



Summer 2019

The Ore Tailings Dam Rupture Disaster in Mariana, Brazil 2015: What We Have to Learn from Anthropogenic Disasters

Délton Winter de Carvalho
Universidade do Vale do Rio dos Sinos

Follow this and additional works at: <https://digitalrepository.unm.edu/nrj>



Part of the [Law Commons](#)

Recommended Citation

Délton Winter de Carvalho, *The Ore Tailings Dam Rupture Disaster in Mariana, Brazil 2015: What We Have to Learn from Anthropogenic Disasters*, 59 Nat. Resources J. 281 (2019).

Available at: <https://digitalrepository.unm.edu/nrj/vol59/iss2/5>

This Article is brought to you for free and open access by the Law Journals at UNM Digital Repository. It has been accepted for inclusion in Natural Resources Journal by an authorized editor of UNM Digital Repository. For more information, please contact amywinter@unm.edu.

Délton Winter de Carvalho*

**THE ORE TAILINGS DAM RUPTURE DISASTER
IN MARIANA, BRAZIL 2015:
*WHAT WE HAVE TO LEARN FROM
ANTHROPOGENIC DISASTERS***

ABSTRACT:

This article presents a description of the largest environmental disaster in Brazil to date, the rupture of the ore tailings dam which occurred in the municipality of Mariana, Brazil. This event of environmentally, economically and socially catastrophic proportions was caused by a tsunami of mud from tailings resulting from ore exploitation. This article preliminarily describes the magnitude of the event, focusing on regulatory failures that can yield lessons in order for future similar events to be avoided. The ultimate goal of this article is to reflect on the low capacity for evaluation and management of catastrophic risks, not only in Brazil, but throughout the world. To this end, this article will discuss how Disaster Law theory can provide a conceptual tool used to identify the regulatory and preventative deficits which compound the impact of serious environmental risks. This article then discusses suitable ways to utilize disaster law theory in the preparation of future disaster risk reduction policies.

INTRODUCTION

This article initially presents a reflection on the biggest environmental disaster in Brazil in 2015: the rupture of the tailings dam of the Samarco Mining Company in Mariana, in the Brazilian state of Minas Gerais. Following this, the article presents a reflection on what can be learned from anthropogenic disasters, commonly named industrial accidents, with the purpose of avoiding future occurrences. The focus presented here incorporates theory from the legal field of Disaster Law. This article begins by making use of preliminary technical documents from the dam rupture prepared by official environmental agencies, as well as material and statements from those involved in the media coverage of this catastrophic event. It should be noted, that this article, far from claiming to be a complete and

* Professor of Law at Universidade do Vale do Rio dos Sinos – UNISINOS Law School Post Graduation Program, Brazil. J.D. and Master of Law at UNISINOS. Visiting scholar at University of California at Berkeley, US in 2013. delton@deltoncarvalho.com.br.

comprehensive description of the entirety of damage to the dam and its environmental, legal, political, and economic repercussions, aims instead to demonstrate the low degree of legal sensitivity to environmental risks in Brazil and, further, to explore how the mechanisms in place prior to this disaster in Brazil are entirely too common not just within Brazil, but throughout the world. The failure to pay greater attention to scientific information and the circularity in risk management contributes to the severity of environmental disasters. This article explores how by disaster law theory might be incorporated into new governmental mechanisms to mitigate future contribution to environmental disasters

1. ORIGIN AND HIGHLIGHTS OF THE MARIANA DISASTER AND ITS AFTERMATH

The Mariana disaster is considered the biggest environmental disaster in Brazil's history.¹ The Mariana disaster had its beginning on November 5, 2015, and the impacts seem far from having an end. The rupture of the Fundão iron ore tailings dam, belonging to the Samarco mining company, controlled by Vale do Rio Doce and BHP Billiton, took place in the Bento Rodrigues sub-district of Mariana, in the State of Minas Gerais, Brazil, causing a flood of ore tailings. After invading the Doce River, the so-called "mud tsunami"² passed through cities of two Brazilian states, Minas Gerais and Espírito Santo, reaching the Atlantic Ocean sixteen days later.

The Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis - IBAMA³ Preliminary Technical Report of November 26, 2015 ("IBAMA Report") on the event states:

"On 05.11.2015, the Fundão dam burst, belonging to the Germano mining complex, in the municipality of Mariana / MG. The dam contained 50 million m³ of iron mining tailings. It is a waste classified as non-hazardous and not inert to iron and manganese according to [Brazilian Norm] NBR 10.004. Thirty-four million cubic meters of these wastes were released into the environment,

1. Dom Phillips. *Samarco Dam Collapse: One Year on from Brazil's Worst Environmental Disaster*, GUARDIAN (Oct. 15, 2016, 3:00 PM), <https://www.theguardian.com/sustainable-business/2016/oct/15/samarco-dam-collapse-brazil-worst-environmental-disaster-bhp-billiton-vale-mining>; Marina Branco and Fabio Ponso, *Maior Desastre Ambiental do Brasil, Deixou 19 Mortos*, O GLOBO (Aug. 8, 2017, 1:00 PM), <http://acervo.oglobo.globo.com/em-destaque/maior-desastre-ambiental-do-brasil-tragedia-de-mariana-deixou-19-mortos-20208009> (Braz.).

2. For reference to "mud tsunami/ tsunami de lama tóxica" see Heriberto Araujo, *Tsunami de Lama Tóxica, o Maior Desastre Ambiental do Brasil*, EL PAÍS (Dec. 31, 2015), https://brasil.elpais.com/brasil/2015/12/30/politica/1451479172_309602.html (Braz.).

3. IBAMA is the executive body responsible for implementing the National Environmental Policy in Brazil, established by Law No. 6.938, of August 31, 1981, and carries out various activities for the preservation and conservation of natural heritage, exercising control and oversight over the use of natural resources (water, flora, fauna, soil, etc.). It is also responsible for granting environmental licenses to undertakings within its competence. It could be said that it is the federal environmental agency in Brazil and is part of the Brazilian Ministry of Environment.

and further 16 million are gradually being carried downstream to the sea, already in Espírito Santo State. (. . .).⁴

Subsequently, in a synergistic effect, the Santarém dam broke, releasing another 7 million m³ of tailings. Cumulatively, the accidents released a total of 62 million m³ of tailings.⁵

Also according to the IBAMA Report, about 663.2 km of water bodies were directly impacted.⁶ The accident resulted in the deaths of 19 people in the district of Bento Rodrigues.⁷ The accident also destroyed and damaged the water supply in several municipalities and continues to cause serious environmental impacts from the Doce River to the Atlantic Ocean, where the river ends.⁸

Due to the immense magnitude of the event, there is significant limitation and great difficulty to describe in a sufficiently comprehensive way all of the complexity and interconnection of the environmental and human impacts resulting from the dam's rupture. In fact, the number of affected people and ecosystems alone demonstrate the magnitude of negative effects as well as the huge diversity in the typology of these impacts. These immense and ongoing damages have come to be known as a slow-motion disaster.⁹ This slow-moving disaster has caused direct, serious, and onerous environmental and social damages. Territorially, it continues to impact an entire region, affecting 663.2 km of water bodies in the states of Minas

4. IBAMA/DIPRO/CGEMA, LAUDO TÉCNICO PRELIMINAR: IMPACTOS AMBIENTAIS DECORRENTES DO DESASTRE ENVOLVENDO O ROMPIMENTO DA BARRAGEM DE FUNDÃO, EM MARIANA, MINAS GERAIS 1, 3 (2015), https://www.ibama.gov.br/phocadownload/barragemdefundao/laudos/laudo_tecnico_preliminar_ibama.pdf. (translated from original Portuguese to English by author) (Braz.) [hereinafter IBAMA Report].

