. An example is the semiarid region, a region with low rainfall volume, but which is located in Brazil, the largest tropical country on the planet (CONTI, 2011).

Brazilian Semiarid

"Brazil is a country of continental dimensions" (MENDONÇA and DANNI-OLIVEIRA, 2007, p.13, free translation), where tropicality is one of its most important characteristics (MENDONÇA and DANNI-OLIVEIRA, 2007; TORRES and MACHADO, 2016). Almost all Brazilian territory extends into the intertropical zone of the globe; however, this is characterized by a considerable variety of climatic types (MENDONÇA and DANNI-OLIVEIRA, 2007).

The semiarid region (Figure 1) is located in the northeastern part of Brazil and the north of the state of Minas Gerais (southeast), where there is the semiarid tropical climate, characterized by "high temperatures generally higher than 25°C" and low rainfall, around 500 mm annually, with scarce and irregular rainfall (TORRES and MACHADO, 2016, p. 204, free translation). Due to this climatic particularity, in addition to macroscale factors, this region is characterized by the occurrence of recurrent droughts that commonly reach proportions of social disasters due to the high social vulnerability of the population and the low infrastructure capacity of most of the region.

Figure 1 - Location of the Brazilian Semiarid, 2020.



Prepared by - SÃO JOSÉ, from data used in the present study.

For a long time, this climatic typology, allied to the phenomenon of drought, was addressed by several literary and scientific works as delimiting agents of the development of the Northeast. This misguided and generalist view of the Brazilian climate and semiarid, overall, still prevails in Brazilian society, as demonstrated in the studies conducted by São José (2019), São José *et al.* (2020), and São José *et al.* (2021).Public opinion, State action, and political regionalism are repeatedly articulated on the basis of an "inferiority complex" that would originate from this exotic (unusual), vast, rude space, vulnerable to desertification (MACIEL and PONTES, 2015, p.22).

In the sphere of political regionalism and the economy, the drought-susceptible nature was conceived as the foundation of poverty and regional problems, a condition used to justify the differentiated distribution of federation resources (CASTO, 1992). At the cultural level, these conceptions were corroborated by a broad production that comprises novels and films of great success, which contributed to solidify the image of a depreciated space (ALBUQUERQUE JUNIOR, 1999).

In the view of Maciel and Pontes (2015), the agreement of science with the stigmas of the semiarid should not be disregarded. These authors, based on Brasil (2004) and on the 2010, 2011, 2012 and 2013 editions of the Caatinga Biotechnological Potential Workshop (*Workshop Potencial Biotecnológico da Caatinga*), warn that for the environmental sciences, for a long time, the caatinga was characterized as a place of little biological importance and low priority for conservation.

São José (2019) also points out that the northeastern elites have historically appropriated this regional climate determinism to explain misery, poverty, and regional backwardness, thus concealing the structural problems of the region. This author argues that, over time, regional backwardness has been attributed to the main climatic phenomenon that characterizes the region: drought.

Ultimately, we can assume that during the 20th century, political, cultural and scientific elites provided bases to create myths and deformations about the semiarid, "sustaining beliefs about its sterility, inadequacy for settlement, and biological irrelevance" (MACIEL and PONTES, 2015, p.23, free translation). Distorted images of the semiarid areas of Brazil were instituted in the national imagery, relating them to a hostile, adverse, desultory, and inhospitable environment due to the climatic phenomenon of droughts (ARANHA, 2006). Drought, therefore, became the villain of the northeastern drama, the main image of "an extremely dry, cursed land, forgotten by God" (CASTRO, 1967, p. 168, free translation).

Scientific studies on this issue started in the second half of the 19th century, when episodes of prolonged droughts put settlement and economic activities at risk in the northeastern hinterland (SILVA, 2007). This author emphasizes that

> "the attempt to discover and explain the natural causes of the drought phenomenon in the Northeast predominated. The partial view of the *Semiarid*, as the drought region, led to the adoption of fragmented solutions, whose key element is the fight against drought and its effects" (SILVA, 2007, p.467, free translation).

Thus, for decades, numerous actions of social public policies have emerged to correct conjuncture distortions due to the phenomenon of droughts, but none of them achieved permanent results (PASSADOR and PASSADOR, 2010). Campos (2014) points out that since the first records of droughts, the Semiarid has been the scenario of policies aimed at fighting drought and emergency actions such as the creation of roads, construction of weirs, and food distribution.

