

Navigating the Depths: The Future of Deep Sea Mining

An Ethical Lens on the Quality of the NORI Impact Assessments

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Abstract—June 2023 is pivotal for Deep-Sea Mining (DSM), potentially marking the issuing point of the first exploitation licenses. This report examines the quality of information on Nauru's NORI DSM project, providing guideline recommendations to the International Seabed Authority (ISA). We evaluated the Environmental Impact Statement, Stakeholder Engagement and Environmental Monitoring System of NORI's test project, as well as scoping documents for a Social Impact Statement of a future exploitation project. The main findings suggest weak social legitimacy due to top-down stakeholder engagement that excludes marginalized groups. The assessments conducted by NORI overlook uncertainty-related risks, relying on indirect impacts modelling and non-applicable frameworks. The monitoring and mitigation mechanisms devised are not sufficient yet to comprehensively address the risks. This report highlights the normative role of the ISA in addressing these deficiencies through: implementing robust guidelines, withholding approval for inadequate assessments, enhancing stakeholder engagement, refining assessment methods, and developing comprehensive monitoring plans.

Keywords: Deep Sea Mining; Ethics; Environmental Impact Assessments; Nauru; NORI; Stakeholder Involvement

INTRODUCTION

In pursuing a net zero future, demand for raw materials is set to soar (Group, 2017; Oberle et al., 2019; Bouckaert et al., 2021). However, sourcing raw materials to fuel this transition towards cleaner technologies poses substantial threats to the environment (Thornton, 1996; Norgate and Haque, 2010; Sonter et al., 2018). Thus, a complex dilemma emerges where climate concerns are confronted with the environmental degradation of terrestrial ecosystems, calling for alternative approaches towards traditional mining.

One such alternative is deep-sea mining (DSM), an emerging practice that involves extracting minerals from the seabed. The absence of reference projects and limited impact assessment guidelines contribute to a contested debate regarding its potential ramifications. On the one hand, the seabed harbours vast reservoirs of essential resources, possessing the potential to facilitate a green transition. On the other hand, the deep sea is inhabited by poorly understood ecosystems, likely integral to the overall

ocean health and, by extension, the planet. Consequently, an important question arises concerning the viability of commercial DSM within the context of transitioning towards a 'sustainable blue economy'¹.

The *International Seabed Authority (ISA)* serves as the primary rule setter to navigate this complex landscape. As such, the *ISA* has been instrumental in developing frameworks guiding the decision regarding the prospecting and exploration of DSM. Projects seeking to engage in DSM undergo a rigorous process, submitting applications for mining licenses to the *ISA*, which carefully evaluates the proposed activities and ultimately determines whether to issue a permit.

The *ISA* has diligently formulated regulations on exploiting seabed resources in international waters since 2002. As part of this process, the *ISA* issued 19 exploration and testing licenses better to understand the environmental impacts of future mining operations.

Project Definition

Nauru is a small island nation in the Pacific that due to the depletion of its main natural resource, phosphate, faces severe social and economic challenges (Connell, 2006). Recognizing the need to overcome this economic legacy, Nauru became the sponsoring state of *The Nauru Ocean Resource Inc (NORI)* project. *NORI* is a subsidiary of the Canadian *The Metals Company (TMC)*, and its primary goal is to commence commercial DSM operations by 2024 (TMC, 2023).

While the international community is discussing a potential moratorium, Nauru's President contacted the / on June 25, 2021, pushing forward the *NORI* project and giving the / a two-year deadline to expedite the completion of regulations required to approve commercial mining plans. He referred to paragraph 15 of section 1 of the Annex of the UN Convention on the Law of the Sea (United Nations,

¹*blue economy* refers to a sustainable approach to economic development emphasizing the responsible use of marine resources (Smith-Godfrey, 2016)

1982) which allows any state party to make a request for the ISA to complete regulations necessary for approval of seabed exploitation project. This situation showcases the intrinsic conflict between the ISA and the NORI project. While the ISA wants to ensure a complete and comprehensive set of guidelines, sponsoring states are leveraging their position to accelerate the drafting phase.

