Community-organised disaster response to the 2019 Northeast Brazil Oil Spill in small-scale fishing territories in Bahia, Brazil

Organização comunitária da resposta ao desastre de derramamento de petróleo de 2019 em territórios de pesca artesanal na Bahia, Brasil

Frances Sentilles [1]

Louise O. R. Machado [2]

Rita de Cássia Franco Rêgo [3]

[1] MSPH in Environmental Sciences and Engineering, Department of Environmental Sciences and Engineering, University of North Carolina at Chapel Hill, Chapel Hill, NC, United States
Email: fsentilles@gmail.com

[2] PhD in in Public Health, Institute of Public Health Studies Federal University of Rio de Janeiro, Rio de Janeiro, Brazil
Email: louisemachado.br@gmail.com

[3] Full Professor, Post-Graduate Program in Health, Environment, and Labor, School of Medicine, Federal University of Bahia, Salvador, Brazil
Email: ritarego1@gmail.com

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ABSTRACT

The 2019 Northeast Brazil Oil Spill represents an opportunity to observe small-scale fishing communities' disaster response capacity and identify opportunities to improve resilience. With a delayed and disjointed national government response, many communities organised clean-up activities and other actions. A mixed-methods study including a questionnaire (n=168) and semi-structured interviews (n=11) was conducted in two municipalities in Bahia to analyse the disaster response. 66.1% (111/168) of the questionnaire respondents participated in clean-up efforts, with greater participation in the community, with more fishing trade associations and government support. The rapid mobilisation of these volunteer efforts was a positive indicator of resilience, although fishers' involvement puts them at risk for health consequences. Risk management, access to materials, and emergency literacy were weaknesses in the disaster response. While government management and ownership are needed during acute disasters, partnerships with fishing communities could serve to enhance disaster resilience due to their pre-existing organisational structures and demonstrated willingness to volunteer as first responders.

Keywords: Oil spill. Small-scale fishing. Disaster response. Disaster preparedness. Community organising.

RESUMO

O derramamento de petróleo ocorrido no Nordeste do Brasil em 2019 representa uma oportunidade para observar a capacidade de resposta a desastres de comunidades pesqueiras artesanais e identificar caminhos para fortalecer sua resiliência. Diante da resposta tardia e desarticulada do governo federal, muitas comunidades se organizaram para realizar ações de limpeza e outras iniciativas. Um estudo de métodos mistos, incluindo um questionário e entrevistas semiestruturadas, foi realizado com pescadores artesanais residentes em dois municípios da Bahia para analisar a resposta ao desastre. 66,1% (111 de 168) dos respondentes do questionário participaram das ações de limpeza, com maior participação na comunidade que contava com mais associações de pescadores e maior apoio governamental. A rápida mobilização desses esforços voluntários foi um indicativo positivo de resiliência, embora a participação dos(as) pescadores(as) os(as) exponha a riscos à saúde. A gestão de riscos, o acesso a materiais e a alfabetização em emergências mostraram-se como pontos fracos na resposta ao desastre. Embora a atuação e a responsabilidade governamentais sejam essenciais em situações agudas, parcerias com comunidades pesqueiras podem contribuir para aumentar a resiliência diante de desastres, devido às suas estruturas organizativas preexistentes e à disposição já demonstrada para atuar voluntariamente como primeiros respondentes.

Palavras-chave: *Derramamento de petróleo. Pesca de pequena escala. Resposta a desastres. Preparação para desastres. Organização comunitária.*

1 INTRODUCTION

Small-scale fishers (SSFs) hold an important role in the food system and environmental sustainability of Brazil. The United Nations Food and Agriculture Organisation (FAO) estimates that the fishing industry directly employs around 1 million Brazilians, serving as the primary food and income source in many coastal communities (Mattos; Wojciechowski; Gandini, 2020, p. 11). Most seafood consumed within Brazil comes from SSFs (Mattos; Wojciechowski; Gandini, 2020, p. 12). For SSFs in Brazil, fishing is both a cultural practice and a primary food source (Mattos; Wojciechowski; Gandini, 2020, p. 12). Many fishing communities are characterised as "traditional populations" that have occupied the same territory and maintained similar subsistence practices across generations (Ferreira *et al.*, 2022, p. 9). Globally, SSFs are key to sustainable development across many domains: environment, food security, culture and economy (Basurto *et al.*, 2025; Fondo *et al.*, 2025). Despite their extensive history of sustainable fishing, Brazil's SSFs often earn less than minimum wage and are at risk of 30 occupational health conditions, in addition to threats of extinction due to climate change, industrial environmental degradation, and tourism expansion (Pena; Gomez, 2014).

As climate change intensifies, SSFs in Brazil and around the world will suffer more frequent and more intense natural disasters. This is a key workstream for the United Nations Food and Agriculture Organisation (FAO), with guidelines produced for disaster response and resilience-building in fishing communities (Cattermoul; Brown; Poulain, 2014; Cook; Rosenabum; Poulain, 2021). In Brazil, many fishing communities experience frequent, small-scale flooding events, but the 2019 Northeast Brazil Oil Spill was the first major multi-state disaster to affect such communities, reaching 11 states between August and November of 2019 (Ibama, 2022).