We observe that, overall, government initiatives of interventions in this reality were developed based on characteristics, such as "emergency, fragmented and discontinuous nature of programs developed in times of public calamity," emergency actions that support the "drought industry" and "the hydraulic solution, with the construction of hydraulic works, usually favoring contractors and large rural properties" (SILVA, 2003, p.369, free translation). According to this author, in any of these characteristics, there is the reproduction of the political use of the discourse of misery and underdevelopment as a direct consequence of droughts.

The fight against drought is a climatological misconception (SÃO JOSÉ *et al*.,2021), considering that human beings do not control the climate phenomenon (SÃO JOSÉ, 2019; CONTI, 2011). Drought depends on macroscale factors, including the ocean-atmosphere interaction (CONTI, 2011), in such a way it cannot be fought by humankind.

The need for a new perspective of the Brazilian Semiarid

"In the first half of the 20th century, other critical views emerged on the structural causes and consequences of poverty in the semiarid" (SILVA, 2007, p. 467, free translation). This author argues

that this critical view of reality contributed to demystify the actions to fight drought, ineffective and reproductive of local structures of domination.

Therefore, contrary to the conception of fighting drought, civil society organizations began developing the perspective of coexistence with the semiarid (AMORIM and GRISA, 2018). In the context of redemocratization, in the 1980s, alternatives were sought to develop the northeastern semiarid, region where civil society organizations and some public institutions of research and extension projects formulated proposals and carried out projects based on the proposition that it is feasible and necessary to live with the semiarid (SILVA, 2007).

In the early 1990s, the Brazilian semiarid region was affected by another drought, a fact that influences the public debate about the creation of definitive solutions for this region (AMORIM and GRISA, 2018). According to these authors, still in this context, the forum of family agriculture, held in 1993, held by the National Confederation of Agricultural Workers (*Confederação Nacional dos Trabalhadores na Agricultura* – CONTAG), organized an occupation of the headquarters of the Development Superintendency of the Northeast (*Superintendência do Desenvolvimento do Nordeste* – SUDENE), in Recife (state of Pernambuco, Brazil). This movement called for permanent public policies and proposed a more sustainable and inclusive development model for the semiarid (ASSIS, 2012).

It is noteworthy, therefore, that the paradigm of coexistence seeks, at first, to subvert the common sense historically created for this "problem-region," which would be the result of a supposedly harmful climate (MACIEL and PONTES, 2015, p.60). With the demystification of this epithet linked to practices harmonized with the environment through knowledge of the *sertanejos* (regional people), the rhetoric of coexistence is presented as antagonistic of the fight against drought, in force since the end of the 19th century.

However, the idea of fighting drought, regional backwardness, poverty, and misery due to the hostile climate still persists in the imagery of a large part of the Brazilian population, also affecting *sertanejos* themselves, who often absorb this discourse and believe that the only solution is migration (SÃO JOSÉ, 2019). Common sense corroborates derogatory ideas regarding the semiarid nature, and research shows that *sertanejos* have been more sensitive to the degradation of the Amazon than of the caatinga itself (PERNAMBUCO, 2002 p.9).

In a more recent context, São José (2019) found that there is media influence in the portrayal of the semiarid as a place of drought, poverty, hunger, among other hardships, being the climate of the region considered "the great villain." This author also pointed out that the images about the semiarid are disseminated in a distorted way, highlighting images of dry and cracked soil, dry weirs, decimated animals, and people with expression of suffering due to drought, suggesting that the poverty of the region is due to this climatic phenomenon, disregarding that the effects of drought are not exclusively produced by the intensity of the phenomenon, but have a strong relationship with the social vulnerability of the *sertanejos*.

In many respects, droughts are an important fact in the history of the Northeast, such as the need for recognizing the drought phenomenon as part of the climatic pattern of the region and not as a problematic factor for the development of the semiarid region. In addition, droughts affecting this region reach proportions of calamities, mainly due to the lack of the management of its effects, historically based on a reaction model, which substantially contributes to aggravate the vulnerability of the regional population (SÃO JOSÉ, 2019).

