



HEALTH SCIENCES

Oil in Northeast Brazil: mapping conflicts and impacts of the largest disaster on the country's coast

MARIANA OLÍVIA S. DOS SANTOS, CAROLINE P.S. SANTOS, MARIA JOSÉ C.F. ALVES, JOSÉ ERIVALDO GONÇALVES & IDÊ G.D. GURGEL

Abstract: The crude oil spill on the Brazilian coast in 2019 is considered the largest environmental disaster of this nature in the country. It had important repercussions on the environment and on the living and health conditions of the population, particularly artisanal fishermen, intensifying the vulnerability process, causing situations of injustice and environmental conflicts with negative repercussions on the territories. Aiming to analyze this environmental conflict and its impacts on environment and health of the affected population, the study applied the method proposed by the Global Atlas of Environmental Justice. It analyzed open-access documents made available by governmental and non-governmental organizations, and publications in newspapers of wide circulation. The data obtained allowed to characterize the oil spill and the identification of the socioeconomic, health, and environmental impacts published in the Atlas. There was a deepening of the vulnerability of the *people of the waters*, influencing the social determination of the health-disease process. The lack of sustainability of the current development model pushes for building environmental and health diagnoses in order to take remedial measures in disasters such as oil spills. EJAtlas is a way to debate situations of environmental injustice and give voice to historically oppressed communities.

Key words: oil spill, petroleum pollution, environmental health, disaster vulnerability, impact of disasters.

INTRODUCTION

The impact on health resulting from production processes is presented in a varied and complex way, since these processes generate pressure on the environment and produce inequalities and inequities related to the distribution of situations of risks, dangers and socio-environmental vulnerabilities (Santos et al. 2019). Their harmful effects compromise ecosystems and the health of the affected population, resulting from professional activities and contaminated environment (Rigotto & Augusto 2007, Rigotto 2008).

The oil production chain is characterized by its high polluting potential and high environmental unsustainability, as it generates situations of occupational, health, environmental and social vulnerabilities that are externalized, compromising health and the environment, through contamination with oil and its derivatives (Gurgel et al. 2019, Rigotto 2008).

Petroleum is an oleaginous liquid composed of a complex mixture of Polycyclic Aromatic Hydrocarbons (PAHs) added to nitrogen, sulfur and oxygen. Studies point to the various health and environmental complications when

petroleum components are absorbed by living beings (Augusto 2009, Arcuri et al. 2012, Gurgel 2017, Kponee et al. 2015).

At the end of August 2019, crude oil slicks appeared on the beaches of Northeast Brazil, contaminating the entire adjacent marine ecosystem in the following three months, affecting more than 3.400 kilometers of the northeast coast and being characterized as the most serious environmental disaster occurred in the coastal strip of the country (Araújo et al. 2020, Soares et al. 2020a, b, Sissini et al. 2020, Brum et al. 2020, Barbosa et al. 2021).

The first government mitigation measures began almost one month after the stains appeared, and even then, they were not effective in stopping the expansion of oil and the socioeconomic and environmental damage associated with the disaster (Borges 2019). The removal of oil was led by volunteers, without training or use of protective equipment, totaling more than 5.3 thousand tons of oil collected (Araújo et al. 2020, Soares et al. 2020a, Brum et al. 2020, Mesquita & Quinamo 2020).

The environmental impacts resulting from oil spills lead to changes in the socioeconomic and cultural order, in the health of people of the affected territories and in the integrity of the environment. The local population was directly affected by this disaster, as the beaches were closed, there was a drop in the fish sales, recreational and tourism activities were interrupted, considerably impacting the income of the residents, increasing unemployment and making the situation of tourism-dependent workers even more unstable (Ramalho 2019a, Pena et al. 2020, Estevo et al. 2021).

The *people of the waters*¹, made up of artisanal fishermen, who were already

experiencing a process of historical socio-environmental vulnerability, were profoundly affected by the oil spill. However, there was a greater intensification of this process with the covid-19 pandemic, which compromised their socioeconomic and health conditions. The introduction of health protection measures such as social isolation and closing of beaches and commercial spaces, led to a significant reduction in the fish market, in addition to situations of infection of people, impeding work activities, compromising their income and their livelihood, as well as their food security (Cavalcanti & Wanderley 2020, Pinto et al. 2020, Mejía 2021).

When analyzing the perception of artisanal fishermen and shellfish gatherers about the impacts of Covid-19, Mejía (2021) identified that the main impacts were due to unemployment, reduced tourism, increased expenses, panic and social rejection, tension and family problems, reduced demand, capture and price of seafood, food shortages and debts.

There is, therefore, a process of environmental injustice, a concept that refers to the forms of permanent expropriation imposed on historically vulnerable subjects, the inequalities in the distribution of environmental damage and common goods, the lack of participation in decision-making processes, livelihoods and public policy, mostly linked to class, race and gender structures (Rigotto et al. 2018, García-López 2018).

This context of social inequity and environmental injustice is a generator of conflicts involving the populations of the affected territories. Acselrad et al (2004 p.294) emphasizes that the conflicts involve “social

¹ NT: The Peoples of the Waters are defined in a Ministry of Health decree as: ...[peoples] that have knowledge developed from the use, observation, coexistence, and dependence

on the natural resources found in marine and continental environments, as advocated by the policy of the countryside, forest, and waters “are peoples and communities with ways of life, production, and social reproduction related predominantly to aquatic environments” (Brasil 2014, art. 2nd).

groups with different ways of appropriation, use and meaning of the territory, originating when at least one of the groups has the continuity of the social forms of appropriation of the environment that they develop threatened by undesirable impacts – transmitted by soil, water, air or living systems – arising from the exercise of the practices of other groups”.

Against this backdrop, many initiatives were launched in order to mobilize diverse sectors of society, based on resistance and struggle for social justice and denouncing human rights violations and environmental conflicts (Acselrad et al. 2004). From this perspective, mechanisms are created to give visibility to the struggles of these groups, such as the Global Atlas of Environmental Justice (EJAtlas). EJAtlas is a tool that brings together ecological activism and science, allowing research and historical reconstruction of socio-environmental conflicts (Temper et al. 2018). By mapping conflicts, this strategy brings science closer to society as a basis for complaints, validating movements in favor of social justice and giving visibility to historically oppressed and socially invisible peoples (Porto et al. 2013, 2014).

It brings together on one platform various conflicts and environmental injustices that have taken place around the world. While providing visibility to the problems of each location, it allows co-creation through a more symmetrical approach, involving different centers of studies, research and movements in defense of global environmental justice and common goods (Temper et al. 2014).

The objective of this article is to analyze the environmental conflict and its impacts on the environment and health of the population directly affected by the oil spill on the northeast coast in 2019, from the perspective of the Global Atlas of Environmental Justice (EJAtlas 2022).

MATERIALS AND METHODS

A documentary, qualitative approach and cross-sectional research was carried out to identify conflicts, environmental injustices and health impacts resulting from the oil spill on the coast of Northeast Brazil, which occurred in the second half of 2019. Documentary research is characterized by the search for factual information in documents that may answer a specific interest from a certain assumption and may reveal problems that should be further studied (Sá-Silva et al. 2009).

