

# The evolution of the protection systems against natural disasters in Brazil: laws, agencies, information and knowledge

É. Soriano & W. A. M. Hoffmann  
*Federal University of São Carlos (UFSCar), Brazil*

## Abstract

Natural disasters occur all over the world in different degrees and levels, by the frequency of events, the intensity of processes, and the vulnerability of population groups. Brazil has always been discursively and popularly considered a safe country regarding the occurrence of natural disasters. This interpretation is due to its geographical localization, which prevents earthquakes' occurrence, volcanic activity and tropical cyclones in its territory. On the other hand, it is one of the countries that registered the highest number of natural disasters, especially those associated with geological and hydrologic processes. According to the United Nations, in 2008, Brazil was the 13<sup>th</sup> most affected country by natural disasters. The Brazilian Atlas of Natural Disasters indicates that the record of natural disasters occurrence in the country reported a positive increase of 268% in the last ten years. After the disaster in the mountainous region of Rio de Janeiro in 2011, the government sought to structure itself in order to prevent new disasters. Thus, different organizations that are part of the National System of Protection and Civil Defense (NSPCD) were created, such as: The National Center for Monitoring and Warning of Natural Disasters (CEMADEN), The System of Urban Occupation Monitoring proposed by the Ministry of Cities (MCid), The Integrated System for Information about Disasters (S2iD), and others. The aim of this study is to analyze the evolution of systems for protections and disasters risk in Brazil, as well as to evaluate knowledge gained by the departments of protection and civil defense.

*Keywords: natural disasters, vulnerability, civil defense, knowledge.*



## 1 Natural disasters

Natural disasters are defined by phenomena that occur in the biosphere and may result in a damaging event, causing death or injuries, material damage, social and economic activity interruption and environmental degradation (United Nation Office for Disaster Risk Reduction – UNISDR, 2007).

According to the UNISDR [1], a disaster represents a serious disturbance to a community or a society, involving human, material, economic or environmental loss in a wide range; its impacts exceed the community or society's ability to afford the damage with their own resources. The Emergency Disasters Database – EM-DAT [2] – defines a disaster as a situation or event that exceeds the local capability, demanding a request for external assistance in national or international levels.

Natural disasters occur all over the planet in different levels and degrees. This represents the apex of a continuous process that shows the imbalance between the social system forces, such as territory occupation by society, with the natural system, through the force of a determined physical process, with the occurrence of a specific igniting process. They represent an abrupt imbalance, which generates modification and rupture in the territory functionality [3–5]. This occurs combined with natural physical processes, with vulnerability processes that increase risk and danger, such as: limitation of technical systems for prevention; States' omission in the occupation of high-risk areas; lack of dialogue between the civil protection agents and the community; the determination of risk areas, and others.

According to the National Secretariat of Civil Defense [6], natural disasters in Brazil have been occurring with greater intensity.

## 2 Natural disasters in Brazil

Brazil is located in the South American continent. It is composed of 27 Federal Units: 26 states and the Federal District. Brazil is the fifth largest country in area in the world, with 8.5 million square kilometers and it is the fifth most populous country, with a total population of 202 million inhabitants [7]. It is a country with great dimensions and complex territorial challenges, as well as high socioeconomic inequality, which results in a high number of people vulnerable to natural processes that may cause disasters. It is estimated that there are around 500 areas at risk of landslides and other 300 are prone to flooding, with approximately five million people in a vulnerable condition.

Brazil has always been discursively and popularly considered a “safe” country, considering natural disasters occurrence, especially those caused by high intensity processes, which may result in a high number of deaths. This interpretation is based on Brazil's geographical localization that prevents the occurrence of high intensity earthquakes, volcanic activity, extreme temperature gradients and severe tropical cyclones in its territory. On the other hand, it is one of the countries that registered the highest number of natural disasters, especially those related to geological processes, as landslides and other mass movements;



and hydrologic processes, such as river floods, flooding and drought. According to the United Nations, in 2008, Brazil was the 13th most affected country by natural disasters. The Brazilian Atlas of Natural Disasters [8] indicates that the record of natural disasters occurrence in the country reported a positive increase of 268% in the last ten years, as can be visualized in figure 1.

