

Oil spill on the Brazilian coast: (in)visibility of knowledges and disregard for the life of shellfisherwomen

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Abstract *In 2019, an oil spill of yet unknown origin affected several locations on the Brazilian coast. The purpose of this research was to capture the perceptions of women shellfish gatherers in the Jaguaribe River estuary, Ceará, about exposure to oil and its consequences. The focal group technique was used for data collection and the Iramuteq software for the processing and analysis of the material. The results indicated the creation of two analytical categories: Social, economic, food production and consumption implications of shellfish gatherer families; and the knowledges, the participation and the surveillance in the context of (in) visibility of exposure to oil. It was observed that shellfisherwomen and their families constitute a population that is very exposed to the negative impacts caused by the oil spill, as they are significant from the socioeconomic, environmental, food production, consumption and health perspectives. Attention is drawn to health and social assistance policies for these fisherwomen/shellfish gatherers, with consequences on the food, water and nutrition security of families and the recognition of their knowledges and practices, constructed within a traditional way of life that produces and reproduces the existence in a close society/nature relationship.*

Key words *Petroleum, Environmental pollution, Fishing, Public health surveillance, Community-Based Participatory Research*

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Introduction

In August 2019, the biggest environmental disaster caused by an oil spill off the coast of Brazil occurred, of unknown origin, involving approximately 5,000 tons of oily waste, affecting 4,000 km of coastline, 1,009 beaches in 11 Brazilian states and 55 conservation units¹. It is considered the largest worldwide tropical coastal contamination in terms of extension¹. In March 2020, there were still traces of the material in 135 locations². Exposure to oil can be harmful to human health, cause environmental degradation and socioeconomic problems to many social groups.

Fishing activities predominate on the coastal zone of the Northeast region of the country, including 223 municipalities and 196,546 fishermen, with an average of 880 fishermen/fishermen per municipality³. Of the groups exposed to the oil spill in Ceará, are the Artisanal Fishermen (MPA, *Mulheres Pescadoras Artesanais*). These women, in addition to being shellfish gatherers, develop multiple activities in the family: taking care of children and household chores; participating in the fishing activities with their partners, in the collection, processing and sale of fish; and many provide the family's livelihood by gathering *sururu* (also known as *charru* mussel) and other types of shellfish.

Shellfish gathering is carried out, preferably, in the mangroves, and the women are in direct contact with the water. This is an essential sustainable development and nature conservation activity, as it reduces poverty, fights gender inequalities and allows Food and Nutrition Security and Sovereignty (FNSS) for thousands of families worldwide, especially in developing countries^{4,5}. Therefore, it constitutes a practice of life resistance and women's autonomy⁶. However, with the contamination of the environment with oil, the workers may experience health condition worsening and Food and Nutrition Insecurity (FNI), contributing to changes in the family dynamics and functionality.

Carneiro *et al.*⁷ refer to the rights of rural, forest and water populations (PCFA, *Populações do Campo, da Floresta e das Águas*), such as: access to education, housing, public transportation, communication and sanitation, as a challenge still pending and, above all, regarding the quality of the offered services. Water populations are characterized by peoples and communities whose ways of life, production and social reproduction are predominantly related to the aquatic environment. The MPA are included in this con-

text. Considering that the effects on the workers' health may remain invisible and that MPA are among the population groups most exposed to the oil spill disaster, the following question was asked: *How did the oil spill affect the life of MPA in the state of Ceará?* The objective is to capture the MPAs' perceptions about the oil exposure and its consequences.

Method

Study type

The present is an investigation with a qualitative approach, aiming at expanding the understanding of a social group to comprehend the transformation of the reality and the problem from the perspective of the individuals who experience it in their daily lives, thus constituting an exploratory and descriptive study⁸. Therefore, it seeks to capture opinions, attitudes and beliefs and provide a new view of the studied phenomenon or problem. The exploratory aspect provides an overview of a given fact, and also develops and modifies ideas and concepts with a view to formulating problems or hypotheses for further studies⁹.

