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GEOSCIENCES

Evolution of public policies on natural disasters in brazil and worldwide

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Abstract: This work aims to carry out an analysis of the evolution of the civil defense protection policy in Brazil, as well as to present an overview of research related to public policies on natural disasters in the world. The research was developed by documentary analysis of Brazilian policies on the protection of civil defense and bibliometric analysis of the global data. The evolution of public policy on natural disasters in Brazil was divided into four different moments: a) military civil defense (1942-1946), b) disaster assistance policy (1967-1988), c) Civil Defense system in construction (1988-2005), and d) consolidation of the civil defense system (2005- to the present). The structuring of public policy reflected in 4 different stages in relation to the recording of information about disasters. Bibliometric analysis showed that the first works related to public civil defense policies in the world appeared only in 1980, and are mainly concentrated in the United States, which accounts for 42.56% of the works, while Brazil is the 6th country with 3.76% of global searches. Thus, it is possible to conclude that public policies and databases have a recent evolution both in Brazil and in the world, especially in developing countries.

Key words: public policies, natural disasters, database, Brazil.

INTRODUCTION

Landslides, erosion, floods, droughts and hurricanes are among the natural phenomena that can severely affect areas or regions inhabited by humans, causing damages and, thus, becoming natural disasters (Burton & Kates 1964, Stillwell 1992, Tominaga et al. 2009, Alcántara-Ayala 2002, 2019).

Worldwide, the United States, China, India, the Philippines, Indonesia, Bangladesh and Japan stand out with a higher frequency of natural disasters, with China showing the highest number of fatalities, Peru the highest number of injuries and the United States the greatest economic losses (Shen & Hwang 2019). Natural disasters can result in a series of negative impacts on communities around the world, including casualties and economic losses. According to Wirtz et al. (2014), more than two million people died due to natural disasters since 1980 and the economic losses add up to more than US$ 3,000 billion. The Sumatra (2004) and Haiti (2010) disasters caused over 220,000 deaths each (Wirtz et al. 2014) and are considered by the United Nations (UN) as one of the worst disasters in the last century, with financial losses of about of 120% of the countries' GDP – Gross Domestic Product (Freitas et al. 2012, Alvino-Borba et al. 2020). International efforts were expanded in the late 20th century, with the 1990s recognized as the International Decade for Natural Disaster Reduction (IDNDR 1990-1999).

In Brazil, the disasters that occurred in the past two decades have had major socioeconomic

impacts. Examples are the cyclone Catarina, which hit the south of the country in 2004, the floods that affected Santa Catarina in 2008, as well as the mega landslide disaster at the Nova Friburgo mountain region in 2011, in which almost one thousand people died. It is important to point out that, in addition to the direct effects of disasters, outbreaks of diseases such as diarrhea, leptospirosis, dermatitis, among others of water transmission, usually follow (Freitas et al. 2014). Other events that stand out are the drought that hit the state of Amazonas between 2005 and 2010 and the floods that occurred in 2009 and 2012, affecting 20,000 families. In 2013, three out of four municipalities in the Brazilian northeast were in an emergency situation as a result of the drought that started in 2010 (Freitas et al. 2014).

Forest fires at the Amazon and Pantanal regions took the spotlight in the international press in 2020. According to De Miranda et al. (2021) and INPE (2021), 28,701 heat points were recorded in the Brazilian Pantanal in 2020, 68.46% of the total in Mato Grosso and 31.54% in Mato Grosso do Sul. These numbers are much higher than those recorded in 2019 and 2018, in which 14,921 and 3,490 hot spots were identified, respectively. In the Amazon biome, 68345 hot spots were recorded in 2018, 89179 in 2019 and 103,161 in 2020. In the last year mentioned, the hot spots occurred mainly in the states of Para (41.26%), Mato Grosso (25.54%), Amazonas (11.92%) and Rondônia (11.05%) the other states registered values below 5 % (INPE 2021).

According to analyzes of the World Bank (2012a, b), losses and damages related to the landslides at Nova Friburgo in 2011 are estimated at R$ 4.8 billion (approximately 2.8 billion dollars), the eighth most destructive landslide event in the world according to the UN (Rosi et al. 2019). The intense rainfall events of 2008/2009 in the state of Santa Catarina, which led to generalized floods and landslides, also had damages calculated in the order of billions of US dollars. Technological disasters (or Natech), such as the rupture of the mining dams in Mariana (2015) and Brumadinho (2019) which caused great environmental impacts and losses of lives.

Databases are essential in the assessment of susceptibility and hazard of natural disasters. Their information is widely used by governments, non-governmental organizations (NGOs), the private sector, research centers and the financial sector (Wirtz et al. 2014). The EM-DAT (Emergency Events Database) is among the main databases, gathering disasters information from 1900 to the present, sourced by data from UN agencies, governmental and non-governmental organizations, insurance companies, research institutes and news agencies. The database considers the number of deaths, people affected, impact, damage and the response capacity of the countries (Barredo 2007). Lee (2014), after performing analysis of extreme weather events, identified several limitations associated to the EM-DAT database. Lee's (2014) findings suggest that the available information may underestimate the number of deaths, especially for small-scale heat and cold events, and show a reporting bias for more developed nations, with developing nations underreporting.

In addition to EM-DAT, there are other global databases such as sigma, GeoMet and Munich Re's NatCatSERVICE database. However, in all cases, there are difficulties in collecting information to determine the extent of human and material damage (Kron et al. 2012, El Hadri et al. 2019). DESInvetar is a database that gathers data from all the countries of Latin America, except Brazil, registering disasters that have caused at least one death or an economic impact

of 1 US dollar on countries that are members of the initiative (Panwar & Sen 2019).

Brazil is a country of continental dimensions, with different climatic and relief conditions, which provides a diversity of events and processes according to the characteristics of each region. The first atlas of natural disasters was published in 2010, with data from the 1990s and the first decade of the 2000s (UFSC 2013). In the last yearbook of disasters, which presented data in relation to events that occurred in 2013, 493 natural disasters were recorded, which caused 183 deaths and affected 18,557,233 people. Disasters reached 4,433 municipalities, 70.99% of which were due to drought / drought (Brazil 2014).

In this context, this study aims at presenting the evolution of public policies in Brazil regarding natural hazards management by the civil defense department, focusing on the Brazilian disasters database. It also aims at discussing the development of public policies related to natural disasters in world considering the data obtained in the bibliometric analysis. The contribution of this study is to better understand how institutional changes, associated with the development of public policies in a country, contribute to improve the quality of existing information on the impacts of natural disasters.

