Stakeholder Perspectives on Offshore Oil and Gas Decommissioning in Brazil

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Abstract. Offshore oil and gas decommissioning represents a complex transition phase involving environmental, socio-economic, and governance challenges, particularly in regions historically dependent on oil production. This study investigates stakeholder perspectives regarding the impacts and challenges associated with offshore decommissioning in Brazil. Data was collected through structured participatory workshops held in the Campos Basin region, involving 41 stakeholders from academia, industry, government, civil society, and environmental organizations. A qualitative content analysis was applied to responses from a structured questionnaire, focusing on perceived critical issues and weaknesses in decommissioning projects. The results revealed heterogeneous perceptions across stakeholders, with knowledge gaps emerging as the most frequent concern, followed by economic impacts related to royalties, employment, and workforce qualification. Social vulnerabilities and governance limitations were also highlighted, particularly regarding regulatory uncertainty and lack of public planning for post-decommissioning transitions. Environmental concerns focused on waste management and recycling of subsea infrastructure. Complementary insights from contextual questions indicated interest in circular economy opportunities and uneven stakeholder preparedness for decommissioning activities. The findings demonstrate that offshore decommissioning in Brazil is perceived not only as a technical process but also as a broader socio-economic transition requiring integrated governance, stakeholder engagement, and capacity-building strategies. The study contributes empirical evidence to support sustainability-oriented decision-making and participatory governance in emerging decommissioning contexts.

Keywords: stakeholder; offshore decommissioning; sustainability; governance; oil and gas installations.

1. Introduction

The decommissioning of offshore oil and gas (O&G) installations represents the final stage of the productive life cycle, occurring when assets reach the end of their useful life or become economically unviable [1]. This process takes place within a global market estimated at approximately USD 100 billion for the 2021 to 2030 period, representing an increase of over 200% compared to the previous 10-year period [2].

It is estimated that the Brazilian decommissioning market will require an investment of approximately US$ 10 billion between 2026 and 2030 for the removal of 18 platforms [3]. This increasingly demanding process entails environmental, social, and institutional impacts that require integrated and transparent management approaches, involving multiple stakeholders in risk mitigation and the maximization of positive outcomes [4].

According to Freeman (1984) [5], a stakeholder is any individual, group, or organization that affects or may be affected, or perceives itself as such, by the decisions, activities, or outcomes of a project. Stakeholder engagement consists of creating opportunities for dialogue that provides a basis for more informed organizational decision-making [6]. In the context of offshore decommissioning, both industry practice and the academic literature recognize that effective governance and decision-support processes must fully incorporate the perceptions and values of different stakeholders [7].

Incorporating stakeholders' perspectives is crucial in the governance of the oil and gas life cycle. Adopting a holistic view allows the expectations of multiple stakeholders to be aligned with the technological requirements and high costs involved [1]. Without considering the views of these actors, decommissioning is more likely to ignore critical socio-environmental or economic variables [8], making the process less efficient and more prone to institutional conflicts [7]. Studies aimed at capturing such views have been growing recently [9].

In this context, content analysis has emerged as a particularly versatile method for capturing stakeholder perceptions, as demonstrated by some autos [8] in their systematic approach.

However, while international literature increasingly recognizes the importance of multi-actor governance in decommissioning, empirical studies analyzing stakeholder perceptions in the Brazilian context remain scarce [10]. This gap is particularly relevant in a setting marked by institutional asymmetries, evolving regulatory frameworks, and uneven preparedness of local production chains.

Accordingly, the objective of this study is to investigate stakeholders' perspectives regarding the impacts and challenges associated with offshore oil and gas decommissioning in Brazil through the application of qualitative content analysis. By systematically examining these perceptions, the study aims to provide empirical evidence to inform governance improvements, enhance project management practices, and support sustainability-oriented decision-making in the sector.

2. Theoretical Framework

2.1. Sustainable Offshore Oil and Gas Decommissioning

Offshore decommissioning has progressively evolved from a purely technical dismantling activity into a complex sustainability challenge involving environmental, economic, and social aspects. Sustainable end-of-life management requires balancing operational feasibility with environmental protection and socio-economic outcomes. Recent frameworks propose integrating lifecycle thinking and risk management into decision-making processes, highlighting the need for structured sustainability-oriented approaches [11]. Multi-criteria decision-making models have also been proposed to evaluate decommissioning alternatives, incorporating environmental performance, costs, and social impacts simultaneously [12]. However, the implementation of such frameworks may be constrained by data uncertainty and conflicting stakeholder priorities, limiting their practical application in some contexts [13].