The states of Northeastern Brazil (Alagoas, Bahia, Ceará, Maranhão, Paraíba, Pernambuco, Piauí, Rio Grande do Norte and Sergipe) were included as the study site, because they were affected with the largest amounts of oil on their beaches, estuaries and mangroves (Brazil 2019, Brum et al. 2020).

The documentary survey conducted in the period September 2019 through June 2020 considered open-access secondary data made available *online*, related to the objective of this paper: epidemiological bulletins, reports and newsletters issued by the Ministry of Health, State Health Department and State Environmental Agency of the state Pernambuco; database of the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA in the Portuguese acronym); articles from major state and national newspapers, institutional notes and letters; and publications by environmental social movements involved in cleaning up the spills on the coast (Table I).

The documents identified constituted a database using a Microsoft Excel 2016 program. The reading and organization of all the material was performed by the researchers. The analysis considered the EJAtlas methodology, which consists of the following steps: registration on the platform; description of the conflict

Table I. Survey of documents on the oil spill on the coast of Northeast Brazil, between September 2019 and June 2020.

Document Type	Selection criterion	Description	Quantitative
Epidemiological and information bulletins	Bulletins, newsletters and reports published during the collection period by the Brazilian Ministry of Health (MH), Health Secretariat of Pernambuco and State Environmental Agency of Pernambuco were selected.	Bulletin No. 29 of the MH, Bulletin No. 32 of the MH, Bulletin No. 33 of the MH, Bulletin nº 34 of the MH; Bulletin on the Oil spill on the Brazilian coast of MH of October 24, 2019; Newsletter No. 4/2019 of the Health Secretariat of Pernambuco (SES/PE); SES Bulletin 10/2019; Report from the State Environmental Agency of Pernambuco No. 40/2019.	8
Newspaper and magazine articles	The electronic collection was carried out on the platforms of the main national newspapers, information portals and independent vehicles, using the words “oil”, “petroleum”, “northeast”, “disaster” and related words on the oil spill.	G1, Le Monde Diplomatique Brasil, Folha de São Paulo, Exame Brasil, Primax, British Broadcasting Corporation Brazil (BBC), Correio 24 horas, UOL, Letras Ambientais, Central Brasileira de Notícias (CBN), MPF, Marco Zero Conteúdo, Empresa Brasil de Comunicação (EBC), Jornalistas Livres, Estado de Minas, Blog do Barreto, Diário de Pernambuco, Jornal o Globo, Estadão.	40
Institutional Notes and Letters	Letters published by research groups and institutions on the oil spill, which were widely disseminated by the scientific community, were selected.	Federal University of Bahia (UFBA); National Health Surveillance Agency (ANVISA); Brazilian Academy of Sciences; National Health Council (CNS); Health, Environment and Work Laboratory (LASAT) - Fiocruz PE; Occupational Health Reference Center (CEREST); Executive Secretariat for Health Surveillance - PE; Brazilian navy; Brazilian Institute for the Law of the Sea (IBDMAR); State Environmental Agency (CPRH); Pastoral Council of Fishermen (CPP); University of Coimbra (UC); Bahia State Government.	54
Institutional social media	They were selected based on their engagement in social media and also when they were mentioned in the articles raised	Save Maracaípe; World Wildlife Fund (WWF) Brazil; Greenpeace Brazil; Movimento Porto 2039; BiomaBrasil Institute; #Vazaóleo	6
Database	IBAMA was the main Brazilian government agency to carry out real-time monitoring of the arrival of oil in different locations	Brazilian Institute for the Environment and Renewable Natural Resources (IBAMA)	1

Source: Authors, 2022.

according to the categories proposed in table II: basic data, source of conflict, project details, conflict and mobilization, impacts, conflict response, sources and material; submission on the platform, evaluation by the reviewers and publication of the conflict (EJAtlas 2022, Temper et al. 2015, 2018).

EJAtlas is an international-scale database that documents and lists social conflicts around environmental issues, coordinated by researchers from the Institute of Environmental Science and Technology at the Autonomous University of Barcelona (ICTA-UAB) (EJAtlas 2022, Temper et al. 2015, 2018) where the collected data are collaboratively entered into the online platform. The EJAtlas allows for comparative studies on the actors of these conflicts and their forms of mobilization, the companies involved, the intensity of the conflicts, including the deaths of activists and other forms of violence, and the factors that lead to failure or success

to achieve environmental justice (EJAtlas 2022, Temper et al. 2015, 2018).

The results were verified by ICTA-UAB reviewers, and after validation, the mapping was published on the EJAtlas platform in October 2019. After publication, the mapping of the oil spill on the beaches of Northeast/Brazil was constantly updated by the teams as the evolution of the conflict.

RESULTS AND DISCUSSIONS

The characterization of the conflict and the socio-environmental impacts resulting from the oil spill on the coast of Northeast Brazil is structured in: basic data and source of conflict; project details, governmental and non-governmental actors; conflict and mobilization; visible and potential impacts arising from the oil spill; conflict response, sources and materials (Table III).

Table II. EJAtlas' analysis categories for environmental conflicts.

Category	Description
Basic data	Name of conflict; country; location of conflict; Location accuracy; Project Area; Population category (urban - rural - semi-urban);
Source of Conflict	Type of conflict: 1st level (main cause of the conflict) and 2nd level (subcauses that are within the conflict); Specific product; conflict description
Project Details	Project details; Investment level; Affected population (quantitative); Company names; International and financial institutions; Relevant government actors; Environmental justice organizations (and other supporters).
Conflict and mobilization	Conflict onset; End of conflict; Conflict intensity; When the mobilization began; Relation of the conflict with other socio-environmental conflicts mapped in EJAtlas; Groups involved in the mobilization; Forms of mobilization
Impacts	Visible and potential impacts on the environment; in health; socioeconomic
Conflict response	Current status of project development; Conflict Result/Response; Space to determine whether or not there was environmental justice for the conflict
Sources and Materials	Images, videos, scientific references among others.

Source: adapted by EJAtlas 2021, Temper et al. 2015.

Table III. Conflicts' mapping and socio-environmental impacts from the oil spill on the Brazilian Northeast Coast.