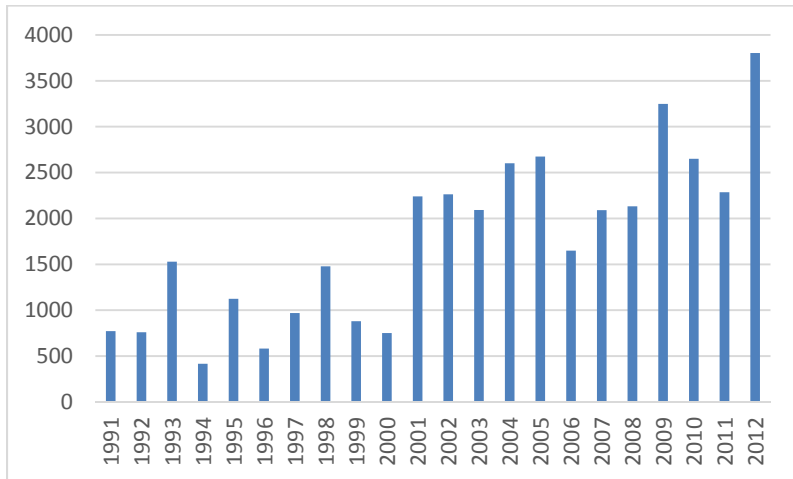


Figure 1: Evolution of natural disasters total occurrence in Brazil (source: Brasil [8]).

According to Valencio [9], disasters are a chronic problem in Brazil and the policies adopted in the scope of the National System of Protection and Civil Defense (NSPCD) have not been able to solve this problem. In the past decade (2004–2013), Brazil presented: 19,941 municipal decrees of emergency situations (ES), defined as an intense and serious deterioration of the normal situation conditions in a particular city, state or region, enacted in disaster reason, partially compromising its responsiveness; or state of public calamity (SPC), when the disaster substantially compromises responsiveness, acknowledged by the National Secretariat of Civil Defense and the Ministry of National Integration.

The urban space requires special attention to the management of natural disasters risk, since these places create or enhance risk factors. Late urbanization and the migration process from rural areas to the cities only started, mainly in developing countries, after the Second World War. This process emphasized the socioeconomic and territorial inequality of some population groups. Exclusion is mainly characterized by the access to inhabit safe areas and the construction of quality housing. In this sense, Brazilian cities may be considered risk sceneries with high potential of resulting in socioeconomic and environmental damage due to: high socioeconomic inequality, lack of urban planning, absence of the State's active participation, property speculation, and high population concentration, leading to a significant part of the population living in risk areas, which enhances

the number of victims and affected people [10]. The risks and dangers associated with urban sprawl “are expressed by the lack of adjust and the adherence of urban space production to natural systems”. The increase in these risks is not only due to natural phenomena caused by climate change, but also to urban development characterized by lack of planning, allowing the development of residential areas in areas at risk, as in floodplains and hillsides.

Brazil has a high rate of urbanization with approximately 85% of the population living in cities, as can be seen in figure 2. According to the State Report of Latin American Cities and the Caribbean [12], in 2020, approximately 90% of the population from Brazil, Argentina, Chile, Paraguay and Uruguay will be living in cities. Nowadays, the Latin American and the Caribbean regions are considered the most urbanized regions in the world with an approximate rate of 80%. The highlights are the cities of Sao Paulo and Rio de Janeiro, combined with the cities that are part of the metropolitan region, resulting in an urban agglomeration of 21 and 12 million people, respectively.