MATERIALS AND METHODS

Documentary research and bibliometric analyses were the two main methods applied in the study. The documentary research was carried out on the federal government portal (http://www4.planalto.gov.br/legislacao/) and on websites of the Ministry of Regional Development (https://www.gov.br/mdr/pt-br). Information on regulations, laws, decrees and institutional publications related to civil defense policies were also searched. The documents were organized according to the date of publication. Then, it was verified the period in which the norm was active and if it was replaced by some other subsequent legislation. Based on this analysis, a chronological order of the norms that guide the sectorial policy and the database was organized, considering the date of publication and the period in which each act was in force. Finally, after these steps, the results were discussed based on national and international publications, aiming at correlating the data with the literature.

The bibliometric method allows to relate different bibliographic data from the same research area through citations, collaborations and writing, networks of interest, keywords, topics, institutions, in which the most commonly-cited terms are aggregated and analyzed in the form of networks (Cobo et al. 2011). Bibliometric analysis consists of relating the points in common in the existing published works in the database (Van Eck & Waltman 2014). For these authors, the bibliographic coupling indicates the relationship between publications in the form of a network based on similarities. Although this method is not recent, since the emergence of free computational tools, such as the VOSviewer software, this methodology has become more usual and easily accessible, allowing the construction bibliometric analysis maps based on the information available in the databases of the research platforms (Van Eck & Waltman 2009)

In this work, the analysis was developed through the Scopus database. According to Elsevier (2017), Scopus is one of the largest databases of abstracts and citations of peer-reviewed scientific literature. On this platform, several searches were carried out with different word combinations. The best results were achieved with the terms (“Natural disaster” OR “emergency events” OR “Natural Hazards” OR

"Adverse events") AND ("Civil defense plan" OR "Public policy") in July 2020. 585 documents=were analyzed in the VosViewer software. The use of searches with the words only in English is a limitation in these researches, which also did not address gray literature documents in bibliometric analysis.

RESULTS

The evolution of public civil defense policy in Brazil

The use of the term civil defense appeared for the first time in the legal system of Brazil in 1942, during the second world war, when the National Directorate of Passive Anti-Air Defense Service was created, through decree-law no. º. 4,716. In 1943, it became known as the National Directorate of the Civil Defense Service, becoming extinguished in 1946 (Brazil 1942, 1943, 1946, Oliveira 2015).

In the 1960s, specific initiatives took place in the states to carry out measures related to the occurrence of natural disasters. Within the scope of the union, in 1967, the newly created Ministry of the Interior, was assigned to develop assistance actions for populations affected by public calamities (Carvalho 2018).

In 1969, the Decree-Law No. 950 created the Special Fund for Public Disasters (FUNCAP), associated to the Ministry of the Interior. The normative provided the foundation for the elaboration of a National Plan for Permanent Defense against Disasters and established the guidelines: a) immediate assistance to populations affected by public disasters, whose status will be declared by decree by the Federal Government; b) reimbursement of expenses from public or private entities providing services and assistance (Brazil 1969).

The 1988 constitution established in Article 21, paragraph XVIII, as the competence of the Union "to plan and promote permanent defense against public calamities, especially droughts and floods" (Brazil 1988a). As a result of this provision, in the same year, the Decree No. 97.274 created the National Council for Civil Defense - CONDEC and the National System for Civil Defense - SINDEC, with the objective of planning and promoting permanent defense against public calamities, integrating the activities of the agencies and public and private entities that, in the national territory, carry out activities of planning, coordination and execution of the assistance measures to the populations affected by abnormal adverse factors, in addition to the prevention or recovery of damages in an emergency situation or in a state of public calamity (Brazil 1988a). The aforementioned decree initiates the instrumentalization of action linked to civil defense for disaster prevention, in addition to measures related to correcting risks and personal or material damages resulting from a state of public calamity or emergency situation. Decree nº 895/1993, replaces Decree nº 97.274 / 1988, and establishes competences for national, state and municipal bodies (Brazil 1988b, 1993).

In 1994, Decree No. 1,080 regulates the Special Fund for Public Disasters (FUNCAP), created in 1969, and establishes that the fund's resources must be used for a series of items and measures linked to finance assistance in emergency situations. To have access to these resources, it is necessary to have a state of public calamity recognized by the federal government (Brazil 1994).

The Decree nº 895/1993 was replaced by Decree nº 5.376 / 2005, which presents a new configuration for the National Civil Defense System - SINDEC, including the focus on disaster reduction, related to: I - disaster prevention; II - the preparation for emergencies and disasters; III - disaster response; IV - reconstruction

and recovery. The following are established as instruments of SINDEC: a) the Disaster Information System in Brazil - SINDESB, which will allow knowledge of the most prevalent occurrences in the country, in addition to enabling the deepening of epidemiological studies, guiding planning and facilitating decision-making in the search for disaster reduction and its consequences, b) the Disaster Monitoring System, c) the Disaster Alert and Alarm System, d) the Disaster Response System, e) the Population Assistance and Assistance System and f) the Prevention and Reconstruction System (Brazil 2005).

One of the important advances made in 2005 was the creation of the National Center for Risk and Disaster Management (CENAD), through the Decree nº 5.376, by the body that manages disaster preparedness and response strategies (Brazil 2020a).

The Provisional Measure No. 494/2010, later converted into Law No. 12,340 / 2010, regulates the transfer of resources for relief actions, assistance to victims, reestablishment of essential services and reconstruction in the areas affected by disaster, related to the use of resources from the Special Fund for Public Disasters (Brazil 2010).

The Decree Nº. 7,257/2010, was published to regulate Provisional Measure No. 494/2010 and subsequently Law Nº. 12,340/2010. This decree provides for the National Civil Defense System - SINDEC, the recognition of emergency situations and the state of public calamity, the transfer of resources for relief actions, assistance to victims, the restoration of essential services and the reconstruction in the affected areas. for disaster. The document presents definitions of civil defense, disasters, emergency situations, a state of public calamity, as well as relief actions, assistance to victims, restoration of essential services, reconstruction and prevention, related to natural disasters (Brazil 2010).

The main advance made by this normative act is the development of a roadmap with the minimum information for an emergency situation to be declared, namely: I - description of the disaster according to the codification, threats and risks, defined by the Ministry of National Integration; II - date and place of the disaster; III - description of the affected area, the causes and effects of the disaster; IV - estimated human, material, environmental and essential services harmed; V - statement of measures and actions in progress, capacity to act and human, material, institutional and financial resources employed by the respective federated entity to restore normality; and VI - other information available about the disaster and its effects (Brazil 2010).