The environmental dimension of offshore decommissioning has received increasing attention due to potential impacts on marine ecosystems and biodiversity. Complete removal strategies may reduce long-term environmental liabilities but can also generate

short-term disturbance to seabed habitats, while partial removal may preserve certain ecological functions but introduce monitoring challenges [14]. These contrasting findings indicate that sustainability assessments must consider trade-offs between immediate environmental disturbance and long-term ecological outcomes [15].

Applying the principles of the circular economy to decommissioning is essential for transforming the closure of operations into an opportunity to retain value, whether through the reuse of infrastructure, industrial symbiosis, or material recovery [16]. Although circular business models can generate economic benefits and regional development [13], their practical feasibility is often restricted by contextual factors, such as the lack of recycling infrastructure and gaps in regulatory frameworks [7].

Economic and governance challenges further influence sustainable decommissioning strategies. The global increase in aging offshore assets has intensified the need for coordinated planning and supply chain readiness [17]. In industrial engineering discussions, the growing decommissioning market has been associated with opportunities for innovation and infrastructure development, particularly in emerging regions [18]. However, institutional fragmentation and regulatory uncertainty may hinder integrated sustainability planning, especially in developing decommissioning markets [11].

2.2. Stakeholder participation in decommissioning projects

Offshore decommissioning projects involve multiple stakeholders with distinct priorities, making perception analysis essential for understanding governance dynamics. Stakeholders may interpret decommissioning as either an opportunity for environmental improvement and economic diversification or as a source of risk and socio-economic disruption [7]. Divergent priorities among stakeholder groups have been documented, particularly regarding trade-offs between environmental protection, cost efficiency, and regional development. These differences highlight the importance of incorporating stakeholder perceptions into decision-making processes, especially in complex socio-technical systems [17].

It is increasingly important that stakeholders' interests and concerns be considered, as offshore decommissioning faces significant challenges in progressing toward sustainability, and transparency and interaction among different perspectives are decisive for this process [16]. In this context, dialogue and consultation with stakeholders constitute a relevant mechanism for incorporating these perceptions into decision-making processes and for fostering regulatory improvements [19].

Converging evidence in the literature indicates that effective governance and decision support processes in decommissioning must fully incorporate the perceptions and values of different stakeholders (operators, government, service providers, environmental groups, and sea users) [15][1][17]. However, incorporating multiple viewpoints may also introduce complexity into decision-making processes, particularly when stakeholder expectations diverge [11].

Stakeholder engagement has been widely discussed as a mechanism for improving sustainability outcomes. Participatory processes can enhance transparency and facilitate consensus-building among actors involved in decommissioning projects [20]. Similarly, incorporating public preferences has been associated with improved environmental decision-making and increased acceptance of decommissioning strategies [21]. However, extensive stakeholder involvement may also introduce challenges, such as increased decision complexity and potential delays in project

implementation. Integrating stakeholder preferences into multi-criteria decision models may further increase uncertainty if conflicting priorities are not adequately structured [22].

Stakeholder perceptions also influence the adoption of circular economy strategies. Collaboration among actors is often necessary to enable reuse and recycling alternatives, particularly when infrastructure repurposing requires coordination across industries. On the other hand, divergent stakeholder expectations may create resistance to reuse options, especially when environmental risks are perceived as uncertain [19].

In addition, stakeholder engagement contributes to shaping governance and regulatory frameworks. Participatory approaches have been associated with improved policy development and more inclusive decision-support mechanisms [20]. In emerging decommissioning contexts, stakeholder coordination is particularly relevant for managing socio-economic impacts and infrastructure demands [18].

3. Methodology

3.1. Data Collection

Data was collected in 2024 using a structured questionnaire with open-ended questions. The sample comprises 41 respondents from government, academia, industry, civil society, and environmental agencies, of whom 56.1% had not previously participated in decommissioning projects.

Invitations to the workshops were sent by email to representatives from stakeholder groups (community, company, workers, public authorities, etc.) affected by offshore oil and gas decommissioning in the Campos Basin region, with volunteer registration conducted via Google Forms. The objective of the event was to consult regional stakeholders as part of a broader research effort in which the research group regularly conducts participatory workshops and structured interactions with local communities to understand stakeholder perspectives on offshore decommissioning and subsea systems.

The geographical scope for holding the workshops was determined by the historical significance of the cities of Campos dos Goytacazes and Macaé in the oil and gas industry. The Campos Basin encompasses both cities and is projected to see investments of 51 billion reais in decommissioning projects by 2029, representing approximately 70% of the capital allocation for that period across the entire country [23].