5. Valdo Cruz, *Volume Vazado em Mariana Equivale a 1/3 da Capacidade da Guarapiranga*, G1, BLOG DO VALDO CRUZ (June 11, 2015, 8:05 PM), <http://g1.globo.com/minas-gerais/noticia/2015/11/volume-vazado-em-mariana-equivale-13-da-capacidade-da-guarapiranga.html> (Braz.). It is now clear that while the initial amount of tailings was cited to be several different amounts, the total amount of tailings released was 62 million m³ of tailings. See Ana Lucia Azevedo, *Acidente em Mariana é Maior da História Com Barragens de Rejeitos*, O GLOBO (Nov. 17, 2015, 2:22 PM), <http://oglobo.globo.com/brasil/acidente-em-mariana-o-maior-da-historia-com-barragens-de-rejeitos-18067899>.

6. IBAMA Report, *supra* note 4.

7. *Há 3 Anos, Rompimento de Barragem de Mariana Causou Maior Desastre Ambiental do País e Matou 19 Pessoas*, G1 (Jan. 25, 2019, 2:28 PM), <https://g1.globo.com/mg/minas-gerais/noticia/2019/01/25/ha-3-anos-rompimento-de-barragem-de-mariana-causou-maior-desastre-ambiental-do-pais-e-matou-19-pessoas.ghtml> (Braz.).

8. Heloísa Mendonça, *Diretores da Samarco Serão Indiciados por Mortes na Tragédia de Mariana*, EL PAÍS (Feb. 5, 2016) (Braz.); see also Vanessa Hatje et al., *Env'tl. Impacts of One of the Largest Tailing Dam Failures Worldwide*, 7 SCI. REP. 10706 (2017), <https://www.nature.com/articles/s41598-017-11143-x>.

9. In this regard, IBAMA's preliminary technical report [*Laudo Técnico Preliminar do IBAMA*] states that "the cause of the damage has not ceased, because the disaster is ongoing and there is still mud leaking from the dam that broke in the municipality of Mariana, traversing the entire affected system. Thus, as long as there is no stabilization, it will not be possible to measure the total damage and impairments to the ichthyofauna." IBAMA Report, *supra* note 4, at 16; see also Bruce Douglas, *Brazil's Slow-Motion Catastrophe Unfolds*, GUARDIAN (Nov. 13, 2015, 2:03 PM), <https://www.theguardian.com/business/2015/nov/13/brazils-slow-motion-environmental-catastrophe-unfolds> (Braz.) (discussing how this event was a slow moving disaster); Michael Faure, *Introduction* to DANIEL FARBER, *DISASTER LAW* xiv (Daniel Farber & Michael G. Faure, eds., 2010) (General discussion on concept of slow-motion disasters).

Gerais and Espírito Santo. Impacts were also diagnosed in the estuary of the Doce River and its coastal region.¹⁰

Released weeks after the event, the IBAMA report contained a preliminary evaluation of the disaster's enormity. The report noted the death and disappearance of people; that populations had been displaced as a result of the destruction of public and private structures (buildings, bridges, streets, etc.); localities were devastated, with the consequent disintegration of community social ties; destruction of agricultural areas and pastures, resulting in economic losses; interruption of electricity generation by affected hydroelectric plants (Candongá, Aimorés and Mascarenhas); destruction of permanent preservation areas and native vegetation of the Atlantic Forest; mortality of aquatic biodiversity and terrestrial fauna; silting of watercourses; disruption of water supply; interruption of fishing which still to this day is for an indefinite period; disruption of tourism; loss and fragmentation of habitats; restriction or weakening of ecosystem services; changes in the quality standards of fresh, brackish and sea waters; feelings of fear and helplessness in the population.¹¹

To breakdown the damaging consequences, this Article now will examine separately the direct human impacts, the environmental impacts, and the other damages as analyzed in the IBAMA Report and the Minas Gerais Government's "*Report on the Evaluation of Effects and Consequences of the Fundão Dam Breakdown in Mariana-MG.*" ("Minas Report").

1.1. Direct and Indirect Human Impacts

The Minas Report published after the disaster exclusively focused on the impact to that state. According to the report, there were a total of 10,482 people affected by the disaster.¹² The event further had drastic direct impacts on the community and region, with negative effects on public health and fundamental safety conditions of people on a microregional scale.¹³ In sum, the direct and indirect human impacts included the impact to public health and fundamental safety conditions of people, impact on the symbolic elements, impact on the access to education, and the

10. *Brazil Dam Toxic Mud Reaches Atlantic via Rio Doce Estuary*, BBC (Nov. 22, 2015), <https://www.bbc.com/news/world-latin-america-34892237>.

11. IBAMA Report, *supra* note 4, at 4-5, 33-34; see also Viviane Machado e Mário Bonella, *Três Anos Depois, Situação do Rio Doce é Incerta e Samarco Tem Previsão de Volta só em 2020*, G1 (May 11, 2018, 8:03 AM), <https://g1.globo.com/es/espírito-santo/noticia/2018/11/05/tres-anos-depois-situacao-do-rio-doce-e-incerta-e-samarco-tem-previsao-de-volta-so-em-2020.ghtml> (Braz.).

12. BELO HORIZONTE: TASK FORCE GROUP, RELATÓRIO: AVALIAÇÃO DOS EFEITOS E DESDOBRAMENTOS DO ROMPIMENTO DA BARRAGEM DE FUNDÃO EM MARIANA-MG, Decreto n. 46.892/2015, 1, 62 (Feb. 2, 2016), http://www.agenciaminas.mg.gov.br/ckeditor_assets/attachments/770/relatorio_final_ft_03_02_2016_15h5min.pdf (Braz.) (translated from original Portuguese to English by author) [hereinafter Minas Report].

13. The micro-regional scale here defined as "... [R]elated to destruction effects by the mud wave generated by the dam rupture on the municipalities of Mariana, Barra Longa, Rio Doce and Santa Cruz do Escalvado, including the affected districts." Minas Report, *supra* note 12, at 8; see also *id.* at 62-65 (Such as exposure of animals to serious diseases; interruption of surveillance services in health, epidemiological, sanitation, environmental and workers health; interruption of public security services; hurt people; psychological impact for the affected population; losses to public health services; social insecurity and fear of crime).

impact on social organization and the economy.¹⁴ According to reported estimates, the disaster caused an initial loss of R\$1.2 billion in Minas Gerais alone, reaching 35 municipalities of that state and, indirectly, a population of 320,000 people as reported by the Minas Gerais State Government task force.¹⁵

First, the Minas Report focused on the damages to public health and fundamental safety conditions of people, including those who were wounded, dead, or psychologically shaken.¹⁶ The report discussed problems related to the security of the affected population, either by the suspension of their temporary shelter conditions or by looting in properties that, though not destroyed, could not be used.¹⁷

Second, the report discussed the impact on the symbolic elements and the impact to the access to education. The report notes that sacred works of art were looted and destroyed – causing the loss of historical and cultural riches.¹⁸ There was also disruption in education services.¹⁹ In Barra Longa, a municipality located in the state of Minas Gerais, approximately 1,000 students were deprived of classes in the municipal and state school network.²⁰

Third, with respect to the impact to social organization and the economy, there were changes in routine activities and the separation of neighbors within the state as a result of the destruction noted above. With the destruction to bridges, streets, roads and other public facilities the means of commuting and of congregating were also destroyed.²¹ Following from the disruption to social organization there was damage to the regional economy, resulting from suspending mining activities, services and trade, and significant losses in rural production. In this aspect, the dam disruption caused losses of approximately R\$23.2 million to rural producers, only considering the municipalities of Mariana, Barra Longa, Ponte Nova and Rio Doce, according to data collected by the Company of Technical Assistance and Extension of the State of Minas Gerais (EMATER-MG).²²

In addition to these impacts, and in total, the report estimates that 311,000 people were diagnosed as being affected by the event. Contributing to the public health impact to these people, the natural resources the population depended on were affected. In Governador Valadares alone the water supply of 275,000 people was compromised.²³

14. *See also id.* at 65 (“The main impacts in this perspective are related to the interruption of the schools functioning, either by destruction of structures and / or by impossibility of access, and, on the other hand, the loss of articles of sacred art and other symbolic references of the culture of these populations.”); *see also id.* at 67-68 (As examples the Report mentions physical separation of neighbors and groups from a community and interruption/change in the routine activities of people affected.).