Natural resource-based communities are known to face the highest risks of such events, and they respond to environmental hazards in different ways (Flint; Luloff, 2005). The 2019 spill led to major economic consequences for Brazil's seafood industry, and SSFs were the class of affected workers that most frequently reported negative socioeconomic impacts due to the spill, facing decreased catches, decreased demand for their products, and food insecurity (Ferreira *et al.*, 2022; Silva *et al.*, 2022). Many fishers were directly exposed to the contaminant, putting them at risk for a variety of acute and chronic health problems (Machado *et al.*, 2025). Given the high risk of disasters in this population, the oil spill provides an opportunity to observe disaster response capacity in SSF territories. This article

compares the disaster response in two fishing communities in Bahia through the lens of community-based disaster preparedness, identifying strengths and weaknesses that can be leveraged to improve community resilience.

1.1 EVALUATING THE OIL SPILL RESPONSE

In the federal government, the response to the 2019 delays and inadequacies characterised oil spill, and six weeks passed between the oil's arrival and activation of Brazil's National Contingency Plan for Oil Spills (Barbeiro; Inojosa, 2022, p. 23) In an internal evaluation of the agency's response, the country's Institute of the Environment and Natural Resources (Ibama) acknowledged weaknesses around timing, leadership and coordination, resource mobilization, knowledge and capacitation, and waste management (Ibama, 2021).Additional criticisms of the national response to the disaster include poor management of oil disposal, failure to implement health monitoring, failure to implement public health emergency protocols, and willingness to let low-income, especially majority-Black and indigenous, communities suffer the worst of the effects (Bastos Lima; Da Costa, 2022; Pena *et al.*, 2020). Meanwhile, affected communities quickly organised their own disaster response actions, highlighting the overall misgovernance (Gonçalves *et al.*, 2020).

It is difficult to apply conventional frameworks of disaster resilience to the case of the oil spill in SSF communities because of the lack of government intervention. For example, the FAO's guidance on disaster response in fishing communities is targeted at disaster preparedness and response professionals, rather than community members (Cattermoul; Brown; Poulain, 2014; Cook; Rosenabum; Poulain, 2021). The common best practices that they cite include disaster preparedness, support for sustainable fisheries, flexibility, responsiveness, inclusiveness, and gender mainstreaming (Cattermoul; Brown; Poulain, 2014). While some of these, such as preparedness and flexibility, can be applied by community members, the guidance centres, non-profit and government institutions. In the case of the 2019 spill, responsiveness, inclusivity, and support for sustainable fishing were key criticisms of the national government response (Bastos Lima; Da Costa, 2022; Pena *et al.*, 2020).

However, community engagement and participation in disasters is a recognised asset for community resilience (Brennan; Barnett; Courtney, 2005; Gamboa-Maldonado *et al.*, 2012; Ryan *et al.*, 2020; Wang *et al.*, 2022) Wang *et al.* (2022) developed a comprehensive, validated evaluation tool for analysing community emergency management capacity (WANG *et al.*, 2022). This article considers five of the six domains described by Wang *et al.* (2022): community organisational resilience, management of risks and hidden dangers, emergency material support, emergency force building, and emergency literacy. Resilience of infrastructure was excluded, as infrastructure features (emergency shelters, community fire stations) were not under threat due to the oil spill. The domains of community resilience are also considered in the context of the risks of oil exposure, as participation in oil clean-up activities is linked to several poor health outcomes (Diaz, 2011; Krishnamurthy *et al.*, 2019; Lee *et al.*, 2010; Strelitz *et al.*, 2019).

2 METHODOLOGY

This paper describes a mixed-methods follow-up study to an epidemiological oil spill exposure assessment conducted in artisanal fishing communities in the state of Bahia. Rêgo *et al.* (2024) describe the exposure assessment study design. The follow-up study occurred in April and May of 2022 through semi-structured interviews and the application of the Oil Spill Response and Perceptions Questionnaire for Fishers (OSRPQF) in Conde and Canavieiras. A concurrent embedded, mixed-methods approach was applied to address the complexity of the disaster and the proceeding response (O'Sullivan; Khan, 2022). Questionnaire responses provide information about how community members responded to the disaster, while interviews contextualize the disaster management approach and describe ongoing needs.

2.1 SITE SELECTION

Budgetary resources and team schedules allowed for follow-up in two of the five sites included in the exposure assessment. Baseline demographic characteristics and response rates were analysed from the five sites, and geographic diversity, enthusiasm, and background knowledge on the disaster response at each site were also considered. Conde and Canavieiras were selected due to their high levels of participation in the initial study, adequate sample sizes, and differential resource access and disaster preparation profiles. The QESP-DP19 had 502 respondents in Canavieiras and 281 respondents in Conde.

Conde and Canavieiras are municipalities in the state of Bahia. Both encompass marine protected areas that suffered significant contamination from the oil spill. Both municipalities have large mangrove forests along the coast, where most female fishers collect shellfish. Male fishers, as well as some women, fish in the open ocean using nets. The communities that are the focus of this study are majority-Black with low average incomes. Figure 1 shows the study sites considered for inclusion.