Study site

The study was carried out in the state of Ceará, Brazil, where artisanal fishing is found in several communities. Therefore, based on a request from the National Articulation of Fishermen (ANP, *Articulação Nacional das Pescadoras*) and the Pastoral Council of Fishermen (CPP, *Conselho Pastoral dos Pescadores*), a listening was carried out on the living and working conditions, especially of women working in shellfish gathering activities in the Jaguaribe River estuary.

Data collection, study participants and ethical aspects

The Focal Group (FG) technique was used, which allows people who have common experiences to be brought together aiming to investigate certain issues, with the researcher playing the role of mediator in conducting the dialogue¹⁰. In this case, aiming to capture the perceptions of artisanal fishermen about the exposure to oil and its consequences.

The FG was held in November 2019, with 13 women. A script was used, which contained questions about: the consequences of the oil spill

on the work, life and health of MPAs. The discourses were recorded, transcribed and analyzed. All participants signed the Free and Informed Consent Form (FICF). This study is part of the research project “*Produção de indicadores para a avaliação das condições de vida das famílias e acesso aos serviços de atenção primária em territórios do litoral e do sertão do Ceará e do Rio Grande do Norte*” (Indicator production for the assessment of living conditions of families and access to primary care services in territories of the Brazilian coast and outback regions of Ceará and Rio Grande do Norte), approved by the research ethics committee of *Escola de Saúde Pública do Ceará* and funded by the Inova Fiocruz Program, *Novos Talentos* Notice.

Data processing and analysis

To support the data analysis, the Iramuteq software (*R pour les Analyses Multidimensionnelles de Textes et de Questionnaires*) version 0.7 alpha 2, developed by Ratinaud in 2009, was used. It is a free program, which is anchored in the R software 3.5.1, allowing the processing and statistical analysis of produced texts¹¹.

The information transcribed from the FG was submitted to Iramuteq through a single file appropriately configured in text format (.txt). The set of texts in the file is called a *corpus*. A text unit, in turn, depends on the nature of the research; for instance, if the analysis is applied from a set of interviews, each one of them will constitute a text¹². In this study, as the FG technique was used, the *corpus* was constituted by the shellfish gatherers’ testimony.

Three techniques provided by Iramuteq were used to support the analysis of textual content: Lexicographical Analysis, Descending Hierarchical Classification (DHC) and Word Cloud. It is important to emphasize that the use of Iramuteq for the compilation and codification of qualitative data does not exclude the researcher’s analytical reflective work¹⁰.

Results and discussions

Characterization of the socioeconomic profile of the shellfisherwomen

In this study, the participating workers totaled thirteen women, nine shellfish gatherers, two artisans, one housemaid and one unemployed woman.

In relation to the nine shellfish gatherers, it is shown that the mean time working as shellfisherwomen is 30 years and 4 months and ranges from 13 to 46 years, with a median of 30 years. The nine workers referred to the Jaguaribe River as their main working environment. According to Xavier¹³, this is the longest watercourse in the state of Ceará, running for an approximate length of 610 km, and the river mouth lies between the municipalities of Fortim and Aracati, comprising a set of ecosystems such as mangroves and estuaries that play a fundamental role for human activities such as fishing.

As for the ethnicity, three shellfish gatherers consider themselves black, three brown, two brunettes and one indigenous. Of this total, six are married, two are single and one is a widow. Individual income ranges from R\$250.00 to R\$988.00 – the latter a minimum wage in 2019. Family income for most of them is at least one minimum wage, with the exception of the family of one of the fisherwomen who earns three minimum wages. The predominant age group, for 55.5% of them, was between 40-49 years old, ranging from 38 to 61 years. All participants stated that their families have lived for more than 20 years in the fishing communities of this region, most since they were born, which resulted in the occupation and control of this space based on their relationships and traditions. According to the MPAs, approximately nine hundred families affected by the disaster live in these communities, and “*many fishermen and shellfish gatherers were affected*”.

Regarding the level of schooling, 6 shellfish gatherers had incomplete primary education, two had incomplete high school education and only one had finished high school, showing a low level of education. The number of children ranged from 0-8, with an average of 4 children. It is noteworthy the widowed shellfish gatherer who has 8 children, and all of them work in artisanal fishing, 5 fishermen and 3 shellfish gatherers. This information reinforces that it is a traditional work, and that shellfish gatherers tend to start working very early, and many inherit this practice from their mothers: “*I started working gathering sururu (with my mother) when I was 12 years old; today I am 54 years old, and I still experience the same struggle*”.