15. *Id.*

16. *Id.*

17. *Id.* at 62-63.

18. *Id.* at 66-67.

19. *Id.* at 66.

20. *Id.*

21. *Id.* at 49.

22. Minas Report, *supra* note 12, at 125.

23. *Id.*

1.2. Environmental Impacts

As it remains impossible to ascertain all of the direct and indirect human impacts of the disaster, it also is not yet possible to measure the full extent of the environmental impacts. As of the publication of this article, the environmental impacts are known to include the destruction of permanent preservation areas and native vegetation of the Atlantic Forest; mortality of aquatic biodiversity and terrestrial fauna; silting of water courses; disruption of water supply; interruption of fishing for an indefinite period; loss and fragmentation of habitats; restriction or weakening of ecosystem services; changes in the quality standards of fresh, brackish and salt water.²⁴

Of these environmental damages caused by the disaster, the following stand out: i) damage to water quality and availability, ii) damage to soil quality and availability, iii) damage to biodiversity iii) damage to soil composition and iv) the impact to vegetation.²⁵ First, the raw water of the water resources affected by the sludge presented “turbidity and physicochemical characteristics different from the historical average and outside the standards stipulated by the norms for consumption.”²⁶ Treated water, however, is “within the parameters considered safe for consumption.”²⁷

Second, there was damage to soil quality and availability. Specifically, the chemical quality of the soil was affected with extremely low values for the main nutrients of the soil, causing its fertility to be highly compromised.²⁸ Thus, the soil has lost its usability for the development of agricultural activities. However, although the soil lost its fertility the contamination values were below the legal limit.

Third, there was damage to the biodiversity in the area. Specifically, there was impact to fish and crustacean mortality, as well as the physico-chemical alteration in the water.²⁹ In addition to the visible mortality of fish and crustaceans along the 600 km of affected water resources, the physico-chemical changes caused by the mud also impacted the entire trophic chain, involving the planktonic community, aquatic invertebrates, fish, amphibians, reptiles and mammals that depend directly and indirectly from the waters of the Doce River.³⁰ Such changes may lead to greater threat of extinction to endangered species and even to previously abundant species.³¹

Fourth, the chemical quality of the soil was affected causing the composition of the main nutrients of the soil to change which caused the soil fertility to be highly compromised.³² Thus, the soil lost its usability for the development of agricultural activities.

24. See generally IBAMA Report, *supra* note 4.

25. Minas Report, *supra* note 12, at 21.

26. *Id.* (translated from original Portuguese to English by author).

27. *Id.*

28. *Id.* at 25.

29. IBAMA Report, *supra* note 4, at 15.

30. *Id.* at 16.

31. *Id.*

32. *Id.*

Finally, the impact on vegetation included the “destruction of 1,469 hectares along 77 km of watercourses, including permanent preservation areas.”³³ According to the Instituto Estadual de Florestas - IEF [Minas Gerais State Forestry Institute] report on the affected vegetation cover, two types of areas were classified, one *main scene* (Santarém and Fundão dams, up to the Gualaxo do Norte river towards the Carmo river), where impact is estimated at 560.35 hectares, 384.71 hectares of which are Atlantic Forest; and *adjacent areas* (subsequent to the main scene, following the extension of the Gualaxo do Norte river towards the Rio Doce estuary), an estimated 1,026.65 hectares of vegetation coverage, 126.37 hectares of which being Atlantic Forest.³⁴ Of note is the fact that ecosystem loss leads to an increase in local vulnerability, affecting regional resilience capacity. After the disaster, the loss of fishing capacity and impairment of other economic activities in the Rio Doce basin impacts, above all, quality of life. Ecosystem services are critical in the aftermath to provide minimal living conditions, such as food, water, extractive activities, shelter, for the affected community.

Ultimately, the Mariana Disaster and its aftermath had extensive direct and indirect human and environmental impacts. It is important to understand the significance of a disaster such as this in order to understand the great necessity to incorporate risk management contingency plans into the governmental structure in advance of such disasters.

2. LESSON OF MARIANA DISASTER: INCORPORATION OF RISK MANAGEMENT PLANNING INTO GOVERNMENTAL STRUCTURE.

Historically, disasters stimulate prevention and trigger the rise of regulatory parameters in a particular sector of the economy, such as in the chemical industry (Bophal), nuclear power generation (Chernobyl, Three Mile Island and Fukushima), offshore oil exploration (BP Oil Spill) and its transport (Exxon-Valdez), among many other examples. In this sense, great emphasis is given to the pedagogical and learning aspect from disasters,³⁵ since catastrophic accidents are often the result of a regulatory deficit, especially in environmental matters. The lesson from these anthropogenic disasters, including the Mariana Disaster, however, is that this historic and practiced human response to disaster ought to instead transition into advance disaster planning and governmental regulation with a goal of anticipating the necessary response and implementing the mechanisms prior to a time of emergency. Creating a risk management culture.

2.1. Absence of a Circular Risk Management Culture in Brazil

The lack of attention and awareness for the need of circular risk management contributes to risk and cost escalation associated with disasters.³⁶ The

33. *Id.* at 10.

34. Minas Report, *supra* note 12, at 26.

35. See generally Sheila Jasanoff, *Introduction* to LEARNING FROM DISASTER: RISK MANAGEMENT AFTER BHOPAL 1, 11-21 (Sheila Jasanoff, ed., 1994).

36. Daniel A. Farber, *Introduction: Legal Scholarship, the Disaster Cycle, and the Fukushima Accident*, 23 DUKE ENVTL. L. & POL'Y F. 1, 4 (2012), <https://scholarship.law.duke.edu/delpf/vol23/iss1/1-at2-5>; Robert R. M. Verchick, *Disaster Justice: The Geography of Human Capability*, 23 DUKE ENVTL.

institution of risk management in all phases of a disaster scenario is only possible through a normative attribution of this constitutive assumption in Disaster Law. Since disasters are due to physical or social vulnerabilities, legal systems are deemed to play a leading role in the fight against social and environmental injustices. Once the legal systems are in place, adoption of risk management into the very culture is required in order to have proper mitigation of future disaster impacts as established in the Disaster Law stages.

2.1.1. Disaster Law Theory.

Generally, disasters have a triggering cycle, the understanding of which is necessary for any analysis, whether it is about disaster prevention, occurrence, or the posture adopted *post factum*. The modality of Disaster Law has defined this 'life cycle' of a disaster. In Disaster Law, a disaster's life is comprised of several stages including: prevention and risk mitigation, the occurrence of the disaster itself, the emergency response, ways of compensation and, finally, reconstruction, as shown below.