Category	Description
Basic data and source of conflict	
Country	Brazil
State or Province	Northeast (Pernambuco, Bahia, Piauí, Ceará, Rio Grande do Norte, Alagoas, Sergipe, Maranhão, Paraíba)
Location accuracy	Medium (regional level)
Type of population	Semi-urban
Type of conflict	Fossil Fuels and Climate/Energy Justice
Description	Data on the conflict were reported, such as the beginning, number of locations affected. In addition, the current situation of the leak and the measures that had been taken by government institutions, local residents, NGOs and volunteers in general were described.
Specific products	Crude oil of unknown origin
PROJECT DETAIL, GOVERNMENT AND NON-GOVERNMENT ACTORS	
Project details	The possible origins of oil on the beaches and the amount of material removed from contaminated sites, the affected population and the actors involved in collecting the material were described.
Relevant government actors	State and City Governments, Environment Secretariats (municipal and state), Health Secretariats (municipal and state), Federal Universities, Research Institutes and Centers in various areas, Ministry of Environment, Ministry of Health, Brazilian Institute of Environment and Renewable Natural Resources (IBAMA), Federal Public Prosecutor's Office, Federal Police, Labor Public Prosecutor's Office; Chico Mendes Institute for Biodiversity Conservation (ICMBio), National Agency of Petroleum, Natural Gas and Biofuels (ANP), Petrobrás.
CONFLICT AND MOBILIZATION	
Environmental justice organizations and other supporters	Pastoral Council for Fisheries (CPP); National Articulation of Fishermen (ANP); Movement of Artisanal Fishermen and Fisherwomen (MPP); Salve Maracaípe, WWF Brazil, Greenpeace Brazil, Movimento Porto 2039, Bioma Brasil Institute, #VazaOleo Rede Manguemar; Humanities Studies Nucleus, National Commission for the Strengthening of Extractive Reserves and Coastal Sea Extractive Peoples (Confrem); Intervozes Communication Collective, other organizations and local social movements in each state
Conflict intensity	Medium (street protests, visible mobilization)
When the mobilization started	Mobilization for remediation as impacts were perceived
Start of conflict	August 30, 2019
Groups that mobilize	Farmers, fishermen, indigenous groups or traditional communities, informal workers, local government/political parties, unions, neighbors/citizens/communities, scientists/local professionals, women, social movements, religious groups
Forms of mobilization	Resource to economic assessment of the environment, arguments for the rights of mother nature, public campaigns, participation of national and international NGOs, lawsuits, judicial activism, media-based activism, community participatory research (popular epidemiology studies), protests street/march, creation of alternative reports/knowledge, development of a network/collective action, complaint letters and official petitions

Table III. Continuation.

VISIBLE AND POTENTIAL IMPACTS ARISING FROM THE OIL SPILL		
Environmental impacts	Visible: excess waste; surface water pollution/ decrease in water quality (physical-chemical, biological); reduced ecological/hydrological connectivity; loss of biodiversity (wildlife, agrobiodiversity); ground contamination; oil spills; food insecurity (crop damage), loss of landscape/aesthetic degradation	Potential: Air pollution; genetic contamination; pollution or depletion of groundwater; large-scale disturbance of hydroelectric and geological systems, other environmental impacts
Health impacts	Visible: Acute and chronic poisonings; mental problems, including stress, depression and suicide; work-related illnesses and accidents; other diseases related to the environment; exposure to complex unknown or uncertain risks	Potential: Accidents, health impacts related to violence; other health impacts; malnutrition; health problems related to alcoholism, prostitution; damage to the nervous system of exposed people; respiratory problems, cardiac arrhythmias, abortion, cancer, anemia, bone marrow aplasia, among other conditions. If exposure is too intense, it can cause coma and death.
Socioeconomic impacts	Visible: Lack of job security, absenteeism at work, layoffs, unemployment; violation of human rights; loss of livelihoods; loss of knowledge/practices/traditional cultures; specific impacts on women; loss of landscape/sense of place	Potential: displacement; social problems (alcoholism, prostitution, etc.); increased violence and crime; other socioeconomic impacts.
CONFLICT RESPONSE, SOURCES AND MATERIALS		
Current status of project development	The origin of the oil and the cause of the spill remain unproven.	
Do you consider this a success in environmental justice? Briefly explain.	No. Government measures taken so far have not been decisive to the seriousness of the oil spill. This is justified by the recurrence of the appearance of large amounts of oil on many beaches, the lack of information about the origin and size of the disaster, the dangers and risks related to contact with the product, the destination of the material removed. Spill costs will never be reimbursed.	
Conflict result / response:	Court decision, new environmental impact assessment/study under negotiation.	
Sources and Materials	There was extensive coverage by the media and social media. Letters, notes, manifestos, articles, interviews, photos and images related to the oil spill were published. Scientific publications were also considered.	

Source: authors, 2022.

Basic data and source of conflict

The oil spill that occurred between the months of August and December 2019, reached the entire coastline of Northeast Brazil, devastating the livelihood of thousands of artisanal fishermen in these territories, triggering several processes of vulnerability, with important repercussions on the conditions of life and health, environment, economy and social reproduction of this population.

The disaster was characterized as a socio-environmental conflict (Figure 1). Configuring

itself as a regional-level conflict, it had catastrophic and considerable repercussions on the lives of those affected. (Araújo et al. 2020, Soares et al. 2020a, Brum et al. 2020, Mesquita & Quinamo 2020).

The affected population was geographically classified as semi-urban, which implies that they live imbricated in the duality of the urban transformation process with the presence of large commercial firms in the territories, too many jobs and underemployment, the resistance of the traditional way of life sustained

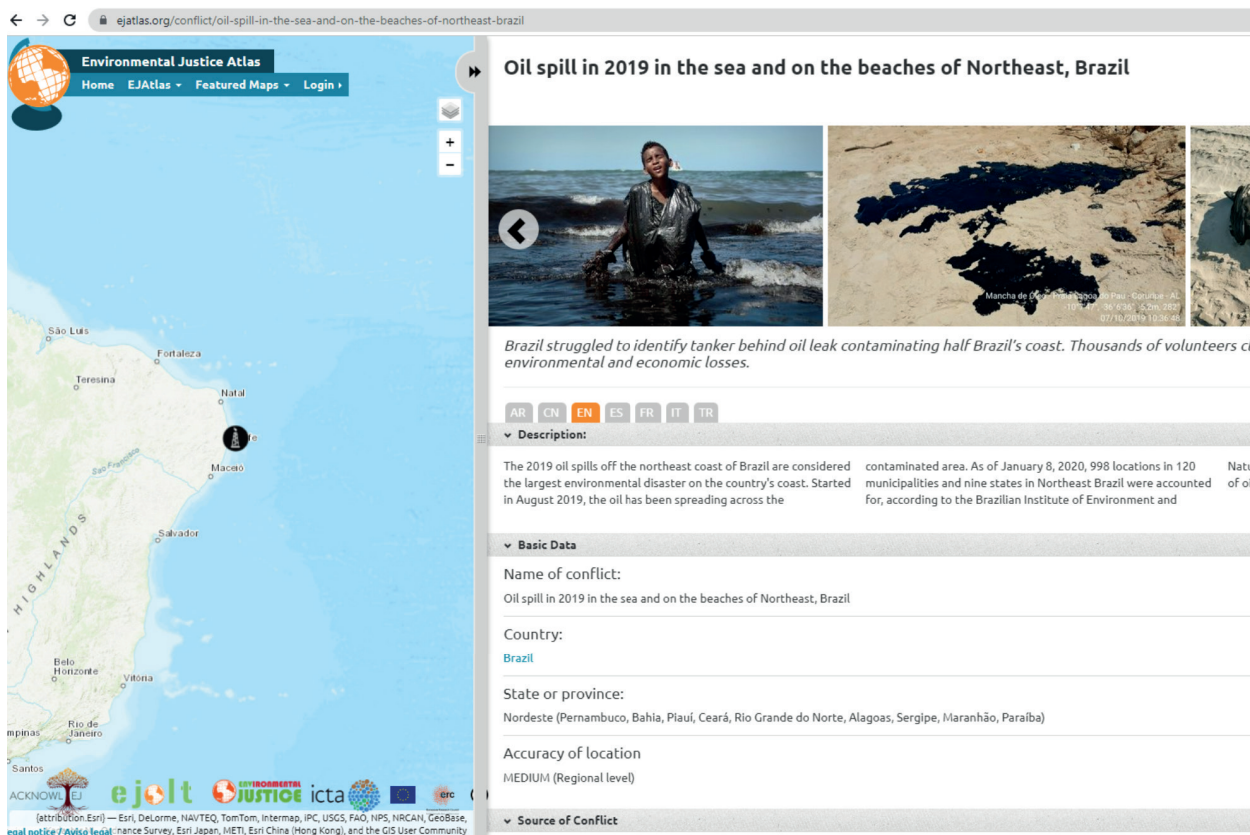


Figure 1. Image of the oil spill mapping page on the coast of northeastern Brazil on the EJAtlas platform. On the left, the virtual map, showing the area where the conflict is located, the symbol (tower in a black circle) used is what characterizes that the conflict is associated with fossil fuels. On the right, the conflict title and brief description can be seen. On the right side, the cover image of the publication was chosen because it represents the exposure to oil, including of children and adolescents. Available on <https://ejatlas.org/conflict/oil-spill-in-the-sea-and-on-the-beaches-of-northeast-brazil>. Source: EJAtlas 2022.

