Participatory Methodologies and the Production of Data on Artisanal Fishing in Areas with Offshore Wind Farm Projects in Ceará, Brazil

Metodologias Participativas e a Produção de Dados da Pesca Artesanal em Áreas com Projetos de Parques Eólicos Offshore no Ceará, Brasil

Thomaz Willian de Figueiredo Xavier [1]

Adryane Gorayeb [2]

Christian Brannstrom [3]

[1] PhD in Geography, Researcher, Geography Department, Federal University of Ceará, CE, Brazil
E-mail: thomwillian@gmail.com

[2] PhD in Geography, Professor, Geography Department, Federal University of Ceará, CE, Brazil
E-mail: gorayeb@ufc.br

[3] PhD in Geography, Professor, Geography Department, Texas A&M University, USA
E-mail: cbrannst@tamu.edu

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ABSTRACT

Offshore wind farms (OWF) are an essential emerging energy source. In Brazil, environmental licensing of OWFs requires an identification map of multiple preexisting uses, targeting potentially conflicting activities, such as fishing and navigation routes. The objective of the work was to evaluate the application of participatory methodologies in the construction of data on fishing activity, aiming at analyzing potential impacts of OWFs in marine territories of the state of Ceará, with a focus on artisanal fishing. A participatory map and fishing calendar were produced in Colônia Z18, Amontada, Ceará. Data collection took place through four participatory workshops with 45 participants. The data were digitized in a GIS environment and later validated with the community. The results show complete overlap between an OWF and the local fishing activity. Thus, participatory methodologies can help in the acquisition of fishery data and the assessment of the multiple uses of marine territories.

Keywords: Environmental Licensing. Participatory Fishing Calendar. Participatory Mapping. Renewable energy. Social Cartography.

RESUMO

Os Parques Eólicos Offshore (PEO) são uma importante fonte de energia emergente. No Brasil, o licenciamento ambiental de PEO requer um mapa de identificação de usos múltiplos preexistentes, visando às atividades potencialmente conflitantes, como rotas de pesca e navegação. O objetivo do trabalho foi avaliar a aplicação de metodologias participativas na construção de dados sobre a atividade pesqueira, visando à análise de potenciais impactos dos PEO nos territórios marinhos do estado do Ceará, com enfoque na pesca artesanal. Foram produzidos mapa participativo e calendário de pesca na colônia Z18, localizada em Amontada, Ceará. A coleta de dados ocorreu por meio de quatro oficinas participativas com 45 participantes. Os dados foram digitalizados em ambiente SIG e, posteriormente, validados junto à comunidade. Os resultados mostram sobreposição completa entre um PEO e a atividade pesqueira local. Assim, métodos participativos podem auxiliar na aquisição de dados pesqueiros e na avaliação dos múltiplos usos dos territórios marinhos.

Palavras-chave: *Calendário de Pesca Participativo. Cartografia Social. Energia Renovável. Licenciamento Ambiental. Mapeamento Participativo.*

1 INTRODUCTION

Offshore wind farms (OWFs) have been consolidated as an energy source. The Global Wind Report 2020 (GWEC, 2020) indicated 29.1 GW of installed capacity (IC) around the world. In the Brazilian context, they make up a potential sector for electricity and, more recently, green hydrogen generation. Estimates of offshore wind potential show that Brazilian waters are an abundant energy resource (EPE, 2020; GOMES *et al*., 2019).

Two decades ago, when studies on Brazilian wind potential were beginning, there was an indication of an offshore wind potential twelve times higher than onshore (ORTIZ; KAMPEL, 2001). More recently, the Energy Sector Management Assistance Program (Esmap) of the World Bank Group, which addresses issues regarding the energy potential of emerging countries for offshore wind technology, published estimates on Brazilian energy potential (DUTTON *et al*., 2019). According to the document, Brazil presents a total potential of 1,228 GW, much higher than the global installed capacity. Meanwhile, the Global Wind Report 2020 (GWEC, 2020), in presenting the countries in a preparatory phase to take advantage of offshore wind potential, spotlighted, for the first time, Brazil together with countries such as Mexico, India, Sri Lanka, and Australia. Publications such as these emphasize, to the global market, the possible directions of investments.