These humanitarian actions are unable to increase, in the long-term, the resilience of those affected by drought (DING; HAYES; WIDHALM, 2011). Therefore, the management of the drought effects requires strategies focused on risk management, which includes proactive planning and mitigation actions, at the expense of crisis management, which is defined by the emergency reaction to drought (FONTAINE, STEINEMANN, HAYES, 2014; WILHITE, 2011).

From this debate, it is worth noting that, in the case of the Brazilian semiarid, the management of drought risk should be related to a new perspective, surpassing the view of fighting drought towards the strengthening of the paradigm of coexistence with the semiarid, in addition to developing programs of coexistence with the semiarid climate and environmental education.

Taking this into consideration, climate determinism was not only used by Europeans and Americans to refer to the tropical environment. As aforementioned, in Brazil, the existence of a climatic determinism was also observed, which preached the inferiority of the Northeast due to the mistaken and generalist view of one of the climatic regimes of this region. "From the colonial period to nowadays, reports and images about the Brazilian Semiarid mostly emphasize bleak natural landscapes and the social scourge of the regional population in periods of drought" (SILVA, 2007, p. 467, free translation). In

Chart 1 we synthesize that, at a global level, in general, there was a concern in developing and recording knowledge of the phenomena of weather and climate, seeking a logical view. Conversely, in the Brazilian semiarid region, whose climate is the semiarid tropical, where droughts are recurrent, the mistaken logical view dissociated of environmental characteristics, especially climatic conditions, lasted for a long time, which contributed to an inadequate management of the climatic risks of this region.

Globally, over the years, an evolution has been observed concerning the knowledge of the atmosphere, as it has increasingly sought to discover the dynamics of natural phenomena (MENDONÇA and DANNI-OLIVEIRA, 2007), besides seeking a more rational explanation for atmospheric phenomena (AYOADE, 2010). In the case of the Brazilian semiarid, in particular, this logic is not observed. For instance, in northeastern Brazil, especially in the semiarid region, since the 16th century the climatic phenomenon of drought and its consequences for the population are recognized (MELO, 1999); however, most public policies implemented in the Brazilian Northeast in the last century have been formulated in the context of fighting droughts (CAMPOS, 2014, p.65), that is, based on a climatological misconception (SÃO JOSÉ, 2019), elucidating a limited conception of the semiarid, with fragmented solutions (SILVA, 2007).

It should be noted that science itself contributed to a limited view of the complexities of the semiarid, considering that, for Maciel and Pontes (2015), the agreement of science with stigmas attributed to the region should not be disregarded. Gonçalves (2015, p.534, free translation) concluded that the "scientific, dogmatic, progressive, and civilizing discourse," by studying and relating the phenomenon of drought to a manifestation of nature "that, as it was believed, could be dominated by human knowledge, thus implying the presence and action of the State through public policies, has served, paradoxically, as an instrument and justification for perpetuating secular backwardness." Nonetheless, it was in the first half of the 20th century that critical views about the structural causes and consequences of regional poverty emerged, demystifying actions to fight drought. Meanwhile, São José (2019) and São José *et al*. (2021) concluded that this paradigm is still in political use and in the imagery of the population.

Chart 1 - Overview of reality at the global level and in the northeastern semiarid.

At the global level (generalized approach)	**Northeastern semiarid**
Improvement of techniques and methods for the precise understanding of the atmosphere and associated facts.	Characterization of the climate as hostile; Pejorative adjectives of drought; Personification of dry seasons and droughts.
Overcoming the victimism condition of the facts related to climate and weather.	Reproduction of victimism in relation to climate, especially climate phenomena (dry seasons and droughts); Reinvention of climate victimism.
Fighting climate determinism.	Perpetuation of climate determinism.
Awareness of the need for environmental preservation.	Inadequate use and exploitation of natural resources; acceleration of environmental degradation and intensification of desertification.
Discussion centered on society.	Debate centered on the sphere of Public Authority and in the interest of the northeastern elite.
Adaptation and mitigation of the impacts of climatic phenomena, as a necessity for social development.	Correction of nature, especially the rainfall regime of the region (fighting drought); Increase and intensification of poverty, increase of social turbulence.
Advances towards efficient management.	Setbacks and distancing from proper management.

Prepared by - The authors, 2021.