In 2011, after the disasters in the mountainous region of Rio de Janeiro, the remodeling of the way in which the government deals with risk situations and natural disasters was carried out. In this way, measures were taken, such as the creation of the National Center for Monitoring and Natural Disaster Alerts - CEMADEN, through Decree No. 7,513 of July 1, 2011, as part of the Ministry of Science, Technology and Innovation – MCTI. CEMADEN is responsible for preparing disaster alerts, disseminating studies, developing scientific, technological and innovation capacity, developing and implementing observation systems for monitoring natural disasters (Brazil 2020b).

These changes were consolidated in 2012, with Law No. 12,608, which instituted the National Civil Protection and Defense Policy - PNPDEC, and made changes to the National Civil Protection and Defense System - SINPDEC and the National Civil Protection and Defense Council - CONPDEC, in addition to authorizing the creation of information systems and disaster monitoring

(Brazil 2012a). This law established guidelines for the PNPDEC, with joint action between the entities of the federation; the systemic approach to prevention, mitigation, preparation, response and recovery actions; the priority of preventive actions; the use of hydrographic basins as a unit for the development of actions related to water bodies; planning based on research and studies on areas of risk and incidence of disasters; and the participation of civil society (Brazil 2012a). In addition, it also dealt with the role of municipalities, the state and the federal government, and modified territorial management instruments, such as the Statute of Cities, Law nº 10.257 / 2001, and Law nº 12.340 / 2010. In practice, the changes made to the legislation in 2012 made it possible to put in place disaster prevention and monitoring instruments, and not only response actions.

The changes made to the Statute of Cities are related to the master plan, which in the case of municipalities susceptible to disasters, such as those related to geological or hydrological processes, should include the planning of preventive intervention actions and reallocation of population of disaster risk areas; the identification and guidelines for the preservation and occupation of municipal green areas, when applicable, with a view to reducing the waterproofing of cities, considering the municipal geotechnical maps; and ordering and controlling land use, in order to avoid exposing the population to disaster risks (Brazil 2001, 2012a).

In the same vein, the Metropolis Statute, promulgated by Law No. 13.089 / 2015, foresaw the need for an integrated development plan for metropolitan regions or urban agglomerations, which considers the delimitation of areas restricted to urbanization where there are risks of natural disasters (Brazil 2015).

This set of changes made after the 2011 mega disaster, has resulted in the adoption of the flow of information in real time and creates a network capable of monitoring the events that occur in each municipality. In addition to creating the National Center for Monitoring and Natural Disaster Alerts - CEMADEN and interconnecting with the National Center for Risk and Disaster Management - CENAD. In addition, after this event, the Geological Survey of Brazil (CPRM) began to systematically develop the mapping of risk and geological-geotechnical areas of municipalities affected by floods, runoffs and landslides to guide land occupation. The set of actions developed by the agencies received funding from the 2012-2015 Pluriannual Plans (PPA) from the Federal Government (Oliveira 2015). These changes were a milestone in the way the public authorities deal with natural disasters in Brazil, leaving a context of actions only in response to disasters, which marked the policies until the 1990s, until the construction of disaster prevention actions and risk reduction.

The last changes made to the standardization were made by Decree No. 10593, of December 24, 2020, which made changes in the way the National Civil Protection and Defense System and the National Civil Protection and Defense Council work and on the National Security Plan. Civil Defense and Protection. The greatest advance in this document was in relation to the standardization of the operation of the National Disaster Information System (Brazil 2020c).

Thus, the history of public management related to civil defense, can be divided into four moments that are presented in Table I and Figure 1.

Table I. division of periods related to the evolution of civil defense in Brazil.

Period	Description
Military civil defense (1942-1946)	related to the second world war;
Civil defense to deal with disasters (1967-1988)	Civil defense actions linked to the Ministry of the Interior, focused on assisting the population affected by disasters; Creation of FUNCAP;
Beginning of SINDEC (1988-2005)	Civil defense as a legal provision in the Federal Constitution of 1988; Creation of the National Civil Defense System – SINDEC; Standardization of FUNCAP;
SINDEC Consolidation (2005 to the present)	Creation of reference centers for the production and monitoring of information on disasters, and being them, the National Center for Risk and Disaster Management - CENAD and the National Center for Monitoring and Natural Disaster Alerts - CEMADEN; Consolidation of FUNCAP as an instrument to develop measures to prevent natural disasters and reduce risk. Creation of the National Civil Defense and Protection Policy – PNPDEC; The Geological Survey of Brazil now has among its lines of action the mapping of risk areas.

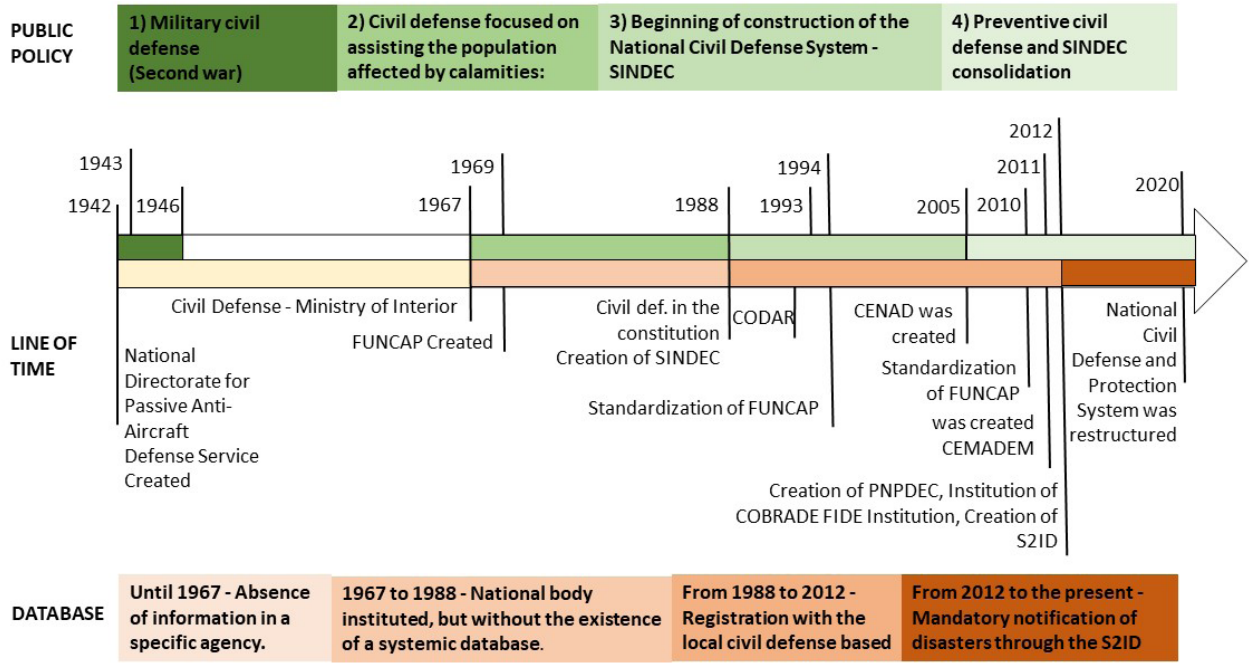

Figure 1. Schematic model of the evolution of civil defense as public policy and the evolution of the record on natural disasters in Brazil (prepared by the authors).