In the national arena, the Ten-Year Plan of Energy Expansion 2029 – PDE 2029 (EPE, 2019, p. 61) foresaw, "[...] for the first time, offshore wind technology as a candidate for expansion, as of 2027". Furthermore, the Energy Research Company (*Empresa de Pesquisa Energética* – EPE) presented the Brazil Offshore Wind Roadmap (EPE, 2020), the first script to indicate possible paths to be followed in the insertion of offshore wind technology in Brazilian waters. The material provides essential information for sector planning, such as identifying possible barriers challenges to offshore wind sector development in Brazil and some recommendations from the planner's viewpoint.

Concerning the Brazilian Northeast, the Roadmap presents a generation potential of over 15,000 TWh/year of electrical energy and the entire coastal extension toward the Exclusive Economic Zone (EEZ) limit. In this context, the importance of the offshore region of the states of Ceará and Rio Grande do Norte is noteworthy (EPE, 2020). However, this estimate did not consider any restriction to the insertion of OWFs (bathymetry, environmental protection areas, shipping lanes, migratory bird routes, oil extraction areas, fishery areas or areas with conflicting uses). In other words, the study neglected to recognize critical technical and socio-environmental criteria that would have better defined the areas appropriate for offshore wind power technology in Brazil.

On the other hand, the Roadmap (EPE, 2020) provides analyses aiming at identifying possible barriers and challenges in different sectors to the insertion of OWFs in Brazil. Thirteen challenges are listed in the document: (1) need for precise meteo-oceanographic and climatological data; (2) compatibilization of the Brazilian port system; (3) adaptation of the current national wind industry; (4) availability of adequate vessels for transport, installation, and maintenance of offshore wind structures; (5) professional training in the public and private sphere; (6) improvement in energy transmission infrastructure; (7) pursuit of environmental management instruments with potential to reduce conflicts related to the use of maritime space; (8) need to adjust current procedures of environmental licensing; (9) need to adapt current rules relating to navigation safety; (10) need to improve regulations in effect for the concession of maritime areas; (11) increase competitiveness of the offshore wind source in relation to other available sources in the integrated national system; (12) identify of areas with exploratory restrictions in the Brazilian EEZ; and (13) uncertainties related to potential socioeconomic conflicts between OWFs and other activities. The last two are essential justifications for this research. Moreover, in November 2020, the Brazilian Institute of the Environment and Renewable Natural Resources (Ibama) published the standard Term of Reference (TR) for federal environmental licensing (FEL) of this type of endeavour (IBAMA, 2020). This document dictates the fundamental aspects that should be observed when preparing the environmental viability study of OWFs. As of the end of January 2022, 37 projects had been filed with Ibama to request licensing.

Regarding the analysis of the locational alternatives and integrated analysis of the environmental diagnosis, the standard TR requires the preparation of a map identifying preexisting multiple uses and fragilities. This addresses information for analyzing the proponents' location choice for the enterprise. Among the layers required are data on potentially conflicting activities, such as fishing and shipping lanes and, consequently, fishing *colônias* (communities) that the navigation exclusion zones may impact in the period of (post)installation of the OWFs.

In the Solar and Wind Atlas of Ceará (*Atlas Eólico e Solar do Ceará,* CAMARGO SHUBERT ENGENHEIROS ASSOCIADOS *et al*., 2019), the estimate is of about 117.2 GW of potential over Ceará's waters at depths ranging from 5 to 50 meters with wind speeds over 7 m/s, making it possible to generate 506 TWh/year of energy. The model proposed in the document estimated the values for a height of 100 m in areas that could potentially receive the projects, excluding areas of environmental protection, fishing, concessions for oil and gas exploration, etc. However, the methodology to define the exclusion areas, including fishing, was not detailed in the document. A total of seven OWF initiatives are located in the waters off Ceará's coast.

For this reason, mapping and debating as early as possible the points relevant to local populations, in the face of planned interventions, becomes a fundamental tool for planning, mainly in terms of consulting the communities that will suffer some impact (HANNA *et al*., 2014). Planning must be done cautiously and holistically because every dynamic already materialized in space, whether social or environmental, will undergo significant alterations during the different phases of OWF existence.

The objective of this work, then, is to evaluate the application of participatory methodologies in the construction of data on fishing activities to analyze the potential impacts of OWFs in offshore territories of the state of Ceará, with a focus on artisanal fishing. This is essential information for guiding the development of the sector and presenting the potential for subsidizing the preparation of maps of multiple uses and fragilities within Brazilian FEL.

