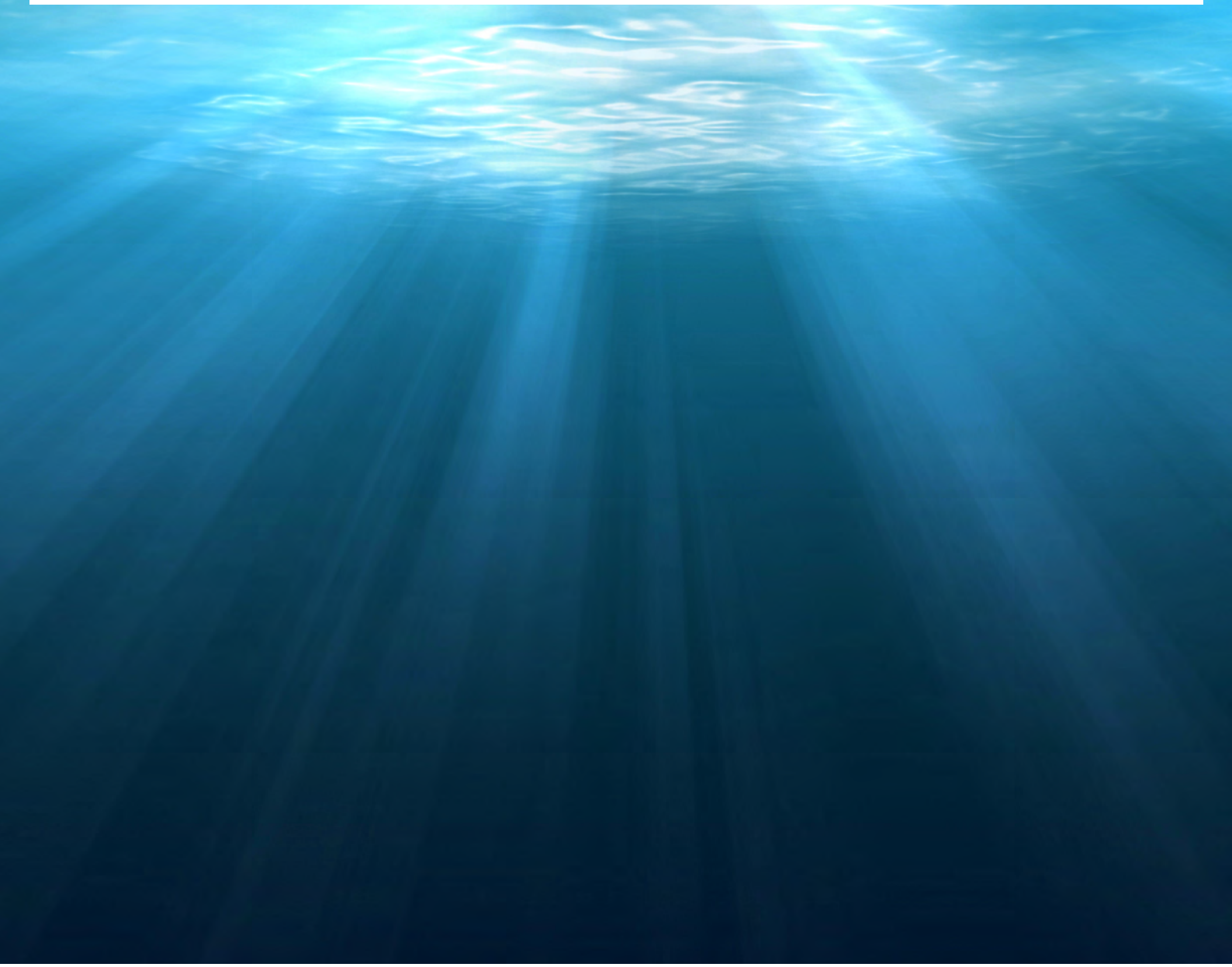
On behalf of

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Federal Ministry for Economic Cooperation and Development



Mining the Depths, Undermining Development? Mapping Deep-Sea Mining and its Social and Economic Implications

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About this report: This report, commissioned by the GIZ Sector Programme "Extractives and Development" on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ), is an executive summary of an upcoming study designed to examine the potential social and economic implications of commercial deep-sea mining (DSM), particularly for developing countries. It focuses on bridging research gaps regarding the socio-economic impacts of DSM. The report analyses the current governance framework and existing narratives surrounding DSM, issues under the International Seabed Authority (ISA) regime, and selected case studies on potential socio-economic impacts of DSM development.

