Precautionary Management of Deep Sea Mining Potential in Pacific Island Countries

Pacific Possible

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Pacific Island countries face unique development challenges. They are far away from major markets, often with small populations spread across many islands and vast distances, and are at the forefront of climate change and its impacts. Because of this, much research has focused on the challenges and constraints faced by Pacific Island countries, and finding ways to respond to these.

This paper is one part of the Pacific Possible series, which takes a positive focus, looking at genuinely transformative opportunities that exist for Pacific Island countries over the next 25 years and identifies the region's biggest challenges that require urgent action.

Realizing these opportunities will often require collaboration not only between Pacific Island Governments, but also with neighbouring countries on the Pacific Rim. The findings presented in Pacific Possible will provide governments and policy-makers with specific insights into what each area could mean for the economy, for employment, for government income and spending.

To learn more, visit **www.worldbank.org/PacificPossible,** or join the conversation online with the hashtag #PacificPossible.

Acknowledgements

Contents

Tables

Figures

Maps

Boxes

Abbreviations / Glossary

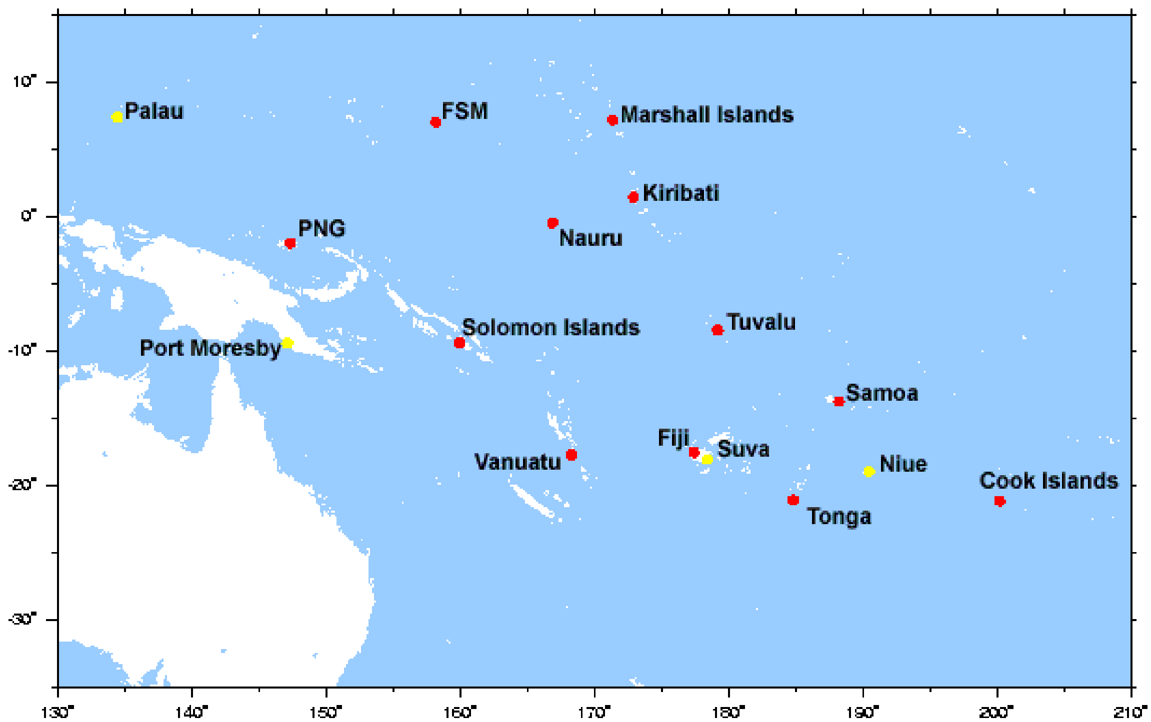
'the Area'	The seafloor beyond national jurisdiction, managed by the ISA
CCFZ	Clarion Clipperton Fracture Zone, nodule-rich stretch of seabed in 'the Area', the site of most ISA contractor interest
COMRA	China Ocean Mineral Resources Research and Development Association
CRC	Cobalt-rich crusts, one of the three types of DSM deposits of current commercial interest
DSM	Deep sea minerals (namely minerals found within: CRC, nodules, or SMS)
DSMM	Deep sea mineral mining
EEZ	Exclusive Economic Zone, a State's marine area of national jurisdiction, where the State holds sovereign rights over the resources
EU	European Union
FSM	Federated States of Micronesia
GSR	
ISA	International Seabed Authority
NM	Nautical mile (=1.852 kilometers)
Nautilus	Nautilus Minerals Inc. (Canadian publicly-listed DSM exploration company)
Nodules	Manganese or polymetallic nodules, one of the three types of DSM deposits of current commercial interest
PIC	Pacific Island country
PNG	Papua New Guinea
REE	Rare earth element
RMI	Republic of Marshall Islands
SMS	Seafloor massive sulphides, one of the three types of DSM deposits of current commercial interest
SPC	Secretariat of the Pacific Community, regional intergovernmental technical assistance agency, hosting the EU-funded DSM Project
UNCLOS	The 1982 United Nations Convention on the Law of the Sea (in force from 1994), to which all Pacific Island countries are signatory

Executive Summary

Introduction

Since the early 1970s, exploration of the deeper sea floor has produced indications of wide-spread metallic mineral commodities, spread across large sections of the Pacific region in association with the "ring of fire" tectonic plates. Similar resource potential has also been indicated for offshore eastern African countries, in South Asia along the eastern Indian continent; in the Atlantic Ocean; and even western continental North America. What has emerged is a proposed set of mining extraction operations that represent a very new type of industry, characterized as Deep Sea Minerals Mining (DSMM) by virtue of the great depths at which these minerals occur. By definition, Deep Sea Minerals (DSM) occur in the deeper-water (400 – 6,000 meters) where minerals are deposited by natural processes as iron-manganese (or ferromanganese) nodules and crusts, massive sulfide, phosphates, and metalliferous sediments.

Map 1: Pacific Island Countries (PICs)



While DSM has been pursued to varying degree over the last few decades, the 2005 – 2013 commodity super-cycle catalyzed new interest by financiers and mining companies to back ventures, and this has helped advance the application of (pre-) commercial-scale technologies. High metallic concentrations within these deposits have led to strong investor interest within the private and public sectors. In response to suggestions of large potential revenue streams, many nations have granted exploration permits even as regulatory and institutional capacities remain weak and environmental and social impacts are still yet to be fully understood. There are material information gaps, for which economic, environmental and social impacts remain uncertain and that carry an element of risk into these development schemes. This report signals a need for governments to prepare for what seems to be the inevitable arrival of seabed mining. Whether any one government would go forward with DSM should perhaps be predicated upon having (a) a better and upfront understanding of possible ecological impacts, for example, impacts to highly sensitive ecological areas such as fish spawning grounds, up front so as to avoid catastrophic ecosystem damage; (b) ensuring good sector governance through strengthening of laws and policies, administrative capacities, revenues management and accountability of decision makers; and (c) introducing and implementing effective environmental safeguards. That stakeholders are concerned that impacts on livelihoods and marine biodiversity should not overwhelm any potential economic benefits, is a required precautionary approach.

That DSM has unknown associated risks is a source of concern. Large-scale mining on land has a long and mixed history of contributing towards positive development outcomes, and resource-rich and/or resource-dependent nations have struggled to leverage natural resource development towards broader economic diversification and sustained growth. Resource development undertaken today will impact a nation for generations to come, and the need for good sector governance, strong institutions and highly skilled professionals to develop and implement sound policies, laws and regulatory oversight is paramount to deriving lasting benefits.

While there is a common understanding that Pacific Island Countries are facing DSM exploration and production decisions today; clearly, there are still a number of uncertainties in the process. The Bank is not taking a position on DSM, but rather recognizes that a comprehensive stock-taking of the issues will inform Pacific Island Countries (PICs) of the information gaps that need to be addressed for informed decisions, and institutional and professional capacities that must be built to ensure sustainable outcomes. In assisting governments with land-based mining, the World Bank undertakes sector governance assessments to: (a) ensure appropriate and adequate content of policies, laws and regulations to manage the varied demands and impacts associated with the sector, (b) create the capacity for effective development, implementation, monitoring and enforcement of rules that ensure effective monitoring and enforcement of policies, laws and regulations; and (c) clarify roles and responsibilities of decision-makers to ensure accountability through transparent and non-discretionary processes that are inclusive of a broad set of stakeholder views and reinforced by codes of acceptable conduct.

While there have been qualitative descriptors of DSM potential, quantitative estimates of the potential, *in-situ* resource value remain restricted to just 2-3 prospect areas that have advanced to the feasibility stage. Pacific Island governments face a complex array of technical challenges. Appropriate fiscal regimes to deliver equitable Government 'take', steps to manage those funds sustainably, and the full economic impact of DSM are untested. Core to understanding this potential (financial and economic) is to have sound estimates of the *in-situ* value of these deposits, some estimates of the capital and operating costs for production, and full payment of taxes and royalties, factoring in the cost of meeting the full contractual and regulatory compliance necessary to keep a license holding in good standing. As is the case for environmental / social impacts, the appropriate fiscal regime and economic benefit to DSM is not clearly understood.

Many foundational actions and analyses have begun. The Secretariat of the Pacific Community (SPC), with support from the European Union, has mobilized leading specialists to prepare draft policies and laws, model frameworks to guide economic, environmental and social performance, regulations to improve contractual and regulatory compliance, and assessment of institutional needs. Workshops, public consultations, learning events, and other stakeholder input processes have been undertaken. And estimates of cost-benefit have begun using indicative costs and assumed fiscal regimes. In all, what has been accomplished by the SPC is commendable, given the multitude of challenges, diversity of views on DSM, and geography encompassed by sector activity. The Commonwealth Secretariat has provided legal and economic policy advice, including support for the development of the Cook Islands Seabed Minerals Act 2009 which has served as a benchmark for other states. The International Monetary Fund, through its regional Pacific Financial Technical Assistance Centre has provided assistance to Tonga and Cook Islands on (i) developing a fiscal policy for raising DSM revenue, and (ii) drafting relevant taxation and royalty regime laws.

The above activities needed to be undertaken given some common characteristics of Pacific Island Countries which includes *inter alia*: (a) significant capacity deficiency on collection and dissemination of geological data and mineral resource information; (b) DSM national policies and laws that vary to some extent from one nation to the next and remain largely untested; (c) fiscal frameworks for DSM that are either direct extensions or derivatives of terrestrial mining frameworks, whose risk profiles and underlying assumptions are materially different, (d) weak understanding of the appropriate environmental framework given the deep marine environment, (e) near total neglect of the social policies necessary for DSM to ensure adequate and commensurate benefit sharing, and (f) institutional weakness across licensing, regulatory compliance monitoring, and revenues management. Most importantly, the majority of nations for which DSM is a potential industry have no previous experience in overseeing large-scale terrestrial mining sector activities.

Under these circumstances there is need for caution, giving special attention to protecting the marine environment and the people who value it. A sound precautionary approach, which does not preclude the option of ‘no development’ is needed to avoid or minimize temporary or lasting harm to the environment, to the people and to the economy. This forms the starting point for this document -- application of the Precautionary Principle for DSM, and the gaps that currently exist that could impede informed decision making.

Background

What is Deep Sea Mining?

There is some confusion as to what actually constitutes ‘deep sea mining’ and a variety of definitions exist according to which the cut offs between ‘near shore mining’ and ‘deep sea mining’ are set at different depths. Those different definitions are typically shaped by:

- Whether specialized equipment is required due to the pressures that are encountered at depth, or whether more conventional technology (i.e. dredging) can be used;
- Whether it is occurring at a depth at which sunlight is still present (the photic zone) and the kind of corals, fish and other sea life that exist at different depths;
- Whether it is likely to interact with other resource uses such as commercial fishing.

These factors are variable and imprecise – sunlight penetration is heavily influenced by the turbidity of the water; different countries have different limits and practices around bottom trawling fishing; some marine mammals can range from the surface to more than 2000m of depth in their diving. Near shore mining already exists and typically focuses on sand, gravel, coral, alluvial precious metals and stones and normally uses trailing suction dredge technology. This is commonly used to extract building materials and as part of land reclamation projects. Near shore precious stone mining includes operations such as De Beers Marine’s diamond mining off the coast of Namibia. There are also some examples of near shore mineral sands (e.g. iron sands) operations.

Maritime Zones and the Jurisdictional Limits of DSM Activities

Deep sea mineral deposits occur in various Maritime Zones. Maritime Zones are defined and described the United Nations Convention on the Law of the Sea (UNCLOS). UNCLOS is the primary legal instrument for the governance of the world's oceans and seas. It sets out the rules governing all uses of the oceans and their resources. Maritime Zones are described in Articles 1, 3, 33, 55, 57, 76, and 86. Information in these provisions are summarized below.

Baselines

In order for States to determine and measure the maritime zones applicable to their territories, States start by determining their baselines. As specified in Article 14, a coastal State may determine its baselines in accordance with any of the methods mentioned in Articles 7-13 of UNCLOS. Once a coastal State has determined its baselines, it must make those baselines publicly known in charts or lists of geographical coordinates and deposit a copy of each such chart or list with the Secretary-General of the United Nations, in terms of Article 16(2).

Territorial Sea

As stated in Article 3 of UNCLOS, the breadth of a coastal State’s territorial sea is up to a limit not exceeding 12 nautical miles, measured from its baselines.

Contiguous Zone

The contiguous zone is the area ‘contiguous’ to the costal State’s territorial sea, which may not extend beyond 24 nautical miles from the baselines from which the breadth of the territorial sea is measured, according to Article 33 of the UNCLOS.

Exclusive Economic Zone

The **Exclusive Economic Zone (EEZ)** is an area beyond and adjacent to the territorial sea, which in addition shall not extend beyond 200 nautical miles from the baselines from which the breadth of the territorial sea is measured.

Continental Shelf

According to the Commission on the Limits of the Continental Shelf (CLCS), the **Continental Shelf** of a coastal State comprises the submerged prolongation of the land territory of the coastal State - the seabed and subsoil of the submarine areas that extend beyond the coastal State’s territorial sea to the outer edge of the continental margin, or to a distance of 200 nautical miles where the outer edge of the continental margin does not extend up to that distance. The continental margin consists of the seabed and subsoil of the shelf, the slope and the rise. It does not include the deep ocean floor with its oceanic ridges or the subsoil thereof.

The “Area”

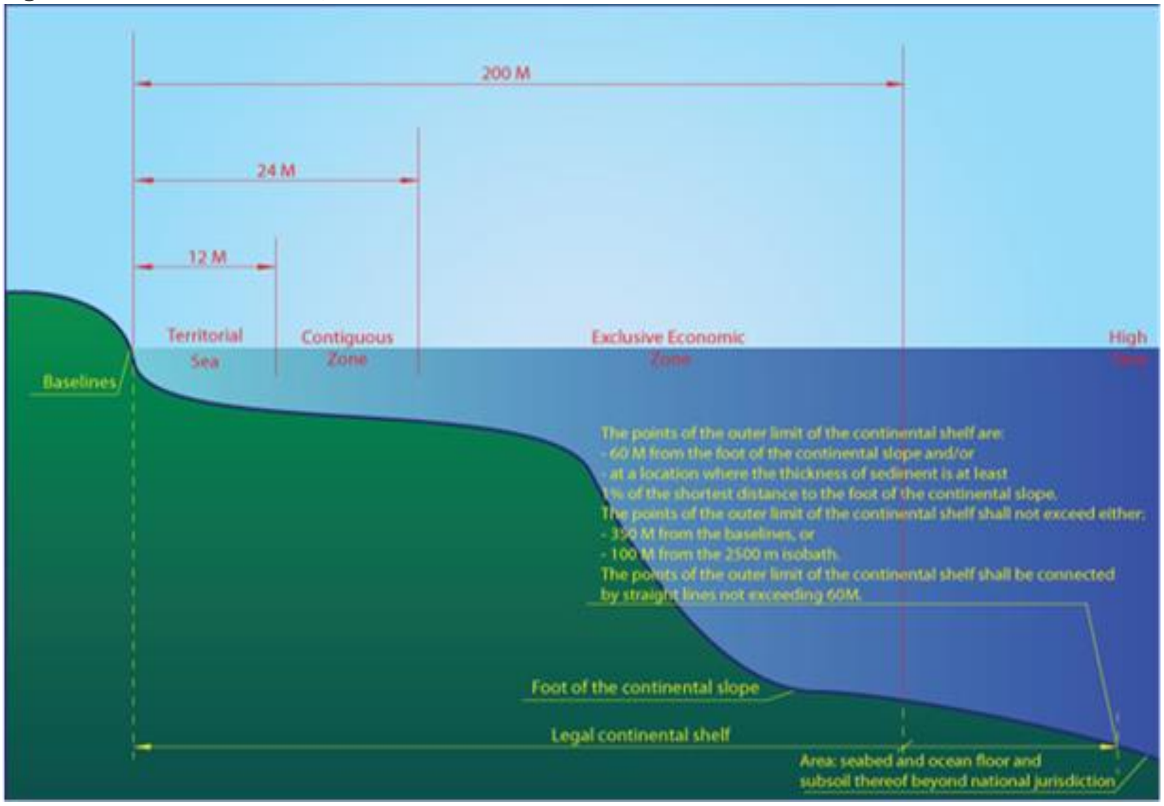
The **“Area”** is defined in Article 1 of UNCLOS as the seabed and ocean floor and subsoil thereof, beyond the limits of national jurisdiction. The Area and its resources are the “common heritage of mankind” as stated in Article 136. of UNCLOS. All rights in the resources of the Area are vested in “mankind as a whole. It is the International Seabed Authority (ISA) which is authorized to act on behalf of mankind in respect of the Area.

The total area of EEZs controlled by Pacific Island Countries and Territories is 27.8 million km^2 (compared with a land area of about 531,000 km^2 - a ratio of 52:1.) (Map 2). Additionally, the area of ECS represents an additional 2.0 million km^2, over which coastal states exercise jurisdictional rights over mineral resources.