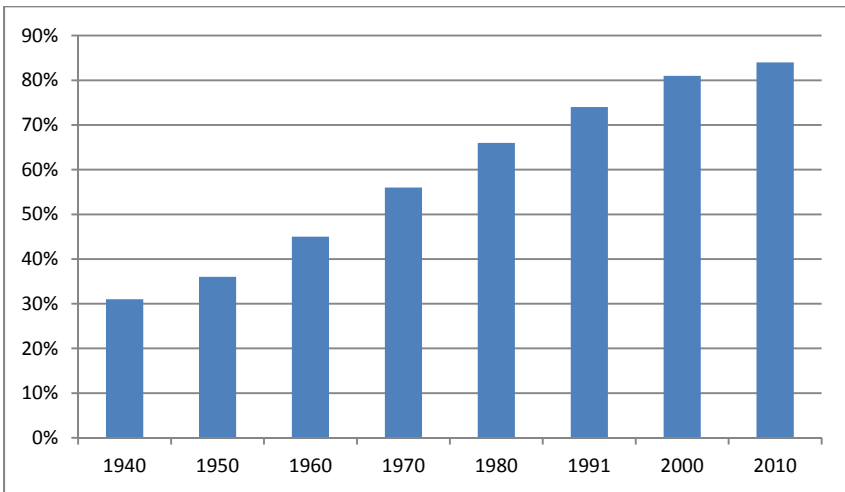


Figure 2: Evolution of urbanization rate in Brazil (source: Demographic Census IBGE).

According to Gonçalves and Souza [13], Brazil presents a paradox through which the economic growth did not reflect in its development, that is, it did not benefit the entire population. This process can be observed in the social vulnerabilities (poverty, low educational level and precarious access to health and housing) of large Brazilian cities, which results in the occupation of areas environmentally vulnerable (floodplains, hills and contaminated places) and irregular ways, without basic infrastructure and a building pattern that would decrease the risks.

These situations are common in almost the entire national territory. However, the risk increases with disorganized occupation of coast areas, which are tropical

wet coastal areas that combine frequent processes of mass movement, shallow soil, great intensity precipitation and high level of human occupation. About 90% of the total population is concentrated in the coast areas, especially around Sao Paulo and Rio de Janeiro.

Thus, population groups of low purchasing power, in most cases, are obligated to live in dangerous environmental areas, as a consequence of the real estate market's mediation, limiting their access to housing. Based on this, it is possible to state that disasters, mainly regarding landslides and flooding in specific urban areas, are socially built [14].

In an attempt to reduce the risk of disasters, mainly the number of victims, Brazil, despite being a belated attempt, presents evolution in the Systems of Protection and Population Defense.

### **3 Evolution in the systems of protection and population defense**

The Organizations of Protection and Civil Defense in the country are responsible for preventive, aid, assistance and recovering actions with the aim of avoiding or minimizing disasters.

The Brazilian Civil Defense agency was created in 1940s. The proposal of considering Civil Defense as strategic institution to reduce risk of disasters occurred with the organization of the National System of Civil Defense, in the Decree no. 97.274, from 12/16/1988 [15]. This decree was revoked by no. 895 from 08/16/1993, which instituted the National System of Civil Defense (NSCD) in the country. According to Article 3, subparagraph I, civil defense is “the set of preventive, aid, assistance and recovering actions designed to avoid or minimize disasters, preserve the populations’ moral and reestablish social normality”.

Considering the natural disasters legislation, The National Policy of Protection and Civil Defense (NPPCD) was approved and sanctioned, Law 12.608, from April 10<sup>th</sup>, 2012. It involves the actions of prevention, mitigation, preparation, response and recovery designed for protection and civil defense. The NPPCD, in its second article, states as a duty of the Union, States, Federal District and Cities to adopt actions necessary to disasters risk reduction, moving away uncertainty as an excuse for inaction [13].

According to this policy, the cities with natural disasters risk areas must develop:

- I) Mapping of areas susceptible to landslides, flooding or geological or hydrologic processes;
- II) A Contingency Plan of Protection and Civil Defense and institute municipal agencies of civil defense, according to the procedures established by the central agency of the National System of Protection and Civil Defense;
- III) A plan of work and services implementation to reduce the risk of disasters;
- IV) Control and supervision mechanisms to avoid construction in areas susceptible to landslides of great impact, flooding or geological or hydrologic correlated processes.

In this context and with the aim of avoiding socioeconomic, environmental and human damages, the Brazilian government created in 2011 The National Center for Monitoring and Warning of Natural Disasters (NCMWND), its activities began in December of the same year. It was a response to the worst natural disaster recorded in the country: the disasters in the Mountainous Region of Rio de Janeiro, in January of 2011. In that period, landslides and severe flooding caused the death of about 900 people [9, 16]. Other actions taken by the government were to hire new employees and expand the infrastructure of the National Center for Risk and Disasters Management (NCRDM), which was connected to the National Secretariat of Civil Defense (NSCD) [9].