2 MATERIALS AND METHODS

2.1 DESCRIPTION OF THE CASE STUDY

Exploratory in nature and starting from a qualitative analysis in a case study, participatory mapping and preparation of a fishing calendar was adopted in *Colônia* Z18, located in Amontada on the West coast of Ceará. Situated approximately 175 km from Fortaleza, it has about 800 associated fishermen and fisherwomen, distributed along the entire coast of Amontada, according to information obtained from the managers during field activities. About 500 fishermen and fisherwomen (62.5%) had an active registration and, additionally, between 40% and 50% of the total were women. We further learned that, as the onboard fishing activities are, essentially, artisanal and for subsistence (ALMEIDA, 2018), the quantity was approximately 400 vessels, divided into *canoas* (sailboat) and *botes* (sailboat with a closed compartment in the hollow) and, in greater number, *paquetes* (small boat with no sail). However, we were informed that the approximate amount of each type of vessel was uncertain to the *colônia* management at the time of information acquisition.

In this region, there are four OWF projects located in the coastal waters of the municipalities of Acaraú, Trairi, Itapipoca, Amontada, and Itarema. However, two of the four initiatives emerged after our fieldwork had been completed, making it impossible to consider them in the research evaluations. Thus, the results presented here analyzed the installation context of only the two older endeavours. All the projects are registered on Ibama's Electronic Information System (SEI) and can be consulted upon request.

The OWF, whose project is located off the coast of Itarema and Amontada, was foreseen to be about 72km², with 50 turbines, 3 to 8 km from the coast, a depth between 7 and 12 m and a planned potential of 400 MW. However, in October 2021, the project mentioned above had its application to SEI/Ibama archived for inaction. However, in January 2022, the entrepreneur filed a new application on SEI/Ibama with a proposal to expand the required area, updating the technology to be installed and adjusting the design of the respective OWF. Thus, the content of the project, as for its location and previous design, is utilized here as an example that can provide socioenvironmental analyses due to its availability when the study was conducted. The OWF in the waters off Itapipoca and Trairi, on the other hand, is about 958 km², 200 turbines, 23 km from the coast, depth of 20 to 50 m and 3 GW of planned power and continues to have an active SEI/Ibama file. Therefore, both enterprises analyzed could occupy a marine zone of over 1000 km².

2.2 METHODOLOGICAL APPROACH AND DATA COLLECTION

Data collection took place through five participatory workshops conducted in three moments: three in September of 2018 (mapping), one in January 2020 (fishing calendar) and another in March 2020 (validation), totalling 45 participants, all male, ages between 22 and 55 years. All are fishers associated with the Fishing *Colônia* Z-18 (Amontada). Because of the exploratory nature of the research, the participants were primarily chosen through contact with the *colônia* management. With consent and authorization from the presidency, we requested announcements be made in the fishing communities associated with the *colônia*, inviting fishers to participate in the workshops on pre-arranged dates. As a prerequisite, the invitations were made to fishers with at least two years of experience in the activity. The predominance of men in the workshops reflects the strict gender division in artisanal fishing, despite women being responsible for almost all shellfish gathering and fish processing (SANTOS, 2015; VASCONCELLOS; DIEGUES; KALIKOSKI, 2011).

Supported by Social Cartography, the mapping was done using sketch maps and scale maps (base maps) using the overlay technique (CORBETT *et al.*, 2006) during the mapping workshops (September 2018). Before beginning the work, we discussed some guiding questions: What fish species are found in the region? What fishing gear is used, and how are the different fish species captured? What types of vessels are used, how many fishers per boat and what volume of fish is it possible to transport? Do you depend on the wind for your fishing activity? What is the maximum distance travelled, and what are the most frequent routes to reach the fisheries?

Together with the participatory mapping, we prepared Swot matrixes (Strengths, Weaknesses, Opportunities, and Threats) to acquire qualitative data that supported the information included in the maps. This tool allows the rapid construction of internal and external indicators by brainstorming ideas about the object under analysis. The object can be a company, a society, a community, a given sector, etc. Their preparation can be done collectively/participative or individually from the perspective of the research subject or the researcher (YAVUZ; BAYCAN, 2013).