States may also sponsor DSM exploration and exploitation activities in the Area. [1]

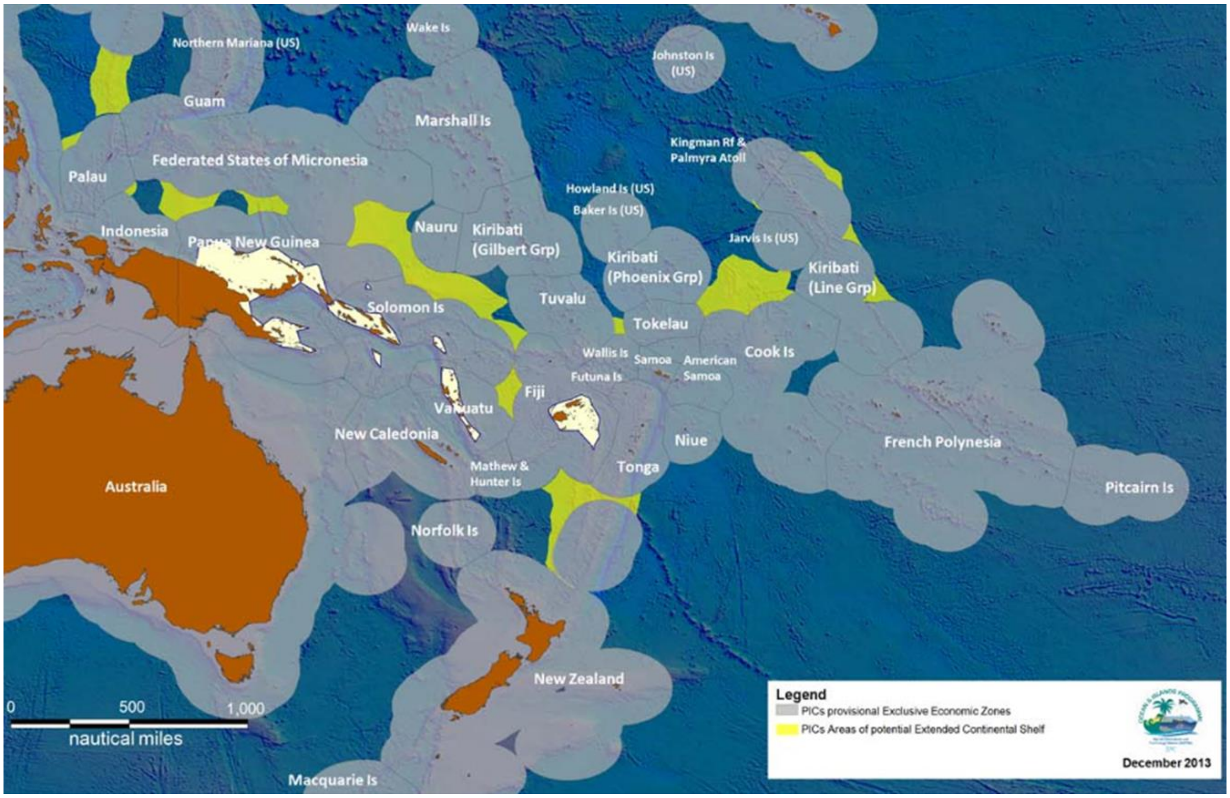
[1] The Cook Islands, Kiribati, Tonga, and Nauru all act as sponsor states for exploration permits in the Clarion Clipperton Fracture Zone (CCFZ). For more information see https://www.isa.org.jm/

Figure 1. Continental shelf / EEZ vs The Area



(Source - Commission on the Limits of the Continental Shelf
http://www.un.org/depts/los/clcs_new/marinezones.jpg)

Map 2. EEZ of Pacific Island Countries and Territories



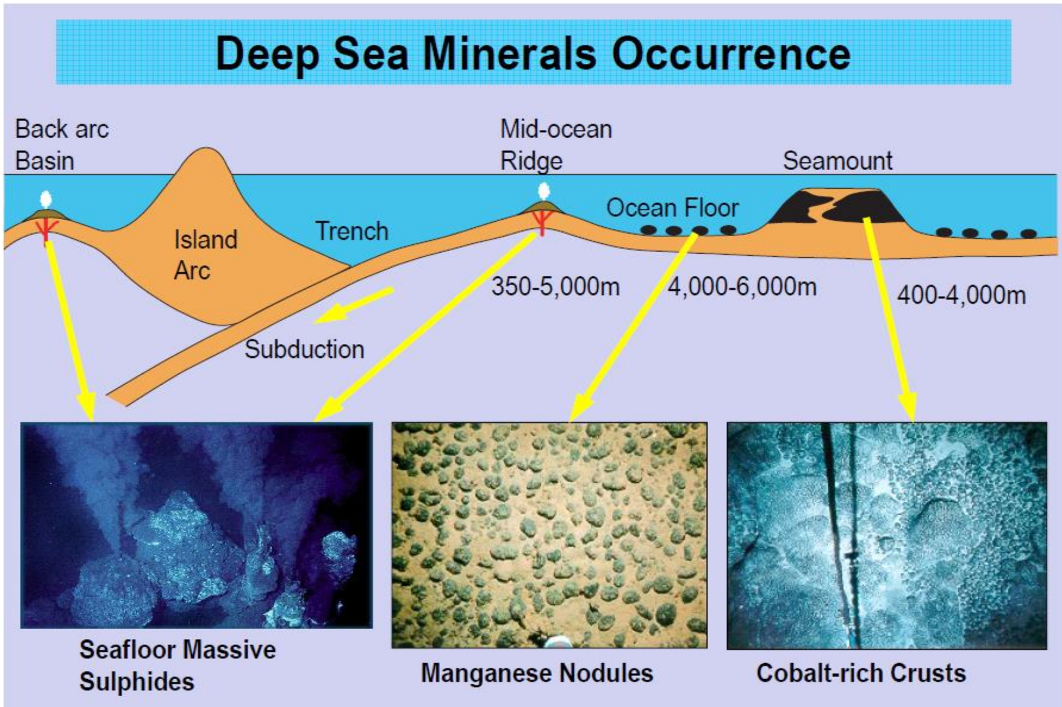
Deep Sea Mineral Deposits in the Pacific Island EEZs

To date, three main kinds of deep sea mineral deposit types have been identified within the national jurisdiction of several Pacific island countries:

- **Hydro-thermal vents** – both active as well as inactive volcanic vents on the seafloor which precipitate out concentrated minerals, including copper, iron, zinc, silver, and gold. Also known as Seafloor Massive Sulphides (SMS), this is resource under development in Nautilus Mineral's Solwara-1 project in Papua New Guinea (PNG - see below). The PICs known to have SMS occurrences are Fiji, PNG, the Solomon Islands, Tonga and Vanuatu.
- **Polymetallic Manganese nodules** – often occurring at great depths (4,000 – 6,000m), these nodules can contain a mix of cobalt, copper, iron, lead, manganese, nickel and zinc. These are the kind of resources prospected for in the Clarion Clipper Fracture Zone (CCFZ) and they are known to occur in the waters of the Cook Islands and Kiribati, and to a lesser extent in Niue and Tuvalu.
- **Cobalt manganese crusts** – which can contain other minerals including precious metals (platinum) and Rare Earth Elements (REE). They are found in a range of 400-4,000m of depth and are known to occur in Kiribati, The Marshall Islands, the Federated States of Micronesia, Niue, Palau, Samoa and Tuvalu.

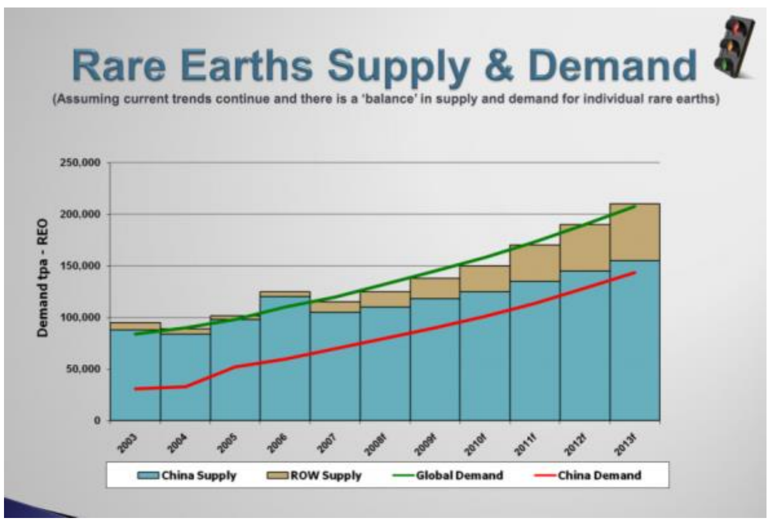
- **Phosphorite nodules** – typically found at between 200-400m of depth, sitting between the near shore resources and the deep sea resources described above (Figure 2).

Figure 2. Deep Sea Minerals Occurrence



DSM: the new frontier for Rare Earth Elements?

One important attraction of DSM deposits is the higher grade compared to equivalent land deposits which translates into a higher value per ton of ore produced. In addition, another important aspect that gives the rationale for DSM exploration/exploitation some more nuance is that these deposits are polymetallic and contain Rare Earth Elements (REEs). REEs are considered strategic minerals and an important component in new technologies, especially within the clean energy, military, and consumer electronics sectors. As these sectors continue to grow and diversify so will the demand for REEs however, despite this growing demand, there is a lack of security in the supply chain. In 2011, over 95% of global REE supply originated from China. China is also has the largest demand for REEs, at 65% of total. The US is the next largest consumer, at 15% of total demand. Reduction in exports from China in 2010 created large instability in the REEs market which led other countries to look for alternative sources (Hatch, 2012). As REEs occur with other minerals reserves are either in small or low-concentration deposits. This makes specific mining for REEs challenging with the number of readily mineable REE deposits small increasing the attractiveness of DSM and its strategic relevance even more accentuated.



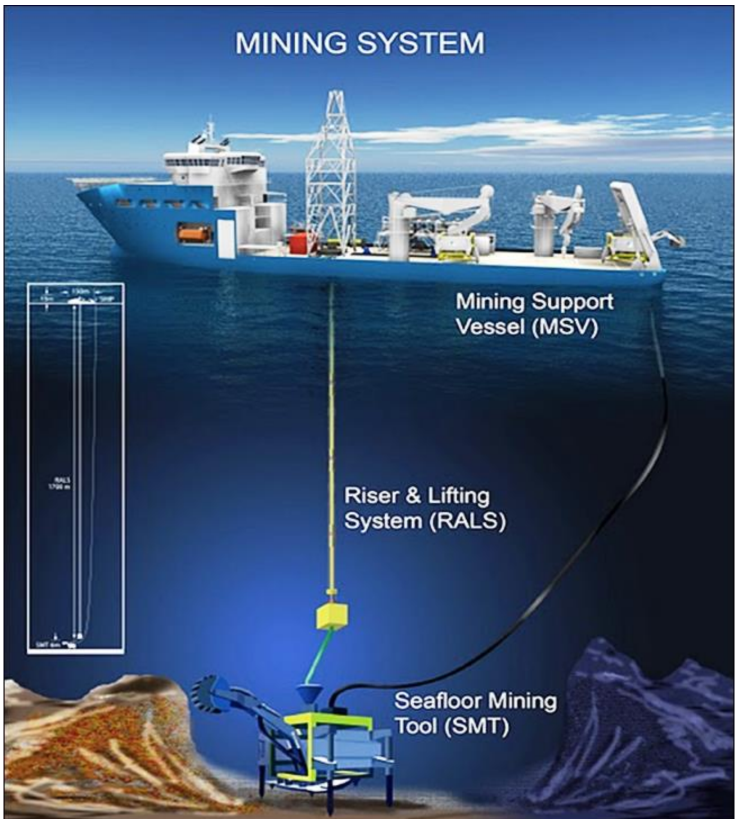
Source: Global Commodities 2015

Rare earth elements have several industrial uses worldwide but are primarily used in the electronics and electrical fields such as rechargeable batteries, computer memory, cell phones, DVDs, magnets, car catalytic converters, fluorescent lighting, and several other instruments. The worldwide demand for these electronic devices and instruments has quadrupled and will continue to grow. Additional supplies of REEs will be needed to meet this demands. There are several industries such as petroleum refining, glass polishing, chemical catalysts, metallurgy, catalytic converters, permanent magnets production, television and monitors, etc. where these rare earth elements are also needed in abundance. REEs are essential for manufacturing rechargeable which are used to power up several electrical and electronic devices, digital cameras, computers, laptops, hybrid vehicles and electric vehicles.

Source: SPC

DSM Technology

While DSM has been actively pursued since the 1970's to varying degrees, the 2008 – 2013 commodity super-cycle catalyzed new interest by financiers and mining companies to back ventures, and this has advanced application of (pre-) commercial-scale technologies. As such, technological breakthroughs towards commercial DSM should be expected; most likely in the waters of Papua New Guinea, Tonga, Solomon Islands, Fiji, Vanuatu, New Zealand and Japan. Governments, principally Russia, China, Korea, India, Japan, are also supporting detailed geodetic/geological surveys to assess mineral resource endowment, seeking to understand the commercial viability of these resources viz. ongoing investor interest and current supply and demand trends. These programs will yield a first descriptor of the inventory of potentially recoverable minerals using current technologies and prevailing prices (the gross value, in-situ).



Mining System

The technology for extraction varies somewhat from project to project, depending on a variety of deposit and seafloor characteristics. Some projects propose to use submersible suction dragged and positioned by surface ships; others propose to use seabed 'crawlers' (i.e. that could move themselves rather than be positioned only by the ship) that would suction up the material on the seabed, or cut through and grind material on the seabed to then be transported to the surface though a separate suction system or crawler.

Deep sea engineering is of course not a new or unknown technology - dredging, marine cable laying and the offshore oil industry have all worked on various technologies that feed into the technology that is proposed for seabed mining, and indeed a number of companies in this area (e.g. Boskalis, Royal IHC, KIOST, JOGMEC) are investigating and have interests in seabed mining ventures. It should be noted, however, that the process of DSM has been estimated by various specialists to have widely varying environmental impacts, including in some cases irreversible damage to the marine ecosystem as detailed in SPC (2015) and summarized in Annex3. DSMM is of a completely different nature, magnitude and severity than any other deep sea engineering activities carried out so far.

Drivers of Deep Sea Mining

Factors that make seabed mining unique and which are driving investment and interest in these areas are:

- The long-term decline of the grade of many onshore minerals compared to relatively untouched and high-grade seabed deposits.
- Lack of fixed capital and infrastructure: while much of the capital cost in accessing terrestrial mines is fixed in the form of roads, trenches, pits and drives (tunnels) to access resources; the capital investment in seabed mining is mobile, with the primary advantages being that it can be removed in advance of extreme natural events; should a project encounter political or social barriers or disruptions; or when a resource is exhausted.
- Terrestrial mines are increasingly constrained by proximity to settlements and communities as well as areas with high environmental values.
- The ability to ship mined materials directly to markets can obviate the need for expensive infrastructure development such as roads, railways and export ports that is often a major cost in terrestrial mining.
- Average mine life for Solwara 1 is expected to be around 2-3 years, very different from the longer term terrestrial mine lives which often exceed 35 years. However, if a series of deposits are mined sequentially the overall "mine life" could be long.
- There is a significant likelihood that the environmental externalities that derive from DSM can remain undetected in the short run (across the short anticipated mine lives), or that their impacts will be felt further afield, and may not be immediately identified as resulting from DSM.[2]

[2] An example for long-term impacts relates to the destruction of the meiofauna as a result of the trawling/scraping of the seafloor for manganese nodules harvesting. Meiofauna, which lives in the first 10 cm of the substrata plays a key role in the food chain, so the impact of its destruction in the mining area would have long term effects on other elements of the ecosystem, following complex ecological processes. An example for distant impacts relates to plumes and other related physical impacts, the particles are

One important attraction of DSM deposits is the higher grade compared to equivalent land deposits which translates into a higher value per ton of ore produced. One ton of land based ore is worth around US$50-180 whereas the typical value of a ton of SMS is around US$500-1,500. Another important aspect that gives the rationale for DSM exploration/exploitation some more nuance is that these deposits are polymetallic and contain Rare Earth Elements (REEs). REEs are considered strategic minerals and an important component in new technologies, especially within the clean energy, military, and consumer electronics sectors. As these sectors continue to grow and diversify so will the demand for REEs. Nonetheless, despite this growing demand, there is a lack of security in the supply chain. In 2011, over 95% of global REE supply originated from China. China also has the largest demand for REEs, at 65% of the total. The US is the next largest consumer, at 15% of total demand. A reduction in exports from China in 2010 created large instability in the REEs market which led other countries to look for alternative sources (Hatch, 2012). As REEs occur with other minerals, reserves are either in small or low-concentration deposits. This makes specific mining for REEs challenging, thereby increasing the attractiveness of DSM and its strategic relevance.

Box 1. Deep Sea Mining Cycle: from Prospecting to Exploitation

Prospecting -- the search for DSM deposits within designated license and/or national areas including estimation of the composition, size and distribution of deposits and their economic values, without any exclusive rights.

Exploration -- searching for and measurement (grade and tonnage) of deposits of DSM (either in the Area or within national jurisdictions) with exclusive rights; and the analysis of such deposits, the use and testing of recovery systems and equipment, processing facilities and transportation systems, and the carrying out of studies for the environmental, social, technical, economic, commercial and other appropriate factors that must be taken into account in exploitation.

Exploitation- the recovery for commercial purposes of DSM from the seabed (either in the Area or within national jurisdiction), and the extraction of minerals, including the construction and operation of mining, processing and transportation systems, for the production and marketing of minerals, intermediate processed products or metals.

Ongoing and Proposed DSM Projects in the Pacific Islands

As detailed in Table 1 below, Fiji, Papua New Guinea, the Solomon Islands, Tonga and Vanuatu have granted DSM exploration permits. The Cook Islands are currently in the middle of a seabed minerals exploration tender process with the tender closing in January 2016.[3] While vast areas are either under application or permit, it is less certain how much active exploration is actually taking

going to be carried on currents over vast distances, so the impacts will not be observable in the vicinity of the mining, but further downfield, and sometimes over considerable distances..

[3] http://www.seabedmineralsauthority.gov.ck/Cook-Islands-Seabed-Minerals-Tender-2015

place in many of these areas.[4] PNG is the only country to have granted a license to mine so far, for the Solwara 1 Project.

Table 1. DSM Engagement by country

Country	DSM Engagement
Cook Islands	Abundant manganese nodule occurrence, with high cobalt content, has been identified within the Cook islands EEZ. There is strong political will to attract DSM investment, and an international invitation to tender for exploration in the EEZ is planned for 2015. Cook Islands lodged an application with the ISA in December 2013, for an exploration contract for nodules in 'the Area', in partnership with GSR.
Federated States of Micronesia	FSM's EEZ is considered to have CRC potential, and some indicators of possible SMS deposits. FSM has had initial discussions with an exploration company interested in SMS (but the Government is unable to issue licences within the EEZ until relevant laws are enacted). There is strong political will to attract DSM investment, to cover budget shortfalls anticipated by the end of US compact in 2023.
Fiji	Hydrothermal vents with SMS potential have been identified in Fiji's EEZ (both in the Lau and North Fiji Basin areas). Exploration licences have been issued by the Government within Fiji`s EEZ to KIOST and Nautilus. Fiji has also expressed interest in sponsoring activity in 'the Area', and has met with Lockheed in that regard.
Kiribati	The largest EEZ in the region, with nodule and CRC potential. No DSM licences yet issued in the EEZ. A Kiribati State company, 'Marawa Research and Exploration Ltd' holds an ISA contract for nodule exploration in the CCFZ. DeepGreen prepared and funded Kiribati's application in return for an off-take agreement. The EEZ borders the nodule-rich CCFZ – in 'the Area', currently the subject of 12 ISA exploration contracts. (Raising a possible opportunity for Kiribati to offer 'local services' e.g. refueling and other supplies for vessels.)
Marshall Islands	Seamounts in the western part of RMI's EEZ have significant CRC potential. Japan, Russia and China have recently taken ISA exploration contracts for CRC in sites close to RMI's and FSM's EEZ. RMI has not been approached by any DSM companies, and has not issued any DSM licences.
Nauru	No data has been collected on the potential of seabed minerals within Nauru's EEZ. A local company, Nauru Offshore Resources Inc (NORI) holds an ISA contract for nodule exploration in the CCFZ. DeepGreen prepared and funded the application in return for an offtake agreement, and sits on the Board of Directors.
Niue	Surveys of Niue's EEZ suggest little promise of nodule potential but more encouraging CRC potential. Further surveys are required for better assessment.
Palau	Surveys confirm the occurrence of CRC and phosphate, as well as indications of SMS. Nodule potential is also possible. Further surveys are required for better assessment. In 2013 the President proposed that the entire EEZ should be a 'no-take' marine protected area.
Papua New Guinea	PNG's EEZ contains SMS with high-grade copper, gold and silver. In January 2011 PNG granted a world-first lease to Nautilus[5] to carry out DSM mining within its EEZ: the

[4] Indeed, given the current difficulties that publicly listed mining companies are having at raising funds – especially for exploration activities – the general trend for many companies is to sit on applications and permits for as long as possible without actually carrying out exploration activity.

[5] Nautilus Minerals is by far and away the dominant commercial player in seabed minerals exploration and development in the South Pacific, holding approximately 423,000km2 of exploration tenements (either under application or awarded) in Fiji, New Zealand, PNG, the Solomon Islands, Tonga and Vanuatu, as well as in the CCFZ via its subsidiary Tonga Offshore Mining Limited. Active exploration, however, appears to be currently limited to PNG and the Solomon Islands. It is also the company closest to the development of a

Country	**DSM Engagement**
	Solwara 1 Project in the Bismarck Sea. Although a dispute with Government and challenges in raising capital had stalled Nautilus' progress, mining is now slated to commence in 2018. The SPC Cost-Benefit Analysis (CBA) report estimates raising US$80m from one DSM project from taxes and royalties. A number of SMS deposits in the Nautilus licence area in PNG are expected to be further assessed and ready to be mined by 2020. There is some community-level and political opposition.
Samoa	Samoa's EEZ is small, prospecting to date has not discovered promising nodule deposits, and the EEZ's geologically-young seamounts do not suggest positive CRC potential. Samoa has expressed interest in DSM activities in 'the Area', and held discussions in 2013 with COMRA.
Solomon Islands	EEZ contains significant SMS deposits. Ninety DSM exploration licenses issued by the Government to Nautilus and Neptune. Exploration activities are ongoing. Applications for DSM mining from Neptune Minerals were received by Government in late 2013.
Tonga	EEZ contains significant SMS deposits (in the Lau Basin). Granted licenses for exploration within its EEZ to three companies (Nautilus, KIOST and Neptune), whose findings are commercially attractive. 2011 Government sponsored a Nautilus subsidiary (Tonga Offshore Minerals Ltd) to obtain an exploration contract to explore the CCFZ in 'the Area' for nodules
Tuvalu	Prospecting results show nodules and CRC, but lower abundance and grade than in other PICs' EEZs. Expressed interest in sponsoring DSM activity in 'the Area', and has met with one DSM company.
Vanuatu	EEZ contains SMS deposits. More than 150 DSM exploration licenses have been granted within the EEZ to Nautilus and Neptune.

producing deep sea mine with its Solwara-1 project in Papua New Guinea. Nautilus Mineral is publicly listed on the Toronto Stock Exchange (TSX), its three largest shareholders are MB Holdings (Oman), Metalloinvest Holding Limited (Cyprus), and Anglo-American PLC.
See http://www.nautilusminerals.com/IRM/content/default.aspx

Chapter 1. Some Knowns but Many Unknowns about DSM

Deep Seabed Resource Potential at a Glance

Core to understanding the economic potential of DSM is to first determine the in-situ value of minerals given the technologies available to exploit them, second to deduct from the in-situ value of minerals the capital and operating costs and risk-adjusted private returns associated with investing in the location, appraisal and exploitation of DSM deposits and third consider how any costs attributable to social and environmental impacts are treated, for purposes of weighing the net private and public benefits of DSM, taking into account the public cost of environmental impacts.