Figure 3: Landslides in Teresópolis (RJ) in the year of 2011 (source: [17]).

The NCMWND has the aim of developing, testing and implementing a system to predict the natural disasters occurrence in susceptible areas in Brazil. The Center not only helps the preventive actions, but also makes it possible to identify vulnerabilities in soil use and occupation, highlighting urban planning and the installation of infrastructure. The line of priority action has the goal of providing data about risk areas related to hillside landslides and flood in the country. The Center's main strategy is to develop partnerships with state and federal institutions all over Brazil in order to improve dissemination of information and detailed analysis to solve problems [18].

The NCRDM is responsible for consolidating the information about risks in the country, such as maps of landslide and flood risk areas, besides the data related to the occurrence of technological and natural disasters and the associated damages. By managing this information, the Center can support states and cities in the actions of preparing the most vulnerable communities for disasters. It is the Center's responsibility to issue and broadcast the warning of national

disasters risk to the competent protection agencies from cities in the entire country [19].

It is important to highlight that there are many local and regional centers of monitoring and warning in many Brazilian cities and states. They are connected to municipal and state government and directly subsidize the local systems of protection and civil defense.

#### **4 Information and knowledge**

Although the country presents an increase in the number of institutions and a new legislation regarding the theme of disaster, the information about risk and prevention has still not reached the entire population. The simulation and training situations with civil defense are extremely individual cases.

Considering school-age children, the topic “General Notions of Civil Defense and Risk Perception” began to be inserted in the teaching units as a transversal theme of the National Curricular Parameters, which may represent the possibility of universalizing the subject and the potential of reaching all students from elementary and high school in the country.

In regard to the scientific knowledge related to the theme, meaningful evolution in the academic environment is highlighted, considering the development of Research Lines, Research Groups and the Centers of Studies and Research on Disasters in many states through the cooperation between states, civil defense and universities, which focuses on the areas of teaching, research and extension related to reducing the risk of disasters. Similarly, the scientific version of The National Center for Monitoring and Warning of Natural Disasters has been contributing to scientific knowledge through the development of scientific research about the theme of risks and natural disasters, in the areas of meteorology, hydrologic resources, geology and natural disasters, focusing on prediction, preparation, prevention and mitigation of external events impact.

However, mechanisms that allow dialogue between groups of population and public managers are still needed. This communication must be based on adequate information and knowledge sharing, as well as the appreciation of the population’s tacit knowledge, which could contribute to identify new risks and understand the causes of vulnerabilization.

#### **5 Conclusion**

Natural disasters as the result of physical processes that form landscapes cannot be avoided. What must be done is to adopt preventive measures that contribute to the reduction of vulnerability and vulnerabilization processes, resulting in damage and victim reduction, especially fatal victims.

In Brazil, despite being presented late, it is possible to observe evolution in the systems of civil protection and natural disasters management, both in prediction and operational level, as well as in knowledge production, in sharing information of risk and in the specific legislation. In addition, the creation and



appreciation of monitoring systems and technologies of risk prevention have shown to be relatively effective.

However, it is necessary to point out that there is much to be done. The main deficiencies that need to be addressed are: lack of precise information on risks and dangers, as well as the vulnerability of population groups; local and regional differences in the protection and civil defense systems; procedures and protocols standardization; improvement in information and communication flow between institutions; lack of preventive measures and appropriate information for population groups at risk; lack of a risk culture; improvement in construction patterns, associated with reducing the vulnerabilization process; more efficiency from the civil defense agents; the need to follow the specific legislation related to natural disasters, such as Law 12.608, and others.

The Brazilian general consideration regarding the dynamics of Civil Defense and disasters combat consists, basically, in actions during or after the disastrous event; that is, it focuses on the mitigation of consequences and not on prevention. There is still the predominance of crisis management, based on facing a disastrous situation, rather than risk management that focuses on prevention.

Therefore, there is a high demand of structural and non-structural measures, with preventive actions, not only mitigating ones. Actions that allow the decrease of vulnerability and, as a consequence, of fatal victims are needed. Thus, it is necessary to establish better articulation between the actors that compose the system of protection and civil defense, as well as a more effective participation of these institutions.

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