The two Workshops were held on May 22nd and 23rd, 2024, from 2 pm to 5 pm, respectively at Instituto Federal Fluminense campuses in Campos dos Goytacazes and Macaé. Each event began with an introductory presentation on offshore decommissioning in Brazil to ensure informed participation, providing stakeholders with technical background information prior to data collection.

Participants then completed individual forms (Individual Registration Form – FRI) for 10 minutes, recording concerns, priorities, and knowledge regarding subsea decommissioning. The questionnaire included three questions: (1) What is your objective of interest in relation to decommissioning projects for subsea oil and gas production systems in Brazil? (2) What are the main critical points and/or weaknesses perceived by your organization in relation to decommissioning projects for subsea oil and gas production systems in Brazil? (3) Has your organization ever operated on a

decommissioning project? If yes, which one? Please indicate the main difficulties. If not, how does your organization plan to operate this type of operation?

It is important to note that participants attended as representatives of their respective organizations, including universities, government institutions, and oil and gas companies. This organizational representation may have influenced how freely perspectives were expressed, potentially affecting the openness of response.

3.2. Content Analysis

The present study investigates stakeholder perspectives of offshore decommissioning impacts through content analysis [24]. The method consists of an approach suitable for the systematic interpretation of verbal communications produced by different participants in a research context, enabling the identification, organization, categorization, and interpretation of meanings present in respondents' statements, producing consistent inferences about perceptions, interests, experiences, and institutional strategies related to the decommissioning of subsea oil and gas production systems in Brazil.

The analysis consisted of four main stages: definition of the corpus, free line-by-line coding of the corpus; the organization of these 'free codes' into related areas to construct descriptive themes and the development of 'analytical' themes. For every new document that was coded new codes were added to the 'code bank', and new ones were developed when needed. Every sentence of each answer had at least one code applied, with many being categorized using several codes, and all the text which had a given code applied was checked for consistency of interpretation. The codes were analyzed to identify similarities and differences between them, allowing the grouping of the codes into a hierarchical tree structure. New codes were then created to capture the meaning of groups of initial codes. As a result, a tree structure organizing 33 descriptive themes in several layers was built, and a draft summary of the findings organized by descriptive themes was written. The corpus is composed of the answers provided to the second question of the questionnaire by the 41 participants.

Although the questionnaire included three questions, only the responses to the second question were used as the analytical corpus, as this question directly addressed stakeholder perspectives on impacts and challenges associated with offshore oil and gas decommissioning. The first question focused on stakeholder interests, and the third question aimed to characterize prior experience, both of which were used for contextual interpretation rather than thematic coding.

4. Results and Discussion

During the content analysis of the 41 responses, it was observed that stakeholders expressed their perceptions at different levels of generality, which generated a significant methodological challenge for coding and categorization. This heterogeneity produced a conflict between codes and categories, as generic codes emerged with the same names as the categories that were meant to group specific codes, creating a hierarchical ambiguity. To resolve this ambiguity, the generic codes were retained as representations of broad mentions, and the categories were renamed. Thus, the information from the responses, across their varying degrees of generality, was preserved without compromising hierarchical coherence. This diversity of levels

reflects the diversity of the stakeholders themselves and, rather than being a problem to be eliminated, it represents an important finding, pointing to the fragmentation of perceptions regarding decommissioning. While technical stakeholders identified specific risks (exotic species, waste disposal), social and political actors emphasized structural dimensions (socioeconomic impacts, governance). The content analysis methodology, by capturing this diversity, allowed the data itself to guide the final analytical structure.

This diversity of perspectives is consistent with previous studies that emphasize the multiplicity of stakeholder interests in offshore decommissioning processes. Highlight that decision-making in subsea decommissioning requires balancing environmental, social, and economic criteria is determinant [25], while some author point out that sustainability performance in decommissioning is strongly influenced by stakeholder priorities [26]. As in other studies that have identified heterogeneous perceptions among Brazilian stakeholders, reinforcing the importance of structured engagement processes to capture these different viewpoints [10].

The coding reached a total of 83 code occurrences, distributed across 33 codes and grouped into six categories. The Sankey diagram in Figure 1 visually demonstrates how stakeholder responses are distributed among the codes and how these codes are grouped into the categories.