A high level of uncertainty is connected with each of the three factors highlighted above and the regulatory mechanisms through which risks are allocated among private and public actors are far from fully developed. Having said that, it must be recognized that a number of PICs either have developed or are in the process of developing robust policy, legislation or both in place with the assistance of the SPC-EU DSM Project and other partners. Any assessment of the overall cost/benefit of proceeding with DSM, therefore, faces a set of challenges that is perhaps an order of magnitude greater than typically encountered in the case of terrestrial mining.

To date there have been rather few comprehensive evaluations of the cost/benefit of DSM mining, other than those contained in project specific submissions by project sponsors to regulators and financial institutions. Recently, a study has been completed on behalf of the SPC, which undertook a cost/benefit assessment of a hypothetical mining operation for each of the three main deposit types found in the Pacific in deep water.

Seafloor Massive Sulphide Resources (SMS)

Based on current knowledge, out of the more than 200 sites of hydrothermal mineralization currently known, only about 10 deposits are currently considered likely to have sufficient size and grade to be of commercial interest for DSM mining. SMS deposit areas are small (e.g. generally between 0.1 and 10 hectares of seafloor surface area), but made viable through the high concentration of metals (clusters of richly mineralized chimneys).

Table 2. Seafloor Massive Sulphide Resources

	PNG	**Fiji**	**Solomon Is**	**Vanuatu**	**Tonga**
Stage of Definition	Advanced Exploration	Early Exploration	Early Exploration	Early Exploration	Early Exploration
Earliest Commerciality	2020s	2030s	2030s	2030s	2020s-2030s
Deposit Value pa	$19.2 million				

5 x deposit[6]	$72 million				
GDP 2013/14	$16,900 million	$4,500 million	$1,200 million	$800 million	$400 million

Notes:

Stage of Definition: Prospecting results in identification of occurrences of target deposits: Early exploration leads to identification of potentially commercial deposits from among occurrences. Advanced exploration establishes size, grade and mineability of specific deposits.

Earliest commerciality: Classified by likely decade in which first commercial projects will take place with duration of exploration, technology and markets being principal drivers.

Deposit Value pa: The estimate of value addition per annum associated with a single specific hypothetical mine – in the case of SMS this is Solwara 1 in PNG, in the case of manganese nodules this is a hypothetical mine operated in the richest known and measured nodule zone. Estimates are from Cardno (2015).

5 x deposit: Five times the Deposit Value pa * 75% to reflect that the first deposit mined is probably the highest value (however this rule may not hold true as exploration knowledge and technology advances)

GDP 2013/14: Current USD GDP according to World Bank (2014), UN or national sources – rounded to the nearest US$100 million

Manganese Nodule Resources

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: (1) the Clarion Clipperton Zone, (2) the Peru basin, (3) the Penrhyn basin in the Cook Islands, and (4) the Indian Ocean. With respect to density, the commonly accepted cut-off in nodule density for commercial mining is approximately 5 kg/m^2. While highly variable, nodule density within the Cook Islands EEZ ranges from 5 kg/ m^2 to more than 50kg /m^2.

Table 3. Manganese Nodule Resources

	Cook Islands	**Kiribati**	**Niue**	**Tuvalu**
Stage of Definition	Early Exploration	Prospecting	Prospecting	Prospecting
Earliest Commerciality	2030s	N/A	N/A	N/A
Deposit Value pa	$43 million			
5 x deposit	$161 million			
GDP 2013/14	$330 million	$200 million	<$100 million	<$100 million

Cobalt Rich Crust Resources (CRC)

While the crusts cover approximately 2% of the ocean floor, the Central Pacific region, particularly the EEZs around Johnston Island, Hawaii, RMI, the Federated States of Micronesia, and international waters in the mid-Pacific offer the greatest potential for crust mining because of their thickness, exposure and metal grades.

[6] This estimate reflects a 25-year window going forward. It is a reasonable estimate given the number of prospective areas within the blocks under investigation; but would be subject to compliance with the precautionary principle.

Table 4. Cobalt Rich Crust Resources

	Marshall Islands	**FSM**	**Palau**	**Kiribati**	**Tuvalu**
Stage of Definition	Early Exploration	Prospecting	Prospecting	Prospecting	Prospecting
Earliest Commerciality	2040s	N/A	N/A	N/A	N/A
Deposit Value pa					
5 x deposit					
GDP 2013/14	$200 million	$300 million	$300 million	$200 million	<$100 million

Cost-Benefit Analysis

The Importance of Industry Learning and Cost

Perhaps the core key challenges to DSM is that it is an industry in its infancy. As such, what is proposed today in terms of the size of an operation and associated technology is a starting point on a path that would certainly evolve through time as significant learning occurs. Present performance is not indicative of future performance. The underlying costs for DSM are projected and have yet to be verified empirically through many actual mining operations. Currently proposed technologies to harvest the mineral resource may be less profitable in the earliest years but would yield significant information upon which the industry would then innovate and improve. And, there is a need to differentiate between different types of mining on the seafloor (from various technologies) that may become as diverse as that which exists in terrestrial mining.[7] In this report, and more broadly, speculating on the cost structure and profitability of DSM at this stage may not be a terribly fruitful exercise, nor is putting any numbers on the potential financial, and fiscal revenues that could be generated.

<u>Need for Cost Models</u>

For government planning purposes, there is need to better understand costs and potential revenues. What is currently available are some indicative costs that have emerged from a limited number of proposed operations, using current market conditions and initial design of new DSM technologies. For long-range planning purposes by governments, cost models are needed to allow better understanding of the costs associated to mining each type of deposit and the economic returns expected to be generated. In addition, these costs would influence the definition of the fiscal regimes for DSM in the PIC. Given few DSM experiences on which to draw, the information to be used to create a cost model might include current literature, company technical reports and interviews with exploration companies. In preparing this report, consideration has been given to

[7] For DSM cost models may vary according to: (a) volcanic massive sulphide-VMS; (b) metallic nodules; and (c) Cobalt-rich ferromanganese crust.

the major steps towards preparing such cost models in support of long-range planning; and are thought to include:

a. Evaluate current literature, company's reports (including 43 101 type reports) and conduct interviews with exploration companies to assess indicated or measured reserves (depending on the data available) for one of each of the three types of known deposits within the PIC countries;

b. Assess size and grade of expected deposits and associated capital and operating costs (by deposit type);

c. Simulate many times expected changes to the size of the operations, recoveries, costs, market conditions and varying fiscal regimes;

d. Arrive at curves that describe associated costs and benefits (including but not limited to revenue), and the distribution of these benefits geographically and across time in order to inform long-range planning of DSM by governments.

<u>Cost Benchmarks that Change in Time</u>

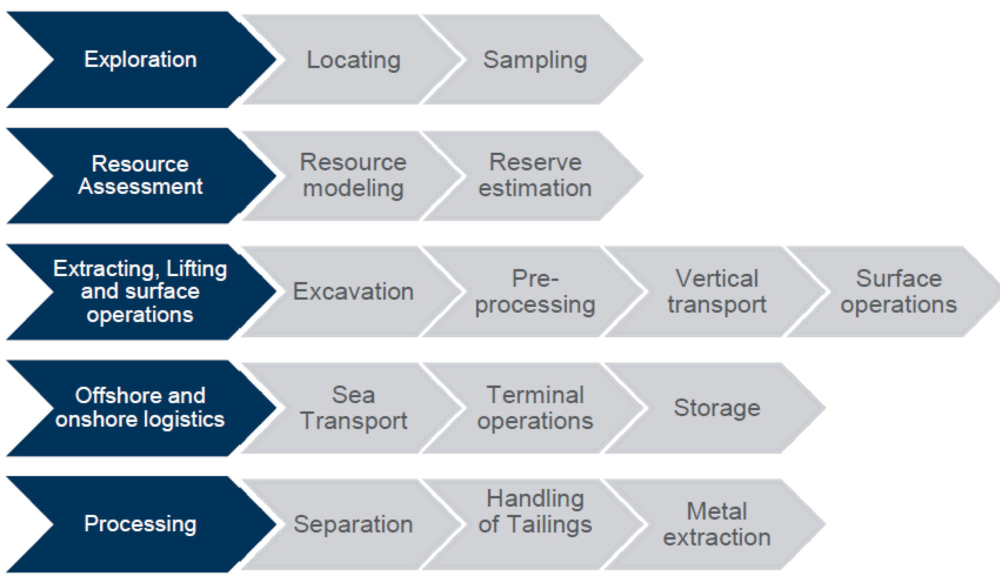
In terrestrial mining, each new operation is often compared using global benchmarks of capital and operating costs that come from an extensive pool of ongoing and past operations. These comparators often vary by commodity type and by the broad geological characteristics used to classify a mineral occurrence according to a particular "deposit model". Setting aside these differences, the end result is a set of benchmark costs that reflect learning in a multitude of geological and political / economic environments – and within an industry that is ever innovating. Indeed, one measure of the global mining industry is the ability of companies to deploy large amounts of capital into technology suites, pilot and learn, and then improve through further innovation. This ability to deploy capital in order to learn has propelled the industry towards improvements across (a) exploration / exploitation technologies, (b) mining and metallurgical productivity, (c) de-risking exposure to uncertainties and use of structured financing, and (d) improved information collection / management / dissemination regarding costs and the distribution of benefits.

By definition, key to learning is time. Some improvements require up to a decade initially, before rapid acceleration in technological innovation that will lead to improved resource efficiency, larger resource rents to be shared, and arriving at the appropriate fiscal policy to guide the allocation of those rents. Indeed, one indicator of the degree to which the industry is learning is the rate of technology switching seen in recapitalization of operations.[8] And in this regard, learning comes with risk and losses. Mining companies require an acceptable return to their capital over time, in order to endure strong commodity cyclicity and associated profit and losses that may partially

[8] A good example of technology switching is seen in the global copper industry that moved from smaller higher-grade deposits to bulk tonnage operations using advanced mining technologies that significantly reduced costs. Concurrently, advances in metallurgical processing led to the mining of new mineralogies that previously had been considered waste. The industry is ever-learning and improving the deployment of technologies, thus improving the commercial viability of operations.

result from inefficiencies and technological weaknesses. So, what may appear an excessively high return on capital in one period may be recovering losses or low returns in the past or future, driven in part by the deployment of new technologies. And so fiscal policy is also underpinned by a recognition of the need to incentivize the industry to continue to innovate, which is effectively years of trial-and-error learning.

While projections of potential revenue streams and economic linkages from DSM are difficult to predict now, there are some guiding principles that can be adopted going forward. To ensure that governments and communities receive the resource rents and other associated benefits they are due, there is need to ensure that the processes by which contracts are awarded are competitive and transparent; and backed by a regular comprehensive audit function. Moreover, the capture of economic rent from DSM should be focused beyond direct payments alone (taxes, royalties, fees etc.), towards indirect and induced economic linkages which come from strengthening interrelationships with other activities on the landscape. This broadening of perspective recognizes the need for DSM to be a driver of "local content" from the outset. And so, while present DSM performance may not be indicative of future performance, ensuring local content guides the overall industry.



Source: ECORYS, 2014

Figure 2-2 Typical Deep-sea Minerals Mining Value Chain

Environmental Impacts and Risks[9]

Ecosystems and biodiversity at the depths in question and their links with coastal or pelagic ecosystems are poorly understood and documented. Furthermore, because no exploitation has taken place to date, there is no real-life data on how it might influence these ecosystems and the services they provide. Consequently, discussions have not been informed by experience but rather by expectations, experiences with terrestrial mines, and models.[10]

Reports prepared under the SPC EU EDF 10 Deep Sea Minerals Project (SPC, 2013a- c; SPC, 2015) lay out expected impacts by type of deposit and associated mining technologies, and by project stage. In summary, "prospecting is expected to have very minimal environmental impact" since "most prospecting studies that are conducted are remote sensing (e.g., ship based or towed sensors) with a few seafloor samples taken to confirm data interpretation. Exploration is expected to have minimal to moderate environmental impact. Many exploration techniques leave no lasting impact on the seafloor, with the exception of drilling, dredging, and test mining. Any test mining activities conducted under an exploration permit – whether at a reduced scale or not, will have impacts, though on a smaller areal scale." Impacts of exploitation "are expected to be severe at the mine site, and potentially permanent." "The three types of deep sea mineral deposits are significantly different in their physical and biological characteristics, thus the mining methods will be different, as will the management of their impacts." (SPC, 2015, p.20). In addition to extraction, disposal from the mining vessel of solid and hazardous wastes, overburden, separated seawater, and tailings also cause environmental impacts (SPC, 2015). Furthermore, impacts of DSM may be exacerbated by or DSM may exacerbate the impact of seismic activity; however, no scientific studies have been carried out on this possible relationship to date. Annex 3 provides detailed presentation of possible environmental impacts by mine type.

Processing of materials mined to recover metals will also cause environmental impacts; however, it is generally expected that no processing will take place in any of the PICs.[11] Furthermore, compared to terrestrial mining, DSM will not have any ancillary impact on the environment, such as through road construction. Conversely, however, one cannot ignore the environmental risks involved with shipping activities.

On the other hand, concern has been expressed that DSM and related activities may impact other economic resources. This includes off-shore and coastal fisheries through destruction of ocean floor habitats at the mining site, sediment and discharge water plumes, noise, and pollution

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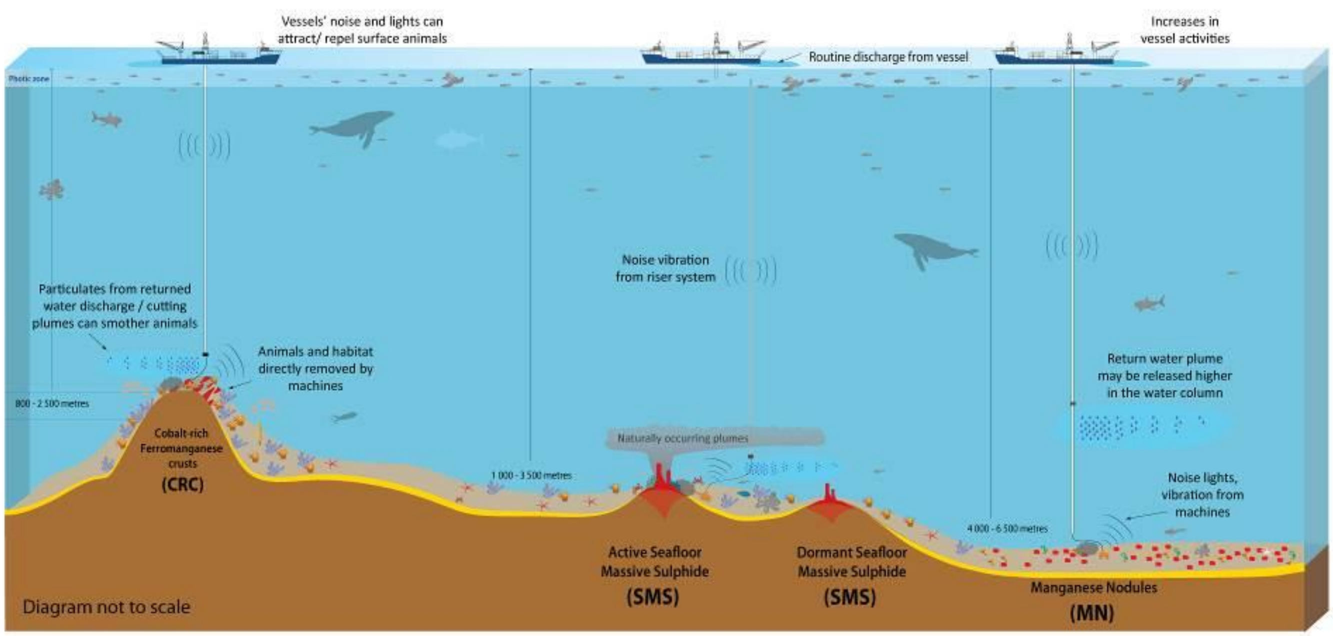
[9] The Chapter "Given the Uncertainties: Apply the Precautionary Principle" presents a discussion on costs and benefits of DSM operations and on deep sea and marine ecosystem services.

[10] The lack of factual data has also impacted regulatory decisions by the International Seabed Authority (ISA) which is currently in the process of drafting a Regulatory Framework for Mineral Exploitation in the Area (ISA, 2015), and regulators in otherwise high-capacity bureaucracies such as that of New Zealand's.

[11] There may be some processing stages, including initial separation and concentration that take place either on the mine vessel or at a shore-based facility but smelting and refining to obtain metals requires scale and reliable cost-effective access to other raw materials, water and power.

through accidental skills and leakages. Two factors seem to be instrumental: the nature of the minerals mined, i.e. massive sulphide minerals v. manganese nodules, and the technology being used. “Dredging” of areas where manganese nodules are found seems to have been entirely devastating. However, long term impacts of DSM on fisheries is very poorly understood. To date, despite the global importance of Pacific fisheries, notably of tuna, no assessment has been carried out on possible impacts.[12] Increased vessel traffic, no matter what form it takes, will always represent an environmental risk and impact, and may also negatively impact tourism, e.g. whale watching and transportation, as well as scientific exploration. While the impacts of individual DSM projects have been the focus of impact assessment to date, the cumulative impacts of DSM have hardly begun to be assessed. It is therefore fortunate that SPC, with EU support, will commission an independent assessment of the potential impacts of DSM on Pacific Island fisheries. The six-month desk study will cover potential impacts from all types of DSM including both exploration and exploitation on all types of commercial artisanal and subsistence fisheries resources that exist in the EEZs of the 15 Pacific states assisted by the EU –SPC DSM Project.

Figure 3. A graphic representation of mining operations at the three main mineral types with key sources of environmental impact.



(Source: SPC)

Social Impacts and Risks

Stakeholder concerns are influenced by the many unknowns and cover a broad spectrum, ranging from impact on livelihoods (fisheries, tourism, and transportation), cultural values (as

[12] Communication by Pacific Possible team with Transform Aqorau, CEO of the Parties to the Nauru Agreement (PNA) office.

demonstrated among others by the traditional practice of shark calling[13]), future use value of genetic resources, or the existence value of unique species endemic to the aphotic depths of the ocean. Surveys of PIC citizen concerns show that these are also shaped by experiences with terrestrial mining in the region[14]. Negative associations include the temporary nature of jobs and unsustainable dependence on mining; social disruption due, among others, to large scale migration to the mining site; surge in HIV AIDS; increased failure of marriages; and rise in general price level pushing some sections of society into poverty. On the positive side, communities appreciate

[13] Shark calling is practiced in the Bismarck Archipelago of Papua New Guinea. It involves religious rituals followed by luring a shark to one's canoe in the open sea and catching it with the help of a noose. The practice is closely tied to the local indigenous communities' creation story. Source: http://www.huffingtonpost.com/2012/08/26/shark-callers-photos_n_1828134.html

[14] Terrestrial mining has a long history in PNG, Solomon Islands and Fiji, and was also once the main economic activity in Nauru. Other PICs by comparison have seen little or no mining aside from low intensity recovery of sand, stone, coral and other minerals for construction and other uses.

increased provision of health and education services by mining companies or by government using mining revenues (SPC, 2014).

Liability for Accidents in the "Area" and the Implications for Investments in DSM

There are other risks that could arise due to accidents that may happen during exploration and operation. Accidents may be caused by the placement of mining equipment on the ocean floor, the collapse or breaking of pipes and the release of toxic substances including oil into the water in the surrounding area. There may also be accidents due to unstable geological formations or the collapse of ocean floors during mining.

In 2011 the Seabed Disputes Chamber (the Chamber), a separate judicial body within the International Tribunal for the Law of the Sea, delivered an advisory opinion on the issue of "*Responsibilities and Obligations of States Sponsoring Persons and Entities with respect to Activities in the Area*" (the Advisory Opinion). The Advisory Opinion came about as a result of Nauru's request to the International Seabed Authority (ISA)'s Secretary-General to seek an advisory opinion from the Chamber.