Database and disaster history series

The evolution of information on disasters followed similar steps as the normative acts. However, the first document that presented a national scenario on disasters in Brazil appeared only at the beginning of the second decade of the 21st century. This document is the Brazilian Atlas of Natural Disasters, which presented the events that occurred between 1991-2010. In 2013, this document was reedited, and the

events that occurred in the years 2011 and 2012 were included. In the years 2013 and 2014, the Brazilian Yearbook of Natural Disasters, relating to the years 2012 and 2013, was also published. After 2014, no new versions were released.

The collection of data for the construction of the atlas was carried out by consulting the records with the State Civil Defense Coordinators, using as source the official documents: (a) damage report; (b) Damage Assessment Reports - AVADAN; (c) Preliminary Disaster Notification - NOPRED; (d) Decrees; and (e) Ordinances (Carmo & Anazawa 2014). This search was carried out in several different sources of information, since until the year 2012, the documents were not binding, that is, a state of emergency could be decreed with only one or more acts, and it is not necessary for all documents to be presented the documents that characterize the disaster (UFSC 2013).

Another important factor is that over the decades there have been changes in the way information was organized. For example, the Damage Report was also a document for official registration used by the Civil Defense until the mid-1990s, being subsequently replaced by AVADAN, which was used until 2012 (UFSC 2013).

The Normative Instruction No. 01, of August 24, 2012, instituted the Disaster Information Form - FIDE, which replaced the Preliminary Disaster Notification (NOPRED) and AVADAN Damage Assessment forms. FIDE is one of the mandatory documents for the federal recognition of the emergency situation or state of public calamity, as well as the Decree of Municipal Declaration of Emergency Action – DMATE, or State Declaration of Emergency Action - DEATE. A photographic report and supporting documents that clarify and illustrate the occurrence are also mandatory and part of FIDE (Brazil 2012b). FIDE is a dynamic document and should be updated during the process of analyzing the recognition request, as long as the abnormal situation continues (UFSC 2012).

The normative instruction also classified disasters into two types: Level I - of medium intensity, in which losses and damages are manageable and expected by local governments, with the reestablishment of the situation made with local resources complemented with state and federal contributions; Level II - disasters of greater intensity, in which the losses and damages cannot be supported and overcome at local level, requiring the action of the three governmental spheres for the situation to be normalized (Brazil 2012b). To be characterized as type I and II disasters, at least two of the damages shown in Table II are required.

The evolution of disasters can be classified into: I - sudden or acute disasters, those that evolve quickly and with great violence; usually, these events occur unexpectedly and surprisingly and they can also have cyclical and seasonal characteristics, such as earthquakes, landslides and storms; II - gradual disasters or chronic evolution, which evolve in stages of progressive worsening, for example, ravines and gullies (Brazil 2012b).

The classification of typologies of Brazilian disasters, proposed in 2012 through the Brazilian Disaster Codification - COBRADE, used as reference the existing classifications in the International Disaster Database (EM-DAT), of the Center for Research on Epidemiology of Disasters (CRED), from the World Health Organization (WHO / UN) (Brazil 2012c). COBRADE replaced the Codification of Disasters, Threats and Risks - CODAR (Brazil 1992). This change occurred in order to facilitate the Brazilian contribution to feed the international database and also to simplify the previous classification, which had about ten pages and twelve tables with disaster classifications.

Table II. Disaster classifications according to Normative Instruction No. 01/2012 (Brazil 2012b).

Characteristics	Type I	Type II
Dead	1 to 9	10 or more
Affected people	Up to 99 people	100 or more
Public health, educational or other service facilities damaged or destroyed	1 to 9	10 or more
Damaged or destroyed housing units	1 to 9	10 or more
Damaged or destroyed infrastructure works	1 to 9	10 or more
Public facilities for community use damaged or destroyed	1 to 9	10 or more
Pollution or contamination, recoverable in the short term, from air, water or soil, impairing health and supply	10% to 20% of the population of municipalities with up to ten thousand inhabitants and from 5% to 10% of the population of municipalities with more than ten thousand inhabitants;	More than 10% to 20% of the population of municipalities with up to ten thousand inhabitants and more than 5% to 10% of the population of municipalities with over ten thousand inhabitants;
Seasonal and temporary decrease or depletion of water, impairing water supply	10% to 20% of the population of municipalities with up to 10,000 inhabitants and from 5% to 10% of the population of municipalities with more than 10,000 inhabitants;	More than 10% to 20% of the population of municipalities with up to 10,000 inhabitants and more than 5% to 10% of the population of municipalities with more than 10,000 inhabitants;
Destruction of National, State or Municipal Parks, Environmental Protection Areas and Permanent Preservation Areas.	Up to 40% (forty percent)	More than 40% (forty percent)
Public economic losses in relation to the annual net current revenue of the Municipality, the Federal District or the affected State, related to the collapse of the following essential services	That exceed 2.77% of annual net current revenue	That exceed 8.33% of the annual net current revenue
Private economic losses	Greater than 8.33% of annual net current revenue	That exceed 24.93% of annual net current revenue

Disasters can be classified as natural and technological. The first is caused by natural processes or phenomena, implying human losses or other impacts on health, damage to the environment, property, interruption of services and social and economic disturbances. The second are those originating from technological or industrial conditions, including accidents, dangerous procedures, failures in infrastructure or specific human activities, which can cause human losses or other impacts to health, damage to the environment, property, interruption of services and social disturbances and economic (Brazil 2012b).