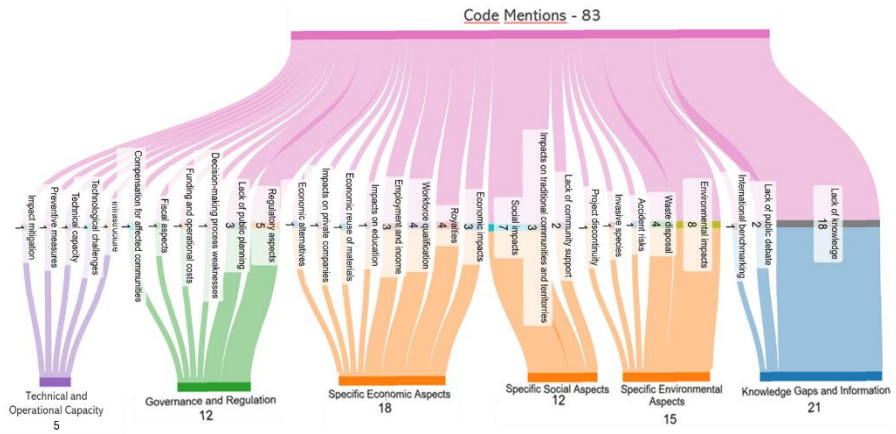

Fig. 1. Sankey diagram shows the distribution of stakeholder responses across codes and their aggregation into analytical categories.

As observed in Figure 1, the category with the largest number of occurrences (21) was "Knowledge gaps and information", with a strong representation of the code "lack of knowledge" (18), the code with the largest frequency by far, appearing in answers from respondents of different types of organizations. As was stated by a representative from the academic community: "Lack of information and regulation as part of academic training; even though we are responsible for educating many professionals who work in the oil sector, we still have limited knowledge about the decommissioning process, which could be better discussed within academia."

This perception from the academic community in a region, where many undergraduate programs aim to prepare students to work in oil and gas fields points to

a relevant gap in the curriculum that could be addressed by adopting a life-cycle-thinking perspective.

The category with the second largest number of occurrences (18) was “Specific Economic Aspects”, with the highest frequency tied to the code’s “royalties” (4) and “workforce qualification” (4), closely followed by “employment and income” (3). These responses reveal a concern not with the operational aspects of decommissioning activities, but rather with the economic impacts on the territory following the end of oil industry activities in the region, as reflected by the following statement: “Territorial impacts related to labor, employment, income, and education. Considering the economic dependence on the sector, what alternatives can be considered with the end of oil activities?”

A similar concern is observed in the category “Specific social aspects”, composed of the codes: “social impacts” (7), “impact on traditional communities and the territory” (3) and “lack of support in the community” (2). These responses demonstrate a general expectation regarding how local society will be affected by the end of O&G operations, with specific concerns about the potential impacts on traditional communities, reinforced by a sense of abandonment and lack of support to such communities. This sentiment is succinctly summarized by the following statement: “The main perceived weaknesses are social. The impact of this on citizens, especially in communities economically dependent on royalties”.

This concern observed in the participants’ responses is expected given that the city of Campos dos Goytacazes has historically been dependent on the O&G industry and has not yet succeeded in diversifying its economy [27], as occurs in regions with this type of profile in North Sea countries.[28].

In this scenario, stakeholders’ perceptions go beyond decommissioning activities and are centered on how the region may survive post-decommissioning. Such questions are often at the center of the just transition debate [29, 30] and highlight how decommissioning activities part of a process whose complexities are extend beyond technical and short-term challenges.

In addition to the categories already mentioned, 15 occurrences coded as “Specific environmental aspects” demonstrate a broad concern with environmental impacts, reinforced by the 8 occurrences related to specific interest in waste management, as illustrated by the code “waste disposal.” In particular, respondents from the Municipality of Campos dos Goytacazes questioned “the appropriate destination of the material, whether recycling or disposal in sanitary landfills is feasible,” while a representative from a company specialized in the sector warns that “the decommissioning of flexible pipelines, power cables, and umbilical is occurring very rapidly […] presenting risks of degradation and contamination by plastics.” These concerns are echoed in the literature [31]. with a predominance of flexible pipelines in its subsea structure, as Brazil has a very particular decommissioning scenario in which waste management will represent a distinct challenge compared to other global markets, and innovative solutions are still beginning to be explored, particularly when sustainability-oriented decision-making frameworks and stakeholder-driven performance indicators are considered [25][26].

In addition to environmental concerns, stakeholders also emphasized the vulnerability of the institutional dimension. The category Governance and Regulation comprise 12 occurrences and reveals a clear perception that the institutional framework for decommissioning in Brazil is still incipient and insufficient. The most frequent code, Regulatory aspects (5 mentions), points to a demand for regulatory clarity, echoed by

various stakeholders: a representative from the port logistics sector mentions "regulatory and fiscal issues in general," while a representative from the local university refers to the "lack of legal regulation of the process."