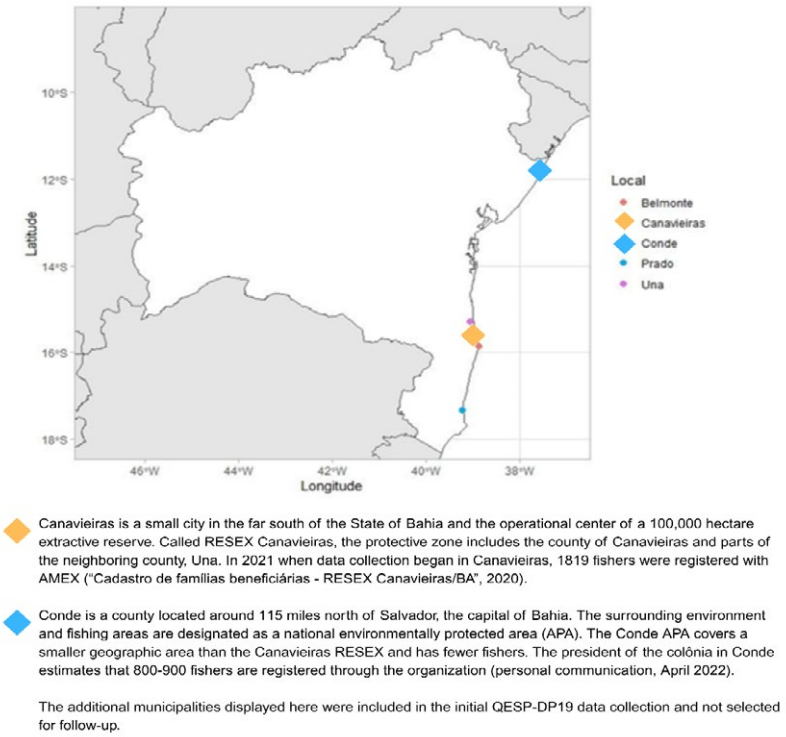

Figure 1 – Map of Study Sites

Source: Authors.

2.2 OSRPQF QUESTIONNAIRE

The Oil Spill Response and Perceptions Questionnaire for Fishers (OSRPQF) is a follow-up survey to the Exposure and Health Effects Questionnaire for Fishers – 2019 Northeastern Brazil Oil Spill (QESP-DP19), an exposure assessment tool designed to estimate oil exposures and certain health outcomes among small-scale fishers. It is intended to provide data to analyse disaster response activities at the individual and community level within the context of the exposures documented by the QESP-DP19.

Research team members developed questions based on documented gaps and challenges in applying the QESP-DP19. Prior to implementation, the questionnaire was tested by the leadership team of a

participating fishing association. The questionnaire includes up to 39 items, applied using conditional survey logic. The questionnaire takes 7-10 minutes to complete.

2.2.1 DATA COLLECTION

A participation rate of 20% of the QESP-DP19 respondents was set as the objective in each municipality based on funding and personnel capacity. This would include 102 participants in Canavieiras and 57 participants in Conde. A random sample of 30% was taken from the original study participants in each municipality with a goal of achieving a response rate of 70%. Researchers attempted to contact all members of the random sample using contact information from the QESP-DP19 and help from community leaders when needed. Meetings with community leaders were held prior to data collection to discuss the study protocol and recruitment strategies. Interviews were scheduled using WhatsApp and hand-delivered written invitations.

In Canavieiras, challenges with contacting participants required that invitations be extended to an additional random sample of 10%. These challenges were unrelated to the research questions; fieldwork was conducted during the coffee harvest season, and many fishers were travelling for seasonal employment in this industry. Table 1 shows the number of participants at each stage from the exposure assessment through the follow-up.

All surveys were administered using the Qualtrics Offline data collection application. Team members read questions to participants, who responded verbally. All surveying was conducted by two graduate students and their supervising professor in May and April of 2022.

Table 1 – Number of participants in exposure assessment and follow-up

Municipality	*QESP-DP19 Respondents*	*Number included in random sample*	*Follow-Up Goal (20% sample)*	*Number of follow-up participants (ORSPQF respondents)*
Canavieiras	502	201	102	100
Conde	281	85	57	68

Source: Authors.

2.2.2 QUESTIONNAIRE DATA ANALYSIS

Quantitative analysis was conducted in RStudio. Frequency analyses for demographic information and disaster response involvement questions from the QESP-DP19 were evaluated. The frequency of each response was determined for all QESP-DP19 respondents, all respondents from Canavieiras, all respondents from Conde, and the subset of participants in each site that participated in the follow-up questionnaire, OSRPQF. Frequency analyses were also conducted in RStudio for questions related to clean-up activities and disaster response efficacy in the OSRPQF.

Proportions of responses were compared between QESP-DP19 respondents and the subgroup for both Conde and Canavieiras to ensure a representative sample, and no statistically significant differences were found. Sentilles reports the full results of these tests (Sentilles, 2023).

2.3 SEMI-STRUCTURED INTERVIEWS

Semi-structured interviews provide additional context about the oil spill response. Individuals who organised disaster response activities in either site (including community meetings, oil spill clean-up

initiatives, etc.) were invited to complete interviews. Interview guides were designed for SSFs who led the disaster response and for environmental or health professionals in the region. Eight SSFs and 3 environmental health professionals participated.