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Abbreviations

DSM	Deep-Sea Mining
ISA	International Seabed Authority
SDGs	Sustainable Development Goals
UNCLOS	United Nations Convention on the Law of the Sea

Executive Summary

Oceans are vital to human well-being, providing resources such as food, pharmaceuticals, and industrial materials, while also regulating the climate and producing oxygen. Since the 1960s, growing recognition of the ocean's economic potential has driven technological advances and expansion into deep-sea exploration, eventually leading to extensive deliberations over the access to mineral resources in areas beyond national jurisdiction ("the Area"). This has fuelled the emergence of deep-sea mining (DSM) as a new industry, regulated by the International Seabed Authority (ISA), an international organisation established under the United Nations Convention on the Law of the Sea (UNCLOS).

Although public debate on DSM has increased, its environmental impacts remain uncertain, prompting scientists calling for precaution before commercial-scale operations begin. While environmental risks dominate current discussions, this report highlights less explored socio-economic consequences – particularly for developing countries, including those highly reliant on land-based mining. Exploring the potential impacts of DSM on developing countries is critical, as they are often more socially and economically vulnerable – and will likely have to bear most of the burdens of DSM without receiving due compensation – and possess limited capacity and agency to influence decision making processes.

To bridge the gap between the relatively extensive body of data on the expected environmental impacts of DSM and the as-yet unexplored potential impacts on social and economic aspects – both direct (e.g., on fisheries) and indirect (e.g., through market changes affecting land-based mining), the study examines commercial DSM through four main areas: the current governance framework and existing narratives around DSM (geopolitical, environmental and socio-economic); outstanding issues under the ISA regime (including the benefit-sharing mechanism, capacity building and transfer of marine technology and access to DSM by developing states); an analysis of current participation of developing countries under the ISA; and case studies of potential socio-economic impacts that could be caused or exacerbated by DSM. Further, the study identified existing lack of evidence showing direct cause-effect linkages between DSM and socio-economic impacts on local contexts, an issue to be taken up by future research.

In Section 1, the study explores the origins, governance, and growing interest in commercial DSM. The section traces its development from early ocean discoveries to the adoption of the UNCLOS, which consolidates the status of deep-sea mineral resources as the common heritage of humankind and established the ISA to regulate activities in areas beyond national jurisdiction.
Rising demand for critical minerals has driven renewed interest in DSM, often framed as essential for the global energy and mobility transition and for reducing geopolitical supply risks. Speculative scenarios by DSM supporters include assumptions that the new industry could reduce or mitigate social and environmental concerns linked to human rights abuse of labourers at land-mining sites and by reducing deforestation, for instance. Thereby, proponents assume that commercial-scale DSM could lead to a decrease in land-mining activities, as the new sector would replace to some extent, the market supply of minerals from terrestrial sources. However, the current lack of evidence makes impractical to ascertain whether, and to what extent, DSM will be able to replace land-mining, as well as what geopolitical and socio-economic impacts could result from it.

At present, scientific efforts are mostly dedicated to understanding potential environmental impacts from DSM on marine ecosystems. Main pressures under investigation include biodiversity loss, disruption of ecosystem functions and services, pollution by heavy metals, generation of sediment plumes, noise, vibration, and cumulative impacts (e.g., with climate change). Despite intensifying research, significant knowledge gaps persist regarding deep-ocean ecosystems and DSM's ecological implications.