In COBRADE, the Natural Disasters category is divided into 5 Groups, 13 Subgroups, 24 Types and 23 Subtypes, while the Technological Disasters category is divided into 5 Groups, 15 Subgroups and 15 Types (UFSC 2012). The EM-DAT Classification, in turn, is divided into Natural (Geophysical, Meteorological, Hydrological, Climatological, Biological and Extraterrestrial)

and Technological (industrial accident, transport accident and miscellaneous accident) (EM-DAT 2020). Although similar, the classifications have differences, from nomenclatures of processes, as for example, in the classification of EM-DAT there is no erosive process. In addition to the differences in classification, the criteria for a disaster to be considered also have different metrics, for example, in the EM-DAT database, at least 10 dead or 100 affected are needed to be considered a disaster (Carmo & Anazawa 2014).

As with public policy, the evolution of information on natural disasters in Brazil can be classified into four moments that were presented in Figure 1 and are described in Table III.

The evolution of research on public policies and natural disasters in the world

The publications on this field of study, according to the keywords searched, started in 1980, totaling, until the time this research was carried out, 585 published documents, including articles in magazines, book chapters, articles by congresses, among others. As shown in Figure 2, the number of publications in this field of research has increased over the years, showing a higher growth peak after the year 2016.

The country with largest number of publications is the United States, with 249 in total (Fig. 3). The graph in Figure 3 indicates a disparity in total publications, with the United States having approximately 6 times more publications than the second most publishing country, Canada, followed by the United Kingdom, Australia, France and Brazil.

Figure 4 shows the quote among the countries that contribute the most in this field of research, with the United States also having the most cited publications. In addition, the works published in the United States cite research from countries that publish the most in this field of research, such as Canada and the United Kingdom. The research carried out in Brazil is related to the United States, Germany, Australia, South Africa and France.

This research field is very multidisciplinary, as shown in Figure 5, with 19% of all articles published in the social sciences area, comprising most publications. In general, these articles seek to evaluate the public policies and strategies adopted, to mitigate or manage the occurrence of natural disasters, or even to evaluate the impacts that these disasters cause in society. In the field of medicine, 16% of the articles were published, which in general seek

Table III. Evolution of the registry on natural disasters in Brazil.

Period	Form of registration
until 1967	Absence of systemic national registration. Records can be found in municipal or state agencies and in newspapers.
from 1967 to 1988	Registration in the Ministry of the Interior of the cases in which the resources of the Special Fund for Public Disasters were used, but without the existence of a systemic database. The information from this period obtained through official documents and secondary sources such as newspapers.
from 1988 to 2012	Registration in the local civil defense, based on non-binding documents, that is, there is no systematic organization of all information about disasters; Creation of Disaster, Threats and Risks Codification - CODAR
from 2012 up to the present	Mandatory notification of disasters through the Integrated Disaster Information System - S2ID and link between mandatory documentation and recognition of the disaster or public calamity. Replacement of CODAR by the Brazilian Disaster Codification - COBRADE

to assess issues related to public health in natural disasters. The areas of environmental sciences and engineering represent 16 and 12%, respectively, and seek to evaluate strategies and policies for managing water and soil quality, assessing the risk of natural disasters, assessing disasters in infrastructure, among others.

Table IV shows the journals that publish the most in this field of research. The journals with the most publications are Disasters, Natural Hazards Reveiew and Science with 15, 14 and 13 publications respectively.

Using the Vosviewer software, the main words that appear in the abstracts, titles and keywords of the documents published in this work area were mapped. A total of 280 words were found, which were repeated at least 7 times, as shown in Figure 6. The larger the font and circle, the greater the number of repetitions of that word in the searched documents. Thus, it is observed that the words "public policy", "natural disasters", "united states", "human", are the words that are most repeated.

In Figure 6, it is possible to observe that the most common words in these articles are divided into 3 groups: a) blue: Words related to issues of population and economic dynamics, with words such as "macroeconomic factors", "population dynamics", "developing countries", "policy", "demography", among others; b) red: occurrence of natural disasters risk analysis and strategies adopted, to mitigate or manage the occurrence of disasters, occurring words such as: "public policy", "disasters", "natural disasters, "natural hazards", "planning", among others; c) green: words related to public health issues in natural disasters, occurring words such as: "human", "adult", "comparative study", "psychology", "Public health", among others.

DISCUSSION

The civil defense in Brazil has undergone profound changes in the last four decades, leaving a stage where the action was disjointed and focused on serving people affected by major public calamities, to an institution with a solid policy, based on technical data and articulated by a system with a capillarity that operates from the municipalities to the Federal Government.

After 1988, with the insertion of the subject of civil defense in the Federal Constitution, and the creation of the National Civil Defense System, the bases were created for the consolidation of

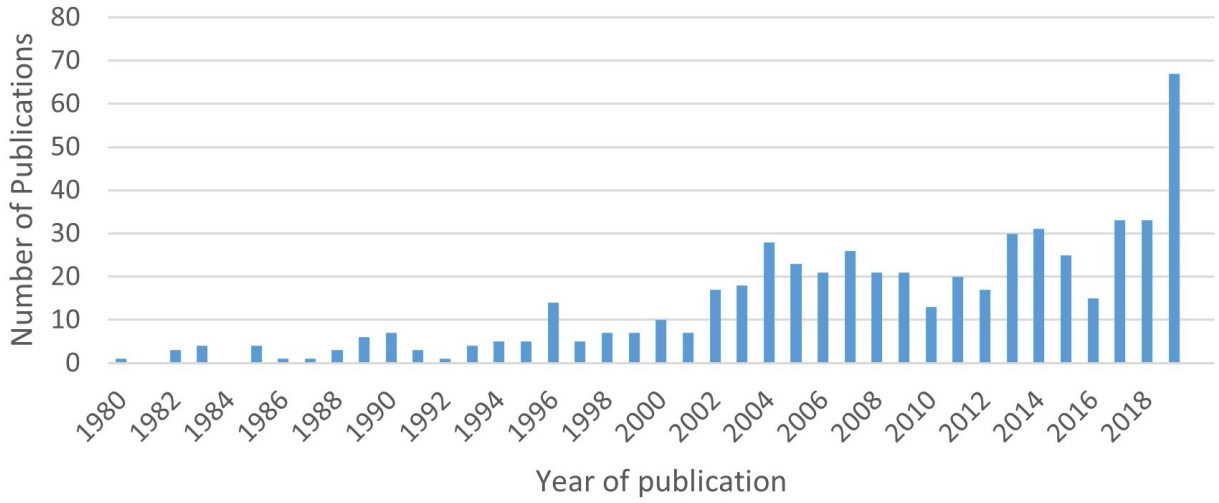

Figure 2. Evolution of the number of publications per year.

a sectorial policy and a database with the record of disasters. The harmonization of codes and nomenclatures occurred at the national level, facilitating the analysis of the records. Such instruments were used in the construction of the Brazilian Disaster Atlas.