Nauru submitted its request to the ISA on the ground that it may be precluded from effectively participating in activities in the Area in case full liability for damage to the environment was to be imposed on the sponsoring State. The Chamber's conclusion was that sponsoring States have two kinds of obligations.

The first obligation requires sponsoring States to ensure compliance by contractors with the terms of their contract and the obligations set out in the United Nations Convention on the Law of the Sea (UNCLOS) and related instruments. This obligation is an obligation "of conduct", and not "of result." By that, the sponsoring State is not obliged to achieve, in each and every case, the result that the sponsored contractor complies with the obligations set out in UNCLOS but rather that the sponsoring State is obliged to deploy adequate means, to exercise best possible efforts, to do the utmost, to obtain the contractor's compliance. The content of this obligation varies over time in light of technological and scientific developments. Also, riskier activities require a higher standard of due diligence.

The second encompasses a number of direct obligations with which sponsoring States must comply. These obligations stem from the UNCLOS and the Nodules and Sulphides Regulations of the ISA and include: assisting the ISA, applying the precautionary approach and "best environmental practices", ensuring that the contractor complies with its obligation to conduct an environmental impact assessment, and providing recourse for compensation.

While defining the content of such direct obligations, the Chamber noted that the Regulations, by embodying the precautionary approach defined in Principle 15 of the 1992 Rio Declaration on Environment and Development, had the effect of transforming a non-binding approach into a binding obligation. Moreover, by stating that the precautionary approach shall be applied by States "according to their capabilities", Principle 15 introduces the possibility of differentiated application according to the capabilities of each State. The Chamber also concluded that the obligation to conduct an environmental impact assessment is a direct obligation under UNCLOS (as noted in footnote 18 of the report) and a general obligation under international law.

With respect to the amount of compensation payable, in the event of damage, the Chamber referred to Annex III, article 22, of the UNCLOS, which states that "[l]iability in every case shall be for the actual amount of damage." A sponsoring State is obliged to provide the full compensation or *restituto in integrum*, based on the principles of customary international law. The same principle of the provision of actual amount of compensation would also apply equally to the contractor, just as it applied to the sponsoring State the Chamber found. On the form of reparation, the Chamber noted that that would depend on both the actual damage and the technical feasibility of restoring the situation to the *status quo ante.*

Of concern is also that, given the technologically advanced nature of DSM operations and plans to process the materials in other countries, direct employment with the mining companies is expected to be limited. Furthermore, there are concerns about the governance and distribution of DSM revenues within the society and with future generations (SPC, 2014).[15]

[15] Opposition on environmental, social and cultural grounds has been voiced by civil society organizations (CSOs), e.g. the *Deep Sea Mining Campaign*

Chapter 2. Given the Uncertainties: Apply the Precautionary Principle

Definition of the Precautionary Principle

Adopted by the 1992 Rio Convention, "the precautionary principle or precautionary approach to risk management states that if an action or policy has a suspected risk of causing harm to the public or to the environment, in the absence of scientific consensus that the action or policy is not harmful, the burden of proof that it is not harmful falls on those taking an action."[16] [17] In deciding to apply the precautionary principle, "potential harm" is defined not only based on technical or scientific information (or lack thereof) but also in terms of social considerations and cultural values (SPC, 2015). The overwhelming uncertainty regarding social, environmental, economic and fiscal impacts warrants the application by policy makers and regulators of the precautionary approach to DSM operations.

In general, the mining industry appears ready to embrace the principle of precautionary approach. The International Marine Minerals Society's Code for Environmental Management for Marine Mining (ISA, 2010) which was adopted by ISA in 2010 calls for "the use of appropriate risk management strategies and the precautionary principle to guide exploration, extraction, waste disposal and closure, and to identify environmental risks, their possible consequences, and their probabilities of occurrence." Specifically mining companies ought to "adopt the precautionary principle in managing identified environmental risks."

The Process of Applying the Precautionary Approach and Key supporting Elements

SPC has laid out the five steps in applying the precautionary approach to DSM (Figure 4). The process is an ongoing and iterative one in that completion of Step 5 leads back to Step 1 in order to reevaluate the likely harm and the necessary approaches. The process is managed by a regulatory authority with strong stakeholder participation.

Stakeholder participation

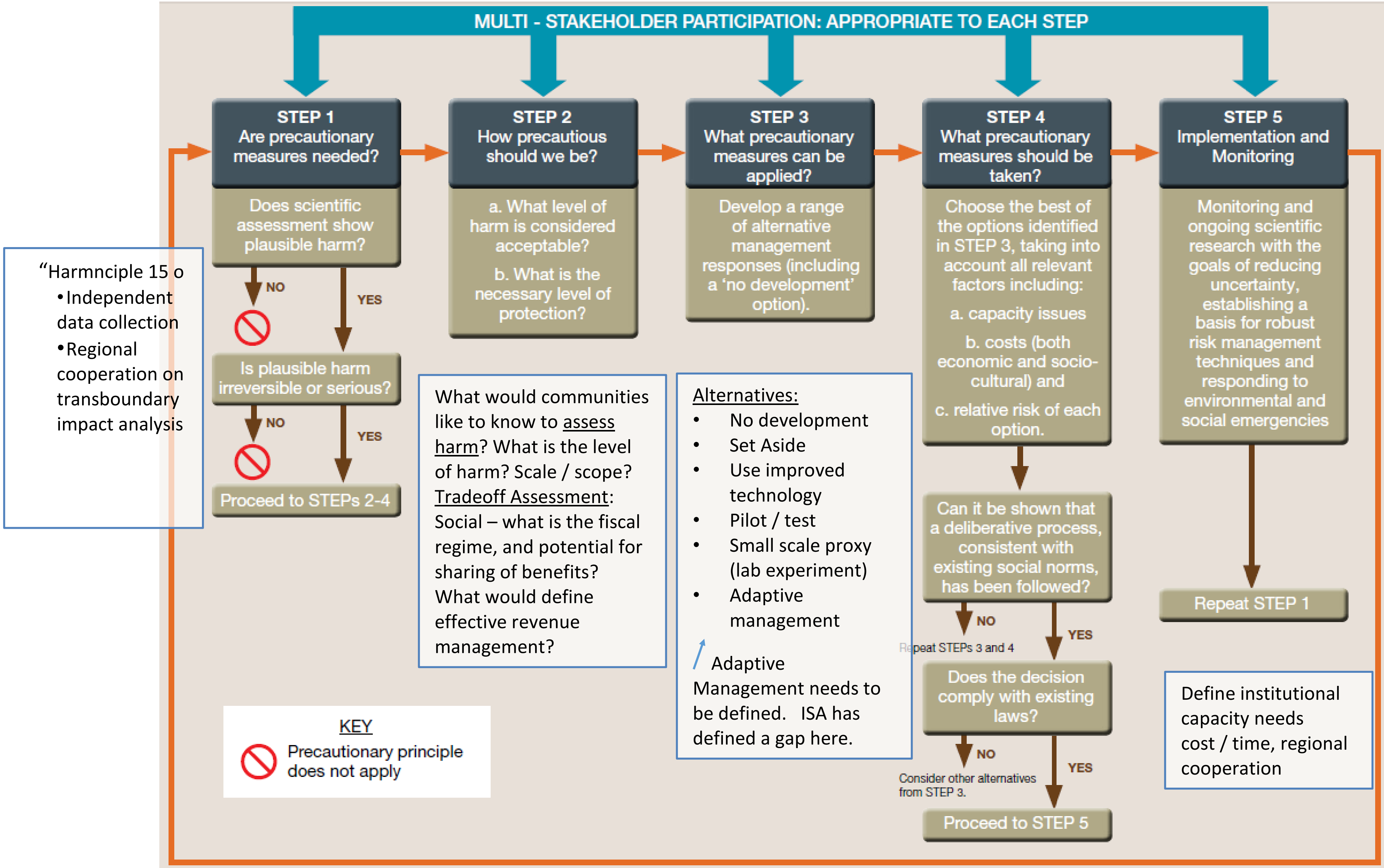
Stakeholder participation is fundamental to the satisfactory application of the precautionary approach, as it is to the mitigation of negative impacts caused by any investment projects. The IFC Performance Standard 1 defines stakeholder engagement as an ongoing process that may involve, in varying degrees, the following elements: stakeholder analysis and planning, disclosure and dissemination of information, consultation and participation, grievance

[16] www.wikipedia.com, accessed on 2 November 2015

[17] Principle 15 of the Rio Convention states: "In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."

mechanism, and ongoing reporting to Affected Communities (Box 5 at the end of this chapter).

Figure 4: The 5 Steps for applying the Precautionary Approach



Source: SPC with authors' additions

Step 1. Are precautionary measures needed?

In the first step, policy makers determine whether there is scientific evidence pointing at plausible harms and if so, whether the plausible harm is irreversible or serious. If the answer is positive, then the precautionary approach should be applied. As discussed in the previous section, some exploration activities and most exploitation activities are likely to cause irreversible or serious harm.

Step 2. Degree of precaution needed

The level of precaution needed depends on the level of harm that is considered acceptable and the level of protection that is considered necessary. Both of these questions are not only crucial but also challenging to answer, mainly due to the dearth of data on the current status ("baseline") of the marine ecosystem and the services it provides, and on the changes that are likely to occur ("impact") as a result of the DSM project.

International law[18] requires an environmental impact assessment (EIA) for serious harm to the marine environment. Therefore, some exploration and all exploitation activities will require an EIA. For most prospecting and some exploration activities, a less comprehensive environmental assessment (EA) will be required. In all cases, the assessment will cover not only the impacts on the physical (marine and possibly coastal) environment, but also the social, economic and cultural dimensions of the human environment. The assessment will document the baseline situation and assess the likely impact of the proposed intervention. Furthermore, the EA/EIA will devise an environmental management plan (EMP), which also outlines the monitoring requirements and specifies the roles of all involved as well as the associated costs. The cost of implementing the EMP will be covered by the DSM developer.

Box 2. What type of information is needed to determine acceptable harm?

Research exploring the acceptability of DSM to Australian stakeholders found that stakeholders were primarily concerned about the potential environmental impact of DSM and highlighted the lack of baseline data "from which [they] rigorously evaluate the relative costs and benefits of seafloor mining activities." In particular, stakeholders were interested in i) information on the nature and location of the proposed activity to evaluate potential impact on the marine habitats or other natural resources that were highly valued; ii) the environmental impacts and in particular, the scale and scope of the impacts as compared with the effects of human interventions in other significant endangered eco-systems, such as the Amazon; iii) the costs and benefits associated with the proposed DSM project, including not only environmental but also social and economic impacts; iv) how the industry would be regulated, and in particular how stakeholder and community consultation would be carried out; and (v) how independent and transparent the information shared would be.

Source: Mason et al., 2010

[18] UNCLOS Article 206; Convention on Biological Diversity Article 14; Noumea Convention Article 16.

Trade-offs – Need for sound cost - benefit analysis

Key principles for adequately assessing the costs and benefits of a proposed DSM project are the following (WBI, 2001):

- The cost benefit analysis should establish the current conditions ("the baseline"), the project scenario, and a counterfactual without project scenario). Expected changes to the baseline under the project should be compared with expected changes if the project is not undertaken.
- The perspective of the analysis should be that of the society of the host country, including government and citizens, although, given cross-boundary environmental effects, a supplemental analysis from a regional perspective may also be useful.
- The analysis should take into account not only a single project but the cumulative effects of existing of planned projects within the subject country's EEZ and neighboring EEZs, whether or not they are implemented by the same company or exploit the same mineral type.[19]
- The analysis should be comprehensive and strive to capture in monetary terms all costs and benefits to different sections of the society (Table 5), including eco-system services (Table 7).
- Government revenues are often straightforward to estimate based on the company's projections on revenues and capital and O&M costs. Having said this, such projections should be subjected to rigorous sensitivity analyses to account for risks and uncertainties in costs due to the as yet commercially untested nature of extraction technologies, and unexpected weather patterns, and in revenues due to commodity price fluctuations, depending on the contractual arrangements between the government and the company.
- For the estimation of losses in ecosystem services two methods have been suggested. i) transferring loss estimates developed for natural habitats of similar biological / ecological significance, as was done for the Solwara 1 Project (Earth Economics, 2015)[20] and ii) the Habitat Equivalency Analysis, a method commonly used in US Natural Resource Damage Assessments, to quantify the cost of providing environmental services that are equivalent in value to the environmental services that are lost due to DSMM activities (SPC, 2016).
- As in terrestrial mining, losses in cultural and spiritual values associated with DSM are challenging to ascertain and nearly always remain unmonetised. As such, they figure in C/B summary tables as zero; which effectively means that they are not accounted for. This is also the case in the economic analyses in SPC (2016) summarized below. In fact, recent advances in the field of participatory GIS based valuation make it possible to quantify and monetize such value losses (Box 4).

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[19] The cost benefit analysis for the Solwara 1 came under criticism for not considering the cumulative impact of the planned Solwara 2-12 projects, for which the company has exploration licenses (Ocean Foundation, 2015).

[20] The said analysis came under criticism for a) valuing the resource and not the change in the ecosystem services due to the project and ii) for selecting reference areas that were considered poor comparators.(reference)

Box 3. New Zealand experience with ecosystem impact evaluation

In New Zealand, in its application for an exploration license, Chatham Rock Phosphate (CRP) contended that while the benthic ecosystems in the proposed mining area would be destroyed, (i) they weren't that unusual; (ii) were not crucial ecosystems for commercial fish species; and (iii) that the overall area that would be lost would be a miniscule proportion of the New Zealand's EEZ. The evidence presented by those opposing the project focused partly on (i) the uniqueness of those benthic environments; and (ii) their role, i.e. ecosystem services, for various fish species. CRP's inability to counter that evidence or to advance an argument beyond 'it's only a small area' contributed to the rejection of their application.

Table 5. Costs and benefits of DSM operations to the host country

Stakeholder	Costs	Benefits
Government*	Cost of developing a national policy and regulatory framework prorated to project	Royalty and tax revenues
	Administrative costs of monitoring, enforcing and reporting on the mine operation. (Some of these costs will be borne by the company per the polluter pays principle.)	Any direct revenues as direct participant in investment
	Any capital and operational costs as direct participant in investment	
Citizens and Communities	Cost of reduction in services provided by deep sea ecosystems, including provisioning, regulating, cultural and supporting services, due to mineral extraction (Table 7).	Income derived by host-country nationals from employment by project company
	Loss of income from off-shore or coastal fisheries and tourism due to regular DSM activities and their impact on the environment	Value added due to secondary economic activities supporting the DSM project
	Damage to property, resources, and livelihoods caused by accidental spill of hazardous materials such as oil	Present value of benefits human and physical capital enhancements due to investments by government from tax and royalty revenues or by company in education, health and infrastructure.
	Reduction in well-being of one or more sections of the society caused by dependency on payments from government, temporary nature of mining employment, or disruption to social fabric due to influx of foreign workers.	Increased knowledge of deep sea ecosystems and geology obtained through regular monitoring data collection during DSM project
	Loss of cultural or spiritual value associated with pristine ocean, sense of ownership of/identification with the ocean and its resources	

*This table assumes that the main company is not based in the host country and pays the government royalties and or taxes for the resource. If the company is incorporated in the host country, its revenues net of its capital and operating and maintenance costs enters in the CB analysis, while taxes and royalties it pays to the government, which are transfers, do not.
Source: Authors and SPC (2016)

SPC has commissioned a preliminary economic cost-benefit analysis of deep sea mineral deposits in the Pacific Island region. The analysis is based on realistic yet hypothetical mining scenarios and was carried out for three mineral deposits thought to have a high potential for economic viability: (a) seafloor massive sulphide deposits in Papua New Guinea (PNG); (b) Polymetallic Manganese Nodules in the Cook islands; and (c) Ferromanganese Cobalt-rich crusts in the Republic of Marshall islands (RMI). As summarized in Table 6, the analyses lead to the following conclusions: First, in the case of massive sulphide deposits in PNG, benefits significantly outweigh the costs producing a net benefit of $82.7 million (refer to Chapter 3 for more details). Second, in the case of the Cook Islands, where four metals are recovered and the miner owns the operation and the processing facility overseas, net benefits reaching some USD467million would be achieved, largely due to the high grades of manganese and other minerals in the nodules. Third, crust mining in the Marshall Islands would not be economically feasible under the constructed scenarios (SPC, 2016).

Table 6. Costs and benefits estimated (in millions USD, 2015)

Country	Resource	Cost	Benefit	Net Benefit
PNG	Cu, Zn, Au	0.64	83.30	71.90
Cook Islands	Manganese nodules	9.60	494.00	467.00
Marshall Islands	Cobalt crusts	7.30	39.00*	0.00

* The project is not commercially feasible. Royalty payments are the only benefit.
Source: SPC (2016)

The above table suggests that some cases of DSMM has high revenue potential for host countries. The key criticisms that may be levelled against the analyses is that (i) they did not take into account the cultural and spiritual values placed on pristine oceans, which are often very difficult to monetize and unknown environmental impacts, that are not captured in the standard analytical framework presented in Table 5 since DSMM has never been carried out in practice; (ii) inadequately valued the economic impact of a catastrophic accident, such as a spill; and (iii) narrowly focused on one project and thereby did not account for the cumulative impact of multiple operations in the same area (which is particularly relevant to Solwara).

Table 7. Deep Sea and Marine Ecosystem Services

Service Category	Service Description
Provisioning	Some benthic organisms are directly consumed by people (e.g. clams and oysters)
	Some benthic organisms are used as bait (e.g. worms, clams) or in other processes (e.g. shells may be crushed used in industrial processes)
	Genetic material may be extracted from sediment dwelling bacteria or benthic organism for research and pharmaceutical use

	Proteins or chemical compounds may be extracted from sediment dwelling bacteria or benthic organisms for pharmaceutical and industrial use
Regulating	Benthic organisms and sediment dwelling bacteria influence climate processes; these organisms regulate some organic decomposition processes which influence CO2 sequestration and the sediment itself may be a sink for organic (e.g. carbon-based) material
	Benthic organisms and sediment dwelling bacteria influence pollution attenuation processes; burying by the sediment itself may reduce the bioavailability of pollutants; sediment and sediment dwelling organisms regulate water purification processes.
	Sediment structure and the accumulation of sediment regulates accretion and erosion processes as well as storm surge and flood control
Cultural	Well-being may be derived via shell fishing outside any consumptive use
	Well-being may be derived by individuals simply because they know a healthy sediment community exists
	Well-being may be derived because the sediment system exists and can be used in the process of education and scientific investigation
Supporting	Sediment dwelling organisms cycle energy, nutrients, and organic matter within and between ecosystems this energy cycling facilitates the production of future services across multiple ecosystems

Source: SPC (2016)

Box 4. Spatial identification of eco-system service value

Public Participation/participatory Geographical Information Systems (GIS) and Social Values for Ecosystem Services Mapping are approaches that have evolved in the past decade and have been used to explicitly identify and map a range of ecosystem services associated with a geographical area. Participants, who can range from lay people to stakeholders to experts, identify spatially explicit direct and indirect benefits from ecosystems that contribute to human well-being and may also include an assessment of the relative importance of the services provided. The application of the methods has ranged from terrestrial landscapes to marine landscapes, such as the Channel Islands off the cost of California.

Source: Brown and Fagerholm, 2015; Van Riper and Kyle, 2014.

Tradeoffs also necessitate distributional analysis

Like good practice economic analysis for any investment operation (WBI, 2001), the economic cost-benefit analysis of the DSM operations should include an analysis of who in the host country would gain and lose from a proposed DSM operation taking into account the gains and losses incurred by different stakeholders as a result of DSM impacts discussed above. Such analysis will inform government's decision on the use of DSM revenues and contractual obligations for the DSM operator, as well as ways for winders to compensate losers.

Step 3. What precautionary measures can be applied?

Six alternative management responses that have been identified:

1) ***No development.*** This option was chosen by the New Zealand Environmental Protection Agency ("NZ EPA") in declining two exploitation license applications on the grounds that the environmental risks outweigh the economic benefits of the proposed projects and "could not be mitigated by any set of conditions or adaptive management regime that might be reasonably imposed." (NZ EPA, 2015)[21]. Whereas the rejections were made in respect of specific mining proposals and not DSM in general, they nonetheless, signal that, in general, DSM will not be permitted unless proponents are able to address the grounds for rejection.