Importantly, socio-economic impacts are intertwined with environmental issues but are far less studied. Socio-economic consequences are particularly challenging to predict due to the wide array of future scenarios and factors that can influence outcomes. Some of the key unanswered questions that could carry significant socio-economic implications in a future scenario of commercial-scale DSM include:

1. **How many contracts will be operating at the same time, where, and for how long?**
2. **What will the future demand for different minerals actually look like?**
3. **Will DSM minerals be economically competitive in the global metals market?**
4. **What (if any) will be the impact of DSM on land-mining activities?**

The hypothetical assumption adopted by DSM supporters argues that land-mining activities, and the socio and environmental concerns resulting from current practices could be alleviated by the start of commercial DSM. Despite existing scientific evidence that DSM activities will cause several environmental impacts – including, for instance, through the generation of sedimentary plumes that can travel for hundreds of kilometres, and seawater contamination by heavy metals – significant less investigation exists regarding if and to what extent DSM could impact coastal communities. Other pending issues include evidence of, what impacts, if any, could DSM have on job accessibility, existing cultural practices from coastal communities, previously existent local conflicts, or other sectors that make use of the marine space, such as fishing. In recent years, there is a growing voice from experts and academics challenging the assumption that DSM could help alleviate environmental and social concerns but rather suggesting that mining on deep waters could lead to increased market competition for metals, conversely resulting in potential exacerbation of socio-economic problems. Although the ISA governance framework envisages compensation mechanisms for countries affected by DSM, socio-economic issues are hitherto addressed only to a limited extent by the ISA. Additionally, other essential matters such as benefit sharing, effective regulation, technology transfer, and equitable participation remain unresolved.

Access to DSM is uneven, with developing states often involved through sponsorship arrangements that may offer limited control and benefits over mineral extraction. These challenges, combined with scientific uncertainty and governance gaps, have led to increasing international support for a precautionary pause or moratorium on DSM, currently joined by 40 countries – including Germany – as well as civil society and members of the technology and automotive industries.

Section 2 explores the diversity of voices within the ISA and identifies key gaps in representation and participation. While the ISA formally allows broad inclusion through its Assembly, Council, and observer system, decision-making power is concentrated among a relatively small group of states, particularly within the Council, whose composition has remained largely unchanged over time and is dominated by a few influential countries.

Institutional imbalances are also evident in the Legal and Technical Commission, whose members are nominated by Member States, with issues such as limited gender diversity operates with insufficient transparency, disparity of necessary expertise, potential conflicts of interests, and yet, holds significant influence over decisions. Although observer participation – especially from NGOs and Indigenous representatives – has increased and brought valuable alternative perspectives, these actors have no formal decision-making power. Indigenous groups, in particular, emphasize cultural and spiritual connections to the ocean that challenge dominant resource-focused narratives and have actively called for a ban on DSM.

At the same time, developing countries face multiple barriers to effective participation. Despite universal membership, attendance at Assembly meetings is inconsistent and often below quorum, with developing states underrepresented. Constraints such as limited financial and human resources, logistical challenges, and competing national priorities reduce their ability to engage fully. Financial obligations to the ISA can further restrict participation, as countries risk losing voting rights if contributions are unpaid. Overall, the section highlights that while the ISA framework appears inclusive in principle, in practice it is shaped by power asymmetries, limited transparency, and structural barriers that restrict meaningful participation – particularly affecting developing countries and non-state actors.

Section 3 discusses the potential socio-economic implications of DSM through a precautionary and exploratory lens. Given the current lack of empirical evidence, the limited comparability between known land-mining impacts and the still uncertain effects of DSM, this section does not attempt to produce forecasts. Instead, it provides a structured reflection – based on existent literature, country statements at the ISA, and stakeholder interviews on how DSM could also potentially result in socio-economic concerns, with a focus on consideration developing countries under different contexts and realities. The analysis departs from a scenario that is growing traction among experts, where DSM will lead to an increase in global minerals' market competition without decreasing land-mining activities, as assumed by DSM proponents. Moreover, the analysis critically engages with other DSM supporters' narrative where the activity could potentially deliver socio-economic benefits. To do so, it applies an analytical framework based on the 17 SDGs under the Agenda 2030, adapted into five key dimensions:

1 **Distributional Equity and Benefit Sharing,**
2 **Food Security and Livelihoods,**
3 **Social Inclusion,**
4 **Labour Conditions and Economic Vulnerability,**
5 **Justice and Power Asymmetries.**

The analysis focuses on five case study countries – Brazil, the Democratic Republic of Congo, Indonesia, Namibia, and Papua New Guinea – selected for their reliance on mining, geographic diversity, and differing mining modalities.