Questions were written to provide background information about the interviewee and their involvement in the oil spill response. Additional questions ask participants to reflect on the efficacy of the disaster response in their community or organisation and what could be improved upon in the future, including what resources are needed. Finally, a scenario-based question was pulled from the Culture and Disaster Action Network's Cumulative Effects: {Prior Disaster} + Covid-19 question bank ("Practitioner-Oriented Semi-Structured Interview Question Bank", 2020).

2.3.1 DATA COLLECTION

The research team was in contact with community leaders at each study site for two or more years at the start of this project, so those contacts were the first individuals recruited for the semi-structured interviews. They were asked to name other organisers involved in the disaster response in accordance with snowball recruitment methods (Naderifar; Goli; Ghaljaei, 2017).

The interviews took place alongside the OSRPQF application, in April and May of 2022, at the fishing associations or in the participants' homes. All interviews were recorded and stored on a handheld recording device.

At the time of this study, a documentary was simultaneously in production about the oil spill, so participants could choose to have their interviews filmed for use in the documentary. In recent years, documentary production has received growing attention as a tool for qualitative research that can expand the audience for research findings and strengthen a project's capacity for the co-production of knowledge alongside participants (Borish *et al.*, 2021; Fitzgerald; Lowe, 2020). Study participants were enthusiastic about sharing their stories in the documentary, and all semi-structured interviewees consented to filming their interviews.

2.3.2 SEMI-STRUCTURED INTERVIEW DATA ANALYSIS

After data collection, a nested coding scheme was developed based on the research objectives and recurring topics from interviews. The initial coding scheme included 6 parent (level 1) codes, with 15 level 2 codes under 3 parent codes, and 3 level 3 codes under one level 2 code. Codes were applied using the qualitative data analysis software Dedoose. During the coding process, 5 level 1 and 2 level 2 codes were added as inductive codes. The coding scheme was used to organize data into relevant themes. After analyzing the questionnaire data, related codes were referenced to find qualitative examples and descriptors of the trends identified from questionnaire analysis.

3. RESULTS

3.1 OIL CLEAN-UP ACTIVITIES

Of the OSRPQF respondents, 66.1% assisted in clearing oil from the environment following the spill, as shown in Table 2. Participation varied between the communities. In Canavieiras, 75% of respondents participated, compared with 52.9% in Conde. On average, respondents participated in oil removal for 11.7 days. 26.1% of respondents reported that they received some kind of training (formal or informal) to assist in these activities, and 71.2% used personal protective equipment (PPE).

Table 2 – Oil spill clean-up participation as reported in the OSRPQF

	Subgroup Overall N = 168 N (%)	*Subgroup Canavieiras N = 100 N (%)*	*Subgroup Conde N=68 N (%)*
Helped			
Yes	111 (66.1)	75 (75)	36 (52.9)
No	57 (33.9)	25 (25)	32 (47.1)
Number of Days			
MEAN	11.66	13.45	7.92
SD	12.29	13.53	8.17
Trained			
Yes	29 (26.1)	23 (30.7)	6 (16.7)
No	82 (73.9)	52 (69.3)	30 (83.3)
PPE used			
Yes	80 (72.1)	57 (76.0)	23 (63.9)
NO	31 (27.9)	18 (24.0)	12 (36.1)

Source: Authors.

3.1.1 ORGANISERS OF OIL SPILL RESPONSE ACTIVITIES

Through the interviews and questionnaires, information emerged about the primary institutions involved in regulating fishing and disaster response. Figure 2 includes a description of these institutions and the purpose they serve in the territories. Institutions related to the RESEX status are present only in Canavieiras.

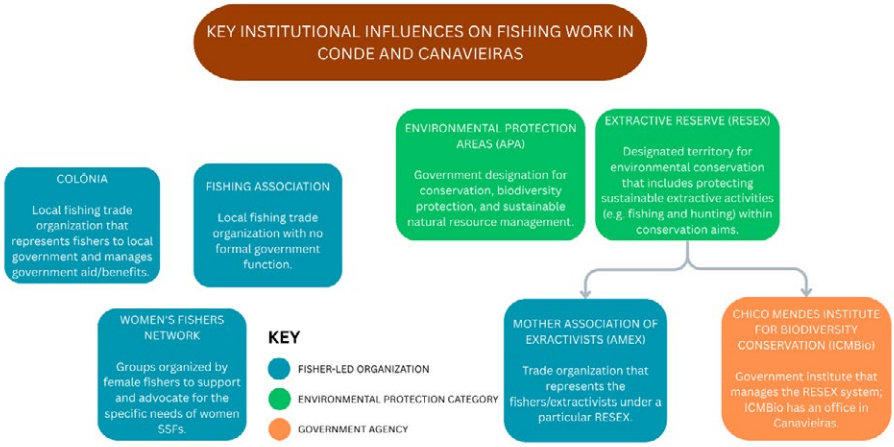

Figure 2 – Key institutional influences on fishing work in Conde and Canavieiras

Source: Personal communication with community members (May and April 2025).