Figure 1. Disaster Law Cycle³⁷

Disaster Law is constituted, in its unity and identity, by an integration of these various stages and strategies used to describe and analyze an event of this nature. This branch of law plays a prominent role in all phases of a disaster, with lawyers, members of the Judiciary and public managers having to adopt anticipatory measures and responses in a coordinated manner throughout all stages.³⁸

What is common to all these steps is the necessary risk management incorporated into their functional specificities. Disaster Law is unified by risk management. In other words, the link between the elements of this structure is provided by necessary risk management at each stage, establishing a circle of risk

L. & POL'Y F. 23, 26-27 (2012), <https://scholarship.law.duke.edu/delpf/vol23/iss1/1>; Daniel Farber, *International Law and Disaster Cycle*, in *THE INTERNATIONAL LAW OF DISASTER RELIEF* 9-10 (David D. Caron, Michael J. Kelly, & Anastasia Telesetsky eds., 2014).

37. Daniel Farber, *Direito Dos Desastres e Questões Emergentes no Brasil*, 4(1) REVISTA DE ESTUDOS CONSTITUCIONAIS, HERMENÊUTICA E TEORIA DO DIREITO-(RECHTD) 2, 6 (2012) (Braz.).

38. See generally Daniel Farber *Introduction: The Role of Lawyers in a Disaster-Prone World*, 31 NOVA L. REV. 403 (2006).

management.³⁹ This circular management of disaster risks consists of a sub-circle of interconnected strategies that links the disaster cycle itself (*See Fig. 1*).⁴⁰ The description provided by this cycle not only demonstrates the preventive role that permeates Disaster Law (due to the magnitude and the uncertainties involved in the diagnosis of probabilities) but also allows the constitution of the objectives of this branch of law.⁴¹ Thus, the emergency response, compensation, and reconstruction measures themselves must manage the risks of new disasters, circling in an integrated way around the prevention of new disasters.

The disaster cycle therefore serves as an important analytical tool for prevention, planning, and response to future disasters by orienting the societal analysis on present disasters of this nature and using the fallout of present disasters to instruct the establishment of new systems and mechanisms in anticipation of future disasters. Specifically the disaster cycle stages may be employed in order to conduct prevention planning, risk assessment and mitigation, or to design adequate emergency responses, ensure accountability and compensation for present and future disasters, and plan reconstructions that mitigate the potential of future disasters). This risk management approach fosters an analytical, systemic, and constructivist response to disaster. In this sense, the interaction of each of the phases of circular risk management not only provides the fundamental underpinnings of Disaster Law but also serves to supply specific objectives and functions upon which society may act.

2.1.2. Historical Absence of Circular Risk Management in Brazil.

As already diagnosed in studies conducted in Brazil, there is a low culture of disaster risk management in Brazil,⁴² which has the effect of increasing the probability of serious disasters, whether natural or anthropogenic. The regulatory deficit (inspection and compliance with the law) is historically known as potential factor for increasing the catastrophic risk probabilities of most environmental disasters. Additionally, a low level of compliance with existing legal regulations also increases catastrophic risk. Regarding the Mariana disaster and its overwhelming severity, some signs of regulatory failures should be mentioned.

One example of how the Mariana Disaster illustrates the regulatory deficit in Brazil is the regulatory failure in assessing the mining company's environmental license. According to a recent statement by the Public Prosecutor's Office "only basic data regarding the enterprise [was] presented at the time of the licensing

39. DANIEL A. FARBER, JIM CHEN, ROBERT R.M. VERCHICK & LISA GROW SUN, *DISASTER LAW AND POLICY* 1, 3-4 (Aspen Pub. 2d ed., 2010); *see also* Daniel Farber, *Symposium Introduction: Navigating the Intersection of Environmental Law and Disaster Law*, 2011 *BYU L. REV.* 1783 (2011), http://lawreview.byu.edu/articles/1325732020_01Farber.FIN.pdf.

40. Daniel A. Farber, *Introduction: Legal Scholarship, the Disaster Cycle, and the Fukushima Accident*, 23 *DUKE ENVTL. L. & POL'Y F.* 1, 4 (2012), <https://scholarship.law.duke.edu/delpf/vol23/iss1/1>.

41. On the objects and functional objectives structuring Disaster Law *see* Délton Winter de Carvalho, *Desastres Ambientais e sua Regulação Jurídica: Deveres de Prevenção, Resposta e Compensação*, EDITORA REVISTA DOS TRIBUNAIS LTDA 46-48 (2015) (Braz.).

42. INT'L FED'N OF RED CROSS AND RED CRESCENT SOCIETIES, *ANALYSIS OF LEGISLATION RELATED TO DISASTER RISK REDUCTION IN BRAZIL* 18-19, 50 (2012), <http://drr-law.org/resources/Brazil-Case-Study.pdf>; Ministério Da Integração Nacional, *Plano Nacional de Gestão de Riscos e Resposta a Desastres – PNGRD: Diagnóstico 2012*, Rio de Janeiro: FGV, 66 (2012).

process, and [. . .] authorization was nevertheless granted.”⁴³ Between the years 2013 to 2015, there were documented findings of dam rupture risks. The company claimed to have adopted all technical measures to mitigate the known risks.⁴⁴ Thus, there are crucial doubts that environmental agencies or the mining company entrepreneur gave due attention to the risks involved in the venture.⁴⁵ In light of the documented dam rupture risks, the absence of an executive design for the project was striking and drew attention of government officials and the Public Prosecutor’s Office. This sort of regulatory loop hole constituted a failure of the legal framework to anticipate a potential disaster.

After a Brazilian history of legislation that only focused on promoting response and reconstruction in the event of “natural” disasters, (Federal Decree 7,257/2010 and Federal Law 12,340 / 2010), Law no. 12,608/12, established the National Policy on Protection and Civil Defense - NPPCD, which instead emphasized prevention of disasters.^{46, 47, 48} In this sense, the priority of preventive actions related to the minimization of natural disasters was a newly established guideline of national policy, and disaster risk reduction was one of its objectives.^{49, 50} However, what this new legislation failed to do was account for man-made disasters, such as that which occurred at Mariana. Thus, after a legal tradition centered on merely corrective actions, new Brazilian legislation did emphasize the centrality of prevention and, consequently, the necessary management of risks in all phases of the natural disaster circle. Risk management is relevant both in the development of prevention strategies and in the response to disasters, mitigating the disaster in question and also preventing new occurrences. The new legislation (Law No. 12,608 /12) showed the “systemic approach to prevention, mitigation, preparedness, response and recovery actions” as a structural guideline. It adopted a circular and systemic basis for risk management of disaster, combining strategies of prevention, mitigation, response, compensation and recovery under the logic of circularity in catastrophic risk management.⁵¹ Thus, anticipation and response were united under the aegis of necessary and constant risk management. Despite the new

43. *MP de Minas Gerais vê Falhas em Licenciamento da Barragem de Fundão*, O GLOBO (Jan. 18, 2016), <http://oglobo.globo.com/brasil/mp-de-minas-gerais-ve-falhas-em-licenciamento-da-barragem-de-fundao-18494612> (Braz.).

44. *Id.*

45. Environmental Licensing is the main tool for risk assessment in Brazil. Every potential polluter activity needs a license approving its locational and environmental feasibility, installation and operation. Through this administrative procedure the environmental agency must ask for and analyze studies such as construction projects, risk assessments, environmental impact assessments, contingency plans, dam safety plans, and so on.