In Section 3.1, the topic of distributional equity and benefit-sharing is discussed. Evidence suggests that developing countries are unlikely to receive meaningful economic benefits from DSM under the current arrangements, while remaining highly exposed to negative impacts from intensified global mineral competition. A fair benefit-sharing mechanism and the full operationalisation of the Enterprise, the entrepreneurial arm of the ISA, remain key priorities, particularly for developing countries, including African states and Brazil.

Section 3.2 reflects on food security and livelihoods. DSM could potentially threaten fisheries and marine ecosystems' health which directly or indirectly sustain coastal communities, potentially undermining food security. Case studies from Namibia and Papua New Guinea highlight both environmental risks and the role of social mobilisation in resisting mining activities.

Section 3.3 explores social inclusion. Current ISA frameworks insufficiently address gender and Indigenous perspectives. Existing evidence from land-mining contexts shows risks of gender-based violence, exclusion of Indigenous peoples, and lack of Free, Prior and Informed Consent – issues that could potentially be worsened under a scenario where land-mining issues are potentially exacerbated.

Section 3.4 highlights labour conditions and economic vulnerability. DSM is unlikely to resolve labour abuses in land-based-mining economies and potentially aggravate poor working conditions due to increased market competition, while it remains unclear how labour conditions would unfold in an industrial DSM scenario. The Papua New Guinea case illustrates significant financial risks associated with high-cost DSM ventures.

Finally, **Section 3.5** explores justice and power asymmetries. Existing governance structures and weak benefit-sharing mechanisms limit DSM's potential to reduce global inequalities. While capacity-building initiatives are emphasised by developing countries as a pathway to equity, concerns remain about corporate accountability and persistent power imbalances.

The analysis of the case studies demonstrates that commercial DSM is marked by significant uncertainty. Frequently cited socio-economic benefits – such as poverty reduction, improved labour conditions, or reduced pressure on land-mining – are weakly supported by current evidence. Instead, DSM could potentially introduce new economic, geopolitical, social, and governance risks, particularly for developing countries already dependent on mining or marine resources.

Key findings of this report include:

- **In a hypothetical scenario where mineral supply from DSM intensifies global market competition, lowers commodity prices and undermines revenues in land-mining economies, developing countries, especially those highly reliant on mining activities, could potentially experience socio-economic impacts.**

- **Economic pressures arising from a scenario of high competitiveness by DSM could potentially worsen existing social vulnerabilities, including poor labour conditions, gender-based violence, and inequalities affecting women, children, and Indigenous communities.**

- **Based on the literature search and on statements issued by representatives at the ISA, current proposals for a benefit sharing mechanism fall short on compensation expectations and as a potential tool to offset potential losses for developing countries.**

- **Coastal and fishing-dependent communities face risks, as shown in Namibia and Papua New Guinea, where environmental concerns, weak consultation processes, and financial failures have led to strong opposition to local DSM proposals.**

- **Governance challenges within the ISA – including unequal participation, limited transparency, and unresolved mechanisms such as benefit-sharing – undermine the promise of deep-sea mineral resources as the "common heritage of humankind"**

Main recommendations from this study emphasise the need to:

- **Elevate socio-economic impact assessments of DSM to match the attention given to environmental risks.**
- **Strengthen interdisciplinary and participatory research with governments, scientists, civil society, and affected communities – particularly in countries most exposed to DSM-related risks.**
- **Establish dedicated initiatives (e.g., task forces, consultations, stakeholder workshops) to better understand and anticipate impacts across sectors.**
- **Advance institutional reforms within the ISA to improve equity and inclusiveness by facilitating the participation of developing countries, expanding capacity-building programmes, improving gender balance, and integrating traditional knowledge.**
- **Draw lessons from other international frameworks (e.g. the Agreement on the Conservation and Sustainable Use of Marine Biological Diversity of Areas beyond National Jurisdiction or BBNJ) to promote more inclusive and transparent governance practices.**

Overall, given the profound uncertainties and potential for unequal impacts, this study suggests that DSM governance should follow a science-based, precautionary and inclusive approach. Addressing socio-economic risks – especially for vulnerable countries and communities – must become a central priority to ensure that decisions about the deep seabed genuinely serve the collective interests of humankind.

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