Following the discussion with the fishers provided by the guiding questions outlined above, the workshop activity listed the factors of each Swot matrix category, using Kraft paper with dimensions of about 2.00 m by 1.50 m. The idea was to simulate an information chart and thus make it easy for the participants to visualize. Different coloured pens for each matrix category were utilized to facilitate comprehension and distinction for the subjects discussed. The construction of the matrix was of fundamental importance to (a) register types of target fish species, (b) indicate socioenvironmental issues that already exist in the context of the colônia, (c) define potential threats, as well as (d) identify sectors in the *colônia* that could improve in the perception of the participating fishers. Some Swot results can also be found in Xavier, Gorayeb and Brannstrom (2020).

After gathering the information in the field and constructing the base social maps (that, is, the base maps plus the mapped social information), the data were synthesized and digitalized in a GIS (Geographic Information System) environment and then validated by the community in another participatory workshop (March 2020). Figure 1 presents the flowchart of the methodological procedures adopted to execute the participatory mapping.

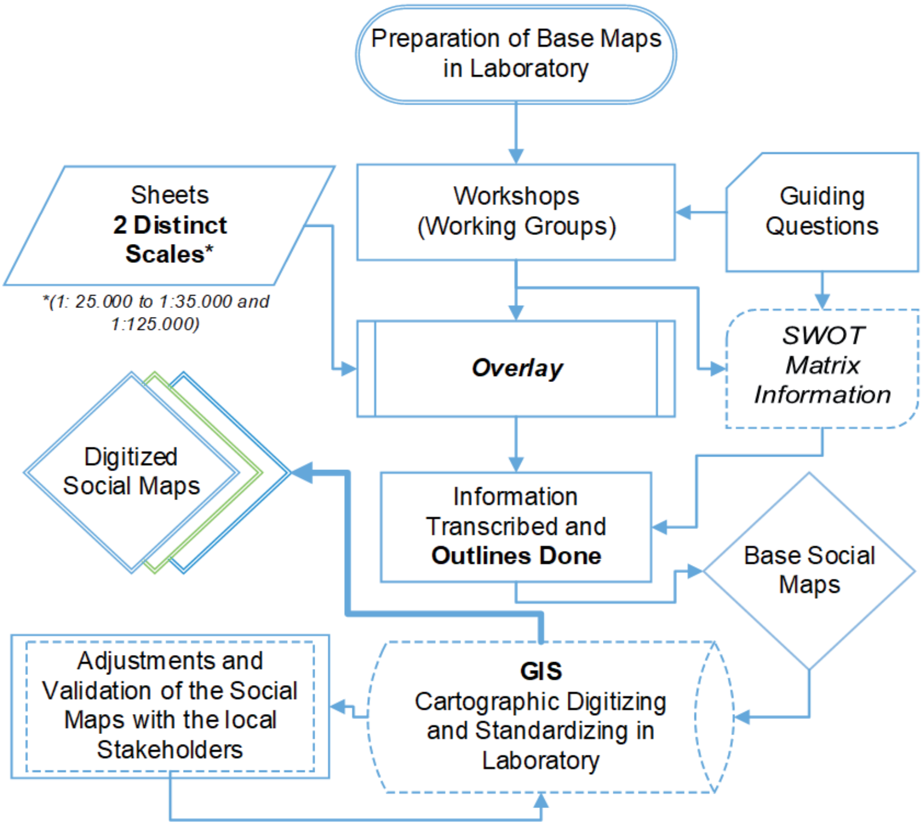

Figure 1 | Flowchart of the processes involved in preparing the social maps.

Source: Prepared by the authors.

In the participatory fishing calendar prepared in a specific workshop (January 2020), we asked four fundamental questions: i) What do you fish? Aiming to gather information on the main types of fish captured; ii) Where do you fish? To understand where the activity takes place; iii) When do you fish? In order to define the seasonalities of the different registered fisheries and iv) How do you fish? To gather information on the fishing gear utilized to catch each type of fish species. The aim of preparing the participatory fishing calendar was to produce additional information on the researched fishing activity.

The participatory methods (mapping, Swot, and fishing calendar) were part of doctoral-level research, and an ethics committee approved the procedures (CAAE/UFC: 06529217.1.0000.5054). To guarantee the highest integrity in the participants' perception, the field team, composed of 2 to 5 members/facilitators, conducted the research so as not to produce interference in the results. In terms of the participants' prior knowledge, only 3 (6.6%) showed that they had any knowledge about the OWF projects. Furthermore, part of the data was produced under the Coastal Economic Ecological Zoning of Ceará (ZEEC Ceará), which, in November 2021, was undergoing a public consultation process by the State Government.. This consists of an essential socioenvironmental survey of the entire Ceará coast to guide a coastal territorial organization (GORAYEB et al., 2021). However, the data utilized in this study are strictly related to artisanal fishing.