The changes implemented in the late 1980s were, created the database that was used to prepare the Natural Disaster Atlas in 2010, demonstrating the importance of instrumentalizing policies so that it is possible to have a statistical monitoring of the civil defense related scenario. The creation of specific bodies for monitoring, analysis and prevention of disasters, contributed to the consolidation of the civil defense and protection system, bodies such as CENAD, CEMADEN and CPRM help to develop tools and critical mass that provide scientific and technological support for development local methods and analyzes.

However, even with the current advances, there are still challenges to be overcome in relation to the characterization and registration of disasters in Brazil. Carvalho (2018) presents a series of discrepancies and incompleteness of data and information related to the record of disasters, among them the duplicity of events, the difficulty of interpreting events, due to flaws in the S2ID database, lack of attachments, little care regarding the record and integrity of the data history, records not individualized by municipalities, records not individualized by type of disaster and lack of identification of the territorial dimension, in addition to incorrect dates.

Regarding the quality of the data presented in the S2ID system, a suggested solution by Xavier et al. (2014), is the crossing of information with other public databases such as the various information systems that make up DATASUS, which allow monitoring from mortality to outbreaks of post-disaster diseases (Xavier et al. 2014).

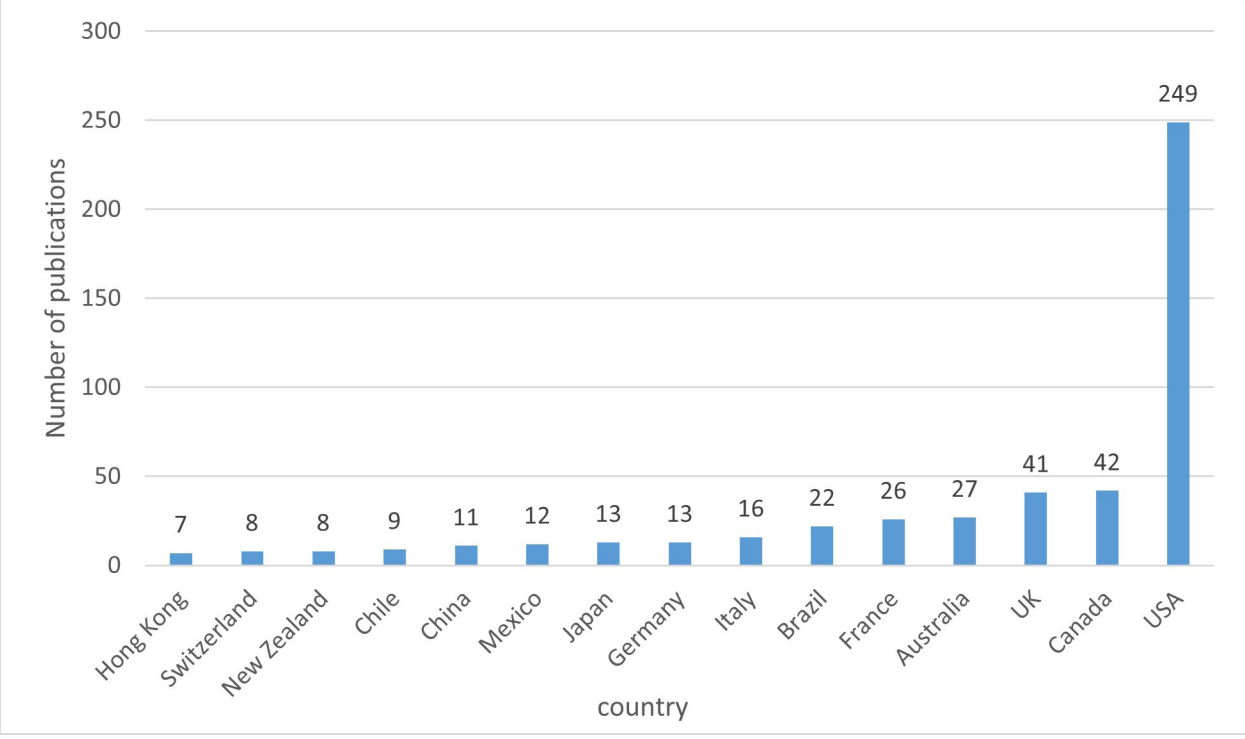

Figure 3. Countries that publish the most.

In addition to information from national databases, there is also an EM-DAT record. Carmo & Anazawa (2014) compared the existing data between information from Atlas and EM-DAT. As a result, similarities were observed in these two databases in relation to the increase in the number of disasters. However, differences were observed in relation to the percentage of the type of disasters, with the most pronounced difference between periods of drought and drought. In the atlas, this type of disaster corresponds to 53.41%, for the 1991-2010 period, in EM-DAT, it is only 7.77% of the total records. The differences between the percentages are also noted in relation to the total flooding, which in the case atlas corresponds to 44.66% and in the EM-DAT it is 32.92%, and in mass movement events, which are respectively 1.43 % and 12.62%, in the latter, showing a higher percentage in the EM-DAT database. For Carmo & Anazawa (2014) due to the adopted criterion, the EM-DAT omitted 13% of the total deaths.

Minervino (2015) also observed a discrepancy between the EM-DAT database and the S2ID, both in relation to the number of disasters, in which 36 events were counted in the first case and 4070 for the second, and for material damage resulting with values R $ 9.2 billion and R $ 331.4 billion, respectively.

The differences between numbers in the Brazilian database and the EM-DAT numbers reflect methodological differences, and may indicate cases of underreporting and under dimensioning of this worldwide database. In addition, the division into two distinct categories of registration, considering disasters of greater and lesser dimensions, favors the construction of indicators and the formulation of disaster prevention policies, especially in regions with low population density.