in the artisanal fishing and agriculture. Thus, the population of the northeastern coast is extremely diverse and formed by social, political, economic and environmental crossings, directly influencing the formation of different degrees of vulnerability caused by oil spills (Oliveira 2016).

As for the type of conflict, the disaster was categorized as involving fossil fuels (crude oil) and climate justice/energy, considering that the source of oil on the northeast coast was identified as tar, containing light hydrocarbons present in the analyzed material from several locations on the coast (Lourenço et al. (2020).

Gurgel et al. (2009) describes the multiple sources of pollution due to oil refining, from the

installation to the refinery processing, namely: noise pollution, air, soil and effluent pollution near the installation site. Due to the diversity of polluting sources in oil processing, several levels of the production chain are affected, reaching biological, socioeconomic, environmental matrices, among others.

The extraction and transport of oil is an expensive and risky process, from the transformation of raw material to products of high social consumption (fuels, plastics, food, clothing, among others). There are numerous accidents involving oil. On a global level, one can cite the large-scale accident with the oil tanker Torrey Canyon in 1967 off the coast of

England; the Exxon Valdez oil spill in Alaska in 1989; and the 2010 accident of the Deepwater Horizon drilling rig in the Gulf of Mexico, where there was an oil spill for 86 days, causing socio-environmental impacts that are still present in the region (Moreira & D'Almeida 2020).

The history of oil spills in Brazil is recurrent. One of the largest spills in the country occurred in the Iguaçu River Basin, Paraná, in July 2000; in the same year, in August, there was an oil spill in Guanabara Bay, Rio de Janeiro. In 2011, the Campos Basin was the site of another disaster involving water contamination by oil (Varella 2015).

Despite abundant evidence of the lack of sustainability of the use of oil as the main source of energy, world consumption is on the rise due to the economic interests of those who hold most of the income from the use of this raw material (Sauer 2016). Faced with these socioeconomic pressures, socio-environmental conflicts emerge as a way of reacting to the injustices applied by an unsustainable socioeconomic model.

Project details, governmental and non-governmental actors

The Brazilian Navy states that more than 5.300 tons of crude oil were removed from the Brazilian coast. By January 2020, around 1000 locations in 11 Brazilian states had been affected, impacting 3400 km of the coastline (Ibama 2020, Brum et al. 2020, Mesquita & Quinamo 2020). Representatives of fishermen report the possibility of affected communities that were not accounted for in the aforementioned amount (CPP 2020a). In June 2020, fragments of oil reappeared on some beaches in Bahia, Pernambuco and Alagoas. According to the Brazilian Navy, only part of the traces found were from the same source as the 2019 spots (Brasil 2020).

Only 30 days after the appearance of the oil fragments on the beaches, government institutions became involved in the activities of containment, monitoring and removal of oil in the affected territories, involving government health and environment entities at the federal, state and municipal levels, the Public Prosecutor's Office, the Armed Forces, Legislative Branch, Chico Mendes Institute for Biodiversity Conservation (ICMBio in the Portuguese acronym), PETROBRAS (national oil company), university and research centers. However, the organizations acted in isolation, without articulation or national coordination (Brum et al 2020).

The participation of hundreds of volunteers was observed in all the affected states to remove the oil that reached the beaches. These actions involved local residents, tourists, schoolchildren, street vendors of food and artisanal products, firefighters, artisanal fishermen and shellfish gatherers, quilombolas, informal workers, people deprived of their liberty, hostels, professionals involved in tourism activities, among other sectors of work. The oil removal by the volunteers, at first, occurred without the use of Personal Protective Equipment (PPE), with no training and without knowing that they were exposing their health to risks of illness by contact with the substance.

Among the various groups affected by the disaster, fishermen and shellfish gatherers, a population whose history shows a process of social invisibilization, are configured as the group that suffered direct consequences, as they depend almost exclusively on products from the sea (Ramalho 2019a, UFBA 2019).

Non-governmental organizations (NGOs) contributed to the oil-spill clean-up and actions with volunteers, including Salve Maracáípe, WWF Brazil, Greenpeace Brazil, Movimento Porto 2039, BiomaBrasil Institute and #Vazapetróleo. Despite

the involvement of several social sectors in the monitoring and analysis of oil slicks, the source of the disaster remains unknown, therefore, there are no culprits who can legally answer for this environmental crime and be compelled to mitigation and repair measures as recommended in Brazilian legislation and International.

The actions of the social actors involved in the disaster were not uniform. It was up to the Ministry of the Environment to guide the National Contingency Plan for Incidents of Oil Pollution effectively and quickly to mitigate the consequences of the disaster. However, in practice, this ministry's actions took place belatedly, after more than one month since the appearance of oil on the beaches, and they were not able to effectively coordinate all other government institutions in favor of helping people affected by the disaster (Borges 2019).

Consequently, state and local governments, as they did not receive effective financial and logistical support, were unable to act broadly in the respective affected locations, however, they occasionally helped to remove oil from beaches and estuaries. IBAMA and ICMBio should have been responsible for most of the oil removal team, the distribution of personal protective equipment, training and guidance for volunteers in this process. This measure was insufficient, with volunteers left to the mercy of donations and NGO actions (Fellet 2019).

The Brazilian Navy was responsible for organizing the execution of the National Contingency Plan (PNC in the Portuguese acronym), while the Federal Police and the Pernambuco's Public Prosecutor's Office (MPP in the Portuguese acronym) pressured the federal government, but there was no restriction due to the delay of public measures on the disaster. In this sense, during the process of investigating the origin of the substance and possible culprits, there was an intense participation of federal

universities and research institutions that continuously seek answers and that informed about the risks of exposure to oil (UFBA 2019, Abrasco 2019).

There was greater discussion about the disaster and pressure from NGOs, unions and social groups on the federal government to support victims in affected locations (Ramalho 2019a). Several public hearings with fishermen and other affected populations were held in all states, where effective actions were demanded to remedy the situation of socio-environmental vulnerabilities experienced by them.

An oil spill Parliamentary Inquiry Committee, was set up to investigate the origin and to identify those responsible for the disaster. In March 2021, the CPI was closed without identifying those responsible for the disaster, and without a final opinion on the work developed and on those responsible for the oil spill (Brasil 2020). Government institutions both at the national (Ministry of Science, Technology and Innovations, National Council for Scientific and Technological Development, Ministry of Education, and regional levels redirected resources to the development of research that could assess the impacts resulting from the spill of oil.