It is worth noting that eight shellfish gatherers receive visits from Community Health Agents (CHAs) and seven from Endemic Control Agents (ECAs) in their territories. However, some authors emphasize that Unified Health System

(SUS, *Sistema Único de Saúde*) policies are still required for self-employed workers linked to artisanal fishing to meet the specific situations related to their way of life¹⁴.

Analytic categories and textual statistics

The file processed in Iramuteq was separated into 164 text segments (TS), which are text fragments consisting of up to three lines and with similar vocabulary. The *corpus* had 139 TS that were able to be used, which corresponds to a retention of 84.76%. The minimum content retention must be 70% for the process to be considered representative¹². The software also calculated 5,958 occurrences of words, forms or expressions, with 734 distinct words and 324 that were spoken only once.

To facilitate the visualization of the representative words in the *corpus*, Figure 1 shows the Word Cloud, which graphically organizes them according to their frequency.

In Figure 1, the bigger the word, the greater its degree of importance, as in the case of: “shellfish, fish, *sururu*, sell, eat, oil, petroleum, Jaguaribe river, knowledge, fisherman, colony, shellfish gatherers”. The words “fisherman”, “sell”, “knowledge”, “Jaguaribe river” and “oil” were the ones that had the highest frequency in the cloud, being spoken by the participants 40, 39, 37, 36 and 33 times, respectively. Therefore, it is possible to infer that the shellfish gatherers discussed mainly about the sale of fish; and the presence of oil in the Jaguaribe River.

The content generated by the FG was categorized into six classes (Figure 2). From these classes, two *subcorpora* were generated, A and B, each consisting of three classes. The DHC lists the words of each class from the Chi-Square test $>3 (x^2)$, which represents the most significant association of each word with the class in which it is located¹⁵.

For each *subcorpora*, two analytical categories emerged (Table 1). It was possible to name them through the analysis of the TS groupings contained in these classes that were understood by interpreting the meanings of the data supported by the literature¹⁶. According to Suassuna¹⁷, the analytical categories arise from the content of the analyzed data, therefore, constituting a guide to knowledge.

Social, economic, food production and consumption implications of shellfish gatherer families

If we want to have our rights, we can't, because we don't have that sururu to sell and pay for the colony, so it's very difficult. And we don't receive any benefits and it gets even more difficult. The shellfish gatherers only pay and don't collect anything, it's very difficult for us. Fishermen still have, at least once a year, the right to receive at least three cash transfers, 'but shellfish gatherers, year in, year out, receive nothing'. You only earn what you get from selling the shellfish.

In this study, “working hard at dawn and during daytime” and health problems such as “scoliosis, hand and knee diseases” are reported. In addition to illnesses and accidents related to work, the shellfish gatherers reinforce that they do not have any social security recognition, making them incapable of obtaining their workers' rights¹⁸.

We pay (the colony), but when we need it, we are humiliated, then it becomes difficult for us. Now, if the unemployment insurance for shellfish gatherers existed, it would make it easier, but where is it?

Shellfisherwomen are vulnerable, there is no public policy for them and the government has to help us at this time [...]

I have to fight to gather the sururu, to have that money to pay for my colony and if I don't go to work, it becomes very difficult [...]

The shellfish gatherers report difficulties to pay the colony due to the oil spill disaster and demonstrate their feelings of concern, as there is a lack of assistance from both the public authorities and the fishermen's colony. In November 2019, the Federal Government published Provisional Measure n. 908/201919, which implemented the emergency aid to fishermen and fisherwomen affected by oil slicks, with an individual value set at R\$1,996.00, aiming at reaching more than 60,000 fishermen. However, only fishermen with the General Fishing Activity Registry (RGP, *Registro Geral de Atividade Pesqueira*)²⁰ had access to the benefit.