2) ***Set-asides.*** This option entails establishing set-aside areas before any test mining or exploitation occurs that are representative of the habitat that will be impacted, also taking into account the possible transboundary nature of some ecosystems (SPC, 2015). ISA adopted this approach in preparing the Environmental Management Plan for the Clarion-Clipperton Zone (ISA, 2011).

3) ***Use technological innovation to minimize impacts***, such as reduction of the footprint of sediment plumes or elimination or mitigate sediment compaction (SPC, 2015), through the design of riser and pump systems and seafloor crawlers and vehicles. The approved EIA may include an obligation to minimize impacts that are understood and can be anticipated or modeled.

4) ***Stage a mining proxy,*** namely an experiment that replicates a DSM operation on an ongoing basis but much smaller scale, in order to gather information on the impacts of DSM. Such a proxy will still be expensive, would require creating some environmental impacts and may only produce useful data if it was carried out over a long period of time.

5) ***Pilot or trial mining* on a small scale**, as part of a staged program, rather than immediately authorising commercial-scale activity (SPC, 2015). Such pilot mining would be accompanied by extensive monitoring before and during the pilot of the mining sites, surrounding areas and control areas. The results of such monitoring would allow regulators to halt or substantially change plans for the main mining project. The advantage of a trial approach over initiating a full scale DSM project right away is the ability to limit the damage to a small area, should one occur. A critical question involves the parameters and length of monitoring.

6) ***Adaptive management*** is defined an iterative process of robust decision making in the face of uncertainty using monitoring results which help reduce the uncertainty. In a DSM project extensive monitoring would be carried out before and during the project of the mining sites, surrounding areas and control areas. Monitoring results would lead to amending or improving the plan of work, including methods of mitigation, in cases where new information requires changes in

[21] http://www.epa.govt.nz/news/epa-media-releases/Pages/EPA-refuses-marine-consent-application-by-CRP.aspx. Accessed on 4 November 2015.
Specifically, in the case of the proposal to mine phosphate nodules on the Chatham Rise, the NZ EPA "concluded that mining would cause significant and permanent adverse effects on the existing benthic environment on the Chatham Rise" and was "left with a lack of certainty about the receiving environment and the adverse effects of the proposal on the environment and existing interests." Furthermore, the EPA "found that the destructive effects of the extraction process, coupled with the potentially significant impact of the deposition of sediment on areas adjacent to the mining blocks and on the wider marine ecosystem, could not be mitigated by any set of conditions or adaptive management regime that might be reasonably imposed."

approach. Complete cancellation of the mining project is also not ruled out, depending on observed results (SPC, 2015).[22]

Step 4. What precautionary measure should be taken?

SPC and NIWA (2015) posits that the best option is to be chosen in the light of (i) capacity issues; (ii) economic and socio-cultural costs; and (iii) relative risk, and following a deliberative approach consistent with existing social norms and existing laws. Options (ii) and (iii) will be largely determined on a case by case manner. However, some general observations on capacity and regulatory issues that will impact the choice can already be made:

- ***Each of the options requires strong technical capacity on the part of the PIC regulator*** to evaluate the proposed DSM project, including the proposed technology, potential impacts, and mitigation measures. Set-asides require the ability to judge the appropriateness of the proposed areas. Requiring technological innovations necessitates a sound understanding of impacts and available technologies. Mining proxy, trial mining, and adaptive management will require intensive monitoring, which the regulator would need to verify and evaluate to decide on the next step.
- ***Investors' unwillingness to finance may make some options impractical.*** In the case of a mining proxy, it is not clear how such an experiment would be financed since no commercial organization would likely be interested in an investment that did not offer the possibility of yielding any returns. Similarly, in the case of pilot/trial mining or adaptive management, it is very difficult for a company to make an internal or external investment case if there is a reasonable chance they might be prohibited from mining some of the resource. [23] This is particularly the case at this very early stage of the industry where many of the major players are single project investment vehicles – i.e. they exist to develop one major resource, and unlike traditional multinational mining companies they cannot offset the high risk of new development against existing producing assets. On the other hand, one aspect of DSM that mitigates commercial risk is the ability to move equipment and vessels to new resources and areas.
- ***Cost of monitoring.*** The cost of monitoring, which would be borne by the investor, would be high in all five options, but especially in adaptive management.
- ***Regulatory clarity will be needed.*** In the case of trial mining, regulatory clarity is needed as to the grounds on which mining, which has been preceded by pilot or trial operations, could nonetheless be rejected. Similar clarity is needed in the case of adaptive management. Moreover,

[22] The International Marine Minerals Society's Code for Environmental Management for Marine Mining (ISA, 2010) calls for adaptive management under the section heading Integrated Environmental Management: "2. Periodically review and update the environmental management system in a structured, iterative process that involves the local or affected community, to ensure that the system remains up-to-date, effective and relevant to the company's evolving needs, improvements in best environmental practices, and to changing community values and expectations." (p.12)

[23] This is different from the common situation governing events that could require terrestrial mining to be halted, such as mine or damn collapses, pollution events and serious safety breaches. In these cases the legal obligations are well understood in advance and such incidents relate to well understood baselines and standards.

there is a general lack of definition of the terms of adaptive management in DSM. Hence, the need for "a regulation that better defines adaptive management" is identified as a high level issue by the International Seabed Authority in its draft regulatory framework for mineral exploitation in the Area (ISA, 2015).[24, 25]

- ***Lack of baseline data.*** The New Zealand experience highlighted the difficulty for a company to incorporate adaptive management into a DSM license application in the absence of baseline data.

Step 5. Implementation and Monitoring

All options will require ongoing data collection including through scientific research on DSM and the ecosystems it may impact. In the "no-development" option, if the decision rejecting an operation was made "for the time being, until more information on the risks become available", there is a need to continue collecting and assessing data on the risk elements. In the five "development options", monitoring would be part of a project environmental management plan based on impacts and risks identified in the EIA. Impact monitoring would cover the project areas and similar non-project areas to control for confounding factors. It will also be important not to limit monitoring to the EEZ where a project is located as impacts may be transboundary or even extend into the Area. In such cases, the regulator needs to coordinate with the regulators of the neighboring EEZ or the ISA. Moreover, in the case of projects in the same general area, cumulative impacts need to be considered. Finally, in the set-asides option, the ecosystems in such sites need to be monitored to ensure that they are not impacted by the DSM operation. The project proponent should be responsible for funding the implementation of this monitoring plan. The regulator, in addition to supervising implementation, must verify the data through independent monitoring, and compile and analyze the data with a view to identifying potential needs for amending the environmental management plan. This is particularly true under adaptive management. Monitoring should focus not only on environmental aspects, but also encompass impacts on livelihoods, other social aspects and cultural values. The regulator must manage an effective grievance mechanism.

Data gathered through the above processes will inform the regulator on the appropriateness of the current option. For example, in case serious social or environmental risks emerge or the operator transgresses the license conditions, the regulator may cancel the operation. The regulator will also decide whether or not to convert a mining proxy or a pilot/trial to a full-scale operation (Table 10.)

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[24] Under "Commentary / Suggested Content" it notes:

"All actors to adopt an adaptive management approach to exploitation activities. Adaptive management may include:-

- The permitting of exploitation operations to proceed on a smaller scale or for shorter defined periods of time in order to assess impacts on the environment and on human health and safety;
- The duration of any approval of an EMP;
- The frequency of review periods to be imposed by the Authority; and
- Additional reporting obligations under an EMP.
- Note: this approach should be balanced with the commercial (economic) viability of operations

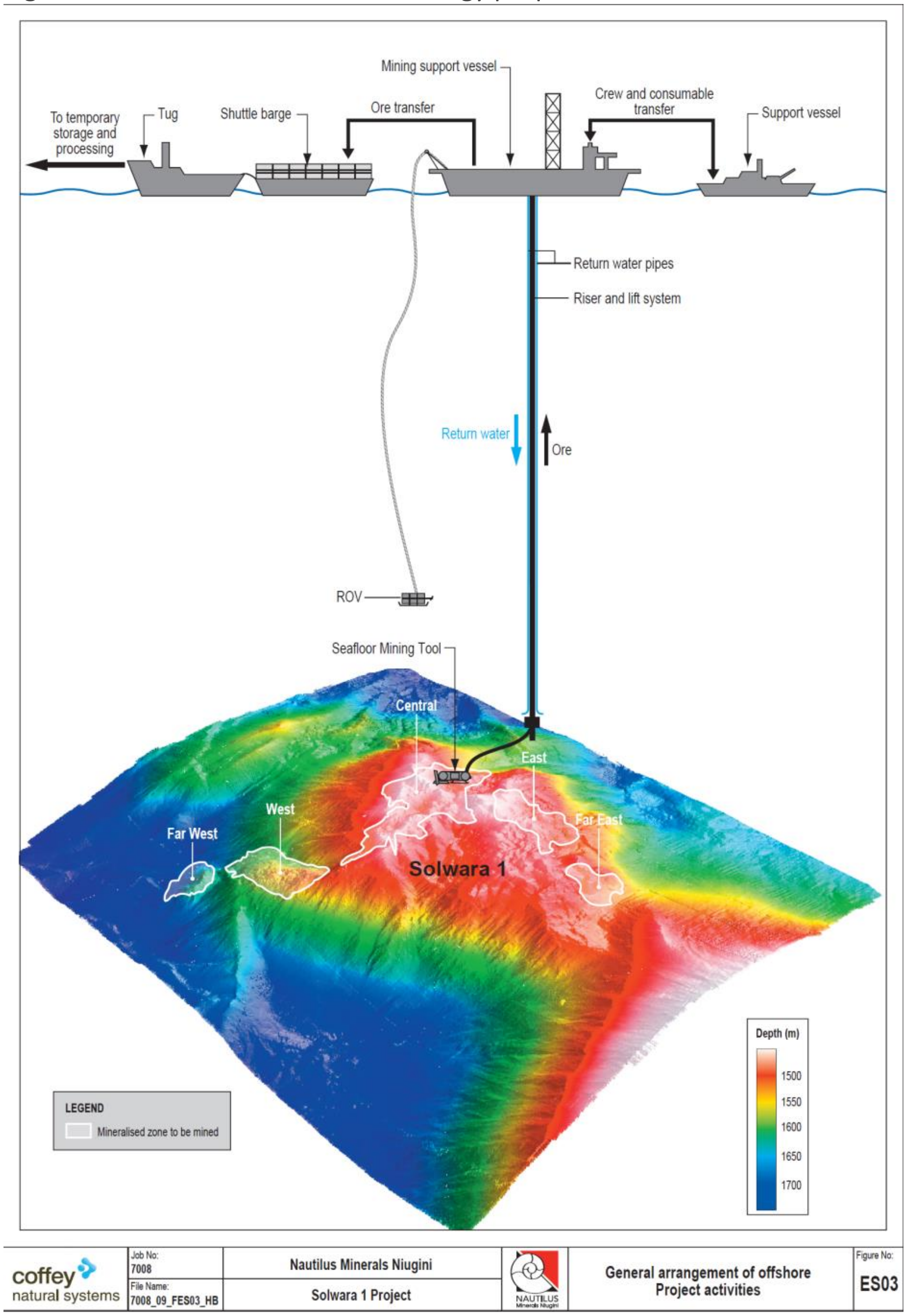
[25] Among next steps in the regulatory framework development, the ISA document lists elaboration with interested parties through a working group and collaboration with the New Zealand Government given its recent regulatory development and marine consent experience.

Chapter 3. The Case of the Solwara 1 Project

Being the first DSM project in the Pacific to have been granted an exploitation license, the Nautilus Solwara 1 project in PNG is expected to move into production in 2018. Solwara 1's successes and failures have and will continue to shape the wider global DSM industry. The project envisages extracting high-grade seafloor massive sulphide deposits from an area of 0.11km2 at a depth of approximately 1,600m around 30km off the coast in the Bismarck Sea of Papua New Guinea. The project is very close to an existing and active seabed volcano - North Su - with resulting sediment plume activity. Solwara 1 is the first of 12 Nautilus projects in the Bismarck Sea with exploration licenses.26 Environmental permits were granted in 2009 and a mining lease in 2011. The project will use three large seafloor production tools (large tracked cutting and collecting machines) to mine material that will then be pumped in slurry form to a surface vessel (Figure 5.) The most recent resource estimates for the project have it standing at an indicated resource of 1 million tons at 7.2% copper, 5 grams/ton of gold, 23 grams/ton silver and 0.4% zinc. By way of comparison, Ok Tedi, a major terrestrial mine in PNG has a resource of 910 million tons but at 0.8% copper and 1 gram/ton of gold.

[26] Nautilus Minerals holds explorations licenses on approximately 420,000km2 of the ocean floor in the western Pacific, including in PNG, the Solomon Islands, Fiji, Vanuatu and Tonga, as well as in the Area in the eastern Pacific.

Figure 5. The SMS Extraction Technology proposed for Solwara 1



Source: Nautilus Minerals

Environmental and Social Impacts

An environmental impact statement (EIS) was issued in 2008 (Coffey Natural Systems, 2008). The EIS reported to be based on a number of physical, chemical and biological baseline studies by leading scientists in the fields. The EIS discussed and proposed mitigation measures for damage from offshore mining activities to seafloor communities, and coastal, shallow and mid-water environments. The EIS also discussed the possible environmental, social and cultural impacts and mitigation measures associated with onshore facilities and proposed mitigation measures. The EIS reported to have had intensive consultations with PNG national government, PNG provincial governments, landowners outside but near Solwara 1, NGOs, industry groups, and academic and research organizations. The EIS did not include an environmental management plan or a monitoring plan and stated that these would be forthcoming (Annex 1).

Critics of the EIS pointed mainly at insufficient treatment of damage to highly valuable endemic benthic[27] fauna, some of which is yet to be discovered; impact on pelagic (water column) fauna; risks of leakage from the riser or discharge pipes and of spills from the Mining Support Vessel, shuttle barges to Rabaul or ore freighters from Rabaul; vertical and horizontal currents transporting sediment plumes and pollutants shorewards and into contact with marine food chains; impact on fisheries and other livelihoods; and cumulative impacts. (Steiner, 2009; Ocean Foundation, 2015). There is also the dispute around the long-term economic impact and benefits for PNG.

Cost–benefit Analysis and Government Revenues

Government interest in Solwara 1

There was then an extended legal dispute with the PNG Government regarding its participation in the project. This was resolved in 2014 when the government agreed to buy a 15% share in the project for US$120m, with options for purchasing a further 15% currently being considered. There are distinct advantages and disadvantages to the direct interest that the government has in the project. The most obvious advantage is that a direct stake in the project might allow the government to compensate for the reduced (compared to traditional mines) onshore benefits from the project. The disadvantages are that it shares in the commercial risk, and there is some concern that it might compromise the government's regulation of the project.

Cost-benefit analysis

The cost benefit analysis commissioned by SPC (SPC, 2016) suggests that the social benefits of DSM mining in PNG far outweighs the social costs, as the net social benefits are positive (Table 8). The report also suggests that the total monetized social costs represents a small portion of the monetized social benefits, ultimately having very little impact on the overall results. Some of the factors that contributed to the report's findings include:

- The remote location of the mine site from populated areas (30-40km offshore) when compared to land-based mining that often disrupts and/or displaces local communities;
- The small footprint of the mine site (0.11 km2) as it relates to the potential for long-term environmental impacts and permanent loss of biodiversity;

[27] The benthic zone is the ecological region at the lowest level of a body of water such as an ocean or a lake, including the sediment surface and some sub-surface layers.(source: Wikipedia.com)

- The advances in technological improvements of SMS mining equipment and processing, allowing for efficiency gains and reduced costs of operation;
- PNG's deep rooted history in the extractive sector with several " world class" mines that produce from some of the most significant deposits of land-based gold, silver and copper in the world has allowed it to draw on its experience to write effective frameworks and policies adapted for DSM mining and make the development of these deep sea mineral deposits more likely to be accepted by the people of PNG; and
- Nautilus' commitment to discourage immigration through its employment policy and its commitment to providing assistance to local communities in the form of social programs.

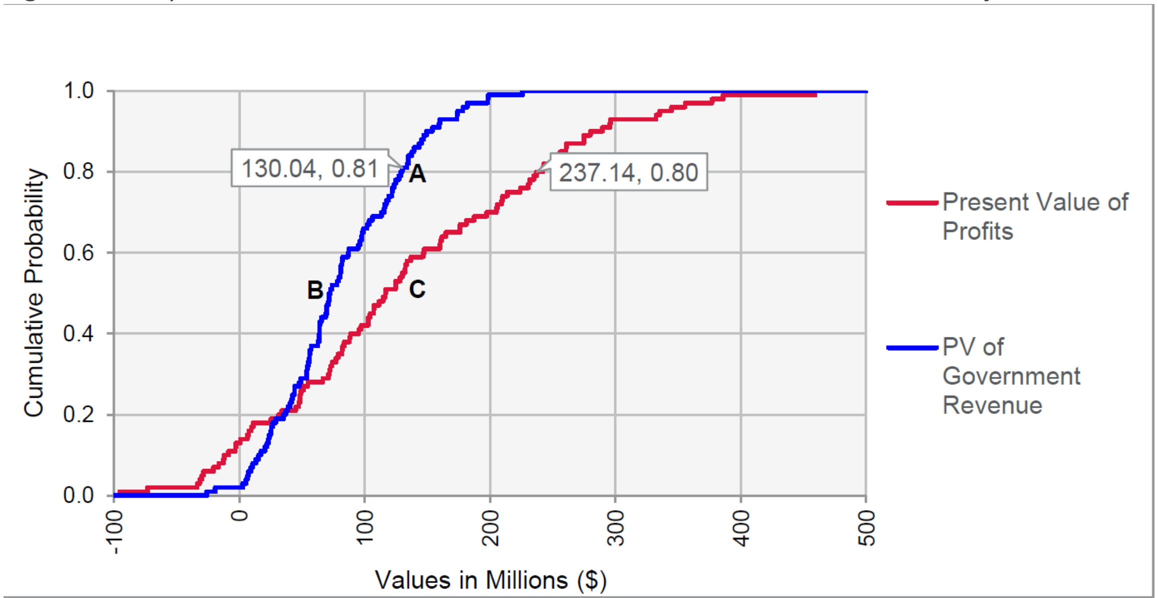
Table 8: Expected Net Social benefits in PNG Mining Scenario (in million USD)*.

Category	Present Value
Government revenue	83.30
Unplanned spills and grounding	-0.03
Replacing lost environmental services	-0.61
Mean net social benefits	82.70
Benefit – cost ratio	124

Source: SPC, 2016
*Mine life of two years

The acceptance of these premises must however be taken with some caution as the many uncertainties regarding the environmental and social costs associated with DSM are still one of the big issues moving forward. Another aspect is that although the Solwara 1 project is well advanced from the exploration point of view, the feasibility study is still under preparation pending additional drilling and reserve estimates. Changes in these premises and further exploration data could change the CBA results. For example, the cost / benefit did not undertake a comprehensive stakeholder consultation, and was not reported to have assessed cultural values.

Figure 6. Comparison of Nautilus Profit and Government Revenue in Solwara 1 Project Scenario.



Source: SPC (2016)

The cost benefit analysis identifies payments made to the PNG government as the primary benefit of DSM mining from the perspective of the PNG citizens. With the exception of monitoring and regulatory costs, considered small, all other revenues would be available to the PNG government. The current Mining Act is being revised to address DSM activities. In addition, Nautilus has also established a Community Development Fund, where approximately $0.75 (USD) per ton of ore mined will be placed into a fund used to support health and education projects in other PNG provinces.

Proposed Precautionary Principle Option

As per information obtained from SPC, following a participatory process, Nautilus Minerals is proposing an environmental management plan (EMP) that applies both the "adaptive management" concept and "set-asides". A reference site has been also been identified that will allow eventual impacts to be evaluated against a control. As of December 2015, the EMP is in draft form and will be shared with the public soon.

Solwara 1 as a Learning Experience

If Solwara 1 exploitation goes ahead in 2018 -as yet still uncertain pending completion of a feasibility analysis and the acceptance of the EMP- it has the potential of setting a good example for proper DSM management. The long lead-in times to the project (it will eventually be almost a decade between the granting of environmental permits and actual production) have already allowed ongoing collection of significant geological and environmental data. To this end, it will be important, that the EMP adequately address stakeholder concerns raised over the 2008 Environmental Impact Statement and include a well-designed monitoring plan to support the adaptive management approach. Monitoring of the impacts of Solwara 1 will also be important for PNG’s decision to move forward with any projects among Solwara 2-12, taking into account not only individual project impacts but also cumulative impacts.

Box 5. Elements of Stakeholder Engagement (Adapted from IFC Performance Standard 1)

Stakeholder Analysis and Engagement Planning

Project proponents should identify the range of stakeholders that may be interested in their actions and consider how external communications might facilitate a dialog with all stakeholders. Where projects involve specifically identified physical elements, aspects and/or facilities that are likely to generate adverse environmental and social impacts on Affected Communities the client will identify the Affected Communities and will meet the relevant requirements described below.