Conflict and mobilization

The mobilization started as soon as the initial impacts were felt with the first arrival of oil fragments on the beaches. The conflict was identified, using the EJAtlas, as of medium intensity with mobilizations carried out through meetings between social groups affected by the disaster and other support organizations, lawsuits and judicial activism on behalf of the environment and populations directly affected by the disaster, protests and marches in the streets, production of official letters and notes, community-based participatory

research for epidemiological studies, scientific committees, public hearings organized by political representatives, collective actions, public campaigns to collect personal protective equipment (PPE). The representatives of affected populations, political parties, researchers, local professionals, tourists, religious groups, social movements, NGOs, unions and communities were involved in these actions (Pena et al. 2020).

More than a year after the oil spill, the negative effects of this disaster, mainly economically and on the health of the local population and on the environment, still persist, although in the media and in government actions this agenda has been almost completely forgotten. Given this scenario, new organizations and social movements appear in search of environmental justice. The Sea of Struggle Campaign: Social Justice to the People of the Waters, is an initiative launched on the date that marks one year of the oil disaster (Intervozes 2020a, CPP 2020a). This movement is formed by shellfish gatherers, artisanal fishermen and organizations that defend human and socio-environmental rights and intends to continue bringing information about the impacts of the disaster on fishing communities, which associated with a process of subsumption in relation to the current scenario of the Covid-19 pandemic, increases the risk and production of vulnerabilities for this population (CPP 2020b).

The Sea of Struggle Campaign demands the continuous and rigorous monitoring and evaluation of the beaches, mangroves and oceans affected by oil, as well as the effective accountability of the State for the incompleteness of the investigation and for social reparation to the communities affected by the disaster and is vehemently opposed to the opening of new oil wells (CPP 2020a).

Visible and potential impacts from the oil spill

In EJAAtlas, the impacts resulting from conflicts are divided into 3 major categories: environmental, health and socioeconomic.

a) Environmental impacts

Among the environmental impacts, changes such as visible pollution of the sea water, contamination of marine ecosystems, turtles, shellfish, fish, algae, and other organisms were found as having oil residues (Disner & Torres 2020, Ibama 2020, Soares et al 2020a).

In this sense, all the complexity in their ecological interactions has been affected from this anthropic disturbance, which may trigger possible changes in trophic levels, through the sedimentation of this material in the coastal micro and macrofauna. Some areas are more vulnerable to contamination, such as benthic regions and mangroves, which amplify toxicity, genetic alterations and other damage from oil contamination along the chain (Santos et al. 2016).

Some studies show the large-scale disturbance of water and geological systems not only in the biome of the affected sites, but also changes in mangroves and other ecosystems related to the coast as a result of these environmental impacts (Euzébio et al. 2019).

b) Impacts on health

The impacts on the health of the population are presented through acute poisoning (signs and symptoms appearing in the first hours or days after exposure) and chronic poisoning (health impairment appearing months or years after exposure).

Among the main signs and symptoms evidenced after exposure, there is mental health impairment and conditions related to respiratory disorders, skin lesions, eye irritation, neurological effects, risk of cardiac events, body pain, genotoxicity, hormonal changes, psychological and neurovegetative symptoms,

manifestations in the immune and endocrine systems (Aguilera et al. 2010).

Acute intoxication associated with symptoms such as nausea, vomiting, vision disorders, headache, mental confusion, dyspnea, pneumonia, coma and, in severe cases, death (Fiocruz 2019a, SEVS 2019, UFBA 2019). Regarding chronic intoxication, individuals can develop leukemia, lymphoma, bone marrow aplasia, anemia, lung cancer, skin cancer, among other negative consequences for human health (Araújo et al. 2020).

There are also potential mental health repercussions for those affected by the disaster, particularly local residents and people who depend on the sea for their livelihoods. This is because fishing, shell fishing and other associated activities are much more than just employment opportunities for the people involved, they reflect cultural, spiritual issues that resonate in all biopsychosocial aspects (Euzébio et al. 2019, Ramalho 2017). Studies carried out in similar disasters analyze the effects on mental health resulting from factors in the social, collective and individual context, both directly and indirectly (Rung et al. 2016, Cope et al. 2013).

Since the times of the manual removal of oil on beaches, there have been reports of people involved in the extraction of the material who have shown changes in well-being after contact with the substance. However, the amount of information collected on the repercussions on the health of the people involved in the disaster fell short of the proportion of the oil spill, given the difficulties and unpreparedness of the health system in welcoming all affected people, actively searching for conditions of health of local residents and volunteers involved (Brasil 2019). As well as the low mobilization of governmental public health institutions such as the Ministry of Health, in the organization of surveillance and

monitoring actions with the most affected states and municipalities, especially in the registration of people exposed to oil in the activity of cleaning the beaches to follow the long term (Abrasco 2019). There were delays in acting, such as the definition of what would be considered a case of compulsory notification (Fiocruz 2019b).

c) Socioeconomic impacts

In view of the changes in the thalasso cycle of the affected places, the local economy was extremely affected, given that most economic activities are based on products from this set of ecosystems (Ramalho 2019b). The populations of the territories had, in the meantime, financial losses that were perpetuated for months after the appearance of the oil slicks, not yet recovering the normal rates of trade due to the uncertainties of how safe it is to consume the products and be on the affected beaches. Informal and self-employed workers, mainly fishermen and shellfish gatherers, are the most affected since their daily income is what often determines whether they will be able to meet the basic needs of their families (Pena et al. 2020).

The number of unemployed people increased substantially in this period, directly influencing the state of misery of this population, drawing attention to the invisibility of these workers. Faced with this situation of socio-economic aggravation, the government has not taken effective measures to help these people, as only 5% of the local workers (lobster fishermen) have been benefited with financial assistance during this crisis, despite protests, public hearings, lawsuits and several manifestations by groups formed by local residents, NGOs, research institutions, among others (Araújo et al. 2020).

Associated with the vulnerabilities arising from the oil spill disaster, the Covid-19 pandemic has worsened the situation of traditional communities such as artisanal fishermen,

due to social isolation, reduced income, food insecurity, overlapping new layers of injustice in the affected peoples (Cavalcanti & Wanderley 2020, Pinto et al. 2020, Mejía 2021). The Pastoral Council of Fishermen (CPP in the Portuguese acronym) carried out monitoring of the impacts of Covid-19 on fishing communities and identified that many of the workers of the waters did not obtain emergency aid, the sale of fish and shellfish that was already in decline since the disaster was hit again, given that for much of 2020, beaches were part of list of prohibited places for circulation or social agglomeration (Reis-Filho & Quinto 2020).

The effects on health from oil are added to the covid-19 pandemic and are sometimes neglected in health services and actions. These difficulties experienced by the populations of the waters express a historical cycle of racism and environmental injustice of traditional peoples, disregard for ecosystems and the unbridled pursuit of profit. Environmental, socioeconomic and health aspects are articulated, since the economy imposes an unequal system, whose functioning occurs from the vulnerability of traditional peoples in favor of the accumulation of wealth by a select social group and the unbalanced exploitation of the environment (Garbois et al. 2017).