Table 3 summarises the questionnaire data about who organized oil removal efforts, showing all groups that fishers worked with on the left, and the primary organisers identified on the right. In Canavieiras, the largest group of respondents (37.3%) identified their town's fishers' association as the primary organiser. However, when listing all groups that they worked with in the oil removal effort, Amex (*Associação Mãe da Reserva Extrativista*, in portuguese) and informal groups of fishers were cited more often.

The interview data helps to contextualise these responses. Amex and fishing associations collaborated in organising clean-up activities. Some participants may have identified their fishing association as the primary organiser, and others worked with Amex independent of the associations. Several participants also described informal efforts by the fishers to remove oil. Many respondents may have participated in both informal clean-up and the Amex/Association-organised removal efforts. Based on the responses in the "primary organiser" question, around 24% of respondents worked primarily in informal efforts, while 62.6% worked mainly with Amex or a fishing association.

Notably, 17 individuals identified a government agency's involvement in coordinating the clean-up. 11 of these cited ICMBio. ICMBio's local team helped the Amex leaders organise their clean-up activities, so these responses likely refer to the same set of activities. During the semi-structured interviews, Canavieiras fishing leaders made clear that ICMBio's assistance came due to local staff members' decision to support the fishers, not from a federal directive. For instance, one Amex leader shared that ICMBio invited fishers to work with them to create a plan to prepare for the oil's arrival once its presence was reported in the north of the State of Bahia. He said that the meetings were "captained by the Resex team here…from ICMBio, but local, nothing to do with the national ICMBio." Conversations with staff at the ICMBio office confirmed that their involvement in response activities and oil spill clean-up was organised at the local level, not through a national ICMBio response program.

In Conde, the majority of participants removed oil in groups of fishers (61.1%) and with the *colônia* (72.2%). 55.6% identified the *colônia* as the primary organiser, compared with 25.0% primarily involved in informal efforts. A substantial portion of respondents (25.0%) listed individuals affiliated with universities as organisers, and 13.9% listed this group as the primary organiser. This differs from Canavieiras, where only one participant cited university involvement. In Conde, no respondents identified a government agency as a primary organiser of clean-up activities, but 5 mentioned city government involvement in oil removal.

The responses in Conde align with the descriptions of the response from interviews. Based on reports from the Conde *colônia* leadership, a group of university and government officials organised clean-up activities in one of the towns affiliated with the *colônia*. The *colônia* organised the clean-up for the other fishing sites in the municipality.

Table 3 – Organisers of oil removal efforts in Canavieiras and Conde

Organizer	*Canavieiras N (%) N = 75*	*Conde N (%) N = 36*	*Primary Organizer*	*Canavieiras N (%) N = 75*	*Conde N (%) N = 36*
Fishers (informal)	47 (62.7)	22 (61.1)	Fishers (informal)	18 (24.0)	9 (25.0)
Colonia	10 (13.3)	26 (72.2)	Colonia	3 (4.0)	20 (55.6)
Amex	31 (41.3)	N/A	Amex	19 (25.3)	N/A
Fishing association	30 (40.0)	0	Fishing association	28 (37.3)	0
University	1 (1.3)	9 (25.0)	University	0	5 (13.9)
ICMBio	11 (14.7)	N/A	ICMBio	3 (4.0)	N/A
City Government	4 (5.3)	5 (13.9)	City Government	0	0
Other or unsure	7 (9.3)	6 (16.7)	Other or unsure	5 (6.7)	2 (5.6)

Source: Authors.

Table 4 shows how participants acquired personal protective equipment during the oil clean-up. NGO and government agencies provided personal protective equipment (PPE) most frequently in

Canavieiras, with 63.2% identifying this as the source of their equipment. In Conde, only 32% acquired PPE from an external agency supporting the fishers. Instead, the *colônia* organised distribution efforts. More than half of the participants received PPE from the *colônia*. In Canavieiras, Amex and the fishing associations also distributed PPE. 21.1% of respondents received equipment from Amex. At each site, a few individuals purchased PPE or brought it from home.

Table 4 – Organisers of PPE Distribution in Canavieiras and Conde

PPE Distribution		
Organizer	*Canavieiras N (%) N = 57*	*Conde N (%) N = 25*
AMEX	12 (21.1)	0
Fishing Association	4 (7.0)	0
Colônia	1 (1.8)	14 (56.0)
NGO or Government	36 (63.2)	8 (32.0)
Purchased	2 (3.5)	3 (12.0)
Brought from home	4 (7.0)	1 (4.0)
Other/Unsure	3 (5.3)	4 (16.0)

Source: Authors.

Table 5 shows the organisations that provided the reported training for oil removal. In Canavieiras, the responses largely align with the organisation of the clean-up activities, with Amex, fishing associations, and ICMBio the most frequently cited. In Conde, 2 individuals reported training by the *colônia* and two by university personnel.

Two training courses are provided by Petrobras, Brazil's national oil company. However, Petrobras was not mentioned as an organiser of the clean-up activities. In the semi-structured interviews, community leaders mentioned that the Petrobras office located in the area had conducted training with fishers who owned boats about how to place containment booms in case of chemical spills. These trainings occurred before the 2019 oil spill began, and Petrobras did not provide support during the oil spill to perform these activities in Conde, but this training likely is what the respondents referred to in the questionnaire.