NORI's has published different assessments related to their small-scale exploration projects laying the groundwork for future assessments related to commercial DSM. This report aims to analyze the existing information in preparation for the imminent decision on the feasibility of NORI's commercial DSM plans. The quality of the information considered in this decision is of utmost importance, as it will set a precedent for future mining projects. Therefore, this report informs the ISA about all available information and how to improve the existing decision process for the upcoming NORI exploitation project.

ARCHITECTURE OF CURRENT ASSESSMENTS

As the deadline for Nauru approaches, the evaluation for the NORI project enters a new stage, with the ISA facing time constraints in finalizing regulations for DSM. This section provides an overview of NORI's current assessment reports to aid in this process. By summarizing this architecture, the report assists the ISA in comprehending the assessment landscape and expediting the regulatory process.

Despite the ongoing tension between NORI and the ISA, NORI stated to adhere to ISA's guidelines emphasizing that it "only [submits] an application for a commercial contract after we complete a comprehensive, science-driven environmental and social impact assessment of the highest quality" NORI (2023).

To fulfill this commitment, NORI has followed the ISA's **Official Guidelines for EIA** during the execution of their initial *Collector Test Project*. This project aimed to evaluate the environmental implications of a DSM collector machine for extracting minerals from the seabed. As part of this project, NORI initiated a screening and scoping process, that was finally reviewed by stakeholders, culminating in the first **Environmental Stakeholder Consultation (ESC)** in March 2021. Although the report introduces all stakeholder participation methods, insights about how stakeholder participation contributed to the EIA drafting phase are limited.

Following the stakeholder involvement, NORI conducted the Environmental Impact Assessment (EIA) study and released the **Environmental Impact Statement EIS** in July 2021, summarizing potential impacts identified by the

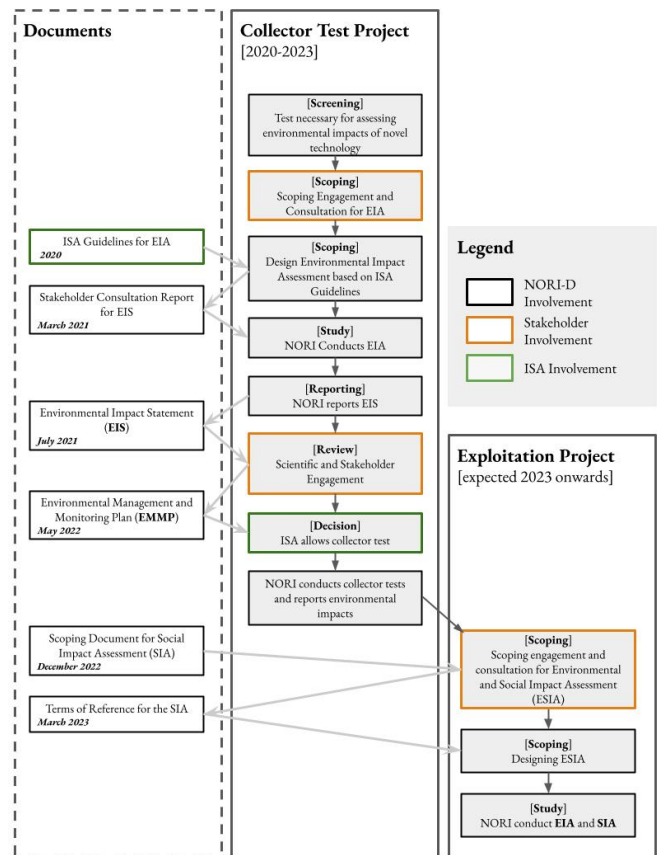


Fig. 1: Detailed architecture of current assessments. The left document column summarises all published documents. The middle column displays the EIA process for the *Collector Test Project*. The right column provides a outlook of future assessments. Arrows between columns and boxes represent the sequential steps and interactions within the decision processes. Different colours identify involvement of different actors (NORI black; Stakeholders orange; ISA green).

EIS on DSM machinery, techniques, and future monitoring systems. Based on the EIS an enhanced **Environmental Management and Monitoring Plan (EMMP)** was developed to support future harm prevention and mitigation measures.