The difficulties in obtaining the RGP regularization are well known, and also that women and young fishermen have not been able to obtain it due to the political discontinuity of the Ministry of Fisheries, Marine Resources and Agriculture, resulting in the exclusion of assistance to thousands of female workers. For Rego *et al.*⁵ what happens is that shellfisherwomen are ignored

Chart 1. Synthesis of the Analytical Categories.

Subcorpora	Classes	Analytical Categories
A	2, 4 and 6	Social, economic, food production and consumption implications of shellfish gatherer families;
B	1, 3 and 5	Knowledge, participation and surveillance in the context of the (in)visibility of exposure to oil.

Source: Study data (2020).

during the collection of official data on non-salaried work, resulting in an impediment to access financial resources, institutional and political support.

In addition, the sale of fish has dropped, in some cases reaching zero sales, violently affecting the main source of income and food for the families of the shellfish gatherers. This was due to the consumers' fears regarding the possibility that the food is contaminated. These events have even generated psychological problems for the workers, such as despair, stress and sadness. According to Won *et al.*²¹, environmental disasters have more significant and prolonged impacts for women from a "physical, mental and socio-economic" perspective, for instance, in the limited work opportunities that trigger conflicts in the communities and depression.

The shellfish, the sururu, there is a man who sometimes buys it, but sometimes they don't want it, so we don't do anything, we don't work and don't get paid.

my husband and my brother-in-law they caught ninety-six kilos of shellfish a week, but now after that oil spill, they don't catch even one kilo, because the man who buys it has stopped buying.

It's very difficult, because whoever sells it, has to gut the fish, right, 'we go through this humiliation', because to sell we have to gut it, if we don't clean it, we don't sell.

I go to the street market and when we arrive there, 'we get very sad', because people don't want to buy it, they keep causing troubles, they keep touching the fish, 'they think there is oil in it'.

Another point that draws attention is the fish and shellfish that were not sold and became the main source of food for the families. Regarding fish contamination in Brazil, of 68 samples analyzed by the Ministry of Agriculture, Livestock and Supply (MAPA, *Ministério da Agricultura, Pecuária e Abastecimento*), two showed health

concern levels defined by the National Health Surveillance Agency (ANVISA, *Agência Nacional de Vigilância Sanitária*), that is, > 6 mg of benzo(a)pyrene – equivalent (BaPE)/kg for fish²². It is noteworthy that these samples were collected in establishments under Federal Inspection, therefore excluding fish caught by Artisanal Fishermen and Fisherwomen (AFF). The BaPE values found were 9.51 and 7.95 mg/kg²². In one of the biggest crude oil spill disasters on record – the Deepwater Horizon, in Gulf of Mexico, in 2010, in which about 450,000 tons of oil were dumped into the ocean – BaPE values in the first 12 months after the spill were 75.4 mg/kg in fish²³. Studies show that Polycyclic Aromatic Hydrocarbons (PAHs) include substances that cause genotoxic damage and that are carcinogenic, such as benzo(a)pyrene²⁴.

If a good soul appears to help us, I'll still sell it, but otherwise we'll eat it little by little and the most difficult thing is that we have to eat this shellfish.

Moreover, because they carry out their activities off the boat – *even by diving we catch shellfish [...] because we work according to the tide* –, that is, in direct contact for hours with the water, shellfisherwomen are exposed to chemical substances present in crude oil, such as PAH, which, as they are health risk factors, are associated with dermatoses, eye problems, nausea, headaches, endocrine diseases and conditions that can potentially affect the reproductive system, such as during pregnancy^{25,26}. Therefore, it is understood that all these problems further aggravated the socioeconomic, environmental, production, food consumption, and health conditions of these populations that are already vulnerable.

The knowledges, participation and surveillance in the context of (in)visibility of exposure to oil

The impacts caused by oil and its components are diverse, and it can "accumulate in the soil, in the sediments, and contaminate the fauna, flora, water and, mainly, human beings"²⁷ (p. 82). Currently, the shellfish gatherers' main demand is to know if the Jaguaribe River has been contaminated, but there are still no concrete answers, according to systematic environmental studies to characterize this situation. In the coastal zone of the state of Ceará region, the extent of the environmental disaster contaminated the beach strip, the sand banks that appear at low tide, priority areas for shellfishing, and the mangrove ecosystem, increasing the risks of the effect of pollut-

ants on the provision, regulation, and cultural ecological services^{28,29}.