46. Decreto No. 7.257, de 4 de Agosto de 2010, DIÁRIO OFICIAL DA UNIÃO [D.O.U.] de 8.23.2019, http://www.planalto.gov.br/ccivil_03/_ato2007-2010/2010/decreto/d7257.htm (Braz.).

47. Lei No. 12.340, de 1 de Dezembro de 2010, COL. LEIS REP. FED. BRASIL, http://www.planalto.gov.br/ccivil_03/_ato2007-2010/2010/lei/112340.htm (Braz.).

48. Lei No. 12.608, de 10 de Abril de 2012, COL. LEIS REP. FED. BRASIL, http://www.planalto.gov.br/ccivil_03/_ato2011-2014/2012/lei/112608.htm (Braz.).

49. *Id.* at art. 4 (The following are guidelines of the National Policy on Civil Protection and Defense: “(. . .) III - priority to preventive actions related to disaster minimization. “).

50. *Id.* at art. 5 (“Art. 5. PNPDEC’s objectives are: I - to reduce the risks of disasters.”).

51. *Id.* at art. 4 (“Art. 4. PNPDEC guidelines are: . . . II - systemic approach to prevention, mitigation, preparedness, response and recovery actions. “).

legal framework, and because such framework omitted potential man-made disasters, there remained a low culture for risk management in Brazil. Perhaps this was because of a misconception that the country was historically immune to disasters, a belief strongly held by the Brazilian population due to the fact that Brazil has not had any major earthquakes, hurricanes, tornadoes or other natural disasters common in other parts of the world. Further, Mariana was the first really catastrophic man-made disaster to occur in Brazil, thus contributing to the populations belief that such disasters were not possible. In addition to the low legal acknowledgement, there also remained a low juridical sensitivity to scientific information.⁵² It should be noted that this institutional insensitivity to catastrophic risk was reflected in a lack of commitment by officials and even in the community to the necessity of circular management of catastrophic risks at all stages of an extreme event, i.e. prevention, emergency response, compensation and reconstruction as discussed above. As a result, the impacts of the Mariana Disaster were made greater in absence of the mechanisms of the Disaster Law stages.

2.1.3. Disaster Law Stages Applied to Mariana Disaster.

Under Disaster Law, there are several phases including the prevention/risk management phase and then following a disaster, the emergency response phase, the compensation stage, and the rebuilding stage cycling back to the prevention/risk management stage. In applying these stages to the Mariana Disaster this article attempts to use that disaster to illustrate how application of Disaster Law theory would mitigate the impact of future disasters.

With respect to the initial prevention/risk management phase, the Mariana disaster, illustrates the significant flaws in the application and design of venture process. There was limited attention by the environmental agencies to the risks involved during environmental licensing, either due to a lack of attention to previously diagnosed structural problems or to deficient monitoring. These scenarios show what I have called technological vulnerability:⁵³ a lack of constant information production and flow needed to prevent disasters and environmental damage from economic activities.⁵⁴ From a preventative standpoint, technological accidents are often due to the public administration's ignorance of what information it should require from the entrepreneur,⁵⁵ as part of its legitimate exercise of the power of administrative police. The lack of technical knowledge sometimes leads to an inability to demand prevention, since what is not known cannot be prevented. These practices of a low-risk management culture makes it difficult to rationally and

52. On the relationship between scientific analysis and law, *see generally* SHEILA JASANOFF, SCIENCE AT THE BAR: LAW, SCIENCE, AND TECHNOLOGY IN AMERICA 1, 6 (1995); DÉLTON WINTER DE CARVALHO, DANO AMBIENTAL FUTURO: A RESPONSABILIZAÇÃO CIVIL PELO RISCO 1, 124-32 (Livraria do Advogado Editora, 2013) (Braz.).

53. Carvalho, *supra* note 41, at 83.

54. According to Sheila Jassanof the right to know about risks establishes (i) who has the right to know; (ii) who has the duty to provide the information; (iii) what information is more relevant to be provided. *See* Sheila Jassanof, *The Bophal Disaster and the Right to Know*, 27 SOC. SCI. MED. 1.117-22, n.10 (1988).

55. Jassanof, *supra* note 35, at 8-12.

properly assess the environmental risks involved making prevention planning of disasters harder.

Following a disaster such as that in Mariana, the failure in managing catastrophic risks became all the more evident in the response phase. This phase includes the preparation (plans and training) and the (actual) response to disasters.⁵⁶ This is a fundamental phase to mitigate the magnitude of harmful events. Depending on the response effectiveness the disaster may cause higher or lower losses. The striking unpreparedness following the Mariana Disaster, due to the lack of adequate plans for dams according to Law 12344/2010, for emergencies, as well as of technical training resulted in public and private inability to act quickly and effectively in the emergency response itself. Specifically, the inadequate response to the Mariana Disaster included the absence of orderly response planning, of an effective alarm system, and of an early documentary description of worst-case scenarios. The low relevance attributed to Emergency or Contingency Plans required for high impact activities and cities subject to disasters⁵⁷ was further impacted due to lack of clarity about the minimum contents required for such plans and by not having established standards for preparing and presenting dam and emergency plans. Far from being an essential tool to proper risk management, response planning instead ends up being a mere bureaucratic formality causing the impact of a disaster such as Mariana to have far greater reach. This article later contains extensive discussion. On emergency planning that could or should have been done prior to the Mariana Disaster, or which could have been instituted following the disaster.

In compensation phase following Mariana, there was an explosion of judicial litigation with individual and collective demands bringing to light the fragility of the judiciary to deal with situations of judicial attendance to disasters. The connection between disasters and lawsuits is not new, it has been observed in the aftermath of both Hurricane Katrina and the terrorist attack of September 11th in the United States of America.⁵⁸ The fragility of the judiciary in Brazil had already been established by prior disasters. For example, in Brazil, the disaster from sudden floods in the mountainous region of the State of Rio de Janeiro in 2011 resulted in Recommendation 40 of the National Justice Council - *CNJ* of 2012,⁵⁹ which

56. Carvalho, *supra* note 52, at 115-24.

57. See MINISTÉRIO DO MEIO AMBIENTE, PLANO NACIONAL DE PREVENÇÃO, PREPARAÇÃO E RESPOSTA RÁPIDA A EMERGENCIAS AMBIENTAIS COM PRODUTOS QUÍMICOS PERIGOSOS - P2R2 2, http://www.mma.gov.br/estruturas/sqa_p2r2_1/arquivos/proposta_do%20_P2R2.pdf (Concerning dangerous chemicals); see also Marília Loschi, *Desastres Naturais: 59,4% Dos Municípios não têm Plano de Gestão de Riscos*, AGÊNCIA IBGE NOTÍCIAS, <https://agenciadenoticias.ibge.gov.br/agencia-noticias/2012-agencia-de-noticias/noticias/21633-desastres-naturais-59-4-dos-municipios-nao-tem-plano-de-gestao-de-riscos> ("Of the 5,570 Brazilian municipalities, more than half (59.4%) did not have planning and risk management instruments in 2017"). In the specific case of the Mariana Disaster it is known that Samarco contracted an Emergency Plan but never put into practice. See Gustavo Werneck, *Samarco Contratou Plano de Emergência Contra Desastres, Mas Nunca pôs em Prática*, EM (Nov. 24, 2015, 6:00 AM), https://www.em.com.br/app/noticia/gerais/2015/11/24/interna_gerais,710870/samarco-contratou-plano-de-emergencia-para-desastre-mas-nunca-pos-em.shtml.

58. Thomas A. Birkland, *Emergency Management and Courts in the Wake of Hurricane Katrina*, in CATASTROPHE: LAW, POLICY, & HUMANITARIAN IMPULSE 116, 123 (Austin Sarat & Javier Lezaun, eds., 2009).