In general, the EIA guidelines ensured a collaborative approach that emphasised environmental considerations with other stakeholders. However, the EIA process remains lengthy and complex. Taking three years for a test project poses challenges in assessing the impacts of a rapidly evolving field. Furthermore, in light of uncertainties inherent to the complex deep-sea system, it is important for the ISA to consider that the effectiveness of mitigation measures in test projects may be limited in providing insights into large-scale DSM monitoring.

From an ethical viewpoint, the NORI project must

balance societal and supply-chain benefits and pollution or degradation of ecosystems. The EIS summarises this trade-off by weighing benefits against environmental costs, valuing the outcomes over principles of rights or justice, taking a consequentialist stance. Furthermore, assessing an EIA involves appreciating its dualistic role, viewing it as applied science, which relies on empirical evidence and scientific reasoning based on values of rationality and objectivity, or as civic science, recognizing the political and social facets of decision-making involving value judgments and power dynamics (Cashmore, 2004).

Moreover, *NORI* has initiated a **Social Impact Assessment (SIA)** guideline, despite the ISA’s yet-to-be-published SIA guidelines. *NORI*’s SIA highlights social impact areas such as workforce and safety. Despite lacking adherence to *ISA* regulations, this SIA should be integrated into decision-making, considering Nauru’s economic vulnerability. It will examine the socioeconomic balance between benefits and risks, including potential overreliance on a single industry and cultural disruption. However, SIA’s limitations encompass a local expertise deficit, the intricacy of predicting long-term impacts, and the influence of political and economic interests.

The philosophy behind SIA encourages participatory decision-making, emphasizing stakeholder involvement, leaning towards a non-consequentialist philosophy assessing a project not only by its direct outcomes but also by moral obligations and the opinion of all stakeholders. It thereby shifts decision-making from a purely technocratic process towards a more holistic and democratic one. Moreover, it elucidates the impact distribution across different groups, highlighting a commitment to ethical considerations of rights and justice.

Based on the provided documents, Nauru asserts sufficient data justifying the shift from exploration to exploitation projects. The *NORI SIA’s Term of Reference (ToR)* report, published in March 2023, outlines the first project’s steps, indicating *NORI*’s pursuit of the *Exploitation Project*. Therefore, it is crucial for the *ISA* to comprehensively evaluate all available information to adequately prepare for *NORI*’s application for a commercial DSM project.

QUALITY ANALYSIS OF ENVIRONMENTAL IMPACT ASSESSMENT

From the assessment architecture, it is apparent that the EIA of the collector test project plays an integral role in the exploitation project. Thus, the quality analysis focuses on EIS, the formal documentation of the EIA.

The quality of information can be understood from perspectives of *content* and *process*. The former assesses the reporting, methods and results drawn from the EIS; the latter assesses the stakeholder involvement in developing the EIS. With the acknowledgement that quality can be subjective, the analysis intends to focus on the ethical imperative as the main measure of quality.

From a holistic point of view, the content perspective primarily focuses on how findings and actions eventually lead to outcomes, which calls for a consequentialist understanding. In contrast, the process perspective analyzes the normative principles - or the lack thereof, such as rights and justice in which stakeholders are involved, which affect the overall legitimacy of the assessment.

Process Perspective (Stakeholder Engagement)

An integral part of the process lies in stakeholder engagement, where stakeholders are involved directly in the assessment to work towards a social licence of the project (Moffat et al., 2016). *NORI* conducted a stakeholder consultation in two webinars on October 5, 2021, and March 7, 2022, where all participation is welcome. The EIS document is analyzed to understand the engagement process. The key focus areas are as follows.

(1) Lack of Representation

With stakeholder involvement as a means to acknowledge the diversity in values and unequal distribution of benefits and risks, good representation is needed to account for them and develop ways to build trust and ensure fair and just outcomes (Webler and Tuler, 2006).