Based on the view presented in Chart 1 regarding the northeastern semiarid, we can infer that the way this region was understood did not contribute to reducing the vulnerability of the population or the climatic risk of droughts. It is not an exaggeration to conclude that this conjuncture excluded from the population the right to coherently understand the dynamics of the semiarid tropical climate, which implied vulnerabilities and numerous socio-environmental problems. According to Silva (2007), the lack of knowledge of the semiarid complexity led to the introduction of inadequate agricultural practices, causing or aggravating environmental imbalances.

This context may have contributed to prevent the creation of a proactive management of the region's climate risk, as the population must effectively participate in discussions on the management. However, as demonstrated by São José (2019), the imagery of the local population is still linked to the ideas of fighting drought, which influences the perception of *sertanejos* about local climate risks.

In this context, one of the major challenges is to find effective ways of enabling the people of the semiarid region to overcome the historical limitation of being mere citizens subject to local climatic conditions, and to understand the functioning and dynamics of a tropical environment. In this context, for example, educational work and scientific literacy projects are used as an effective tool to provide knowledge that allows men and women from the semi-arid region to read the region in which they live, with the aim of transforming it. In addition, it is necessary to disseminate meteorological, climate and agro-meteorological information. In addition, it is also necessary to create and develop development projects in partnership with the local communities, valuing their knowledge of the semi-arid region and aiming at the protection of the biodiversity and the improvement of the socio-biodiversity.

For Hazen and Trefil (2005, p.12, free translation), scientific literacy grants autonomy for the citizen "to have the necessary knowledge to understand public debates on science and technology issues." Chassot (2003, p.94, free translation) argues that "it would be desirable for the scientifically literate not only to have facilitated perspective of the world in which they live, but to understand the needs of transforming it — and preferably to transform it into something better." Schools, museums, radio and television programmes, magazines, printed newspapers and the media in general must be "partners" in this mission of democratising scientific knowledge in a critical way for the population" (KRASILCHIK; MARANDINO, 2007, p. 17), in addition to taking into account the knowledge of local communities, which is fundamental for effective strategies for coexistence with the semi-arid region. This could be one of the steps towards a new view of the Brazilian semiarid region.

FINAL CONSIDERATIONS

By a narrative literature review, in this study we analyzed the narratives created on facts related to meteorology and climatology by ancient civilizations. In addition, we sought to highlight how the tropical environment has been characterized over time, whose heterogeneity was disregarded. The tropical world comprises a huge variety of environments such as the semiarid. In Brazil, a tropical country, the semiarid region, the main object of analysis, was characterized from a generalist and reductionist view, spreading misconceptions about the climate and the region.

Overall, the literature review showed that from the earliest prehistoric men to our contemporary societies, climate has always been a matter of interest because of its influence on the dynamics of nature and on the life of human beings.

It was also evident, in the analyzed studies, the importance of knowledge of weather and climate as well as its temporal and spatial variation. Moreover, we highlight as the main challenge to humanity that, only through a broad and correct understanding, it is possible to create strategies to adapt to climatic adversities. In the specific case of the Brazilian semi-arid region, there are still many challenges and gaps. These are mainly due to the lack of knowledge of the environmental dynamics of the semi-arid region, which has led to practices that are disconnected from the natural characteristics of this region and have nothing to do with the ancient ways of life of the local population. Thus, misconceptions must be overcome — such as the very climatic determinism, which reinvents itself over time. For example, still in this region, the idea of the "hostile climate" is disseminated by different types of media.

Hence, the need to take the opposite path is evident, finding methods that are, in fact, effective in enabling coexistence with the climate and in particular with the semiarid. An important means to enable this coexistence may be scientific literacy, which should be provided to *sertanejos*, in general, and should not be restricted to formal school spaces.

It is therefore necessary to value the knowledge and coexistence practices of local communities and, in this perspective, to seek to promote dialogue between the different actors of the semi-arid region, but with emphasis on the knowledge of the local inhabitants in order to build a proactive management of this territory, since the ancient knowledge of traditional communities living in the semi-arid region is essential for living in this tropical environment. Therefore, from education, especially scientific literacy, it may be possible to break with the recurrent climatic determinism present in local, regional, and national public opinion, in the various types of media, and repeatedly used in political discourses.

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