3 RESULTS AND DISCUSSION

Alencar and Maia (2011) indicated that the North and Northeast concentrate most Brazilian fishers, though the data are somewhat outdated due to the statistical void on fishing over the past decade in Brazil (NETO *et al*., 2021). More recently, Petrobrás S/A, in its report on the monitoring project of fisheries in the petroleum basins of Ceará, noted that there are local, cultural, technical, and logistical particularities in Ceará's fishing (PETROBRAS, 2016). Notwithstanding, the report concludes that there is a lack of data on the local fishing activity.

Fishes are an essential source of food and work for those who live on the coast (VASCONCELLOS; DIEGUES; KALIKOSKI, 2011), especially in Ceará where there is a traditional and widespread practice of artisanal fishing, which directly influences the food security of the local population and the economy of more than twenty coastal municipalities (QUEIROZ *et al*., 2020).

In the area mapped in conjunction with the fishers of *Colônia* Z18, approximately 840 km^2, we registered localized information from the beach stretching outward to ≅25 km (≅13.5 nautical miles or nm) from the coast of Amontada. A total of 16 items makes up the Social Map legend (Figure 2), of which: 8 refer to Fishing, 3 indicate Various Territories, and 5 indicate Existing and Potential Conflicts and Problems perceived by the fishers.

Concerning Caetanos de Baixo beach, where the *Colônia* Z18 headquarters can be found, an OWF Project (Itarema and Amontada) is situated at ≅8.25 km (≅4.5 nm) to the Northwest. As for the planned area of the other OWF (Itapipoca and Trairi), it is located about 24.2 km (≅13 nm) to the Northeast.

According to the fishers, fishing takes place along the entire extension of the sea, with emphasis on specific locations. In the participatory mapping, we spotlighted fisheries, examples of fishing routes, and mooring and anchoring locations of the artisanal vessels, mainly for the communities of Moitas, Caetanos de Baixo, and Caetanos de Cima. The data showed the possibility of an overlap of fisheries with the Itarema and Amontada OWF, possibly harming the execution of the activity in these locations. The fishers perceived the potential installation of the OWFs in the region as a threat to their fishing (XAVIER; GORAYEB; BRANNSTROM, 2020). Thus, in the Social Map legend (Figure 2), the OWF projects are inserted in the field "Existing/Potential Conflicts/Problems". However, this may be associated with prior negative experiences with onshore wind farms located in the same region (ALMEIDA, 2018).

Although they address onshore wind power endeavours, studies point to the existence of socioenvironmental and socioeconomic issues in the different phases of installation, mainly in the state of Ceará (ARAÚJO, 2016; BRANNSTROM *et al.*, 2017; GORAYEB *et al.*, 2016, 2018; LOUREIRO; GORAYEB; BRANNSTROM, 2015). Meireles (2008) reported that the insertion of a specific wind farm in the coastal zone of the West coast of Ceará altered the social, economic, and environmental reality of the communities adjacent to the enterprise significantly. For example, Mendes, Gorayeb and Brannstrom (2016) reported marked changes in lagoons utilized by the fishers of Xavier community in Camocim, Ceará. There is a clear need for effective methods of predicting socioenvironmental impacts related to wind power initiatives (BRANNSTROM *et al.*, 2017) to evaluate the possible pressure on the coastal populations.

