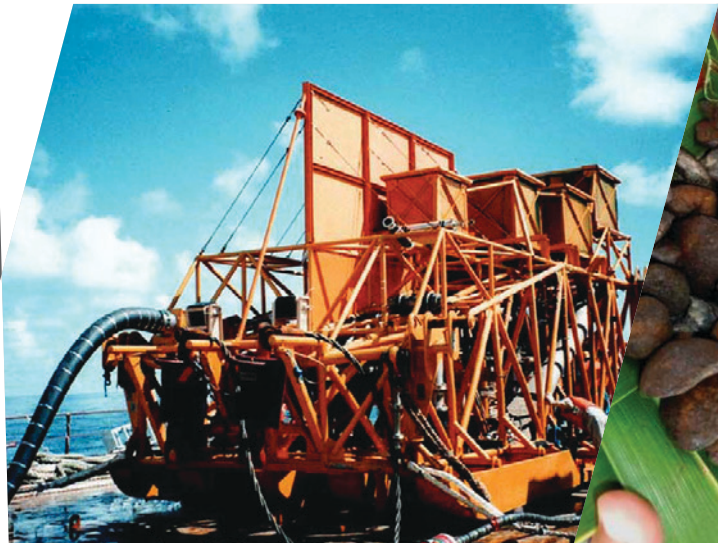
Assessing the Costs and Benefits of Mining Manganese Nodules in the Cook Islands

This analysis provides decision makers with a comprehensive overview of the potential costs and benefits of deep-sea mining from the perspective of Cook Island citizens.



Manganese nodule collector – COMRA

Mineral deposits – Cook Islands Seabed Mineral Authority

Overview

The purpose of this study was to provide a preliminary cost-benefit analysis (CBA) of deep-sea mineral (DSM) mining in the Cook Islands (CI). This process includes cataloguing and assigning monetary values (where possible) to a project's positive (benefits) and negative (costs) impacts. The costs and benefits are assessed from the prospective of citizens of CI and based on the operation of a single mine site. The results of this preliminary analysis will provide decision makers with a better understanding of the magnitude of the costs and benefits likely to be associated with DSM mining in CI.

Mineral Resource

Manganese Nodules (MN) are rock-like minerals that contain manganese and limited amounts of nickel, copper, titanium, cobalt, and rare earth elements. They range in size from as small as a golf ball to as large as a potato, and are found lying loosely on the sediment covered abyssal plains of the world's deep-sea basins at depths ranging from 3,500 to 6,000 metres. While the nodules can be found in many regions of the world's oceans, there are four primary locations with densities high enough for potential commercial extraction, one of which is located in the Penrhyn basin in the Cook Islands.

Mining Scenario

Since commercial DSM mining has yet to commence anywhere in the world, the scenario upon which the costs and benefits are assessed is based on realistic conditions in the Cook Islands from a recently published peer reviewed article in 2015 by James Hein. Using historical data from a series of sampling events, the study provides detailed information on areas with the highest potential for commercial mining based on different combinations of metals with economic interest. To inform the CBA, an area with high nodule density and high concentrations of several metals of interest was selected. Some of the basic characteristics of this site include:

- Total footprint of the mine site (2,705 square kilometres),
- Estimated duration of the mining operation (20 years),
- Total resource potential (50,000,000 dry tonnes), and
- Estimated metal grades for Manganese (Mn), Cobalt (Co), Nickel (Ni), Copper (Cu), Titanium (Ti), and rare earth elements (REE).

Results

The net social benefit (NSB) of the Cook Island mining scenario is calculated as the present value of social benefits minus the present value of social costs, where the monetised social benefits include revenue to the government through royalties and taxes paid by the mining operator, and monetised social costs that include private administrative costs to the government as well as a variety of external costs.

The total monetised social costs represent a small portion of the monetised social benefits, ultimately having very little impact on the overall results.

The external costs include the cost of:

- Replacing lost deep-seabed ecosystems,
- Offsetting carbon dioxide emissions,
- Avoiding the negative impacts of introducing nutrient rich sea water to the surface, and
- Cleaning up and restoring the environment in the event of an unplanned spill or release.

Table 1 reports the mean NSB and benefit-to-cost ratio (BCR) associated with the Cook Island mining scenario with the highest net benefits. These results suggest that the mining activity has the potential to increase the well-being of CI citizens.

Table 1: NSB of CI Mining Scenario - in millions, USD

Category	Present Value
Government revenue	$494
Administrative cost	(-$2.3)
Replacing lost ecosystem services	(-$24.9)
Disposal of nutrient rich water	$0
Offsetting carbon dioxide emissions	$0
Compensating for unplanned spill or release	(-$0.2)
Mean NSB	$467
BCR	18

Policy Implications

The CBA provides decision makers with a comprehensive overview of the potential costs and benefits of DSM mining from the perspective of Cook Island citizens. This includes, to the extent practical, quantification and monetisation of financial, environmental and social impacts. This analysis considered three scenarios: a mining company that sells ore to a processor, a mining company that owns the processing facility, and construction of an on-island processing facility. In a scenario where the miner owns both the mining operation and a four-metal processing facility that recovered Mn, Co, Cu and Ni, there was a reasonable expectation of profits for the mine owner and net social benefit were consistently positive (see results in Table 1). Some general observations that contributed to this outcome include:

- The assumption of regulatory mechanisms designed to transfer potential environmental externalities to the mining company,
- A large supply of minerals that contain high grades of metals with economic value,
- Regulatory frameworks and domestic policy (either existing or in development) to protect against direct environmental damage, and
- Somewhat advanced mining and processing technology, allowing for gains in efficiency and reduced costs.

A Note on Indirect Benefits:

In addition to the CBA, a regional economic impact analysis (REIA) was performed to assess how the DSM mining operation would affect the Cook Island's regional economy. The results indicate that the direct mining operations and expenditures for goods and services procured by the mine will support a total of 147 new jobs. It is also estimated that income to local workers, income throughout the country from operational expenditures and household spending throughout the country will generate a total of $3.4 million (2014 USD) in annual income from DSM mining operations in the Cook Islands.