Social determinants of health understand the health-disease relationship as a result of historical and social processes experienced by the subjects, considering the social relationships constructed, and dimensions, both biological and social, connected in such a way that they influence each other, resulting in situations of attrition or strengthening, helping to understand the situation experienced in the territories affected by the oil spill (Breilh 2010, Borghi et al. 2018).

Conflict response, sources and materials

Even with the lack of answers about the origin of the crude oil and the repercussions of the spill, the Brazilian government decreed in January 2020 the withdrawal of observation and monitoring teams from the affected sites (Disner & Torres 2020).

From the mapping, it was observed how much the late and precarious action of the Brazilian government increased the vulnerabilities and proportions of the disaster (Borges 2019). Although the socioeconomic, environmental and health impacts were relevant for a large number of people, it is possible to observe that after the most critical period of the oil spill (September to November 2019), that is, with greater amounts of oil that arrived on the beaches, the disaster was progressively made invisible by the government and various media outlets, becoming yet another neglected socio-environmental injustice and racism in the country (Intervozes 2020b, Ramalho 2019b).

The mapping shows that the affected populations will have to deal with the short, medium and long-term repercussions of the disaster through their own efforts, because since the beginning of the socio-environmental conflict they have not received effective support from federal, state and/or municipal government representatives (MPP 2019).

CONCLUSIONS

Given the insufficiency of Brazilian institutions and large firms associated with the government in preventing and coping with environmental disasters, it is increasingly urgent and relevant to discuss this topic in the various formats of debate that current technology allows. This will allow to cover essential planning and articulation actions with the different sectors, to ensure more

careful, transparent and participatory processes in the territories.

Apart from discussing the disaster, the denunciation of these events is a way of trying to highlight the historical damage that this unsustainable development has produced, mainly, to traditional populations (indigenous, quilombolas, artisanal fishermen, among others), united by socio-environmental injustices and the environmental racism reproduced continuously over the decades.

The publication of conflicts and injustices on platforms such as EJAtlas may be understood not only as an isolated event, but as processes that bring together different conflicts and their interrelationships, enabling a global articulation between institutions interested in social well-being. It will also illuminate the invisibilities experienced by different populations, effectively expanding access to information at the international level of these conflicts.

It has become urgent to build environmental and health diagnoses in order to take remedial and mitigation measures against the spill, to prepare an organized and hierarchical health care network, a participatory and community-based health surveillance, as well as socioeconomic recovery through social protection policies that are even more necessary in the current pandemic context. It is also necessary to prepare public institutions for accidents, disasters and global environmental problems that are increasingly recurring in Brazil, with repercussions on changes in ecosystems due to the complex interrelationship between the environment, production processes, health and the dispute for common goods.

Acknowledgments

This study was financed by the Public Call of the Research Program for SUS: shared management in health nº 06/2020 (PPSUS–Pernambuco/FACEPE – CNPq - Ministry of Health/Decit/SCTIE); Public Notice for Sustainable

and Healthy Territories of the Inova and Institutional Program for Sustainable and Healthy Territories (PITSS/FIOCRUZ); Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) – Finance Code 001.

REFERENCES

- ABRASCO - ASSOCIAÇÃO BRASILEIRA DE SAÚDE COLETIVA. 2019. Derramamento de petróleo é risco para saúde da população <https://www.abrasco.org.br/site/noticias/saude-da-populacao/derramamento-de-petroleo-e-risco-para-saude-da-populacao/43706/>.
- ACSELRAD H, HERCULANO S & PÁDUA JA. 2004. Justiça Ambiental e Cidadania. Rio de Janeiro: Relume Dumará/ Fundação Ford.
- AGUILERA F, MÉNDEZ J, PÁSARO E & LAFFON B. 2010. Review on the effects of exposure to spilled oils on human health. *J Appl Toxicol* 30(4): 291-301. <https://dx.doi.org/10.1002/jat.1521>.
- ARAÚJO ME, RAMALHO CWN & MELO PW. 2020. Pescadores artesanais, consumidores e meio ambiente: consequências imediatas do vazamento de petróleo no Estado de Pernambuco, Nordeste do Brasil. *Cad Saúde Pública*, Rio de Janeiro, v. 36, n. 1,
- ARCURI ASA ET AL. 2012. Efeitos da exposição ao benzeno para a saúde. *Série Benzeno*. Fascículo 1. Fundacentro, 52 p.
- AUGUSTO LGS. 2009. Exposição ao benzeno em misturas aromáticas: uma história modelo. *Saúde do trabalhador e sustentabilidade do desenvolvimento humano local*. 1ª ed. Recife: Editora Universitária da UFPE, p. 25-46.
- BARBOSA LG, ALVES MAS & GRELE CEV. 2021. Actions against sustainability: Dismantling of the environmental policies in Brazil. *Land Use Policy* 104: 105384.
- BORGES A. 2019. Salles só formalizou plano 41 dias após manchas aparecerem no Nordeste. O Estado de S. Paulo. Available at: <https://sustentabilidade.estadao.com.br/noticias/geral,salles-so-formalizou-plano-41-dias-apos-manchas-aparecerem-no-nordeste,70003059406> acessado em: jul 2022.
- BORCHI CMSO, OLIVEIRA RM & SEVALHO G. 2018. Determinação ou determinantes sociais da saúde: texto e contexto na América Latina. *Trab Educ Saúde* 16(3): 869-897.
- BRASIL. 2019. Boletins epidemiológicos. Ministério da saúde (MS). Available from: <https://www.saude.gov.br/boletins-epidemiologicos>.