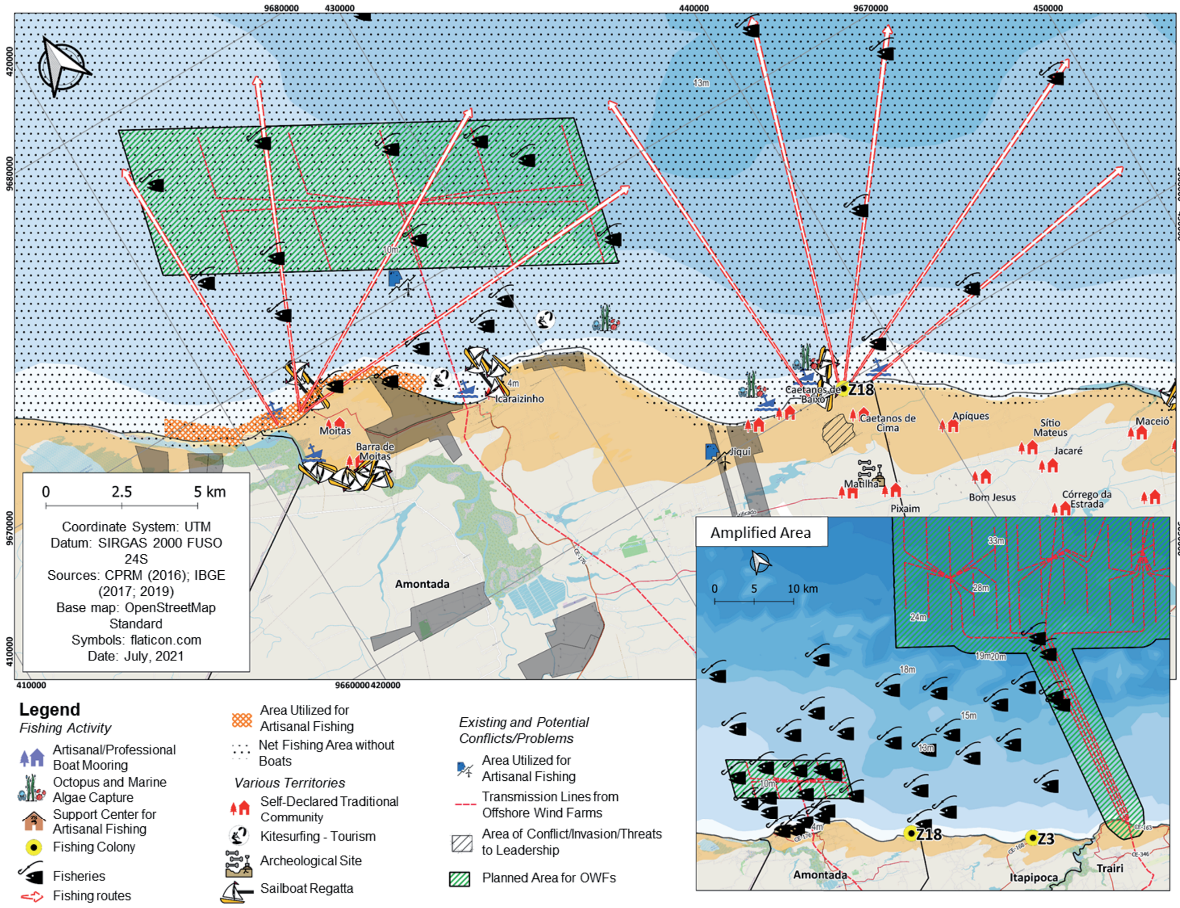

Figure 2 | Colônia Z18 Social Map in Amontada.

Source: Fishermen associated to Colônia Z18, August 2018 and March 2020.

The fisheries are located from the shore until depths of ≅20 m, about 25 km (≅13.5 nm) from the coast. Therefore, it is possible to visualize a total overlap between the locations of the fisheries mapped in Moitas with the planned area for one of the OWFs. As for the other OWF project, fisheries cited by the fishers are located where the underwater cables are projected to carry electricity to shore.

Though the fishers from the Caetanos de Cima community had indicated fisheries located, primarily, in maritime zones with low potential for direct influence from the OWF projects, the concern over the impact on their boat movement was apparent during the mapping activities. This is clear in the words of one of the participants: "with the construction [of the offshore wind farms], the wind is going to take us there, and it will be hard to go around" (Fisherman residing in the Caetanos de Cima community in Amontada, September 2018). Thus, it is evident that, given the predominant use of sailboats, the insertion of the wind turbines could become a significant impediment for fishing, provoking negative consequences on the fisherfolk's traditional way of life.

In addition to the OWF possibly intervening in the direction of the vessels, another critical point raised in *Colônia* Z18 was the potential influence the water turbidity would have on the fishing gear. It is possible to infer that the wind turbines, mainly from the OWF located closer to shore, may become an obstacle for fishers in their operational phase and during the construction phase. It could cause alterations in the fishing dynamic due to the higher levels of turbidity generated when driving the monopiles that support the wind turbines into the seabed. Identifying the period that this impact would occur and the extension along which it could occur is fundamental in creating mitigating and compensatory measures for the artisanal fishers.