However, even with the aforementioned advances, in many Brazilian municipalities the person in charge of civil defense does not have adequate technical training, or in some cases, there is not even any local coordination. For

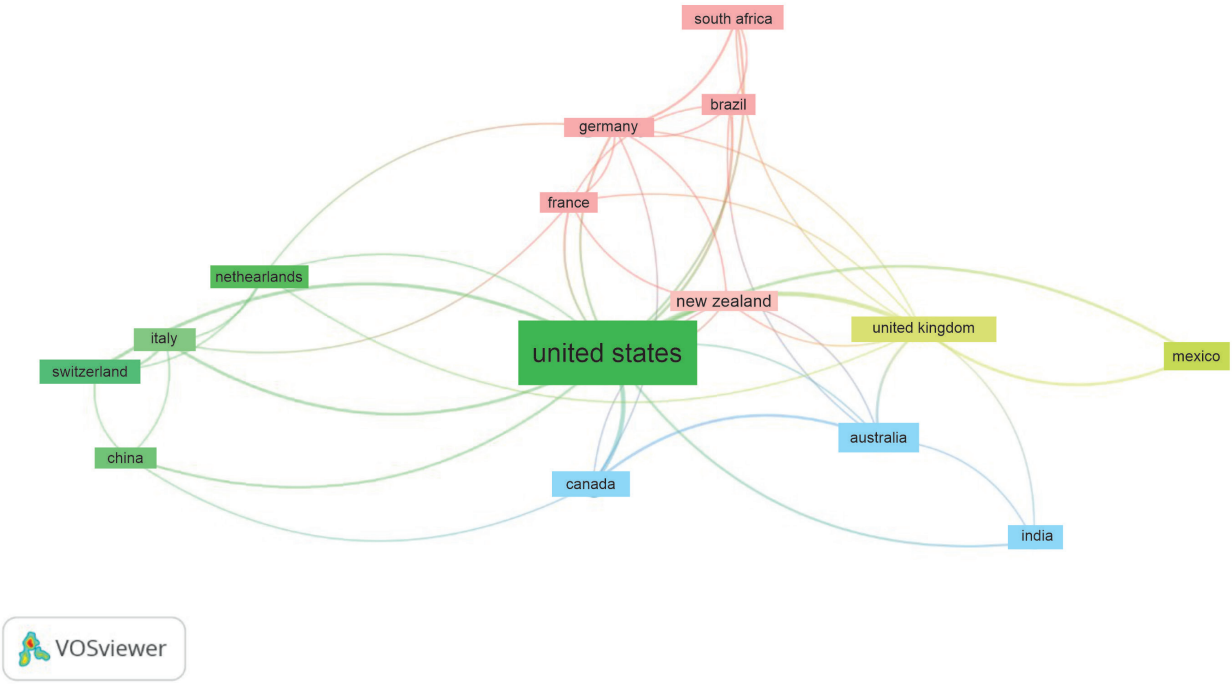

Figure 4. Citation mapping between countries.

Wirtz et al. (2014), the reliability of analyzes related to natural disasters can be guaranteed through data collection, verification and management by people with a high degree of professional specialization. Since there are already specialized bodies linked to the federal government, it is necessary that municipalities and states also have personnel with adequate qualifications to perform the registration and analysis of information.

The map of keywords presented in Figure 6 and the wide diversity of areas with a concentration of publications on the subject, reinforce the understanding of the multiple dimensions of natural disasters, including social, economic and environmental. Although research on natural disasters and public policies only gained strength on the world stage in 1980, the theme has shown considerable growth from 2016 to 2019, especially in relation to the

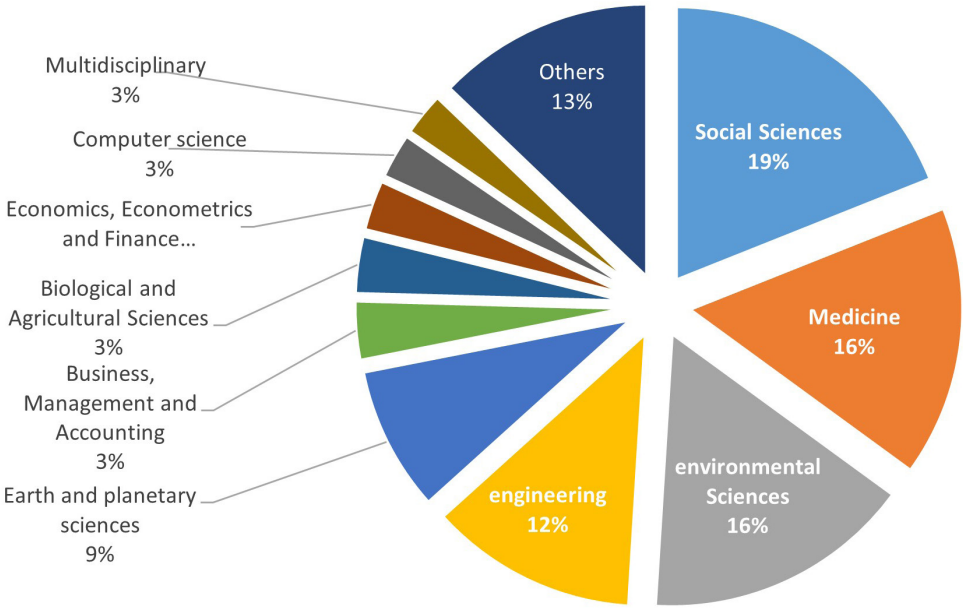

Figure 5. Documents by research areas.

Table IV. Periodicals that publish the most.

Periodical	Total publications
Disasters	15
Natural Hazards Review	14
Science	13
Environmental Management	10
Natural Hazards	9
Plos One	6
Environmental Science And Policy	6
Journal Of Forestry	4
American Journal of Public Health	4
Australian Journal of Emergency Management	3

understanding of the effects of disasters in the health area. The limited number of documents prior to the 2000s may be related to studies that were published in the form of reports not indexed in the Scopus database or other international databases.

On the world stage, countries like the United States lead the numbers in relation to the total research produced on public policies related to disasters. A fact that certainly contributes to a better characterization of impacts and to the construction of prevention policies. However, one of the reasons for the small number of publications in other countries, may be related to the fact that bibliometric analysis was carried out with terms in English, which often means that works published in other languages are not counted in these databases. international standards.

The reality described in the literature in other countries, especially in relation to small events, is quite different. Balzerek et al. (2003) when developing works on impacts of linear erosion in the state of Gombe, in Nigeria, registers houses, streets and bridges destroyed by gullies. However, he reports that the limited number of victims does not provide headlines for the international press. For Xavier et al. (2014) disasters with less extension or impact, occur without producing major political or social repercussions, but if added together, these small events have a greater impact than some major disasters.