59. See CONSELHO NACIONAL DE JUSTIÇA, RECOMENDAÇÃO Nº 40 DE 13/06/2012, <http://www.cnj.jus.br/atos-normativos?documento=841> (Braz.).

recommended to the State Courts that the courts were to prepare Contingency Plans for the Judiciary enabling them to stay operational in extreme cases. Although this recommendation dealt primarily with so-called natural disasters, nothing prevented its use for so-called anthropogenic disasters. However, despite having this legal instrument the absence of structural legal theory to put these instruments effectively into practice contributed to the judiciary remaining fragile several years later when the Mariana Disaster occurred. In effect, despite having Recommendation 40, the courts have failed to implement and adopt it. Had the State Court in Minas Gerais done so and established a Court Contingency Plan, the Judicial answer to the Mariana disaster response and compensation would have been faster and more effective. The consequence of this has been thousands of lawsuits for which the State Judiciary was not prepared.

Generally speaking, disaster compensation methods consist largely of jurisdictional litigation in the form of civil liability for damages and risk and insurance and government assistance. In case of an industrial accident, there is a historical trend of greater emphasis on the application of the civil liability institute due to damages of individual and collective nature.⁶⁰ In the absence of governmental assistance to help those affected by industrial accidents, the pure civil liability route is slow, complex and at times very fragmented. In light of this, the formation of funds for victim assistance has proven to be an adequate alternative for the speedy and global aid to those affected. In such cases, legislation is enacted by a jurisdiction requiring that an entrepreneur obtain and provide proof of adequate insurance coverage, a special fund, to cover potential victims of an entrepreneur's operation. In absence of such a fund, mass litigation (tort) results supplemented by government assistance programs. The mining company here, Samarco, is owned by the two largest mining companies in the world (VALE and BHP). These companies did create a Foundation to manage the emergency financial aid and compensation to the victims, In the Mariana disaster the amounts to which the entrepreneur was supposed to have been insured were insufficient to cover the losses hitherto verified.⁶¹ In moving forward from Mariana, and in effectively incorporating the compensation phase of Disaster Law, legislation could be enacted requiring mining companies maintain a disaster fund thereby ensuring that future victims would have immediate compensation without extensive litigation.

The phase of reconstruction and recovery completes the circle of risk management, seeking to take measures to prevent or at least mitigate new disasters. The reconstruction and recovery phase is meant to aim at the recovery of material goods and reestablishing stability in the social, economic and environmental dimensions of the affected community. The ultimate goal of this phase is to aim for an improved future scenario where society is more resilient and less vulnerable to

60. Daniel A. Farber, *Tort Law in the Era of Climate Change, Katrina, and 9/11: Exploring Liability for Extraordinary Risks*, 43 VAL. U. L. REV. 1075, 1079 (2009), <https://scholar.valpo.edu/vulr/vol43/iss3/4>; see also Carvalho, *supra* note 52, at 129-40.

61. Leonardo Augusto (PMDB / MG), *Seguro da Samarco não é Suficiente Para Pagar Indenizaç*, ESTADÃO (Nov. 16, 2015), <http://brasil.estadao.com.br/noticias/geral,seguro-da-samarco-nao-e-suficiente-para-pagar-indenizacoes,10000002106> (stating that new Mining Code, the mining company Samarco's insurance is 1 billion dollars, equivalent to R \$ 3.8 billion reais, would require a value between R \$ 10 and 14 billion.) (Braz.).

future disasters. It should be emphasized, therefore, that due to the severity of the effects in the case of the Samarco disaster, the post-disaster scenario offered the opportunity to establish a new normality, since, in view of the irreversible damages which were already known, a return to an old normality was not possible. In other words, the reconstruction and recovery of the Rio Doce basin and the affected communities in Minas Gerais and Espírito Santo offered the opportunity to address some of the necessary objectives for the formation of greater community resilience. However, while the monitoring was initially being improved, another mine tailings dam disaster collapsed in January 2019. As with the dam collapse in Mariana, this second dam collapse this year also followed internal reporting that the dam was at risk.⁶² So, the new normality has seemingly become a degraded environment and the failure to take action to prevent future man-made disasters of this sort.

Ideally the reconstruction and recovery phase should have proceeded differently, and as part of this resilience planning, authorities should have acknowledged the need for more complete scientific understanding of the damage caused by disaster to ecosystem services and the encouragement to these services to recovery, maintenance and assessment. Additionally, extreme anthropogenic and natural scenarios must be anticipated in the process of reconstruction and urban planning of towns in the affected communities. Specifically, there remains a need for the urbanistic choices made in the rebuilding of devastated areas to include avoiding occupation of future vulnerable areas.

2.2. The importance of emergency plans for both the private sector and the judiciary

Creation of emergency or contingency plans is an integral part of the application of disaster cycle. In the case of the mining company Samarco in Minas Gerais, the media reported that the Emergency Plan the company had made contained an erroneous estimate of the environmental risks of a possible dam rupture with mining tailings.⁶³ According to news stories, the risks that were incorporated in said plan was imprecisely or insufficiently assessed, as the documents submitted to the environmental agency foresaw the arrival of the mud only up to the “urbanized area of the district of Bento Rodrigues”, whereas a posteriori its capacity was found to reach far beyond this point, having actually covered approximately 700 km.⁶⁴

62. *Brumadinho Dam Collapse in Brazil: Vale Mine Chief Resigns*, BBC NEWS (Mar. 3, 2019), <https://www.bbc.com/news/business-47432134>.

63. See *Plano de Emergência da Samarco Previa Lama só em Bento Rodrigues*, G1 (Dec. 19, 2015, 8:53 PM), <http://g1.globo.com/minas-gerais/desastre-ambiental-em-mariana/noticia/2015/12/plano-de-emergencia-da-samarco-previa-lama-so-em-bento-rodrigues.html> (Braz.); see also Estêvão Bertoni, Juliana Coissi, & Jose Marques, *Plano de Emergência de Mineradora Samarco Ignora Alerta a Moradores*, FOLHA DE S. PAULO (Nov. 21, 2015, 2:00 AM), <https://www1.folha.uol.com.br/cotidiano/2015/11/1709264-plano-de-emergencia-de-mineradora-samarco-ignora-alerta-a-moradores.shtml>.

64. G1, *supra* note 63 (The study appearing in the 2008 Fundão dam license presents three scenarios for the case of disruption, with differences in speed, width and height that the mud wave would reach. But in all cases, only the “urbanized area of the Bento Rodrigues district” is cited.); see also Estêvão Bertoni & Nicola Pamplona, *Estudo da Samarco não Previa Danos no Rio Doce e em Distritos de MG*, FOLHA DE S. PAULO (Dec. 15, 2015, 8:46 AM), <https://www1.folha.uol.com.br/cotidiano/2015/12/1719134-estudo-da-samarco-nao-previa-danos-em-paracatu-e-barra-longa.shtml>.