International studies have highlighted the importance of considering socioenvironmental impacts that take place in all phases of OWF creation (HATTAM; HOOPER; PAPATHANASOPOULOU, 2017; KALDELLIS *et al*., 2016; KERN *et al*., 2015; KLAIN *et al*., 2017; LADENBURG, 2009; LEUNG; YANG, 2012). For example, Kaldellis *et al*. (2016) reached three fundamental conclusions: i) there is a knowledge gap on the socio-environmental impacts of offshore installations; ii) there is no evidence that socio-environmental impacts of OWF are less severe or less disruptive than onshore wind farms and iii) Research and Development (R&D) centred on new materials, new technologies and construction methods has a very significant mitigating effect on the environmental impacts and the efficiency of the offshore installations.

As a means of adding data to the social map, the *Colônia* Z18 participatory fishing calendar, presented in Figure 3, was prepared (the hyphen indicates the absence of information). Twenty-six types of fish were cited (What do you fish?). In terms of the fishing period (When do you fish?), a significant amount of the various types of fish are caught throughout the year: 22, 84.6% of the total target species cited in the participatory fishing calendar. In addition, lobster and Shrimp were said to be captured during a specific period. *Burdião* and *Cação de Escama* are caught by chance.

Regarding distance travelled to fish (where do you fish?), we registered the maritime fishing zone where the activity is most habitual, location is completely aligned with the fisheries registered in the participatory mapping (Figure 2). According to the fishers, this zone is between 1 and 8 nm (about 2 to 15 km) off the coast of Amontada, comprising, in this sector, a total of 21 types of fish (80.7%), as follows: *Ariacó*, Stingrays, Catfish, *Biju-pirá, Bonito, Burdião, Camurim, Camurupim, Cangulo*, *Cara/ Traíra, Carapitanga, Curuca, Galo do Alto, Guarajuba, Lixa*, Moray eel, Whitefish, *Pirá*, Sardine, Sawfish, and Mullet.

What do you fish?	When do you fish?	Where do you fish?	How do you fish?
Ariacó	Throughout the year	≅1nm to ≅8nm	Line, Gill Net and Fish Traps
Stingrays			Line
Catfish			Trawl and Drift Net
Biju-pirá			Line, Gill Net and Fish Traps
Bonito			Drift Net
Burdião	By chance		-
Cação de Escama		-	-
Shrimp	January to July	Shallow waters (50 cm to 1 m)	Drift Net
Camurim	Throughout the year	≅1nm to ≅8nm	Line and Drift Net
Camurupim			Trawl, Line and Drift Net
Cangulo		200 m depth	Line and Fishtraps
		≅1nm to ≅8nm	Drift Net
Cará/Traíra			Line and Drift Net
Carapitanga			Line and Diving
Curuca			Line and Drift Net
Galo do Alto			
Guarajuba			
Lobster	June to November	Up to 80 *Braças* (120 m)	Lobster trap
Lixa	Throughout the year	≅1nm to ≅8nm	Trawl and Line
Moray eel			Line
Whitefish			Line and Drift Net
Pirá			Line
Octopus		-	Hand-gathering (Corals)
Sardine		≅1nm to ≅8nm	Drift Net
Sawfish			
Crab		-	Hand-gathering (Mangrove)
Mullet		≅1nm to ≅8nm	Drift Net and Casting Net

Observation: the hyphen means lack of information

Figure 3 | Colônia Z18 Fishing Calendar.

Source: Fishermen associated with Colônia Z18, January 2020.

The fishermen stated that a measure of 80 *braças* is the maximum depth limit for catching lobster, which represents about 120 meters. The unit of measurement "*braças*" is commonly used by artisanal fishers on the Brazilian coast and is the distance between palms with arms spread wide, about 1.5 meters (CHIEUS JR, 2009). From the bathymetric data available (CPRM, 2013), the depth mentioned above is located between 40 and 50 km off the coast of Amontada.

According to the fishers, *Cangulo* is caught in two different fishing zones: between ≅6 and 8 nm (≅11.1 to 14.8 km), where the depth is between ≅12 and 15 m in the vicinity of *Colônia* Z18 and maritime zones with minimum depths of 200 m, at about 36 nm (≅66,7 km) from the coast of Amontada. Notably, this second fishery is located beyond the continental shelf limit – where the depth is over 200 m. Thus, this information emphasizes fisherfolk's ability and traditional knowledge as a fundamental component in recognizing fishing territory.