The client will develop and implement a Stakeholder Engagement Plan that is scaled to the project risks and impacts and development stage, and be tailored to the characteristics and interests of the Affected Communities. Where applicable, the Stakeholder Engagement Plan will include differentiated measures to allow the effective participation of those identified as disadvantaged or vulnerable. When the stakeholder engagement process depends substantially on community representatives[*] the client will make every reasonable effort to verify that such persons do in fact represent the views of Affected Communities and that they can be relied upon to faithfully communicate the results of consultations to their constituents.

Disclosure of Information

Disclosure of relevant project information helps Affected Communities and other stakeholders understand the risks, impacts and opportunities of the project. The project proponent will provide Affected Communities with access to relevant information** on: (i) the purpose, nature, and scale of the project; (ii) the duration of proposed project activities; (iii) any risks to and potential impacts on such communities and relevant mitigation measures; (iv) the envisaged stakeholder engagement process; and (v) the grievance mechanism.

Consultation

When Affected Communities are subject to identified risks and adverse impacts from a project, the client will undertake a process of consultation in a manner that provides the Affected Communities with opportunities to express their views on project risks, impacts and mitigation measures, and allows the client to consider and respond to them. The extent and degree of engagement required by the consultation process should be commensurate with the project's risks and adverse impacts and with the concerns raised by the Affected Communities. Effective consultation is a two-way process that should: (i) begin early in the process of identification of environmental and social risks and impacts and continue on an ongoing basis as risks and impacts arise; (ii) be based on the prior disclosure and dissemination of relevant, transparent, objective, meaningful and easily accessible information which is in a culturally appropriate local language(s) and format and is understandable to Affected Communities; (iii) focus inclusive*** engagement on those directly affected as opposed to those not directly affected; (iv) be free of external manipulation, interference, coercion, or intimidation; (v) enable meaningful participation, where applicable; and (vi) be documented. The client will tailor its consultation process to the language preferences of the Affected Communities, their decision-making process, and the needs of disadvantaged or vulnerable groups.

Informed Consultation and Participation

For projects with potentially significant adverse impacts on Affected Communities, the client will conduct an Informed Consultation and Participation (ICP) process that will build upon the steps outlined above in Consultation and will result in the Affected Communities' informed participation. ICP involves a more in-depth exchange of views and information, and an organized and iterative consultation, leading to the client's incorporating into their decision-making process the views of the Affected Communities on matters that affect them directly, such as the proposed mitigation measures, the sharing of development benefits and opportunities, and implementation issues. The consultation process should (i) capture both men's and women's views, if necessary through separate forums or engagements, and (ii) reflect men's and women's different concerns and priorities about impacts, mitigation mechanisms, and benefits, where appropriate. The client will document the process, in particular the measures taken to avoid or minimize risks to and adverse impacts on the Affected Communities, and will inform those affected about how their concerns have been considered.

Indigenous Peoples

For projects with adverse impacts on Indigenous Peoples, the project sponsor is required to engage them in a process of ICP and in certain circumstances the client is required to obtain their Free, Prior, and Informed Consent (FPIC). The requirements related to Indigenous Peoples and the definition of the special circumstances requiring FPIC are described in IFC Performance Standard 7.

External Communications and Grievance Mechanisms

External Communications. Clients will implement and maintain a procedure for external communications that includes methods to (i) receive and register external communications from the public; (ii) screen and assess the issues raised and determine how to address them; (iii) provide, track, and document responses, if any; and (iv) adjust the management program, as appropriate. In addition, clients are encouraged to make publicly available periodic reports on their environmental and social sustainability.

Grievance Mechanism for Affected Communities. Where there are Affected Communities, the client will establish a grievance mechanism to receive and facilitate resolution of Affected Communities' concerns and grievances about the client's environmental and social performance. The grievance mechanism should be scaled to the risks and adverse impacts of the project and have Affected Communities as its primary user. It should seek to resolve concerns promptly, using an understandable and transparent consultative process that is culturally appropriate and readily accessible, and at no cost and without retribution to the party that originated the issue or concern. The mechanism should not impede access to judicial or administrative remedies. The client will inform the Affected Communities about the mechanism in the course of the stakeholder engagement process.

Ongoing Reporting to Affected Communities

The client will provide periodic reports to the Affected Communities that describe progress with implementation of the project Action Plans on issues that involve ongoing risk to or impacts on Affected Communities and on issues that the consultation process or grievance mechanism have identified as a

concern to those Communities. If the management program results in material changes in or additions to the mitigation measures or actions described in the Action Plans on issues of concern to the Affected Communities, the updated relevant mitigation measures or actions will be communicated to them. The frequency of these reports will be proportionate to the concerns of Affected Communities but not less than annually.

Source: (Adapted from IFC Performance Standard 1)

* For example, community and religious leaders, local government representatives, civil society representatives, politicians, school teachers, and/or others representing one or more affected stakeholder groups.
** Depending on the scale of the project and significance of the risks and impacts, relevant document(s) could range from full Environmental and Social Assessments and Action Plans to easy-to-understand summaries of key issues and commitments. These documents could also include the client's environmental and social policy and any supplemental measures and actions defined as a result of independent due diligence conducted by financiers.
*** Such as men, women, the elderly, youth, displaced persons, and vulnerable and disadvantaged persons or groups.

Chapter 4. Establishing DSM Sector Governance

Need for Long-range DSM Sector Planning

The economic contribution from mining is highly varied across countries, and negative outcomes have resulted from governments failing to convert mineral endowment into sustained forms of sustained economic activity. The quality of mining sector governance is paramount in this regard.[28] In summarizing lessons learned for mining resource rich nations, the IMF notes that key requirements that strengthen sector governance include:

- Good management to ensure efficient and effective exploitation;
- Good tax design to ensure appropriate government revenue and adequate incentives for investors;
- Good revenue administration to ensure that revenue is collected in practice; and
- Good public expenditure management to ensure that volatile and temporary natural resource revenue translates to permanent benefits for the nation and to manage the risk resource wealth poses to the wider economy.

There is a global experience that modest mining revenues that are well managed lead to larger development outcomes, than larger revenue streams that are poorly managed. At the core of this challenge is that few countries have a comprehensive governance strategy for effective natural resource management, owing to a fragmentation of stakeholder views limited by incomplete information (gaps) regarding the underlying resource endowment.

There is a growing recognition that public sector governance may well be the key determinant of the extent to which any one mine is economically, politically, socially, and environmentally viable. Where governance is weak or incomplete, instability and lack of predictability too often prevail and result in conditions of heightened risk and uncertainty for all. Mining investors require stability / predictability of financial and economic policies, and a transparent non-discretionary implementation of laws and regulations. Given an array of technical, commercial, and political risks; mining is high-risk / high-reward and financial gains and losses are both highly volatile and cyclical. Moreover, environmental / social / economic performance standards have become a core prerequisite for achieving sustainable outcomes, together with new demands regarding "shared value" that leverage mining investments to align with public sector development plans and ensure sharing of benefits with those most affected by mineral industries.

This interdependence between public sector performance and private sector risk is well known to investors. A 2015 World Bank compendium of industry perspectives and outlooks underscore the challenges facing the mining sector within emerging economies:

[28] At a general level, many conceive of mineral sector governance as a series of questions: *what the basic rules are that guide activities within a specified society; how these rules are implemented, monitored, and enforced; and who determines the rules and how this authority is conferred and employed?*

- Governance. Following the financial crisis of 2008, the mining industry is emphasizing a need for good sector governance in order to access scarce investment capital. Those nations offering higher levels of sector governance offer greater stability / predictability to investors.
- Social License to operate. Earning the social license to operate through inclusive growth processes and increased benefits sharing is essential. This requires improved revenue mobilization and tax administration by the public sector. As a part of this challenge, there is a need for increased “shared Value” to address the underlying root causes of community concerns and unlocks economic opportunities for companies in the extractives sector. Key opportunities include (a) the sharing of mutually beneficial infrastructure, (b) policies for local content to improve local workforce, suppliers and community health, and (c) creating the enabling environment for local cluster development, local infrastructure networks, and playing an active role in regional and community development. Shared value initiatives align private and public sector investments towards common goals.
- Integrated landscape management**.** Over the past decade there has been an increased appreciation of the importance of integrated spatial / temporal planning, recognizing that mines exist within complex landscapes having many other complementary and non-complementary uses. Moreover, the intersection of mining and its associated infrastructure with water and forest resources is a leading source of negative impact, and an area where integrated management can help to address the impacts of climate change.

Deep Sea Mining, like surface mining, has a number of unique characteristics that influence fiscal policy design and tax design and administration. These include:

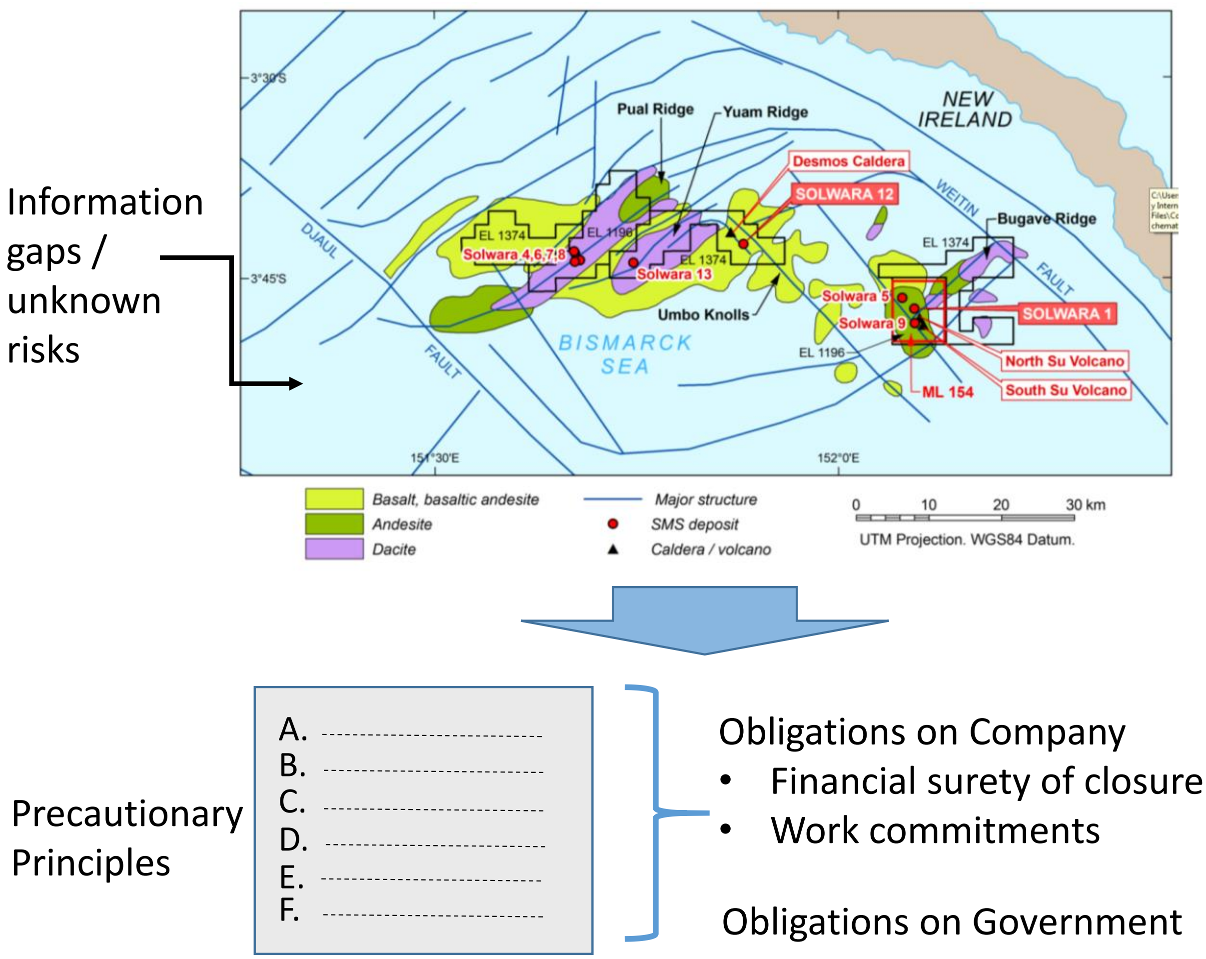
- Mineral resources are a valuable nonrenewable national asset, and governments expend much capital to assess the total resource endowment to understand (a) the full resource potential and (b) how any one mine development is impacting the depletion of this national asset.
- The profitability of a mining operation can vary significantly with changes in commodity prices, production costs, and fiscal policy.
- The industry has long been characterized as high-risk, high-reward, requiring large capital investments backed by strong technological expertise.
- In lower-income countries most of the natural resources produced are exported, and most of the high-value equipment and services used for natural resource operations are imported.
- Natural resource companies often operate under distinctive risk-sharing commercial arrangements.
- Transfer of ownership of interests in natural resource operations is common.
- Natural resources present exceptional challenges to governance and transparency.

Need for Quantitative Resource Assessment

However, Deep Sea Mining carries one unique characteristic – an inability by PIC governments to conduct a resource assessment of the broader mineral endowment in order to inform on the design of an appropriate fiscal policy, and understanding of economic potential. The current understanding of resource potential comes from a very small number of blocks (1-2) for which Bankable Feasibility Studies have been submitted and are available. It is not known where these first deposits are located upon the full spectrum of possible deposit sizes and qualities, and thus the potential size of the next “discovery” and the corresponding potential economic contribution.

The resulting information gaps extend physically across an area much larger than the proposed mining operation itself, and the provision of information to address these gaps may have to come from a partnership with those companies exploring the seafloor itself. Application of the Precautionary Principle for mitigating and managing environmental and social impacts may be useful in this regard, serving as a framework for approaching the economic resource potential – in that different options under the Precautionary Principle could include alternative incentives and obligations for the company to provide such data.

Figure 7. Unknowns and Obligations as per the Precautionary Principle



Need for DSM -Driven Local Content

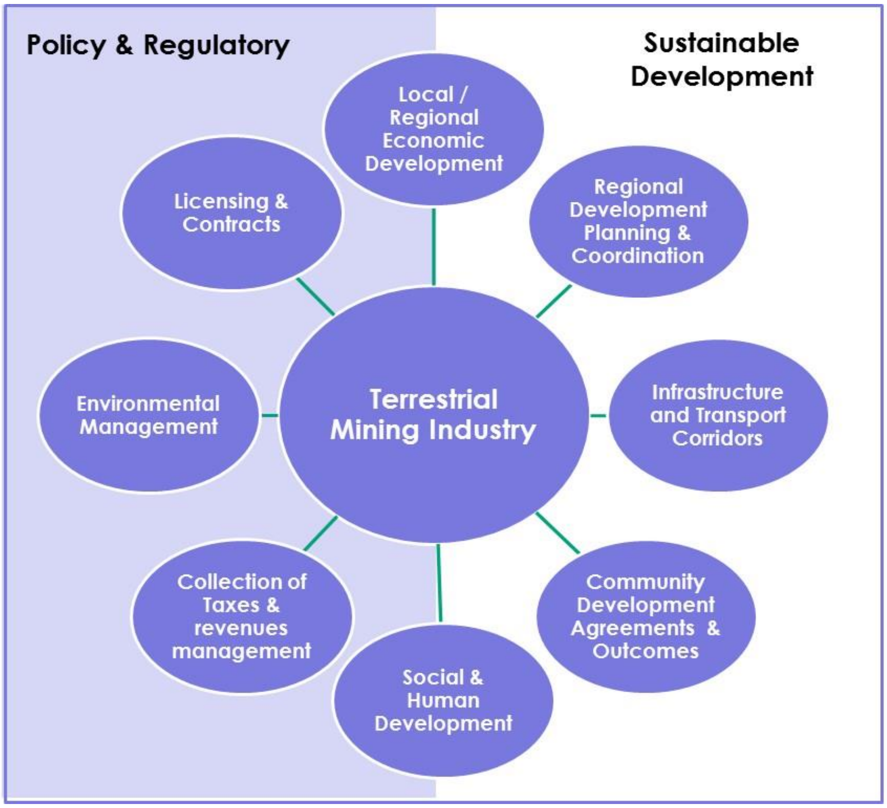
Decades of practical experience in capturing the economic impacts and linkages of mining highlight the existence of limited spillover effects in developing countries. Mining enclaves having few local linkages, result from the use of specialized input, often at the high end of the technology spectrum, sourced through globally integrated supply chains or global value chains. This is a DSM challenge given technology-intensive methodologies from a concentration of suppliers, many of whom may more commonly service offshore hydrocarbon exploration and development.

Policy interventions to strengthen economic linkages often taken the form of local content requirements, local ownership requirements, local processing standards, local hiring of staff, compulsory corporate social responsibility (CSR) programs, mandatory local content reporting requirements and supplier development programs among other (Hirschman, 1958, Kokko, 1994; UNCTAD, 2001; and Alfaro et al., 2010). Today, ninety-percent of all resource rich countries have policies or regulations related to promoting local content from extractive industry FDI, ranging from harder, and targeted requirements to softer approaches (Dobbs et al., 2014). Although these policies were designed to correct for enclave development, their application has achieved mixed results.

In approaching DSM, some useful lessons can be learned from the experience of other countries, policies and implementing tools aimed at developing productive linkages are context-specific – again aligned with the foundational premise of achieving "shared-value" combing the lessons of Porter et al. (2013) and the World Bank (2016).

- What types of DSM policies can be used to guide investment while increasing local linkages in PIC's? Do they differ across the region?
- What are the costs and benefits of introducing such policies, and how can this best be determined for potential DSM investors, PIC governments, and the society as a whole?
- How can the implementation of such policies be measured and monitored and the national level and through regional cooperation?
- What kind of technological and knowledge spillovers are more easily transferred to the PIC's? How would they be measured?
- What exactly is "shared-value" in the context of DSM in PIC's?

PIC governments will want to catalyze their position as owner of the mineral resources to leverage new collaborative partnerships around shared-value by aligning private sector DSM investments and public sector investments targeting poverty reduction and increased shared prosperity. Creating "shared value" within PIC's goes well beyond contractual and regulatory compliance challenges within PICs towards developing strategies for that deliver tangible social benefits. Figure XX below depicts several interrelated issues around shared value and sustainable development for mining. As applied to DSM, PIC governments would want to move beyond narrow definitions of policy and regulatory compliance (on the left side of the diagram), towards the strengthening of economic linkages (local content) through integrated planning, benefits that target community, and the sharing of infrastructure (which for DSM might relate to marine infrastructure and information technology systems to improve connectivity).



And, in approaching DSM it is equally important to understand what potential investors might need or want from governments. While no survey has been taken of potential DSM investors, the World Bank for many years has conducted surveys of terrestrial mining companies in emerging economies. Table XX below underscores the key elements of predictability, stability, and consistency of policy and decision making processes. Any poor practices that erode the enforcement of a competitive, transparent non-discretionary regime – serve to directly erode the viability of the investment, and PIC governments will want to safeguard against poor practices.