According to the Emergency Plan, the company affirmed it followed all the steps predicted in its Emergency Plan presented to the pertinent agencies.⁶⁵ Furthermore, according to the contracted authors of the Emergency Plan, they had delivered to the contracting company a study that also considered the scenario of mud covering up to Barra Longa, that is, approximately 75 km down from the dam.⁶⁶ Without going into the merits of this information, it reveals an evident deficit in the administration and assessment of catastrophic risks in the country. This is not new. If that information is true, the risk scenario described to the environmental agency considered the mud reaching only Bento Rodrigues, a municipality located only 2.5 km from the dam. Thus the entire licensing process can be deemed as permeated by this *underestimation* of environmental risk regarding the distance the mud would cover in case of structural failure. Thus, it can be said that the discrepancy between the risk presented and managed in the environmental licensing procedure, in this respect alone, is equivalent to 0.35% of the real distance covered by the mud. Even if the distance of the mud to the city of Barra Longa (75 km down) were adopted as a parameter for the study presented, it would still be a risk assessment of only 10% of the distance actually traveled by the tailings in the disaster. The absence of a precautionary or preventive standard minimally related to the real scenario, either by the entrepreneur or by the pertinent administrative environmental agency, is undeniable. The discrepancy between the risk scenario presented and the real unfolding of the disaster is 99% in one case, and 90% in the other, depending on the version presented (to Bento Rodrigues or Barra Longa).

In more general terms, Emergency or contingency plans consist of fundamental studies for the diagnosis and adoption of preventive measures, as well as the assignment of responsibilities and ordered actions for emergency response to ongoing disasters.⁶⁷ Emergency Plans respond to the need for an early reflection on the risks of an activity, designing measures for each of the possible scenarios. In this sense, one of the fundamental lessons from the Mariana disaster and many other industrial accidents is the need for preemptive planning and preparation, otherwise the reaction capacity of responsible public and private bodies will be severely compromised.

2.2.1. Emergency or Contingency Plans

Disaster Emergency or Contingency Plans should contain actual planning studies designed to minimize impact and vulnerability in the event of a disaster, as well as to facilitate reconstruction efforts⁶⁸ and shall encompass all phases of the disaster cycle, including prevention, mitigation, preparedness, response, rehabilitation and reconstruction. Plans are often criticized for being static and merely routine measures, however, they have important value in the process of their design and drafting, requiring that organizations not only maintain directions and planning for response actions, but further requiring organization to think through

65. *Id.*

66. *Id.*

67. See generally Denis Binder, *Emergency Action Plans: A Legal and Practical Blueprint Failing to Plan is Planning to Fail*, 63 U. PITT. L. REV. 791, 791 (2002).

68. *Id.*

potential future disaster risks.⁶⁹ These plans are often required by law or by discretion of the administrative environmental agency, especially for those activities potentially causing significant environmental degradation or risks of abnormal hazards.⁷⁰ Ultimately, emergency plans (i) arise from a standard of care incorporating a reasonable duty of care, (ii) they have certain defined elements that must be included in order for them to be successful, (iii) they may be developed at multiple levels within the society including the government and the judiciary, and (iv) they serve the preliminary function of guiding the emergency response phase following a disaster.

First, these emergency or contingency plans are often directly linked to professional standards of care, that is, the standards adopted in a given area.⁷¹ The standard of minimum care required is plans must anticipate, prevent, and mitigate the flaws and consequences related to rationally predicted risk (including in construction, design, operation, procedures, etc.).⁷² To this end, such plans must present rational steps to be taken in cases of extreme events, be they natural, man-made, or of mixed nature. These steps taken together form a duty of care that plan authors, and the entities that employ them, owe to the broader society. It is notable that this duty is one of a reasonable standard of care, not one of guaranteed success prevention of an extreme event.⁷³ In other words, it should be made clear that if the plan had to bring full efficiency to extreme events, it would be subject to a pattern of obligation of result, which is too demanding for catastrophic, often uncertain, events with low probability. The safety standard applicable in cases of emergency plans is reflected in the duty to provide reasonable care to be taken in the design of emergency preparedness and response strategies for a given event, without requiring full effectiveness. It is, therefore, an obligation of means, not of ends or result.⁷⁴ This duty of care, as already mentioned, must be delimited by the standard arising from the “professional standard of care”.⁷⁵

Second, and flowing from this standard of care and the duty owed to society, emergency or contingency plans must clearly define the following: (i) the roles and responsibilities of the organizations involved in emergency responses; (ii) the structure and formation of a crisis office; (iii) the identification of risks and particularly vulnerable areas; (iv) the inventory of physical, human and financial resources available and the procedure to access them; v) strategic location of resources and supplies; vi) determination and signaling of evacuation routes and areas for temporary accommodation of those affected; (vii) a network of internal communications and public information; (viii) descriptions of lessons learned from previous events, and the respective duty of attention to these lessons, in order to avoid recurring misunderstandings and to encourage the adoption of best practices. If all emergency plans adhere to and include this information, the plans will likely not only meet the basic standards of care, but will be more successful in anticipating,

69. Birkland, *supra* note 58, at 123.

70. See Binder, *supra* note 67, at 800-01.

71. *Id.* at 805-08.

72. *Id.* at 794-95.

73. *Id.* at 803-04.

74. *Id.* at 804.

75. *Id.* at 806.

preventing, and mitigating the flaws and consequences related to rationally predicted disasters.

Third, emergency or contingency plans may be developed at many different levels within the society including the governmental or sectoral level and the judiciary level. In this sense, there are statutes requiring Contingency Plans for public entities, mainly focused in dealing with the so-called “natural disasters.” In other cases, highly dangerous industrial activities are required by law to present Emergency Plans. In sum, for all public entities there is a requirement for a Civil Defense and Protection Plan, but for all industrial activities, additional emergency plans are required. At the government or sectoral level, after the promulgation of Law No. 12,608 / 12, all federal levels (Union, States, Federal District and Municipalities) must have their respective emergency or contingency plans.⁷⁶ Currently, the civil defense and protection plans are limited to contemplation of natural disasters (mainly focused in meteorological, hydrological, geological and biological hazards, although the statute also mentions nuclear and chemical hazards). However, this requirement should not be limited to cases of so-called natural disaster risks; it is also of great importance for the plans to contemplate preparedness regarding man-made disasters. In the case of disasters considered in the National Policy on Civil Protection and Defense, the elaboration of contingency plans has become a duty of care normatively imposed in Brazil, and each government entity must prepare the respective contingency plan. In Brazil, the law requires that for industrial activities, the mining sector is required to issue and present emergency plans to public officials through an administrative hearing. This requirement is imposed by a federal statute entitled the National Dam Safety Policy Act and requires the company to present a dam safety plan.⁷⁷ Where failure to comply with this duty has led or contributed to a disaster, there may be civil liability of the institutions obliged to prepare and implement the plans, in three scenarios: (i) in the absence of an emergency plan; ii) when it proves to be inadequate; iii) failure to follow and implement the plan.⁷⁸ Thus, specific risk activities and those normatively obligated to prepare such plans must carry them out from a rationally predictable risk pattern, developing and adopting strategies, responses, and mitigation steps.

These plans are also developed at the judiciary level. To this end, it is interesting to note that on June 13, 2012, the National Council of Justice (*NCJ*) issued Recommendation No. 40, which instructed the states’ Courts of Justice to prepare Action Plans to deal with and solve situations arising from catastrophes and environmental disasters.⁷⁹ These Judiciary Emergency Plans are meant to address situations so serious that an operational change in the judicial service of the affected community is justified, as long as an emergency or state of public calamity is declared.⁸⁰ This recommendation was important because the lack of planning by the

76. Lei No. 12.608 de 10 de Abril de 2012, at arts. 6, VIII, 7, III, and 8, XI, http://www.planalto.gov.br/ccivil_03/_ato2011-2014/2012/lei/l12608.htm.

77. Lei No. 12.334 de 10 de Setembro de 2010 at art I, http://www.planalto.gov.br/ccivil_03/_Ato2007-2010/2010/Lei/L12334.htm.