There, where they put up the protections, they found oil. Then they put up several protections so it would not go too far into the Jaguaribe river, if they hadn't put it up, it would have entered [...] but some of it can still pass through it, that's what they told us in a meeting [...] but I don't know this answer, if it entered or not.

We fear for our health, because the consumers will not buy the shellfish, but all the people who live here and who eat the shellfish and the fish do not know what it will do to our health later, because we found oil in the river.

The concern of shellfish gatherers about the problems with oil can be evidenced, in particular, by the lack of dissemination of information and environmental analysis to guarantee the quality of the water and food. The fisherwomen alert to the omission of the local government in disseminating clarifications, which makes it difficult to plan the fight against oil slicks. According to Pena et al.³⁰, in this disaster, the dissemination of conflicting information from the authorities without a technical basis was commonplace, such as, for instance, the indication of the general suspension of fish and shellfish consumption in the Northeast of Brazil. As a result, a high level of concern and stress was perceived regarding the uncertainty of ecological and socioeconomic impacts in the short, medium and long term.

It's a pretty glaring situation because I think it's still underreported. I was in another meeting this week in my community, and I was shocked at a fisherman [...] he didn't know that our community, our beach has and had found traces of oil, he didn't know. I mean, a fisherman didn't know it and it is on television every day, but those who live off fishing are still very uninformed.

The monitoring the beaches in Ceará had the support of fishermen and fisherwomen, who helped to clean up and identify the pollution. According to Rêgo et al. (p.7)⁵ “artisanal fishermen and shellfisherwomen are central social subjects of health practices and of the processes to improve working and health conditions in fishing territories”. The water peoples can work in data collection and help in monitoring and to mitigate the impact caused by the disaster. through the knowledge they have of their own territory. However, Health Surveillance, which currently joins epidemiological, sanitary, environmental and workers' health surveillance, still has a long way to go, especially in the creation of more participatory working methods³¹.

It is inherent in the concept of Occupational Health Surveillance (VISAT, *Vigilância em Saúde do Trabalhador*) the participation of workers' social organizations involved in the discussion of the work process and the necessary changes to improve living and working conditions; however, the advent of this surveillance in these territories, and with this conception, remains a great challenge, as previously highlighted by some authors⁵. According to Pena et al.¹⁴, the public action must consider the provision of individual and collective protection, which is socially and culturally constructed, to ensure preventive medical assessments for an early diagnosis of work-related illnesses, professional rehabilitation with the identification of social security nexus, the improvement of notification systems for artisanal and self-employed work-related diseases and accidents, among others.

Therefore, a new claim process is required to improve the working conditions of populations affected by environmental problems³². Therefore, the Environmental Health Surveillance (VSA, *Vigilância em Saúde Ambiental*) and VISAT are understood as a path that has a lot to contribute to SUS, as they act significantly in the protection of populations exposed to environmental and work-related risks, such as oil spills.

However, it was observed that the voices of the MPAs were scarcely considered in identifying this problem. According to the shellfisherwomen, no efforts were made to allow them to help in the work and the environment surveillance and their information is not considered by the government. A depreciation of the knowledges of artisanal fishermen and fisherwomen about their territories still prevails³³. However, the dialogue of knowledges with these peoples is essential to create a more comprehensive and democratic Environmental Labor Law (DAT, *Direito Ambiental do Trabalho*), aiming at a healthy working environment, mainly when these populations are affected by environmental problems³².

We know what's happening [...] 'we scream, but they are muffling our screams' [...] we have no voice [...] we have no opportunity [...] this is very serious because our voice is 'that of the ones who know, our problem', our situation.

They said that we should have called (the public authorities) and that there should be other people to affirm what you say. So, what you say isn't good enough, and that's what made me so upset, I say here I won't even continue, because I've been talking to the government with concerns related to nothing else but our health.