- BRAZIL. 2019. Boletim - Manchas de Óleo no Litoral do Nordeste. Ibama, Brasília.
- BRASIL. 2020. Combate ao óleo. Marinha do Brasil. Available from: <https://www.marinha.mil.br/combate-ao-oleo>.
- BREILH J. 2010. Las tres 'S' de la determinación de la vida: 10 tesis hacia una visión crítica de la determinación de la vida y de la salud. In: Nogueira RP, editor. Determinação social da saúde e Reforma Sanitária. Rio de Janeiro: Cebes, p. 87-125.
- BRUM HD, CAMPOS-SILVA JV & OLIVEIRA EJ. 2020. Brazil oil spill response: Government inaction. *Science* 367(6474): 155-156.
- CAVALCANTI JAS & WANDERLEY BEB. 2020. Os pescadores e as pescadoras artesanais em tempos de COVID-19. *Rev Geogr Trab* 21(2): 493-510.
- COPE MR, SLACK T, BLANCHARD TC & LEE MR. 2013. Does time heal all wounds? Community attachment, natural resource employment, and health impacts in the wake of the BP Deepwater Horizon disaster. *Soc Sci Res* 42(3): 872-881. Available from: <https://dx.doi.org/10.1016/j.ssresearch.2012.12.011>.
- CPP - COMISSÃO PASTORAL DA PESCA. 2020a. Manifesto Campanha Mar de Luta: Justiça Social aos Povos das Águas. Available from: <http://www.cppnacional.org.br/publicacao/manifesto-campanha-mar-de-luta-justi%C3%A7a-social-aos-povos-das-%C3%A1guas>.
- CPP - COMISSÃO PASTORAL DA PESCA. 2020b. Iniciativa que reúne pescadores, pesquisadores e ativistas, monitora os impactos da Covid-19 nas comunidades pesqueiras. Available from: <http://www.cppnacional.org.br/noticia/iniciativa-que-reune-pescadores-pesquisadores-e-ativistas-monitora-os-impactos-da-covid-19>.
- DISNER GR & TORRES M. 2020. The environmental impacts of 2019 oil spill on the Brazilian coast: Overview. *Rev Gest Ambient Sustentab* 7(15): 193-209.
- EJATLAS - GLOBAL ATLAS OF ENVIRONMENTAL JUSTICE. 2022. Available from: <https://ejatlas.org> acessado em: jul 2022.
- ESTEVO MO ET AL. 2021. Immediate social and economic impacts of a major oil spill on Brazilian coastal fishing communities. *Mar Pollut Bull* 164: 111984.
- EUZEBIO C, RANGEL G & MARQUES R. 2019. Derramamento de Petróleo e seus Impactos no Ambiente e na Saúde Humana. *RBCIAMB* 52: 79-98.
- FELLET J. 2019. Vazamento de óleo no Nordeste: quais órgãos são responsáveis por limpar, investigar e punir. *BBC News Brasil*. Available from: <https://www.bbc.com/portuguese/geral-50191420>.
- FIOCRUZ - FUNDAÇÃO OSWALDO CRUZ. 2019a. Óleo no Nordeste Brasileiro: uma emergência de saúde pública! Elaborada por: Observatório da Política Nacional de Saúde Integral das Populações do Campo, Floresta e Águas. Available from: <http://www.saudecampofloresta.unb.br/oleo-no-nordeste-brasileiro-uma-emergencia>.
- FIOCRUZ - FUNDAÇÃO OSWALDO CRUZ. 2019b. Carta aberta pela declaração de estado de emergência em Saúde Pública diante os perigos da exposição ao óleo de Petróleo nas praias nordestinas e para o desenvolvimento de ações de vigilância popular e cuidado em Saúde. Departamento de Saúde Coletiva, Laboratório de Saúde, Ambiente e Trabalho (LASAT), Instituto Aggeu Magalhães, Pernambuco. <https://racismoambiental.net.br/2019/10/29/cartaaberta-pela-declaracao-de-estado-de-emergencia-em-saude-publica/>
- GARBOIS JA, SODRÉ F & DALBELLO-ARAUJO M. 2017. Da noção de determinação social à de determinantes sociais da saúde. *Saúde Debate* 41: 63-76.
- GARCÍA-LÓPEZ GA. 2018. As múltiplas camadas de injustiça ambiental em contextos de desastres (des) naturais: o caso de Porto Rico pós-furacão Maria. *Justiça Ambiental* 11(3): <https://doi.org/10.1089/env.2017.0045>.
- GURGEL AM. 2017. Neurotoxic effects of organophosphorus pesticides and the governmental regulation system: from scientific doubt to concealment of danger to human health. 2017. Tese (Doutorado em Saúde Pública) - Instituto Aggeu Magalhães, Fundação Oswaldo Cruz, Recife.
- GURGEL AM, GURGEL IGD, FRIEDRICH K & AUGUSTO LGS. 2019. Uso do coque verde de petróleo como matriz energética e potenciais danos à saúde e ao ambiente. In: Santos MOS, Gurgel AM & Gurgel IGD (Eds), *Conflitos e injustiças na instalação de refinarias: os caminhos sinuosos de Suape, Pernambuco*. Recife: Ed. UFPE, p. 119-146.
- GURGEL AM, MEDEIROS AC, ALVES P, DASILVA J, GURGEL IGD & AUGUSTO LGS. 2009. Framework dos cenários de risco no contexto da implantação de uma refinaria de petróleo em Pernambuco. *Ciênc Saúde Coletiva* 14(6): 2027-2038.
- IBAMA. 2020. Manchas de óleo no litoral brasileiro. Available from: <http://www.ibama.gov.br/manchasdeoleo> Accessed on: 07/2022.
- INTERVOZES. 2020a. Mar de Luta: movimentos pesqueiros e organizações lançam campanha contra petróleo no Nordeste. <https://intervozes.org.br/mar-de-luta-movimentos-pesqueiros-e-organizacoes-lancam-campanha-contra-petroleo-no-nordeste/>.
- INTERVOZES. 2020b. Vozes silenciadas - justiça socioambiental e mídia A cobertura do vazamento

de petróleo no litoral brasileiro. Available from: <https://intervozes.org.br/publicacoes/vozes-silenciadas-petroleo/>

KPONEE KZ ET AL. 2015. Petroleum contaminated water and health symptoms: a cross-sectional pilot study in a rural Nigerian community. *Environ Health* 14(1): 1-8.

LOURENÇO RA ET AL. 2020. Mysterious oil spill along Brazil's northeast and southeast seaboard (2019–2020): trying to find answers and filling data gaps. *Mar Pollut Bull* 156: 1-1.

MEJÍA JP. 2021. Impacto de la pandemia COVID-19 en ingresos de comunidades pesqueras de Marcovia y Amapala, Honduras. *Escuela Agrícola Panamericana, Zamorano, Honduras*. Available from: <https://bdigital.zamorano.edu/server/api/core/bitstreams/8cdf0eb8-7893-43df-a55d-c7151ddaf359/content>.

MESQUITA B & QUINAMO T. 2020. Impactos socioeconômicos e ambientais da contaminação por petróleo nas praias do litoral da região nordeste do Brasil. Recife; Sep.

MOREIRA JFM & D'ALMEIDA AL. 2020. Indústria de petróleo e gás: acidentes relevantes no mundo. Available from: <https://docplayer.com.br/94549104-Industria-de-petroleo-e-gas-acidentes-relevantes-no-no-mundo.html>.

MPP - MINISTÉRIO PÚBLICO DE PERNAMBUCO. 2019. Carta de repúdio do Movimento dos Pescadores e Pescadoras Artesanais do Brasil (MPP) sobre o maior desastre ambiental do Brasil. Available from: <https://racismoambiental.net.br/2019/11/05/carta-de-repudio-do-movimento-dos-pescadores-e-pescadoras-artesanais-do-brasil-mpp-sobre-o-maior-desastre-ambiental-do-brasil/>.

OLIVEIRA RT. 2016. O território e as questões socioespaciais: uma análise dos processos de transformação do espaço a partir da implantação do complexo industrial e portuário de Suape - PE. Dissertação (mestrado), Universidade Federal de Pernambuco, CFCH, Programa de Pós-graduação em Geografia. Available from: <https://repositorio.ufpe.br/bitstream/123456789/27120/1/DISSERTA%20c3%87%20Rinaldo%20Thomaz%20de%20Oliveira.pdf> Accessed on: 03/2021. (Unpublished).

PENA PGL ET AL. 2020. Derramamento de óleo bruto na costa brasileira em 2019: emergência em saúde pública em questão. *Cad Saúde Pública* 36(2).

PINTO PBA, BASTOS RS & DE SOUZA EC. 2020. Impactos da pandemia de COVID-19 na atividade pesqueira artesanal de Itaipu. *Mares: Rev Geogr Etnociênc* 2(2): 61-71.

PORTO MF, PACHECO T & LEROY JP. 2013. *Injustiça Ambiental e Saúde no Brasil: Mapa de Conflitos*. Editora FIOCRUZ, Rio de Janeiro.