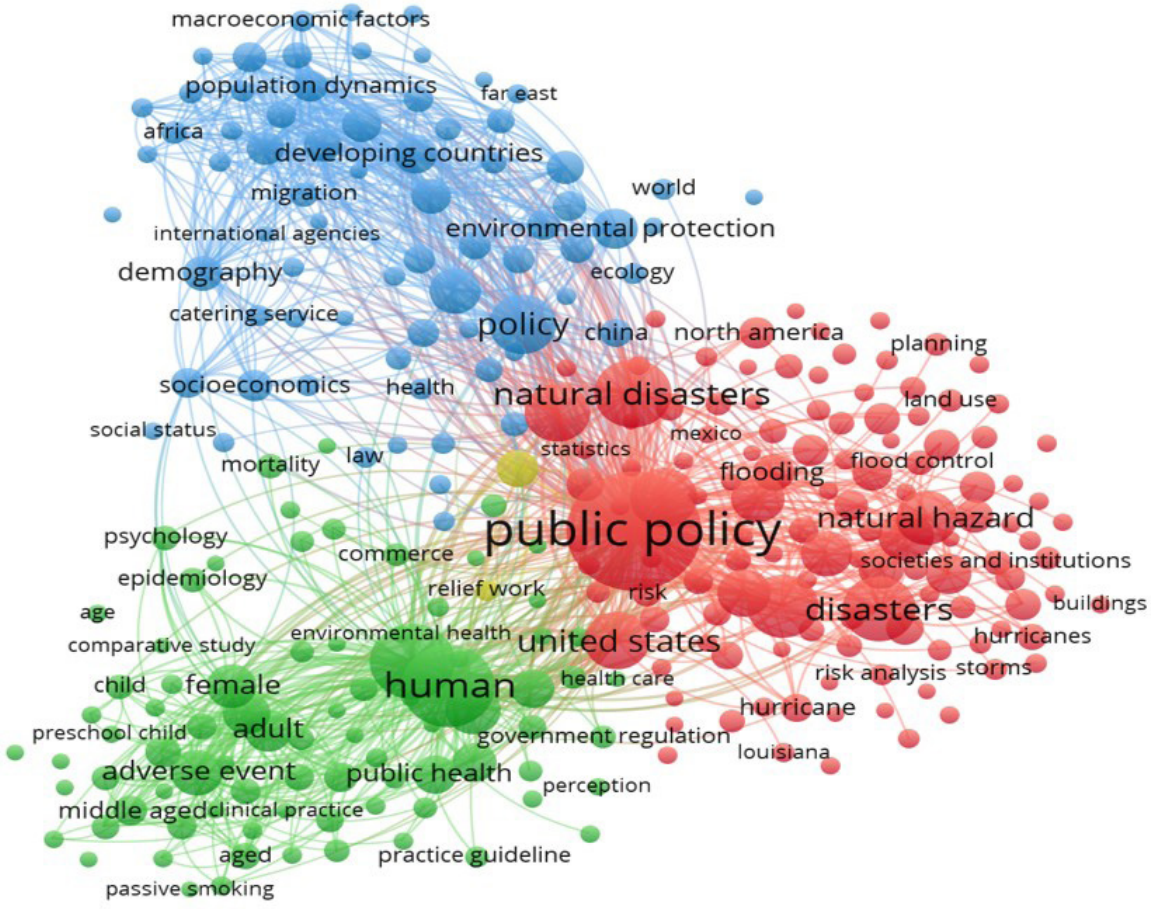

Figure 6. Keyword Map.

The data presented allows to analyze the evolution of public civil defense policy in Brazil and by relating this information to the bibliometric analysis of global data, it is possible to debate the differences in the record of disasters and the quality of information in the world, especially in the countries developing countries and poor nations. In these places in general, public policies tend to be fragile or almost nonexistent. Collaborating with this interpretation is the increase in the number of registrations in Brazil. The Atlas of Natural Disasters in Brazil (date), presented 38,996 records between 1991 and 2012, of this total, 22% occurred in the 1990s, 56% in the 2000s and 22% between 2010 and 2012. The data indicate an increase in the number of disasters by 40% in the last ten years (UFSC 2013). This gradual increase in the number of registrations may result from the evolution of public policy and the consequent reduction in underreporting of minor disasters.

However, the absence of official publications such as atlases and yearbooks, after the year 2014, where data referring to 2013 were presented, indicates that even with the implementation of the S2ID system, there is a discontinuity in relation to the provision of official information to society regarding natural disaster. This scenario suggests that after 2014 there was a weakening of institutions related to public civil defense policies. That may be linked to the restructuring of the sector's public bodies, reduction of the budget foreseen in multi-annual planning, or the disruption of part of the national system for the prevention of natural disasters.

The discontinuity of policies related to disasters may have a relationship with the memory of disasters, that is, although after the mega disaster in the mountain region of Rio de Janeiro in 2011, there was a national mobilization that resulted in legal changes and strengthening of the organs even with an increase in budget availability, after a period the weakening of the policy indicates that disaster prevention has lost strength within the governmental sphere. This new scenario may put at risk every effort made by Brazil, both in the structure of a system and in investments made in mapping, prevention and public containment works. This can cause serious problems in the coming years, with an increase in disasters of great magnitude in the country and an increase in the number of people affected.

CONCLUSIONS

The consolidation of public protection and civil defense policies are fundamental to reduce the impacts of natural disasters and to improve the quality of the databases that record these catastrophes. Countries in the world have different degrees of institutional development, which contributes to the underreporting of natural disasters events, especially in developing countries.

The recent evolution of the research on public policies and natural disasters shows that the theme still needs to evolve in order to generate more reliable global indicators. Likewise, when analyzing historical series, it is necessary to consider the existing limitations, both in terms of quantity and quality of data. This caveat is very important when considering the increase in disaster records as a direct consequence of climate change.

Brazilian data on disasters show a change in the way the state manages a civil defense issue. Four moments were identified, starting with a military civil defense related to the second war, moving on to a civil defense to respond to catastrophes, followed by an incipient civil defense system and, finally, the consolidation of a national system. Such changes also reflected

in the way in which information is recorded in the national database, which also has a history that can be divided into 4 moments, namely: 1) registration in newspapers and other documents; 2) registration of major disasters in the federal government and minor events in newspapers and other documents; 3) registration with the local civil defense, but without the existence of a set of binding documents; and 4) registration in a national system with binding documents.

The discontinuity of investments in public policies evidenced in Brazil, especially, after 2013 is a point that can undermine the entire effort to structure an integrated civil defense system in the country. The reduction of new mapping of risk areas, as well as of containment works, can charge a very relevant social, economic and environmental cost for the country in the coming years.

The assessment of the real representativeness of information in international databases is a technical and scientific challenge to understand the evolution of natural disasters in the world, the natural and anthropic conditioning factors involved and the social, economic and environmental consequences.

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