Investment Decision Criteria	***What Government Needs to Do***
Geological Potential / Resource Certainty	Geological Survey providing basic geo-data and undertaking mineral resource assessment

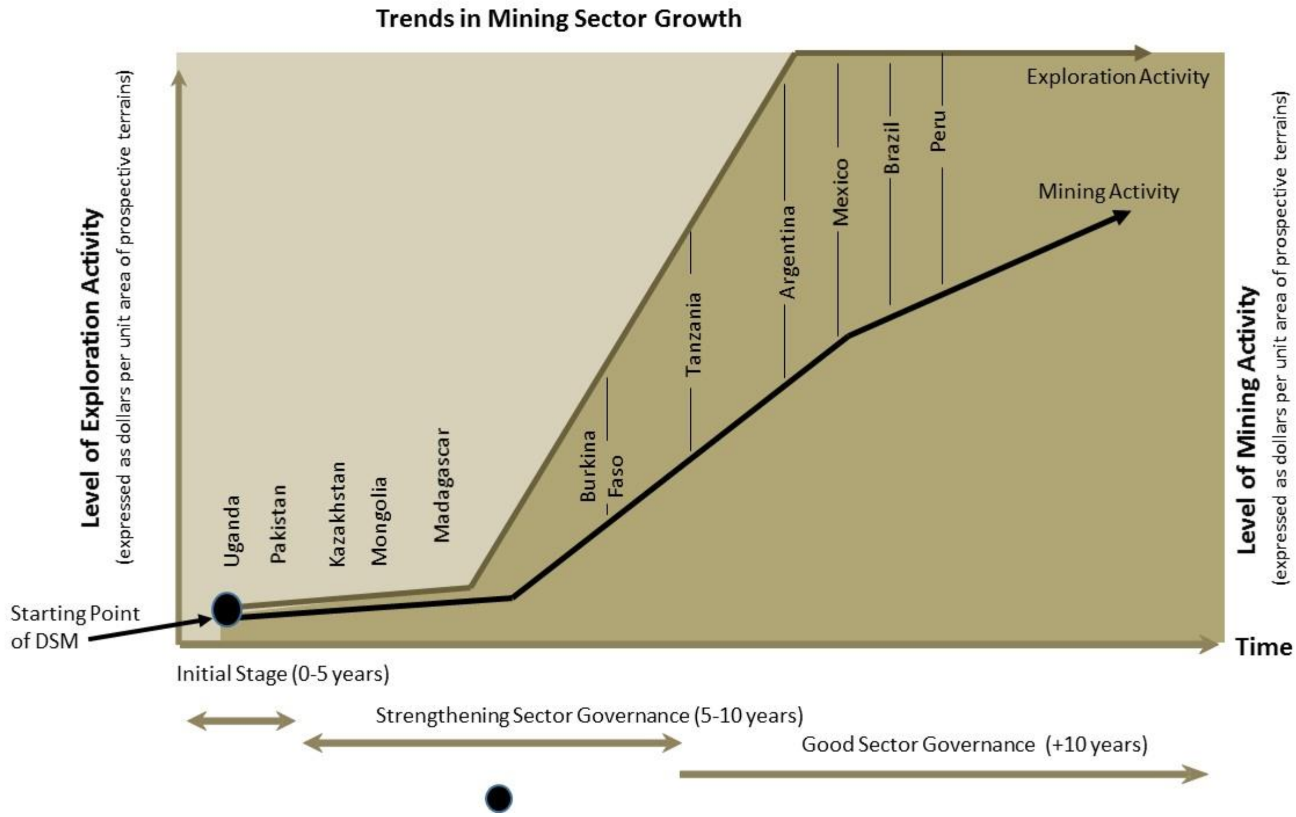
Profitability of Potential operations – competitive fiscal regime, realistic foreign exchange controls	Investment Laws
Security of Tenure – clear, non-discretionary mining rights and title for permitting	Mining Cadastre
Consistency of Mineral Policy – clarity of roles and responsibility, stability of exploration / exploitation terms and conditions, mineral ownership (resource nationalism)	Mineral Policy Tax Legislation
Stability of Legislation –predictable environmental / social obligations, non-discretionary transparent regulatory environment	Clear, consistent mining, environmental, social, and tax regulations
Availability of Infrastructure	Public Private Partnerships

What Investors Want, World Bank 2002

Need to Grow Industry

The mining industry in a new country is often stimulated by one exceptionally large or rich discovery. In the context of DSM, this might be a particular PIC licensing a single operation and the industry using that opportunity to "learn" how to better optimize production technologies and exploration to improve operational efficiencies. A second operation might then be begun, and one-by-one clusters of mining operations emerge. As such, the economic impact of DSM ten-to-fifteen years into the future could be more robust, making modelling of potential revenue streams all the more difficult absent a sense of the rate of learning associated with DSM.

Likewise, it is the experience in many countries having undergone World Bank supported reforms that governance also improves in incremental stages and the rate of improvement of sector governance ten-to-fifteen years into the future could also be appreciably different (most often improving in non-linear fashion). This learning by industry and government alike leads to some conceptual curves used by the World Bank to convey that reforms and concurrent sector activity (exploration and exploitation) take time to germinate, but once having achieved initial levels of efficiencies, can have marked further improvements thereafter (see Figure XX). It is not known if DSM would replicate the experience of terrestrial mining, only that incremental rates of increase through learning should be expected.



In summary, DSM will be an industry that undergoes learning, recognizing that the process has begun and there is need to signal and prepare governments for this process. The challenge is to systematically build capacity to (a) collect new data that informs upon the ecological situation, (b) identify where potential problems lie, (c) understand how to address administrative and fiscal management deficiencies of government, including policy and regulatory development, and (d) introduce effective environmental safeguards. And in this regard, time is not always on a government's side.

Fiscal Considerations

As with terrestrial mineral deposits, a commercial company will want to proceed with mining at sea when there is the prospect that the value of minerals produced will exceed the costs of finding and exploiting those minerals at least enough to cover the costs of the capital invested. However, unlike terrestrial mineral deposits far less is known about the costs of finding and exploiting deep seabed deposits. Nor have enough data been collected to know the economics of the "average" deep seabed deposit or to predict the frequency of above and below average deposits. This is a challenge for both the investor and the Government, which hopes to capture a portion of any profits made.

The repercussions of these unknowns for the design of a fiscal regime may be summarized as follows:

- It will be especially hard to determine in advance how profitable mining will be, at least in the initial stages of development of DSM. Fiscal terms fixed in advance could turn out to be entirely unbalanced, favoring one side or the other far too much. Indeed, if terms were left to negotiation, the high level of uncertainty and risks borne by the investor would likely lead to the Government having to make large concessions to secure any investment. If, later on, it turned out that mining could in fact be done very profitably, the Government would not be in a position to share in those benefits, except by reneging on the agreement and changing terms in its favor. This problem, which is encountered in terrestrial mining as well, will be especially acute for DSM until the sector has matured.

- These circumstances would tend to favor flexible fiscal regimes, in which the share in profits obtained by the investor and the Government would vary in proportion to the level of profits made (ex-post). This means that if profitability turns out to be greater than thought at the time of the investment, the upside would be shared and not benefit the mining company alone.
- In its purest form, a resource rent tax, such flexibility will, however, tend to mean that fiscal receipts will be back-end loaded to allow investment recovery to take place first. In addition, by linking fiscal receipts so closely to profitability, revenue flows would be more likely to match the highly cyclical and volatile nature of mineral commodity markets. Whereas a large and diversified economy could probably absorb erratic revenues from mining, that will not be the case in small mineral-dependent economies.
- Some governments in the region may see DSM as an opportunity to generate windfall revenue, even as early as when awarding rights to explore for exploit deep seabed minerals, through a system of cash bonus bidding, such as is commonly used in the oil industry. However, this is unlikely to be a viable approach so long as commercial risks remain very high and only a small field of players exist.
- Similarly, some governments may wish to participate financially in DSM, to gain direct access to profits. However, it should be recognized that such equity participation would be placing public funds in the riskiest of all mining ventures. Governments could be better off limiting or eliminating downside risks, while retaining an opportunity to participate in any upside through a resource rent tax.
- There will undoubtedly be considerable pressure on Governments to offer fiscal incentives to investors in DSM on the grounds of the high risk and the “pioneer” character of DSM projects. Fiscal incentives are only justifiable if the counter-factual is no investment at all or if the incentives generate non-fiscal benefits (i.e. additional jobs, additional infrastructure) that justify the tax revenue foregone. Because of the new nature of DSM, Governments may be poorly placed to assess the counter-factual and unless incentive systems are very well defined and monitored, they can be open to abuse, denying Governments badly needed revenues.
- There is also likely to be pressure from investors to receive fiscal stabilization assurance for the same reason that DSM projects are high risk and the investor is acting as a pioneer. Companies will want to protect themselves from any temptation the Government may later have to renege on the fiscal terms to the disadvantage of the company. Care should be taken to limit the application of such stability assurances in terms of both duration and scope.

Chapter 5. Regulatory and Institutional Gap Analysis

The management of deep sea mining in a fiscally, environmentally, and socially responsible manner in line with the precautionary principle requires a sophisticated regulatory regime and highly specialized technical expertise.

Regulatory framework. As late 2015, of the 14 PICs only four, namely Palau, Tonga, Tuvalu and Nauru had legislation in place that covered DSM specific issues. In five countries, namely FSM, Kiribati, Republic of Marshall Islands, Niue, and Solomon Islands, draft DSM legislation prepared under the EU-SPC DSM project was at various stages of processing for enactment. Separately, in Papua New Guinea, a review of the mining laws and the national minerals policy currently is in progress and will result in the revision of the mining laws to include DSM. In Vanuatu, a DSM policy has been completed and submitted to cabinet for adoption. A number of regional frameworks (i.e. legislative and regulatory framework; financial framework; environmental framework; and scientific research guidelines) are prepared by the SPC-EU DSM Project for information and can be used by PICs as a guide to develop similar national frameworks (Table 9).

The SPC has laid out the main elements of a regulatory regime that embodies and supports the application of the precautionary approach in dealing with the environmental and social impacts and risks of DSM (SPC, ND; SPC, 2015). Whether a self-standing DSM legislation or as part of a more general existing legislation on mining, the legislation and associated regulations would need to clearly define: i) the requirements for assessing and documenting the environmental and social impacts and risks associated with the proposed DSM project, at each stage of the project, including prospecting, exploration, exploitation, closing, and post-exploitation; ii) monitoring and compliance requirements, and iii) transparent and enforceable procedures, including public participation, at each step, and a grievance mechanism. As such, the proposed regulatory regime is in line with the key requirements of UNCLOS and the World Bank Group Safeguards Policies and Standards summarized in Table 10.

Institutional capacity. Specialized technical capacity of government personnel dealing with DSM issues is limited at best in most PICs (Table 9). While no systemic analysis of environmental management capacity with regard to DSM has been carried out, it is likely also very limited in most countries. Under the EU project, SPC facilitated the establishment of national offshore minerals committees, which are tasked with facilitating and/or reviewing of DSM policy and laws and conducting awareness programs, among others. To address technical capacity shortages, the said project also sponsored training workshops, internships, conference attendance, and short-term attachments. However, the sustainability of the capacity thus built is questionable as qualified and experienced professionals tend to join the private sector and regional organizations or migrate to countries such as Australia and New Zealand.

Table 9. Status of Regulatory Capacity by Country

Country	In-Country Capacity	Status of DSM Law and Policy	Areas in Need of Strengthening
Cook Islands	Despite no commercially-generated income from DSM yet, Cook Islands has an established Seabed Minerals Authority, reporting to the Minister of Finance and comprising a Seabed Minerals Commissioner, a Legal Advisor, and a Natural Resources Advisor (funded by Commonwealth Secretariat). Government also includes two trained GIS specialists, and a Secretary of Finance with significant international experience of raising and managing extractive industry revenue. SPC-EU DSM Project is currently reviewing the Cook Islands Tender Process.	A Seabed Minerals Act 2009, Income Tax Amendment (Seabed Minerals) Act 2012, Seabed Minerals (Royalties) Regulations 2013, and Seabed Minerals Policy 2014, Seabed Minerals (Prospecting and Exploration) Regulations 2015 are all in place. A draft law to establish a sovereign wealth fund for DSM revenue is under consultation. A letter of agreement is in place with GSR for a joint venture application for ISA contract, under Cook Islands sponsorship.	• Review of Seabed Minerals Act, and/or Environment Act with full prior environmental impact assessment before any DSM exploration license • Environmental Permitting (Seabed Minerals) Regulations, under the Env. Act • Tender process guidelines • Running a tender process • Negotiating the terms of a joint venture for exploration in 'the Area', with GSR. • An Act to cover the Cook Islands sponsorship of DSM activities in 'the Area'.
FSM	FSM has no minerals or other extractive industry experience, no technical personnel or regulatory infrastructure within Government. The Ministry of Resources and Development has been designated the lead agency for DSM issues, but has no in-house expertise. Assistant Attorney-General has received DSM law training.	A draft Seabed Mining Bill (and Explanatory Guide), prepared by SPC, is due for submission to Congress in 2014. Consultations in each of the four States were undertaken in 2014 and 2015.	○ Capacity-building within Government ○ Development of a regulatory authority – personnel and infrastructure capacity-building ○ National DSM Policy ○ DSM licensing Regulations, including model licenses and agreements ○ DSM environmental permitting guidance / regulations ○ Economic planning assistance ○ Fiscal policy and law assistance ○ Additional DSM prospecting / exploration within national jurisdiction
Fiji	Fiji has some institutional structure and capacity from its (small-scale) onland mineral industry. The former Director of Mineral Resources (now Permanent Secretary of the Ministry of Lands and Mineral Resources) is apprised of DSM issues, and 1 junior Law Officer has received DSM law training. Fiji, via Foreign Affairs (UN Office), have historically been very active at the ISA, and this	In 2013 Fiji passed an International Seabed Minerals Management Decree (to cover future sponsorship of DSM activities in 'the Area') with SPC's assistance. With regards to the EEZ: a draft Minerals Exploration and Exploitation Bill 2006 has been under review for 7+ years, but does not cover DSM. DSM licences have been issued using the Mining Act 1978, which	○ Capacity-building within Government ○ Updating and publication of Offshore Minerals Policy ○ Public consultation / awareness-raising, including traditional leaders and landowners. ○ Review and finalization of the Minerals Bill, incorporating DSM provisions (or a separate DSM law)

Country	In-Country Capacity	Status of DSM Law and Policy	Areas in Need of Strengthening
	continues to date with: Fiji holding a place on the ISA Council, a Fijian nominee being a member (and former Chair) of the ISA's LTC, and Fijians hired as senior ISA Secretariat staff.	was amended in 2010 to include the seafloor within its scope (but which does not otherwise cover DSM). A draft DSM Policy exists.	○ DSM licensing Regulations, including model licenses and agreements. ○ DSM environmental permitting guidance / regulations. ○ Economic planning, and fiscal policy and law.
Kiribati	There is a Government minerals unit staffed by junior officers, but experience and infrastructure is lacking. A senior officer and a junior officer are appraised on DSM issues. There may be in-country financial management knowhow garnered from Kiribati's phosphates fund. It is unclear how Kiribati will perform the exploration and other requirements of their ISA contract, which will require significant financial and technical capabilities. Some national awareness-raising has been conducted (e.g. a Government radio phone-in on DSM).	A cross-Ministerial National Offshore Management Committee has been established to progress DSM matters. A DSM policy has been drafted, and is due for national consultation in 2015. Draft DSM Bill and Explanatory Guide prepared by SPC, is due for submission to Cabinet in 2015. A Mineral Development Licensing Ordinance 1977 provides a framework that can be used for a DSM regulatory regime, but would require additional regulations – and sets a 2% royalty rate that should be re-examined. A national law is required for the management of DSM activity under Kiribati sponsorship in 'the Area'.	• National law to cover Kiribati sponsorship of DSM activities in 'the Area'. • Review / replace 1977 Mineral Development Licensing Ordinance • DSM licensing Regulations, including model licenses and agreements. • Development of a regulatory authority – personnel and infrastructure capacity-building. • Review of environment laws and assistance with developing a regime for DSM environmental management • Economic planning assistance. • Fiscal policy and law assistance. • Technical support and advice for implementation and management of ISA contract and related loan and off-take agreements. • Additional DSM prospecting / exploration in national jurisdiction
Marshall Islands	RMI has no minerals or other extractive industry experience, no technical personnel or regulatory infrastructure within Government. Interim Seabed Minerals Board established in October 2014. Marine Resources Authority appears reluctant to expand its (currently fishery-focussed) remit to include DSM, and Resources and Development – which has been designated the lead Ministry – is under-resourced and slow-moving on DSM issues. Two assistant	A draft Seabed Mining Bill and Explanatory Guide prepared by SPC is with the AG's Office, due for submission to Congress in January 2016. Draft DSM Policy prepared by SPC is currently under review. National consultations were held in Majuro and Ebeye in April 2015, second round of consultations was held in October 2015. A session on DSM was held with the new parliament in the 1st week of March 2016 to briefing the Members of Parliament on	• Capacity-building within Government • Development of a regulatory authority – personnel and infrastructure capacity-building. • DSM Licensing Regulations, including model licenses and agreements. • DSM environmental permitting guidance / regulations. • Economic planning assistance. • Fiscal policy and law assistance.

Country	In-Country Capacity	Status of DSM Law and Policy	Areas in Need of Strengthening
	Attorney-General officers have received DSM law training.	the recent DSM work in RMI and the status of the DSM Policy and Bill.	
Nauru	Nauru has no technical personnel, Ministry or regulatory infrastructure relevant to DSM, and limited legal capacity within Government. Two Attorney-General's officers have received DSM law training.	No relevant policy in place. Draft DSM Bill and Explanatory Guide prepared by SPC and was submitted to Parliament in September 2015. The DSM Act was passed by Parliament in October 2015.	• Development of a regulatory capacity • Technical support and advice for implementation and management of ISA contract and related loan and offtake agreements. • Economic planning assistance • DSM prospecting / exploration within its EEZ.
Niue	As may be expected from a country with a population of just 1200: very limited access to technical personnel or infrastructure, no minerals experience or relevant Ministry. One Crown Law's officer has received DSM law training.	A draft Bill for the national regulation of DSM mining, and licensing Regulations, prepared by SPC, are with Crown Law.	○ Securing further survey work in the EEZ ○ Finalization of policy and law ○ Economic planning. ○ Fiscal policy and law ○ Additional DSM prospecting / exploration within its EEZ
Palau	The Palau Government has an established task-force for offshore petroleum (although has no oil/gas projects), and strong Fisheries management. But no minerals authority or personnel.	No DSM policy or law, but in 2012 Palau enacted a full suite of policy and legislation for petroleum, with the support of the World Bank – which appears adaptable for DSM also.	○ Review of petroleum laws and amendment, or additional laws to extend the regime to cover DSM. ○ Economic planning, particularly with regards declaration of EEZ as no-take zone
Papua New Guinea	PNG has several on land metal mines and a well-resourced Ministry of Mineral Policy and Geohazards Management, and Mineral Resources Authority – who are also responsible for DSM. PNG however has a history of civil conflict, environmental degradation, and poor revenue management associated with its mining industry. Civil society groups complain of lack of consultation (although Nautilus records having met with 20,000 community members) and there are local campaigns opposing Solwara 1. PNG has recently become an EITI candidate country.	The Nautilus DSM mining lease was issued under existing mining laws, amended only to extend the definition of 'land' to include the seabed. The same fiscal regime as applies to on land minerals has been applied to Solwara 1 (and PNG exercised their right to take a 15% equity share in the project). Review of the mining laws in progress. The revised instruments include DSM. National offshore minerals policy under review.	○ Public consultation / awareness-raising, including traditional leaders and landowners. ○ Complete review of mining laws. ○ Incorporating DSM provisions (or a separate DSM law) into mining laws. ○ Fiscal policy for DSM, and DSM tax / royalty laws. ○ DSM licensing Regulations, including model licenses and agreements. ○ DSM environmental permitting guidance / regulations. ○ Work towards EITI compliance. ○ Economic planning. ○ Engaging with the ISA, and seeking partnership opportunities for DSM activities in 'the Area'.

Country	In-Country Capacity	Status of DSM Law and Policy	Areas in Need of Strengthening
			○ Advice in obtaining further downstream benefits from DSM – e.g. refinery work in-country
Samoa	The Ministry of Natural Resources and Environment, and AG's Office, appear reasonably well-informed and well-resourced, although Government has not much engaged with DSM issues to date.	No policy or law in place. Samoa has yet to make a firm policy decision on whether to engage in DSM activities (including in 'the Area').	○ A national DSM strategy and policy. ○ Engagement with the ISA, and finding partnership opportunities for DSM activities in 'the Area'.
Solomon Islands	Despite on-land gold-mining, and a Ministry of Mines, Energy and Rural Electrification, capacity to progress DSM matters in the Solomon Islands is slow. With the support of the SPC-EU DSM Project, some community-level information-sharing by a joint Government, NGOs and industry initiative, in Temotu province in 2014, and a Youth Debate on DSM in 2015.. EITI-candidate country	Review of existing mining policy, law and Government structures with World Bank support draft Mineral Resources Authority Act, due for enactment mid-2013, has yet to be passed Draft DSM Policy prepared by SPC and submitted in January 2015. Recent discussion between SPC, the World Bank and the Government regarding collaboration on the review of the Minerals Policy and Mines and Minerals Act to include DSM.	○ Enactment of the Mineral Resources Authority Act ○ Establishment of the new Mineral Resources Authority ○ Review of the Minerals and Mining Act, incorporating DSM provisions (or prepare a separate DSM law) ○ DSM licensing Regulations, including model licenses and agreements. ○ DSM environmental permitting guidance / regulations. ○ Economic planning. ○ Fiscal policy and law. ○ Work towards EITI compliance. ○ Public consultation / awareness-raising, including traditional leaders and landowners.
Tonga	Regulatory expertise and infrastructure for minerals licensing and environmental permitting is very limited The Ministry of Finance is more advanced with regards to fiscal policy and laws DSM companies with interest in the EEZ have requested new DSM-specific laws and regulatory processes in order to move to mining phase.	Seabed Minerals Act 2014 DSM licensing Regulations in progress, National DSM Policy in progress IMF provided DSM fiscal policy and legislation assistance. Discussions are ongoing with SPC on the drafting of the DSM fiscal legislation in 2016.	○ Public and industry consultation on the draft DSM policy and law ○ Amendment and finalization of DSM policy and regulations ○ Government capacity-building ○ Establishment of regulatory authority and other institutions envisaged in the DSM policy and law ○ TA for implementation and management of ISA contract and related loan and off-take agreements ○ Advice in obtaining further downstream benefits from DSM – e.g. refinery work in-country.