NORI frames their inclusiveness by publishing statistics (see Table I) on their engagement’s well-distributed participation by role (i.e., industry, the scientific community, government, *ISA*-affiliated and civil society). However, there is a noticeable absence of detailed documentation regarding the representation of local communities interests in stakeholder engagement. Instead, their participation is often summarized at the continental level and listed briefly in a single sentence, lacking specific information if individual communities are present at the table (Nauru Ocean Resources Inc. (NORI), 2021, p. 270)

TABLE I: Distribution of participants in the stakeholder webinar (Nauru Ocean Resources Inc. (NORI), 2022a, p.6)

	Participant Role	Percentage of Participants
1	ISA Observe or ISA Member state	23%
2	Member of Industry	16%
3	Scientist/Researcher	22%
4	Civil Society	23%
5	Government Representative	16%

While the proportion of each role in the engagement is almost equal, the share of participants constitutes no adequate

measure of representation. Interests of large organizations are prepared and aligned, potentially rendering civil voices overshadowed despite their presence in equal numbers.

Insufficient representation can also be expected from the voluntary and non-targeted nature of the invitation process. Such a process likely results in selection bias towards participants from informed backgrounds, such as representatives from large organizations, instead of unaware but yet affected participants. This exemplifies a lack of procedural justice.

(2) Lack of Informed Consent

The stakeholder's engagement is analyzed to the degree that informed consent is achieved. A key aspect of informed consent lies in the accessibility of information, where stakeholders must have complete access to and understanding of the risks and benefits. This serves as a prerequisite for stakeholders to express their willingness to accept and bear those risks and benefits (Hanna and Vancley, 2013).

The EIS presentations and executive summary are highly technical, making the information inaccessible to the general public. Furthermore, while the opportunity to submit comments is open to the public, it is limited to the *NORI* portal, requiring comments to be presented in a recommended written format. This adds complexity to the process of providing feedback. It is also worth noting that only ten individual comments were reported to have been submitted (Nauru Ocean Resources Inc. (NORI), 2022b).

Procedural equity is lacking. The current process seems to overlook individuals or groups who may not possess strong technological or scientific aptitude (Jaekel et al., 2023). Structural barriers hinder vulnerable communities access to information and their ability to provide meaningful input.

Content Perspective (Analysis and Reporting)

The environmental effects identified and reported in EIS have a twofold objective; prevent and mitigate the impacts generated by the collector test, and provide insights for the deployment of the exploitation project. Therefore, the EIS is assessed in relation to its underlying objectives, to determine its adequacy in meeting those objectives.

(1) Assumptions in EIA Framework

The chosen approach of the EIS follows the Canadian Environmental Agency's 1992 framework, which aims to identify impacts that are considered "adverse, significant, and likely" (The Metals Company, 2021, p.41). However, when applying this framework to activities with limited precedents, like DSM, there is an increased risk of disregarding potential impacts that could be detrimental to the ecosystem.

This assumption can be irresponsible and ethically problematic due to its inadequacy in dealing with uncertainties (known unknowns) and susceptibility to ignorance (unknown unknowns). This highlights the presence of premature prescriptive judgements as a result of adopting heuristics and assumes certain ethical acceptability of risks. Therefore, it is necessary to adopt a more descriptive-oriented, focusing on uncovering the uncertainties surrounding DSM's impacts as opposed to hastily limiting the scope of risks and impact assessment.

(2) Inadequate Assessment of Impacts

Additionally, the impact assessment methods are also inadequate in dealing with epistemic factors, especially in dealing with spatial and temporal complexities. Neglecting impacts beyond the assessment's project area and time horizon is another conceptual drawback. This is especially important due to the long-term nature of oceanic currents and the wide-scale effects on migratory species.

The transboundary impacts have been acknowledged to a certain extent by hydrodynamic models (Nauru Ocean Resources Inc. (NORI), 2021, p. 170), and the data obtained from this test will further refine and calibrate these models. However, it is important to acknowledge that the scale difference between the current assessment and potential future exploitation projects may limit the applicability of these findings, especially for cumulative and long-term impacts.

Specific examples of concerns include biochemical tipping points, heat stress, and the health impacts on migratory species resulting from noise and sediment plumes. These aspects have been the subject of evaluation, as referenced in studies on noise impacts (Williams et al., 2022) and sediment plumes (van der Grient and Drazen, 2022). However, there is a need to recognize the inherent complexities associated with these factors, and further research and assessment are necessary to fully comprehend their potential effects on the environment and species in the long-term.

