

Implementing Economic-Environmental Precautionary Concepts: the Case of Deep Sea Mining

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Abstract

This research develops an evaluation framework for assessing the net-benefits of deep seabed mining. The goal is to support the implementation of the regulatory regime now being developed by the International Seabed Authority (ISA), and policymaking by countries with seabed resources under their coastal jurisdictions. The possibility of deep seabed mining has received increasing interest in the past decade. As of 2016, the International Seabed Authority (ISA) had issued more than 25 exploratory leases in international waters, covering a seabed area roughly the size of Peru (Jaeckel, 2017) and twelve individual Pacific Island countries having issued a total of 300 exploratory leases (World Bank, 2018).

The commercialization/exploitation of seabed mining faces significant challenges, however. Seabed mining methods are being adapted from well-known terrestrial mining technologies, but their operational reliability has yet to be established in marine environments. The costs of these technologies is uncertain, and the difficulty of forecasting future commodity prices makes for uncertainty on the benefit side. These economic uncertainties create financing risks and concerns about the financial stability of mining firms. Until the technology is successfully demonstrated, mineral deposits discovered through exploration cannot be designated as "resource reserves" in mining firms' asset valuations. This creates a second-mover advantage that has slowed the development of the industry.

The potential environmental impacts of seabed mining have also generated significant attention. Relatively little research has been conducted on deep seabed environments, and not much is known about the structure (including extent of biodiversity), function, and ecosystems services in the prospective mining areas (World Bank, 2017; Le et al., 2017). Seabed mining under coastal jurisdictions nearer to shorelines raise concerns about impacts on local environments, economies, and cultures. The most significant step towards commercialization, Solwara 1, off the coast of Papua New Guinea has created significant political opposition. Its operator, Nautilus Minerals, declared bankruptcy in February 2019 and its stock delisted in March, halting the project.

The precautionary principle is the guiding management framework for the ISA when activities on sea beds pose the possibility of "serious harm" to the marine environment (See Levin et al., 2016; Jaeckel, 2017), and the ISA is now finalizing regulations governing exploitation leases (ISA, 2019). The extension of the legal precautionary framework has also been recommended for the regulation of seabed mining in coastal jurisdictions with seabed resources (World Bank 2017).

To implement precautionary principles in the context of deep-sea mining assessments, a menu of potential evaluation frameworks is surveyed which address the varying levels of uncertainty, including "deep uncertainty" with aspects of these projects. From these, hybrid approaches combining benefit-cost analysis and robust decision-making (e.g., Lempert 2014) and elements of sequential decision-making (e.g, as in Gollier and Treich , 2003; Hammitt et al., 1992; and

Mahnovski, 2007) are considered. The framework also incorporates an adaptive environmental management perspective from the ecology literature (e.g., Walters and Holling, 1990). This hybrid framework involves adapting methods designed for climate change to this new substantive area. These are then compared and contrasted with the evaluation undertaken in an EU-sponsored benefit-cost analysis of deep seabed mining (Cardno, 2016; Wakefield and Myers, 2018). Based on this comparison, recommendations are made for the decision-support required for the evaluation of exploitation leases for deep sea mining projects.

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