Table 5 – Organisers of trainings in Canavieiras and Conde

Trainings		
Organizer	*Canavieiras N (%) N = 23*	*Conde N (%) N = 6*
Amex	9 (39.1)	N/A
Fishing Association	8 (34.8)	0
Colônia	2 (8.7)	2 (33.3)
ICMBio	5 (21.7)	N/A
University	0	2 (33.3)
Petrobras	0	2 (33.3)
Other or unsure	3 (13.0)	0

Source: Authors.

3.2 PARTICIPATION IN ADDITIONAL ACTIVITIES RELATED TO THE OIL SPILL

Beyond documenting participation in oil removal, the OSRPQF collects information about involvement in other kinds of response activities: community meetings, leadership, and protests. This information is displayed in Table 6. Overall, a larger portion of participants in Canavieiras helped to lead aspects of the oil spill response, attended community meetings, and participated in protests related to the spill. In both study sites, a majority of respondents attended community meetings (65.0% in Canavieiras and 61.8% in Conde), which were described in the questionnaire as meetings scheduled to discuss the events of the oil spill. Protests were attended by 23% in Canavieiras and 17.6% in Conde. 8 survey respondents in Canavieiras (8%) and 3 in Conde (4.4%) were involved in the coordination or leadership of disaster response activities. Community meetings and protests were most often organised by fishing community leadership (Amex and associations in Canavieiras, the *colônia* in Conde). University personnel were also involved in organising the clean-up in one town in Conde, and ICMBio officials in Canavieiras (Sentilles, 2023).

Table 6 – Participation in non-clean-up activities related to the oil spill

Variable	*Overall N (%) N = 168*	*Canavieiras N (%) N = 100*	*Conde N (%) N = 68*
		Community meetings	
Yes	107 (63.7)	65 (65.0)	42 (61.8)
No	61 (36.3)	35 (35.0)	26 (38.2)
		Leadership	
Yes	11 (6.5)	8 (8.0)	3 (4.4)
No	157 (93.5)	92 (92.0)	65 (95.6)
		Protest/Activism	
Yes	35 (20.8)	23 (23.0)	12 (17.6)
No	133 (79.2)	77 (77.0)	56 (82.4)

Source: Authors.

3.3 FUTURE CONCERNS AND COMMUNITY-EXPRESSED NEEDS

Beyond the details of the community-based disaster response, a theme in the semi-structured interviews was the ongoing threat of environmental disasters. No community leader expressed doubts about the potential for another oil spill to affect their community. Many discussed strategies within the fishing organisations to prepare for spills as well as other disasters, and we followed up with questions about what kinds of support the fishers need or hope for as they plan for the future.

When discussing their concerns about the future, all participants expressed anxiety about environmental crises. Some are certain that another oil spill will occur. As one participant in Canavieiras shared when asked about the possibility, “I do not just believe [that more spills will occur], but I know that they will. Maybe not on that scale, but they will. That’s for sure. As long as we still live in a world that insists on depending on fossil fuels, petroleum exploration will not end now. It will not end now, so it is certain that it will come, and it might even be on a larger scale.”

Despite expressing these concerns for the future, this community leader was optimistic about the capacity of fishers in Canavieiras to apply experience from the past spill and improve their outcomes: “Despite this, we know that, because of what happened before, in whatever moment it comes,

we already know what to do to try to protect [ourselves]." Several other leaders expressed similar sentiments in Canavieiras: "I think that, if it happens again, I think that there has already been learning about the process through what happened." For another example, "We already have the experience from before. We are already stronger. I believe that we managed to be better prepared to confront it."

This language about learning and capacity-building from the 2019 oil spill was not present in Conde. Rather, participants expressed concerns about how future disasters would harm the fishers. One leader shared, "There were things that happened that I pray to God never happen again because, if they do, this time, the fishers are dead. We don't have what we need to survive. Fishing here is not that kind of abundance, so the little that we have? Something like that comes to an end. I pray to God that it never happens again."

None of the interviewees expressed this hopelessness in Conde, but none said that the community was prepared for such an event. A lack of preparation was more frequently the focus:

> We have no form of preparation. If it came again, it could even be worse than the first time because no one came to offer a course, no one came to pay attention to anything, no one came to give reparations for what happened, no. They are not coming here. No one is coming here… I think that today it would be worse because it happened, and no one came here to talk, to prepare. The state did not show up. The city government did not show up. There is no NGO. Petrobrás, the institution responsible for this, did not show up.

This quote touches on why there may be a different sense of preparedness between the two sites. The NGO and government presence in Canavieiras is more significant. With the ICMBio staff assisting in the clean-up and preparation for the oil's arrival, the community leaders have input from environmental specialists. Conde has less technical support, and any lessons learned from the spill do not necessarily prepare the community for a future response. With few resources, they cannot realistically invest in high-quality PPE or other materials.