(3) Insufficient Monitoring and Reporting

Given the transboundary and multi-time-frame nature of DSM impacts, monitoring systems and protocols are especially crucial. However, the current monitoring system is insufficient as it heavily relies on indirect impact monitoring methods such as Slurry monitoring and modelling (Nauru Ocean Resources Inc. (NORI), 2021, p. 45) and does not include an adaptive management approach. The reasons are as follows.

Indirect monitoring methods are insufficient as they may not fully grasp the complex interactions and ecological processes involved. They often capture only a limited subset of potential impacts, neglecting cumulative or synergistic effects from multiple stressors. Additionally, they lack the spatial or temporal resolution necessary to detect localized

or short-term impacts. Instead, they provide a generalized understanding of overall trends, potentially missing critical details or variations at smaller scales. As a result, indirect monitoring falls short of capturing the complete range of consequences and impacts associated with certain activities.(Katona et al., 2023).

In addition, reviewers from *NORI*'s EMMP have raised concerns about the lack of sufficient detail regarding the overall sampling design and monitoring specifications (Singh and Guilhon, 2022). This indicates a need for more comprehensive and well-defined monitoring protocols to ensure accurate and reliable data collection. Additionally, it is crucial to address the potential for emerging and unforeseen environmental effects. Unfortunately, the current EMMP does not include Adaptive management mechanisms mentioned in the *ISA*'s EMMP guidelines (p.8) to incorporate and monitor emerging effects and future knowledge and techniques.

RECOMMENDATIONS FOR ISA

Approval has been granted for the collector test, despite the identified deficiencies in the EIA. It is imperative to address these unsatisfactory characteristics to ensure a more robust evaluation of environmental and social impacts for the forthcoming commercial exploitation project.

Furthermore, it is crucial to note that attributing the flaws in the EIS primarily to *NORI* would be misleading, as the lack of adequate regulations governing the EIA process plays a more significant role. The *ISA* holds the authority to determine the approval of any DSM project. Consequently, recommendations should focus on enhancing operational guidelines in areas where deficiencies have been identified.

Improvement of Process

(1) Better Representation of Stakeholders

The *ISA* needs to establish more precise and tangible standards that guarantee the adequacy of representation within stakeholder engagement processes. Currently, *NORI* relies largely on organizational roles for determining representation, which falls short of ensuring social legitimacy.

To address this issue, the *ISA* should dictate a more holistic stakeholder engagement system that explicitly defines the necessary representation and establishes minimum standards for its attainment. Implementing an intermediate stakeholder analysis process could prove valuable in comprehending the various dimensions of stakeholders that require consideration, such as utilizing tools like the power interest grid, layers of diversity diagram, and differentiating between stakeholders who can provide consent and those who cannot. This approach would facilitate a more robust and inclusive representation of stakeholders, fostering social legitimacy

within the decision-making process.

(2) More Equitable Feedback System

ISA must dictate better standards in the feedback submission system for stakeholder engagement. Establishing a feedback system that addresses their needs is recommended to ensure equitable participation, particularly for less scientifically and technologically oriented stakeholders. A more proactive consultation approach is necessary instead of relying on a passive approach where stakeholders must approach authorities. *NORI* should take the initiative to approach stakeholders to seek their informed consent and engage them in the decision-making. This approach acknowledges and accommodates stakeholders' diverse perspectives and expertise, enabling a more equitable and inclusive feedback system to overcome existing power dynamics.

Improvement of Content

(1) Expanding the Scoping of Risks

Recognizing the uncertainty and criticality of the potential environmental effects of DSM, an explicit precautionary principle should be implemented. Currently, *NORI* has adopted a conventional scoping approach where the reported risks are only those considered "significant and likely" (The Metals Company, 2021, p.41). It is recommended to expand this scope and request sponsoring states to include a wider array of risks until more knowledge is available that can further ascertain what likely and significant risks are.