PORTO MFS, ROCHA DF & FINAMORE R. 2014. Saúde coletiva, território e conflitos ambientais: bases para um enfoque socioambiental crítico. *Ciênc Saúde Colet* 19(10): 4071-4080.

RAMALHO CWN. 2017. *Embarcações do encantamento: trabalho sinônimo de arte, estética e liberdade na pesca marítima*. Campinas: Centro de Estudos Rurais, Universidade Estadual de Campinas; São Cristóvão: Editora UFS.

RAMALHO CWN. 2019a. Os possíveis impactos dos vazamentos de óleo nas comunidades pesqueiras artesanais em Pernambuco: um breve e provisório balanço. Recife: Núcleo de Estudos Humanidades, Mares e Rios, Universidade Federal de Pernambuco.

RAMALHO CWN. 2019b. A situação do comércio de pescados em algumas localidades pernambucanas: reflexões preliminares após os vazamentos do petróleo. Recife: Núcleo de Estudos Humanidades, Mares e Rios, Universidade Federal de Pernambuco.

REIS-FILHO JA & QUINTO D. 2020. COVID-19, Afastamento social, pesca artesanal e segurança alimentar: como esses temas estão relacionados e quão importante é a soberania dos trabalhadores da pesca diante do cenário distópico. Disponível em <https://preprints.scielo.org/index.php/scielo/preprint/view/54/64>.

RIGOTTO RM. 2008. Desenvolvimento, ambiente e saúde: implicações da (des)localização industrial. Rio de Janeiro: Ed. FIOCRUZ, 426 p.

RIGOTTO RM, AGUIAR ACP & RIBEIRO LAD. 2018. *Tramas para a justiça ambiental: Diálogo de saberes e práxis emancipatórias*. Edições UFC, Fortaleza.

RIGOTTO RM & AUGUSTO LGS. 2007. Saúde e ambiente no Brasil: desenvolvimento, território e iniquidade social. *Cad. Saúde Pública*, Rio de Janeiro, 23 Sup. Available from: https://www.scielosp.org/article/ssm/content/raw/?resource_ssm_path=/media/assets/csp/v23s4/02.pdf. Accessed on: 07/2022.

RUNG AL, GASTON S, ORAL E, ROBINSON WT, FONTHAM E & HARRINGTON DJ, TRAPIDO E & PETERS ES. 2016. Depression, Mental Distress, and Domestic Conflict among Louisiana Women Exposed to the Deepwater Horizon Oil Spill in the WaTCH Study. *Environ Health Perspect* 124(9): 1429. Available from: [/pmc/articles/PMC5010393/](https://pmc/articles/PMC5010393/).

SANTOS HF, CARMO FL, ROSADO AS & PEIXOTO RS. 2016. Contaminação de recifes de coral por petróleo e seus

derivados. In: Zilberberg C, Abrantes DP, Marques JA, Machado LF & Marangoni LFB (Eds), *Conhecendo os recifes brasileiros: rede de pesquisas Coral Vivo*. Rio de Janeiro: Museu Nacional/Universidade Federal do Rio de Janeiro, p. 183-194.

SANTOS MOS, GURGEL AM, & GURGEL IGD. 2019. Conflitos e injustiças na instalação de refinarias: os caminhos sinuosos de Suape, Pernambuco. Ed. UFPE, Recife.

SÁ-SILVA JR, ALMEIDA CD & DE GUINDANI JF. 2009. Pesquisa documental: pistas teóricas e metodológicas. *Rev Bras Hist Ciênc Soc* 1(1). Available from: <https://periodicos.furg.br/rbhcs/article/view/10351>. Accessed on: 12/2021.

SAUER IL. 2016. O pré-sal e a geopolítica e hegemonia do petróleo face às mudanças climáticas e à transição energética. *Recursos Minerais do Brasil*.

SEVS - SECRETARIA EXECUTIVA DE VIGILÂNCIA EM SAÚDE. 2019. Intoxicações exógenas relacionadas à exposição ao petróleo no litoral de Pernambuco. Available from: https://12ad4c92-89c7-4218-9e11-0ee136fa4b92.filesusr.com/ugd/3293a8_c5ecdbfcb41a4a0fb92ac3fa780e718d.pdf.

SISSINI MN ET AL. 2020. Brazil oil spill response: Protect rhodolith beds. *Science* 367(6474): 156.

SOARES MO ET AL. 2020a. Oil spill in South Atlantic (Brazil): Environmental and governmental disaster. *Marine Policy* 115: 103879.

SOARES MO ET AL. 2020b. Brazil oil spill response: Time for coordination. *Science* 367(6474): 155.

TEMPER L, DEL BENE D & MARTINEZ-ALIER J. 2015. Mapping the frontiers and front lines of global environmental justice: the EJAtlas. *J Political Ecol* 22(1): 255-278.

TEMPER L ET AL. 2014. EJATLAS, mapeo colaborativo como herramienta para el monitoreo de la (in) justicia ambiental. *Ecología Política* 48: 10-13.

TEMPER L ET AL. 2018. The Global Environmental Justice Atlas (EJAtlas): ecological distribution conflicts as forces for sustainability. *Sustain. Sci* 13(3): 573-584.

UFBA - UNIVERSIDADE FEDERAL DA BAHIA. 2019. Pela declaração de estado de emergência em saúde pública para controle dos riscos recorrentes da maior tragédia de contaminação pelo petróleo da costa brasileira.

VARELLA MD. 2015. A necessidade de repensar os mecanismos de responsabilidade ambiental em caso de riscos de vazamento de petróleo na Zona Econômica Exclusiva do Brasil. *Revista de Direito Internacional*, Brasília, 12(1). Available from: <https://www.rdi.uniceub.br/rdi/article/view/3460/0>.

How to cite

SANTOS MOS, SANTOS CPS, ALVES MJCF, GONÇALVES JE & GURGEL IGD. 2022. Oil in Northeast Brazil: mapping conflicts and impacts of the largest disaster on the country's coast. *An Acad Bras Cienc* 94: e20220014. DOI 10.1590/0001-376520220220014.

*Manuscript received on January 7, 2022;
accepted for publication on September 1, 2022*

MARIANA OLÍVIA S. DOS SANTOS^{1,2}

<https://orcid.org/0000-0002-2129-2335>

CAROLINE P.S. SANTOS²

<https://orcid.org/0000-0001-8023-2853>

MARIA JOSÉ C.F. ALVES¹

<https://orcid.org/0000-0002-6704-6623>

JOSÉ ERIVALDO GONÇALVES¹

<https://orcid.org/0000-0001-7841-8296>

IDÊ G.D. GURGEL¹

<https://orcid.org/0000-0002-2958-683X>

¹Oswaldo Cruz Foundation (IAM/Fiocruz), Aggeu Magalhães Institute, Department of Collective Health, Av. Prof. Moraes Rego, s/n, Cidade Universitária, 50670-420 Recife, PE, Brazil

²Federal University of Pernambuco, Center for Life Sciences, Agreste Academic Center, Av. Marielle Franco, s/n, Km 59, 55014-900 Caruaru, PE, Brazil

Correspondence to: **Mariana Olívia Santana dos Santos**

E-mail: mariana.santos@fiocruz.br

Author contributions

All the authors actively participated in all the stages of the manuscript's elaboration.