At a community meeting in Conde during our fieldwork, the *colônia* shared plans to assist shell fishers in replacing outdated equipment, and equity concerns were raised by other fishers also needing assistance. The organisation is under-resourced and must carefully allocate funds to serve the immediate needs of its community. The leaders did not consider oil spill response an area in which they could invest, nor did they consider it their responsibility. As the quote above expresses, the government or NGOs should be providing those kinds of support.

When asked about what the community in Conde needs, they described various kinds of institutional support: "The first thing that the *colônia* needs is some kind of support from the municipality. That is very important. That municipal, state, federal support, you know? I think that those are the first steps, very important steps, along with NGOs that want to contribute, to help." Beyond this call for long-term support, equipment and training were cited as potential aids. They also wanted more information about the source of the oil and accountability for the responsible party.

While in Conde, participants focused on the ongoing need for direct government support and for preparation at the community level, Canavieiras leaders discussed the need for disaster preparedness and preventative efforts within the government itself. The following quote explores each of these themes:

> I think some things are important for us to point out. First, the state is not prepared. Second, there should be preventive infrastructure for eventual, future events. And the other thing is, the state has to look, for real, at the communities as a partner and help to implement positive action, which, for us, is fundamental because we are in areas where there are prospective areas for future petroleum drilling, and all of this could happen again.

According to the Canavieiras participants, the community had adequate preparation for their role in disasters, but the government needs to improve their preparation to provide support. Suggestions for government intervention included evaluations of the level of risk that the community faces and ongoing monitoring to determine whether their water sources and fishing territories remained contaminated.

While training and capacitation in Conde were frequently described as lacking, the leaders in Canavieiras were less enthusiastic about training programs. Several community leaders had completed disaster response training years before the spill, which they found unhelpful. They also understood that training without investment in proper equipment and resources would be inadequate. One participant suggested that disaster preparedness and capacitation programming could be harmful, stating:

> I think that they should not even prepare the communities because this process, of the government understanding that these communities should be prepared for these impacts, puts them in a place for the extraction process [of petroleum resources] to continue, because we [the community members] are prepared for those impacts.

Ultimately, the leaders in Canavieiras determined that preparedness efforts should occur at the federal government level, and additional burdens should not be placed on the fishers, who already demonstrated a high degree of disaster response organization during the spill. In Conde, participant did not refute the need for the Brazilian government to enhance their preparedness, but they were not optimistic about improvements in government intervention. Instead, they saw partnership with the municipal government and NGOs, as well as organization-level training and capacitation, as the most promising means of protecting their community from future environmental issues.

4. DISCUSSION

4.1 COMMUNITY ORGANIZATION OF THE DISASTER RESPONSE

Oil spill disasters in Brazil, the United States, South Korea and other countries have generated consequences that require the mobilization of social systems and government agencies to effectively respond (Diaz, 2011; Machado, 2025; Pena *et al.*, 2020). However, the response to the 2019 spill was marked by a lack of coordination, without effective integration among governmental agencies and coherent intersectoral strategies. As a result of this institutional neglect, fishing organizations experienced overload and distress, assuming a central role in coordinating the disaster response in their territories. In Conde and Canavieiras, fishers were the first responders to the oil spill and played a key role in leading local response efforts. Community mobilization levels were higher in Canavieiras, particularly for the oil removal effort, where more fishers participated and they worked on the clean-up for more time.

This high degree of community organisation reflects the strength of these communities in the domain of “emergency force building” as proposed by Wang *et al.* (2022), especially around social force and volunteer recruitment. Collaboration with fisher-led organisations could be a key strategy for community mobilisation in environmental disasters. The Canavieiras leaders reported better preparation for the disaster, partially due to support from government officials at ICMBio. The environmental impacts of the spill were successfully reduced there, as community-organised efforts prevented the oil from entering the estuary where most fishers work; in Conde, the oil continued to contaminate the primary estuary at the time of fieldwork.

Despite differences in preparation and outcomes, both sites’ efforts demonstrate a commitment to the fishing trade organisations to respond to disasters and protect community members. Brazil’s national oil spill contingency plan did not include strategies to address an open-ocean spill from an unidentified

source, leading to delays in the disaster response as agencies developed approaches to manage the crisis (Barbeiro; Inojosa, 2022; Coordenação Operacional, 2020). In a state of urgency, the fishers quickly developed their own strategies and response efforts to fill the gap in government intervention. This rapid mobilisation reflects the Wang *et al.* principle of community organisational resilience (Wang *et al.*, 2022). Overall, Canavieiras demonstrated a greater capacity in this domain, largely due to the availability of technical and institutional support.

4.2 DISASTER RESPONSE SAFETY

The fishers demonstrated a high degree of social organization and mobilization during the disaster. However, the safety conditions of the disaster response demonstrate weaknesses across the following Wang *et al.* domains: management of risks and hidden dangers, emergency material support, and emergency literacy. This study population has documented exposures to crude oil during the 2019 spill, partially due to a lack of safety precautions in the disaster response (Machado *et al.*, 2025; Sentilles, 2023).