The participants cited seven different types in considering the fishing gear used (How do you fish?). The absolute quantity of fish types captured by type of instrument, in decreasing order, was: Line and Hook (15), Drift Net (14), Fish Trap (*Covo)* (3), Gill Net (*Caçoeira)* (2), Trawl (2), Lobster Trap (*Manzuá)* (1) and Casting Net (1). In addition to this fishing gear, the fishers also cited diving as the technique for catching *Carapitanga* and hand-gathering for Octopus and Crab.

The data acquired from the *Colônia* Z18 participatory fishing calendar demonstrate that fishing takes place throughout the year without interruption. This indicates the importance of this activity for the survival of the families of fishermen and fisherwomen along the West coast of Ceará, which depend directly on the different types of fish they catch for family consumption or commercialization. Moreover, it corroborated the information inserted in the map concerning the extent of the fishing area beyond the wind farm projects' area and expanded the data that legitimized the fishing territories.

Thus, the results confirm St. Martin and Hall-Arber's (2008, p. 785) idea that coastal communities "need to put themselves on the map if they are to play an active role in emerging ecosystem-based and [marine spatial planning] approaches to marine resources."

4 FINAL CONSIDERATIONS

The study showed how participatory methodologies could foster qualitative and spatial data acquisition in multiple-use marine zones. In this case, the objective was to register the fishing territories of a sector of the West coast of Ceará, where there are OWF projects. These elements can lead to a greater understanding of socioeconomic conflicts resulting from installing renewable energy projects in the coastal waters of Ceará, where there is a traditional and widespread practice of artisanal fishing.

In this sense, mapping demonstrated the overlap between the fisheries pinpointed by the *Colônia* Z18 fishers with the OWF projects in the municipalities of Itarema and Amontada. The qualitative and spatial data produced by participatory methods align with the information required in the standard TR, the starting point for the FEL. The maps identifying preexisting multiple uses and fragilities require the presentation of fishing routes and the respective colonies that the navigation exclusion areas could impact. Another item of the standard TR closely related to the data obtained is the diagnosis of artisanal fishing in terms of productive activities in the local economic dynamic, mainly the data produced from the participatory fishing calendar. Thus, the methodology adopted adequately obtained data on people directly involved in the fishing activity, demonstrating the potential for application in the FEL of offshore wind power endeavours.

However, it is interesting to highlight some of the pros and cons of implementing the participatory methodological procedures evaluated here. Weak points are: i) the data reflected the spatial perception of a group of fishers; ii) participants lacked experience in mapping activities and iii) the researchers needed to maintain a neutral posture, without determining rules or impositions on the participants, in order to guarantee the reliability of the data obtained. Strong points are: i) the methods are versatile and can be reapplied as necessary to expand and validate the data, a characteristic intrinsic to qualitative methods; ii) it was possible to locate the sociospatial relationships of the fishing activity on the marine space; and iii) the fishers were willing to participate in the activities, collaborating with studies that aim to protect their ways of life.

For future research, several topics could be developed. For example, the analysis of residents' perception of justice (participatory, distributive, recognition, etc.) during the phases of the enterprises is a specific research area with specific methodologies to provide greater depth, following the example of Klain *et al*. (2017). The various groups and not only the fishers should be considered so that the communities can be analyzed in their totality. Another critical topic is the use of marine space within a perspective of the marine organization through management tools, such as the Strategic Environmental Evaluation, whose approach is considered a challenge to be overcome for the growth of the offshore wind power sector in the EPE Roadmap.

Furthermore, within a context of democratic governance based on local human development, participatory methodologies can collaborate to guide the decision-makers involved. Therefore, employing the participatory methodologies evaluated here can collaborate in understanding the social uses of the sea. However, there is no way of guaranteeing that using these models will promote equitable and sustainable development in terms of actual inclusion of the wishes of the fishers and residents. Therefore, follow-up and monitoring measures should coexist in this scenario, both by the public and private entities and civil society as a whole.

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NOTE

1 | For more details, see: https://www.sema.ce.gov.br/gerenciamento-costeiro/zoneamento-ecologico-economico-da-zona-costeira-zeec/documentos-previos-para-consulta-publica-do-zeec/

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