The lack of public planning (3) emerges as another central facet in discussions on a just transition: the absence of a transition strategy. The statement of a representative from organized civil society is emblematic: "The lack of planning by public authorities regarding this change in scenarios, which will bring many impacts, both financial, with the reduction of employment in oil companies and the end of royalties, as well as social, environmental, and others."

In addition, financing and operational costs, as well as fiscal aspects, point to a practical concern: who will pay for decommissioning? A sectoral representative of small enterprises observes that "the financing of decommissioning and dismantling is a problem, as it was not anticipated in the past." Finally, compensation for affected communities emerges as an understanding of the need for a governance mechanism, once again connecting the regulatory dimension to social justice.

Although the thematic coding focused on the second question of the research instrument, the first provided complementary information on stakeholders' objectives regarding decommissioning projects. The responses indicate interest in participating in recycling initiatives, developing local infrastructure, providing technical services, and engaging in new business opportunities associated with the decommissioning market. At the same time, stakeholders emphasized environmental protection, knowledge generation, and institutional coordination as relevant motivations. These findings suggest that decommissioning is perceived not only as a technical challenge but also as a strategic opportunity for regional development, reinforcing previous studies that highlight stakeholder expectations regarding circular economy initiatives and local value creation [26].

The third question, which addressed prior experience in decommissioning projects, revealed heterogeneous levels of familiarity with the topic. A smaller portion of participants (18) reported having had contact with the subject; among these, they described previous involvement in environmental studies, regulatory processes, and operational support. Meanwhile, those who indicated no prior experience (23) expressed their intention to contribute through research, training, technical consultancy, and policy development. This variation suggests uneven institutional preparedness and highlights the importance of capacity-building and knowledge-sharing mechanisms. Such findings are aligned with earlier research emphasizing that stakeholder experience influences governance maturity and decision-making in offshore decommissioning contexts [25].

5. Final Considerations

Respondents' perceptions regarding the occurrence of offshore O&G production decommissioning indicate that, although there is consensus on environmental concerns, attention ranges from opportunities to foster the circular economy to concerns about the loss of fiscal revenues and the termination of social projects. This finding points to a lack of understanding or even confusion regarding the distinction between the actual or potential impacts of the decommissioning phase and the drivers behind the cessation of O&G production in the territory. Although one results from the other, they should be considered strategically in different ways, as one is inevitable, the cessation of

production due to resource depletion, while the other may become a driver of positive socioeconomic and environmental impacts.

In the analyzed content, a central weakness could be observed: the discrepancy between the operational pace of decommissioning and the preparedness of society, government, and the supply chain to deal with its consequences. Participants with experience in decommissioning projects highlighted challenges related to the termination of environmental education projects and licensing conditions, which may weaken social support mechanisms. Other respondents emphasized plans to update technical curricula, create courses focused on the decommissioning industry, and organize local infrastructure to receive removed materials, aiming to attract investment to municipalities.

These findings indicate that offshore decommissioning in Brazil is perceived as a socio-economic transition requiring coordination among institutions, industry, and local actors. Environmental precautions, regional development, workforce qualification, and governance capacity emerge as interconnected priorities. The results also highlight knowledge gaps and uneven preparedness among stakeholders, reinforcing the need for capacity-building initiatives and improved planning for post-decommissioning scenarios.

This study contributes to establishing the state of the art of offshore O&G production decommissioning in Brazil by presenting an overview of strategic stakeholders from the Campos Basin, a region particularly relevant to the country's O&G industry, and by providing inputs for project management and asset life cycle governance, with implications for public policies and sustainability practices in the sector. It should be noted that the analysis is limited to a specific regional context, which may restrict the generalization of the results. In addition, participants represented their organizations, which may have influenced their responses, and the qualitative approach does not allow for statistical generalizations. However, as an empirical study that analyzes stakeholders' perceptions in the Brazilian context, it provides an important contribution to advancing the scientific literature by addressing an identified gap.

Future research could extend the analysis to other offshore regions, enabling comparative assessments across different socio-economic settings. Complementary quantitative approaches may support decision-making frameworks, while longitudinal studies could examine how stakeholder perceptions evolve as decommissioning progresses. Further work may also focus on integrating stakeholder perspectives into sustainability assessment tools to support governance and planning of offshore decommissioning activities.

6. Acknowledgments

The authors would like to thank the Brazilian National Agency of Petroleum, Natural Gas and Biofuels (ANP) for the financial support that made this research possible, and researcher Izabel Cristina Costa de Sousa for her contribution to the field research.

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