(2) Enhancing the Impact Assessment

The *ISA* should urge *NORI* to enhance the depth of its assessments. Given the intricate and uncertain characteristics of the deep-sea environment, there is a risk of overlooking critical tipping points in a small-scale test project which drastically changes the fundamental set of assumptions and rules in predicted outcomes. While *NORI* acknowledges the transboundary and multi-timescale nature of environmental effects, it is advisable not to solely rely on the insights gained from the test project as evidence of risk. Instead, it is crucial to recognize the potential for non-linear scaling of environmental impacts and consider this possibility in the assessment process. This could come in the form of more comprehensive scenario analyses.

(3) Strengthening EMMP Guidelines

The current EMMP published by *NORI* was developed using the 17-page-long guidelines published by the *ISA*. As DSM's environmental effects are diffuse, long-lasting, cumulative, and non-localized, monitoring such effects will be challenging and prone to overlooks. More precise and up-to-date EMMP guidelines need to be published that further define sampling and monitoring standards as well as the adaptive management approach mentioned in the previous guidelines to incorporate the latest knowledge in this rapidly evolving arena.

CONCLUSION

In conclusion, DSM remains a controversial topic, and the next weeks will be crucial for the future of the *NORI* project. This report investigated the currently available information and served as a tool for the *ISA* to improve its regulatory processes. It is observed that social legitimacy is weak as current stakeholder engagement holds a top-down management style that excludes marginalized groups. Moreover, the current assessments overlook risks and uncertainties and make overzealous assessments of minimal information. The monitoring and mitigation tools employed to address uncertainties are also insufficient in addressing the associated risks. These problems will likely continue towards assessing the commercial exploitation project.

The report underscores the potential of the *ISA* to address these shortcomings by recommending the implementation of more robust guidelines and the authority to withhold approval in cases of inadequate assessments. Critical areas for improvement in the EIA guideline include enhancing stakeholder engagement, refining scoping, and assessment methods, and developing comprehensive monitoring plans. Furthermore, the *ISA* needs to explore the feasibility of conducting risk assessments that account for the deep uncertainties associated with the subject. As the *ISA*'s upcoming meeting on July 10 approaches, marking the end of the two-year deadline, the following weeks will become pivotal in the collective effort to safeguard the deep sea.

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REFLECTION

Research Process

Although the research process was divided into four distinct stages, we adopted an iterative approach throughout, allowing for continuous refinement and adjustment. The first stage served to provide an initial and project-unspecific overview of motivation, state-of-the-art, stakeholder positioning, and limitations of DSM. Second, research on what generally must be known for the approval of DSM projects was performed and implemented in the analysis of *ISA* guidelines, existing review papers, and identification of overlap to lecture content. The specific project was chosen hereafter, and the group split into teams focusing on information quality within either SIAs or EIAs.

Subsequently, the team's confluenced and compared their findings against the review papers and *ISA* guidelines in a fourth step, providing us with a comprehensive overview. The second iteration was conducted to generate an initial draft paper used to ensure overall team alignment. In the third cycle, the report was fine-tuned and validated against the up-to-then obtained literature. The biggest difficulty was the complexity of the current situation and getting an overview of what documents are available as well as how the *ISA* works. We overcame these challenges by creating

a diagram of all available documents with a timeline and furthermore, reading on the general function and capabilities of the *ISA*.

Use of AI Tools

AI methods, such as Consensus, Elicit.org, or GPT-4 (the latter two referred to as LLMs in the following), were employed as supplementary tools in our research process, serving as exploratory instruments to broaden our thinking and the scope of considerations. Overall, the team is deeply enthusiastic about recently emerged AI assistants. Simultaneously, the evident limitations and uncertainties around their deployment must be acknowledged. GPT-4, for instance, used with plug-ins such as browsing and PDF-reading, was understood as an incredible tool on the one hand but as untrustworthy on the other. Our prompting demanded to provide proof and direct citations on every observation made within PDFs or websites or academic referrals to the training data. Within our research process, as with prior experience, rigorous output validation proved necessary to compensate for LLMs shortfalls. Moreover, we could not expand the use of AI assistants beyond high granularity. While LLMs help structure one's thoughts on single issues and arguments, they are far from connecting the dots to construct a storyline as a subject-affine human could.