78. Binder, *supra* note 67, at 793.

79. Conselho Nacional de Justiça, Recomendação Nº 40 de 13/06/2012, <http://www.cnj.jus.br/atos-normativos?documento=841> (Braz.).

80. *Id.*

Judiciary itself at the local level has always been of particular concern, as was demonstrated by the difficulties experienced in the mountainous region of the State of Rio de Janeiro in 2011.⁸¹ This lack of planning at the judiciary level was not unique to Brazil. In New Orleans after being hit by Katrina in 2005 similar issues were experienced.⁸² In the North American case, the criminal system collapsed and was not operational.⁸³ Arising out of this system failure, the Louisiana Supreme Court following the disaster encouraged local courts to have a plan and structure to anticipate disasters. Some of these plans included having computer back-ups of and easy access to information about court servants and officials.⁸⁴ Thus, judicial courts must understand and inform their own priorities and action steps, in the form of emergency or contingency plans, in order to effectively respond to possible or recurrent disasters.

Finally, the Emergency Plans have the preliminary function of guiding the emergency response phase, establishing functions, structures and decision criteria for this phase of relief to the victims and restoration of essential public services. However, it should not be forgotten that these instruments (Plans) also have a preventive function, since they require the diagnosis of scenarios and early technical reflections on the activity catastrophic potential. What the present case demonstrates is that a low attention and perception to the necessary circular risk management by the community, agencies and company played a prominent role in the occurrence of the event or at least contributed to the catastrophic consequences of the event. If there is any doubt about the preventive functions of an Emergency Plan, this case serves to dissipate them. In the case of the Mariana disaster, the need for early analysis should have demonstrated a greater variation in the scenarios designed in case of rupture. It is noteworthy that in all scenarios described in the company's Emergency Plan, the tailings would have the same final destination, Bento Rodrigues, 2.5 km away from the dam that collapsed. As seen, the forecast that the tailings would arrive only at Bento Rodrigues, when in fact they reached 700 km from the rupture site, attests a deviation of the expected magnitude (between drawn scenarios and post-disaster reality) of 99%. In other words, this was the case of an absolute unpredictable event (ignorance) for the *standard of professional care* or almost the complete absence of an accurate and feasible risk management.

81. See Vladimir Passos de Freitas, *O Direito dos Desastres Chega ao Brasil e Reclama Especialistas*, CONSULTOR JURÍDICO (Sept. 24, 2017, 10:39 AM), <https://www.conjur.com.br/2017-set-24/segunda-leitura-direito-desastres-chega-brasil-reclama-especialistas> (stating that “[d]isasters create a number of legal problems. Some should be addressed as they occur or soon after. For example, bodies may have to be buried, even if the deceased are not identified. Orphans may need temporary custody for the urgent practice of acts of civil life. Problems of this type arose in the mountainous region of the State of Rio de Janeiro which, in January 2011, was hit by flooding and landslides that affected seven cities, leaving a balance of about one thousand dead.”) (translated from original Portuguese to English by author) (Braz.).

82. See generally Birkland, *supra* note 58.

83. *Id.* at 122-23.

84. *Id.* at 121.

2.2.2 Contingency Plans in EU: Brief Case Study

As a point of comparison, attention should be drawn to the description of Emergency Plans by the European Community Directive 96/82 (known as SEVESO II), intended to prevent major accidents involving dangerous substances. According to it, specifically in its Article 11⁸⁵, Emergency Plans should be designed in such a way as to delimit and control serious industrial incidents, minimizing their effects, and limiting damage to humans and the environment.⁸⁶ To that end, such plans must clearly state: protective measures to be applied in the event of a major accident; procedures and people responsible for informing the public and the authorities; provisions for environmental recovery and sanitation following a major accident.⁸⁷

According to this Directive, the operator shall draw up an internal emergency plan designed to be applied within the establishment and provide the pertinent authorities with the information necessary to enable them to draw up the external emergency plan.⁸⁸ Thus, the plans are made to cover the internal (own operator) as well as the external service (pertinent authorities) meeting the emergency. Internal staff shall be consulted (employees, subcontractors and others) on the elements of the internal plan, and the community in the area of influence should be consulted on the content of the external plan.

In anticipatory manner, periodical communication to the people who may be affected, at least every five years, is also provided for in Article 13 of Seveso II.⁸⁹ The information has to be reviewed by the operator at least every three years.⁹⁰ This communication must contain adequate instructions for correct action in the event of a major accident. Emergency Plans should be reviewed, updated and rehearsed at intervals not exceeding three years.⁹¹

3. FINAL CONSIDERATIONS

Unfortunately, lessons are learned from catastrophes and in turn they play a prominent role in the evolution of Environmental Law by way of response instead of anticipatory action. In order for disasters to spur changes in human response, information and statistical data about their causes and consequences must be produced and assimilated. This collective energy must necessarily be channeled into the production of constructive reflections on the role of the Law in imposing disaster prevention duties. Disasters often reveal the convergence of faulty risk management, either in analyzing the magnitude or in diagnosing the event probabilities. This regulatory deficit largely correlates with a lack of conscious imposition of standards of care implementing reasonable legal duties upon organizations, governmental

85. Council of the European Union, No. 96/82/EC of 9 Dec. 1996, art. 11, 1996 O.J. (L 010) 0013-33, <https://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX:31996L0082>.

86. *Id.*

87. The European Parliament and the Counsel of the European Union, No. 2012/18/EU of 4 July 2012, art. 12, 2012 O.J. (L 197) 1-37, <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32012L0018&from=pt>.

88. *Id.* at 4.

89. *Id.* at 11.

90. *Id.* at 10.

91. *Id.*

entities, and the judiciary in an attempt to incorporate circular risk management into the societal structure.

In this sense, at least two points deserve to be highlighted in the case of the Mariana environmental disaster of November 2015. First, the law must consider circularity in the process of managing exponential risks. Second, attention must be paid to the scientific analysis, formation and implementation of solid Emergency Plans for activities with abnormal or very serious risks, in addition to cases in which specific laws already require environmental permits and authorizations.

Obviously, it is very difficult to properly assess environmental risks. Sometimes institutions show low sensitivity to them. In other cases, there is an overdimensioning of these risks. In the case of Minas Geris, the emergency plan which was submitted clearly contained deficient information which led to a greater impact to the surrounding communities. Even admitting possible differences between probabilistic prognostics and post-event reality, such significant discrepancies denote at least serious deficiencies in environmental risk governance processes in Brazil. Notwithstanding the precariousness of journalistic information presented here, which can be challenged, it is undeniable that a reasonable precautionary standard was not adopted in the plan for Minas Geris. Undoubtedly, what the plan does illustrate is a low sensitivity of the environmental agencies to the necessary management of serious risks, a trenchant recipe for regular reoccurrence of environmental disasters.

In sum, in addition to the preventive and preparatory function of Emergency Plans, disaster theory in general must find a place within the society in order to best anticipate and mitigate future disasters. Such policy change requires a dynamic reflection in advance of possible scenarios, including advance measures to be adopted in each of the scenarios, delimitation of incumbencies, criteria for decisions and composition of crisis teams. These plans should be periodically reviewed and in constant development.

Although it is still early for conclusions of any nature, the Mariana disaster seems to send a clear message that society must adopt a culture of circular management of environmental risks and the need for institutionalized preparation and presentation of Emergency Plans. The disaster cycle theory, and emergency planning, presents a true strategic guide for society in the fallout of disaster, by providing legal stability and security for those currently impacted and mitigating the impact of future disasters. The clearest lesson from the Mariana Disaster is that the historic way of approaching disaster is outdated and society must institute new mechanisms to avoid times of chaos.