Due to the health risks of oil exposures, oil spill first responders typically receive significant training on topics including oil disposal practices, environmental issues, workers' rights, heat injury prevention, proper use of PPE and others (IMO OPRC, [s.d.]; National Institute for Environmental Health Sciences, 2010). In Conde and Canavieiras, the trainings conducted by fishing trade organisations were described as informal efforts at the start of clean-up activities to demonstrate how to collect the oil from the environment and where to store it. There was a lack of evidence-based training oriented toward public health protection. Ibama and Petrobras offered formal training in major cities around Northeast Brazil during the second week of November 2019, more than 10 weeks after the oil first arrived on the coast (Coordenação 2020, p. 18). The fishers' clean-up efforts were well underway prior to this date, and none of the participants in this project were included in the formal government training program. Overall, this represents a general failure to manage safety risks and ensure adequate knowledge among the first responders.

The PPE materials available did not meet professional guidelines and were not used by all participants (Coordenação Operacional, 2020, p. 17; Oil Spill Cleanup Initiative, 2010; Sentilles, 2023). Fishers' willingness to participate in the clean-up with inadequate PPE likely reflects a lack of knowledge of the risks of this activity, a theme acknowledged in several semi-structured interviews. In addition to the inadequacy of the PPE provided to fishers, it is unfortunate that many participants provided their own PPE. Using equipment from home subjects personal belongings to damage, and these items could be expensive for fishers to replace. If fishers did not discard this equipment after participation, it also raises concerns about oil exposure and the storage of contaminated items in their homes.

4.3 DISASTER PREPARATION NEEDS AND ONGOING BARRIERS

The SSFs' rapid organization and high levels of participation in disaster response activities demonstrate their commitment to protecting the ancestral territories where they live and work. The organizing role of fisher-led institutions reveals a high degree of social capital and highly effective leadership within these groups. Prior research on disaster response demonstrates the importance of these factors (Hidayati, 2018; Ma, Qirui, Yang, 2023). These strengths of the fishing organizations can be mobilized to enhance disaster response efforts and other sustainability initiatives; however, they have limitations, particularly in events with significant health and safety risks to first responders. High prevalence of oil exposure during clean-up activities and inadequate PPE use provide evidence of such limitations in the oil disaster (Sentilles, 2023). Even relatively well-equipped communities like Canavieiras cannot adequately manage disaster response without proper equipment and technical support (Machado *et al.*, 2024) .

The fisher-led organisations involved in this study express ongoing concerns about environmental disasters and a willingness to engage in preparedness efforts. From this fieldwork, a community education workshop at the colônia in Conde emerged to increase hazard awareness and resources, but adequate government support remains a major barrier (Sentilles *et al.*, 2025). Institutionalising community organisation and government coordination improves disaster response and recovery outcomes (Molina, 2019). Through collaboration with fisher-led organisations, government agencies at all levels could leverage the SSF communities' preexisting social capital and organisational capacity to develop preparedness for future disasters.

While community-government coordination holds promise for overall disaster preparedness, fair compensation and community member rights remain a concern. During the oil spill, the fishers worked with hazardous substances to protect their territories. The lack of training and proper PPE availability should be considered in the context that fishers participated as volunteers; thus, they may not be eligible for the same occupational health services or hold the same legal rights as exposed petroleum industry professionals. Their status as volunteers should be carefully considered in efforts to address the harms caused by the oil spill. In the future, fishers' willingness to serve as first responders in chemical spills should inform disaster planning, and efforts should be made to compensate them fairly for this labour and risk.

In 2022, the national government passed an updated oil spill response law informed by the 2019 disaster, the "Plano Nacional de Contingência para Incidentes de Poluição por Óleo em Águas sob Jurisdição Nacional (PNC)" (Decreto nº 10.950, 2022). The policy addresses many challenges of the 2019 crisis and establishes the national Ministry of the Environment as the responsible party for coordinating the response (Decreto nº 10.950, 2022). Changes related to fishing include providing information about the fishers registered in impacted areas, providing information about impacts of the spill on fisheries, and strengthening the communication and monitoring network for oil spills . Unfortunately, none of the changes reflect the role that fishers played as first responders in the 2019 oil spill. They do not address the need to protect fishers from environmental hazards or to prevent their participation in hazardous, unpaid labor without adequate preparation. The unique vulnerabilities of fishers in environmental disasters are also not accounted for in the responsibilities described for environmental and health services. These should be considered for the long-term sustainability of these communities and the economies that they support.

5 CONCLUSION

Small-scale fishers were the primary first responders to the disaster in Conde and Canavieiras, intervening quickly to protect their territories in the face of institutional neglect. In both Conde and Canavieiras, fishing organisations mobilised their members to participate in a variety of activities, including clearing oil from contaminated environments. The social capital concentrated in fisher-led organisations is an important resource for mediating disaster impacts in fishing communities, contributing to strengthening disaster responses and other sustainability initiatives. However, the fishers lack key resources, knowledge, and sources of power that necessitate government intervention. They are at risk of health effects based on their exposure to the disaster and the role they played in its response.

Fishing leaders shared that they want the government to treat them as partners in disasters that affect their territories, but the responsibility for managing these events and coordinating the first response should not fall on them alone, especially considering the inadequate training and safety precautions taken during the 2019 spill. Efforts to include SSFs in safe and culturally appropriate ways should be a priority in disaster preparedness to address SSFs' safety and economic and environmental security.

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NOTES

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