One way the workers found to work in the surveillance was participating in discussion spaces, such as in public hearings, aiming to contribute with SUS and the Municipal Secretariats in the decision-making processes as a type of shared management to reduce pollution and environmental damage. It is essential to have an intersectoral discussion on how to act in this oil episode. Therefore, the testimony of those who suffer the direct impacts can be used to call on public and private services to act more firmly, aiming at improving the quality of life in a challenging context.

As for the ecological damage, the aquatic and terrestrial fauna of the Brazilian coast was affected by the oil, such as tortoises, sea turtles, marine mammals, fish and birds. According to the last Official Report published by the Brazilian Institute for the Environment and Renewable Natural Resources (Ibama, *Instituto Brasileiro de Meio Ambiente e Recursos Naturais Renováveis*)², there were 159 reports of oiled animals in February 2020, with 112 deaths.

There, in my community on the beach, fish were found with traces of oil and a dead turtle covered in oil [...] the turtle was found covered in oil.

In the Canavieira Community, my cousin, I don't know if it was something in her mind, but we caught sururu for consumption and she said it smelled like oil. [...] even after it was cooked, the smell remained.

There is some oil on the beach that stuck to the rocks [...]

Moreover, the FG reported the occurrence of diseases that may be related to the ingestion of contaminated food and contact with river and sea water.

And I have already eaten shrimp after that, but on that day after I ate the shrimp, after one hour, my face swelled up and I'm used to eating shrimp. I got all swollen, my face was all swollen and my voice was hoarse [...]

I told my grandson: look, you're not going to swim in the river, because I was already afraid because of that water. Then a tuna boat arrived, I know that the boat was still loaded with big fish, tuna, and he decided to go up there, he went swimming and came back. When he got home, he had a swollen face and a swollen tongue, full of blisters.

According to Pena *et al.*³⁰ “the toxicological risks involved are serious, acute and chronic, with special attention to toxic oil fractions that can lead to death by intoxication, especially that associat-

ed with aromatic compounds”. Acute toxicity is defined as a short-term and immediate effect by simple exposure to the spill, and chronic toxicity refers to long-term effects, that is, caused by the continuous exposure to a contaminant, which is harmful to human health and the environment after a long period of time³⁴. Therefore, the above reports may be the result of acute exposure, that is, when the individual is exposed to high concentrations, resulting in the onset of diseases such as the irritation of mucous membranes, skin and eyes.

Final considerations

Work-related diseases have been constantly neglected in the working population in general, and the MPAs should be considered a priority group for public health actions in the event of exposure to oil due to the off-boat fishing activity, as well as the vulnerabilities associated with different contexts, such as pregnancy. Therefore, attention is drawn to health and social assistance policies, since, as observed, the workers do not have unemployment benefits for artisanal fishermen, unemployment and emergency insurance, with severe consequences for families under FNI situation, and they must be monitored in the short, medium and long term .

The presence of shellfisherwomen in the discussion environments was seen as fundamental for outlining strategies for VISAT and VSA, controlling the damage caused by the emergency and developing more participatory surveillance practices, while dialoguing with the communities. It should be noted that, in addition to the participation of the MPAs, it is essential to recognize their knowledges and practices, constructed within a traditional way of life that does not separate and exclude the work, the experience of living with family dynamics and that produces and reproduces life in a close society/nature relationship.

Finally, it can be verified that the support environmental systems for food and water sovereignty were strongly affected, as observed in the testimonies of the shellfisherwomen. The damage caused to ecosystems for community use was evidenced by demonstrating high levels of contamination in the food chain, aggravating the consequences to life and collective health. These damages are associated to the cumulative impacts that affected the ecological services in environmental systems with high socio-environmental fragility.

Collaborations

LRC Silva: first author; worked on data analysis and interpretation; writing of the manuscript and its critical review; and approval of the version to be published. VM Pessoa: worked on the study conception and design; the writing /critical review of the manuscript and approval of the version to be published. FF Carneiro: worked on the study conception and design; in the writing and critical review of the manuscript. NSM Andrade: worked on the writing and critical review of the manuscript. AJA Meireles: worked on the writing of the manuscript and approval of the final version to be published.

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