Country	In-Country Capacity	Status of DSM Law and Policy	Areas in Need of Strengthening
	Tonga recently raised its exploration fees, increasing its annual exploration income from $20k to $3m		
Tuvalu	Capacity for progressing DSM matters is limited, but the Ministry of Natural Resources and government well-informed One Attorney General's officer has received DSM law training	Seabed Minerals Bill 2014 DSM licensing Regulations and DSM Policy in progress	○ Continued pursuit of commercial partnership opportunities for DSM activities in 'the Area' ○ Finalization of DSM policy and regulations ○ Economic planning ○ Fiscal policy and law ○ Additional DSM prospecting / exploration within its EEZ
Vanuatu	Capacity within the Department of Geology, Mines and Water Resources, but staffing is limited and training is required.	Public consultations on th draft DSM policy completed and it has been finalized and submitted to cabinet. New DSM law, or significant amendment to the Minerals and Mining Act 1986 required for a comprehensive national DSM regulatory regime. At the request of the government SPC is currently drafting the DSM Bill.	○ Public consultation / awareness-raising, including traditional leaders and landowners ○ Review of the Minerals and Mining Act, to incorporate DSM provisions (or prepare a separate DSM law) ○ DSM licensing Regulations, including model licenses and agreements ○ DSM environmental permitting guidance / regulations ○ Economic planning, Fiscal policy and law ○ EITI candidacy (or equivalent initiative for DSM)

Table 10. DSM Environmental and Social Management Requirements as per WBG Safeguards Policies and Performance Standards, UNCLOS, and the ISA Mining Code.

World Bank Safeguards	IFC Performance Standards	UNCLOS	ISA Mining Code*
Environmental (OP 4.01, OP 4.04, EHS Guidelines) (i) Impacts on terrestrial and marine biodiversity; (ii) water quality, use and discharge; (iii) noise and vibrations; (iv) sedimentation; (v) worker health and safety. Instruments: Environmental Assessment (EA) + environmental management plan (EMP) for nearly all types of projects. Environmental Impact Assessment (EIA) + EMP for serious or irreversible impacts. Stakeholder consultations (2X for EIA). Public disclosure. Social (OP 4.01, potentially OP 4.10) (i) Equitable benefit sharing schemes (possibly including technology transfer concerns?); (ii) Public participation and engagement, including free, prior and informed consultations for certain communities; (iii) Livelihoods impacts on other users, especially fishing communities and tourism service providers Instruments: Social Assessment; Grievance mechanism International (OP 7.50, OP 7.60) Transboundary impacts – on water quality; (ii) Maritime boundaries – not all maritime boundaries have been delimited and disputes abound.	Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts • Methodological approach to identify and manage environmental and social risks and impacts in a structured way on an ongoing basis. • Mitigation hierarchy to anticipate and avoid, or where avoidance is not possible, minimize, and where residual impacts remain, compensate/offset for risks and impacts • Grievance from Affected Communities and external communications from other stakeholders to be responded to and managed appropriately • Adequate engagement with Affected Communities throughout the project cycle; relevant environmental and social information to be disclosed and disseminated.	• Provides for regulation of all ocean space, access to the seas, navigation, protection and preservation of the marine environment, settlement of disputes. • Sets out the legal framework for exploration and exploitation of the deep seabed. • Establishes the EEZ measuring up to 200 nm. • Grants all coastal states have a right to engage in exploration and exploitation of the seabed and subsoil within their national jurisdictions.	• Governs DSM in the Area together with legislation by sponsoring sovereign states. • Bound by UNCLOS • Three sets of regulations for exploration (one each for nodules, sulphides and cobalt): • Regulatory framework for exploitation under development.

* Currently encompasses three sets of regulations on prospecting and exploration of i) polymetallic nodules, ii) polymetallic nodules, and iii) cobalt rich crusts in the Area. Regulations on exploitation of deep sea minerals is currently under development.

Table 11 presents the specific regulatory functions with regards to environmental and social risk management that PIC governments would need to carry out under the precautionary principle. The majority of these functions require specialized expertise and equipment, as indicated by the red highlights.

Table 11. Environmental management functions under various precautionary principle options for DSM management

<table>
<tr><th>No development</th><th>Set asides</th><th>Use technological innovation to minimize impacts</th><th>Mining Proxy</th><th>Pilot or trial mining on small scale</th><th>Adaptive management</th></tr>
<tr><td rowspan="10">If decision is made “for the time being, until more information on the risks become available”, then there is a need to continue to collect and assess data on the risk elements</td><td>Selection and demarcation</td><td>Define limits on impacts</td><td></td><td></td><td></td></tr>
<tr><td>Monitoring impact on set-asides</td><td>Evaluate whether appropriate technologies are deployed.</td><td></td><td></td><td></td></tr>
<tr><td colspan="5">Supervision and independent verification of company’s monitoring activities.</td></tr>
<tr><td colspan="5">Monitoring of transboundary effects</td></tr>
<tr><td colspan="5">Continued public consultations, incl. grievance mechanism</td></tr>
<tr><td colspan="5">Monitoring data compilation, analysis and interpretation</td></tr>
<tr><td colspan="5">Enforcement in case of transgressions against license (EIA) conditions</td></tr>
<tr><td colspan="5">Decision to cancel operation in case of significant risk or impact</td></tr>
<tr><td colspan="5">Emergency preparedness and response</td></tr>
<tr><td colspan="5">Coordinating with ISA on regulatory development and management of DSM operations whose impact span across the boundaries between EEZs and The Area</td></tr>
</table>

Specialized expertise and equipment needs

Moderate

High

Costs. Establishing and implementing the regulatory framework and institutional capacity is costly. SPC (2016) estimates the annual recurrent expenditures for Papua New Guinea at US$205,000, as detailed in Table 12. The estimates provide a useful ballpark figure, while one must keep in mind the large variation among the PICs in terms of key cost determinants, including the extent of DSM resources, their distances from the capital city, and general wage levels.

Table 12. Estimated Costs of establishing Regulatory and Institutional Capacity in a PIC

Cost item	Amount	Details
One time expenditure		
Development of a DSM regulatory framework	$2,000,000.	This includes the labor and personnel associated with drafting the initial regulations and the establishment of a regulatory body to carry out / enforce the regulations.
Annual recurrent expenditures		
Monitoring and reporting of DSM activity associated with a single mining operation	$120,000	Six full-time equivalent workers to provide constant monitoring of DSM mining activities (e.g. PSV on-board monitoring)[29]. Semi-skilled positions priced just above the median income for PNG. Including salaries, benefits and overhead.
Collection and distribution of DSM related payments	$50,000	One full time equivalent[30] with a salary bracket in the top 10% of income distribution. Including salaries, benefits and overhead.
Contract Administration	$35,000	One full time equivalent. Including salaries, benefits and overhead.[31]

DSM Management in the Area

The International Seabed Authority ("ISA" or "the Authority") administers the Area in accordance with the 1992 United Nations Convention on the Law of the Sea (UNCLOS) and its 1994 Implementing Agreement relating to the deep seabed mining. Within this general legal framework, ISA issues rules, regulations and procedures, the totality of which is referred to as the "Mining Code".

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[29] Assuming mining is a 24/300 operation and allowing for 30% of a monitors time to be spent on administrative duties and travel, 6 workers are required to ensure 100% at-sea coverage.

[30] Even without onshore processing, DSM mining would be a large part of the economy. This is a fairly skilled employee who makes sure payments are received in a timely manner and funds are dispersed to coastal residents in a manner consistent with laws and policies. It is envisioned as a full-time position with a salary bracket in the top 10% of income distributions.

[31] This position would be considered entry-level in the U.S. and requires an employee who would be responsible for monitoring contractor performance for compliance with applicable laws, delivery schedules, payment provisions, inspections, contract and date reporting requirements. Salary is based on similar job posted by the U.S. government for a contract administrator for the Department of Defense (https://www.usajobs.gov/GetJob/ViewDetails/412169800 Accessed August 7, 2015.

As of November 2, 2015, ISA had issued Regulations on Prospecting and Exploration for Polymetallic Nodules in the Area (adopted 13 July 2000) which was later updated and adopted 25 July 2013; the Regulations on Prospecting and Exploration for Polymetallic Sulphides in the Area (adopted 7 May 2010) and the Regulations on Prospecting and Exploration for Cobalt-Rich Crusts (adopted 27 July 2012).[32] In 2011, the Authority's Legal and Technical Commission issued an environmental management plan for the Clarion-Clipperton Zone (ISA, 2011).

The Authority is in the process of developing regulations on exploitation of mineral resources in the Area. In July 2015, the Authority issued a Draft Framework for the Regulations of Exploitation Activities ("Draft Framework") (ISA, 2015) The next step will be a zero draft of the regulations for exploitation, including standard contract terms to be considered by the Legal and Technical Commission in February 2016. The initial draft will then be circulated to stakeholders in March 2016 and presented to the Council in July 2016.

The Draft Framework provides an outline of a suggested structure for future exploitation regulations. The Draft Framework does not address the development and resourcing of a mining inspectorate within the Secretariat function. It recommends that the administrative and enforcement functions of a "typical" mining regulator, environmental management agency and perhaps maritime security regime are benchmarked in due course (ISA, 2015).

[32] https://www.isa.org.jm/mining-code/Regulations. Accessed on November 2, 2015.

Chapter 6. Where Regional Cooperation needs to be strengthened

For any Pacific Island country that is considering to derive economic benefits from deep sea minerals in its EEZ in a fiscally, environmentally and socially responsible manner following the precautionary principle, the cost of regulatory measures is high. Meeting the demands for specialized expertise and equipment is a significant challenge for most PICs given limited national budgets and populations. Recognizing these challenges, PICs have voiced growing interest in formalized regional cooperation in regulating DSM building on the ongoing current collaboration under the auspices of the EU SPC Project ("Current Situation") and following the existing regional cooperation arrangements for the management of fisheries (Box 6)

Box 6. Existing Regional Modes of Cooperation for managing the Resources of the Pacific

- The **Framework for a Pacific Oceanscape** (2010) is a framework for policy implementation to better understand and conserve the Pacific Ocean in support of the Pacific Plan's (2005) key objective of ensuring the health of the Pacific Ocean and the fisheries resources it supports. The Pacific Islands Forum Secretariat houses an Oceanscape Unit responsible for monitoring implementation of the Framework while the Pacific Islands Fisheries Agency provides direct oceanic (tuna) fisheries management, development and compliance services to the Forum's member countries. The Pacific Community provides coastal fisheries science, management and development services to its members, together with the oceanic scientific research.
- The **Nauru Agreement** Concerning Cooperation in the Management of Fisheries of Common Interest (" The Nauru Agreement") signed in 1982 by 8 PICs, namely the Federated States of Micronesia, Kiribati, the Marshall Islands, Nauru, Palau, Papua New Guinea, Solomon Islands and Tuvalu, who collectively control 25–30% of the world's tuna supply and approximately 60% of the western and central Pacific tuna supply. The 'Parties to the 'Nauru Agreement' (PNA) aim to improve regional conservation measures and financial returns from foreign vessels operating within their EEZs. To this end, the PNA have developed a vessel day scheme as a specific system for collective action to manage the shared purse seine fishery within their waters, which is administered by the PNA Office based in Majuro.
- The oceanic fishing activities occurring on the high seas neighboring the waters of some PICs are managed collectively by the **Western and Central Pacific Fisheries Commission** established under the United Nations Fish Stocks Agreement.

Caution should be exercised however, when considering the fisheries regime as a model for cooperation on DSM because of several, important differences between DSM and fisheries. First, the fisheries regime under the Nauru Agreement aims to optimize revenue and benefits to PICs from an activity that is already fully developed. Second, as a shared renewable resource, fish provide a greater incentive to cooperate since one country's unsustainable actions damaging the stock would affect all other countries. Therefore, a common position in negotiations benefits all.

Possible Cooperation Arrangements

Current Situation

As detailed in Tables 13.1 and 13.2 below, under the Current Situation, the PICs cooperate with SPC on general regulatory functions (items 1-3 on Table 13.1); however, PIC governments carry out all specific project-related measures (items 4-6). The latter include scoping, reviewing and approving environmental and social assessments; selecting an appropriate precautionary principle option, including possibly 'no development'; supervising and enforcing the agreed environmental management regime under the selected option. However, given their current capacity and resources, most PICs are not in a position to perform most of the project-specific regulatory functions. SPC has provided technical assistance or to national regulators in some areas. Specifically, SPC provides technical and legal advice on the pros and cons of each option, while the decision of the appropriate precautionary principle option rests with sovereign states.

Table 13.1. Regional Cooperation under the Current Situation and Possible Alternatives - General

	Current		Possible Alternatives	
	PIC Gov't	SPC	Regional Technical Service Provider	Regional Regulator
ONGOING and GENERAL				
1) Ongoing data collection and management				
a. Collect, compile and evaluate baseline data		X	X	X
b. Regional / sub-regional strategic impact assessment		X	X	X
c. Manage independent scientific research program	X	X	X	X
2) Maintain specialized EIA and monitoring consultants list		X	X	X
3) Ongoing stakeholder consultations	X	X	X	X
PROJECT SPECIFIC				
4) Environmental and social assessments				
a. Determine scope	X		X	X
b. Review	X		X	X
c. Approve	X		Advice	X
5) Select precautionary principle option	X	Advice	Advice	X
6) Environmental management under chosen option (details in Table 12.2)	X		See Table 13.2	X

Possible Alternative Scenarios

Two scenarios replacing the Current Situation have been identified. The first alternative may be the establishment of a Regional Technical Service Provider which would build on and expand SPC's current function. More concretely, as detailed in Table 13.2, the Regional Technical Service Provider would manage or supervise all technical activities and provide advice to the national authorities on the choice of the appropriate precautionary principle option, on enforcement decisions in case of transgressions in the chosen option, and on questions regarding conversion of a mining proxy or trial operation to a full-scale (adaptive management). The decision making authority on these questions would rest with PIC national governments. Shifting the technical aspects of DSM regulation to a competent regional body, would drastically reduce the demands on national institutions. The Regional Technical Service Provider may also engage in capacity building capacity on DSM issues among decision makers.

The second alternative may entail a regional regulator, which would have not only the technical competency to carry out all technical functions listed above, but also the authority to make and implement decisions on enforcement matters, and choice of precautionary principle option, including conversion from proxy or trial to adaptive management or termination of an operation. The regional regulator would act on behalf of the sovereign states and be supervised by an advisory council.

While the establishment of a regional body, whether a technical service provider or regulator, would be much more efficient and effective, than individual PICs building up regulatory capacity, a critical question concerns the source of funding. It would seem natural and consistent with the polluter pays principle to suggest that the regional body be funded by companies licensed to carry out prospecting and to larger degree by companies licensed for exploration and exploitation. The "taxing" of companies at the exploration stage makes sense given that a large number of critical regulatory functions, including the social and environmental assessments and decisions on the precautionary principle option take place during the exploration phase, as discussed before.

Caution needs to be exercised on possible conflict of interest regarding a regional body, in particular and a regional regulator. If the *raison d'etre* of such a regulator is to help develop DSM and if it is funded through fees paid by mining companies, it may find itself torn between two motivations, one to make a mining operation happen on the one hand and to exercise the precautionary principle to its fullest extent, including not going ahead with or terminating a DSM exploitation project.

Table 13.2 Regional Cooperation under the Current Situation and Possible Alternatives – by Option

	Current		Possible Alternatives	
	PIC Gov't	SPC	Reg. Technical Service Provider	Reg.Regulator
ENVIRONMENTAL MANAGEMENT BY CHOSEN OPTION				
a. No development				

	Current		Possible Alternatives	
	PIC Gov't	SPC	Reg. Technical Service Provider	Reg.Regulator
If decision is made “for the time being, until more information on the risks become available”, continue to collect and assess risk data	X	X	X	X
b. Set-asides				
· Determine most suitable set-asides	X	X	X	X
· Demarcate set-asides	X		X	X
· Monitor impact of DSM on set-asides	X		X	X
· Monitor impact in other areas	X		X	X
· Monitor transboundary effects	??		X	X
· Continue public consultations; grievance mechanism	X	X	X	X
· Monitoring data compilation, analysis, interpretation	X	X	X	X
· Enforcement in case of transgressions	X		Advice	X
· Emergency preparedness and response	X		X	X
c. Use technological innovation to minimize impacts				
Define limits on impacts	X		X	X
Supervision and independent verification of company’s monitoring activities.	X		X	X
Monitoring of transboundary effects	X		X	X
Continued public consultations; grievance mechanism	X		X	X
Monitoring data compilation, analysis and interpretation	X		X	X
Enforcement in case of transgressions	X		Advice	X
Decision to cancel operation in case of significant risk or impact	X		Advice	X
Emergency preparedness and response	X		X	X
d. Mining proxy				
· Monitor impact	X		X	X
· Monitoring of transboundary effects	X		X	X
· Continued public consultations; grievance mechanism	X		X	X
· Monitoring data compilation, analysis, interpretation	X		X	X
· Enforcement in case of transgressions	X		Advice	X
· Emergency preparedness and response	X		X	X
· Determine whether full-scale operation (adaptive management) is warranted	X		Advice	X
e. Pilot or trial mining on a small scale				
· Monitoring of impact	X		X	X
· Monitor transboundary effects	X		X	X

	Current		Possible Alternatives	
	PIC Gov't	SPC	Reg. Technical Service Provider	Reg.Regulator
· Continued public consultations; grievance mechanism	X		X	
· Monitoring data compilation, analysis, interpretation	X		X	X
· Enforcement in case of transgressions	X		Advice	X
· Emergency preparedness and response	X		X	X
· Determine if trial may be converted to full-scale operation (adaptive management)	X		Advice	X
f. Adaptive management				
· Monitoring of impact	X		X	X
· Monitoring of transboundary effects	X		X	X
· Continued public consultations; grievance mechanism	X		X	X
· Monitoring data compilation, analysis, interpretation	X		X	X
· Updating of ESMP plan based on monitoring data	X		X	X
· Enforcement in case of transgressions	X		Advice	X
· Emergency preparedness and response	X		X	X
· Cancel operation in case of significant risk or impact	X		Advice	X

Chapter 7. Can the International Community support the PICs in applying the Precautionary Principle?

The international community can further support governance of the DSM industry by strengthening national and regional regulatory capacity. Areas that need support in particular are environmental management and monitoring, revenue and fiscal issues, adaptive management and local participation. More specifically, the following short and medium term priority areas could be supported.

Short term priority (Next 5 years)

Medium term priority (5-10 years)

<u>Removing unknowns</u>

- Filling gaps in baseline data in consideration of need for companies to provide data, and institutions to effectively review technical and environmental reports
- Need to review and compile quantitative resource information; together with improved understanding of extraction (CAPEX and OPEX in a DSM mine model per deposit type).

<u>Need for Long-range DSM Sector Planning</u>

- Build capacity for improved management to ensure efficient and effective exploitation;
- Strengthen tax design to ensure appropriate government revenue and adequate incentives for investors;
- Agree upon a financial model to better understand resource rent distribution, uncertainties, and good revenue administration to ensure that revenue is collected in practice; and
- Build capacity for improved public expenditure management to ensure that volatile and temporary natural resource revenue translates to permanent benefits for the nation and to manage the risk resource wealth poses to the wider economy.

<u>Integrated marine management</u>

- Build capacity for holistic integrated marine planning similar to landscape management as is done with terrestrial mining

<u>Capacity building for effective implementation of the Precautionary Principle</u>

- Including need for effective citizen engagement, including trans-boundary regional perspective
- Including regulatory monitoring and reporting

<u>Compile information regarding costs / benefits for effective stakeholder engagement, including:</u>

- The cost / benefit analysis based on (a) the current conditions ("the baseline"), (b) the project scenario, and (c) a counterfactual without project scenario.
- Need to take into consideration the cumulative effects of existing of planned projects within country's EEZ and neighboring EEZs
- Agree a methodology for the estimation of losses in ecosystem services.

- Need to assess losses in cultural and spiritual values associated with DSM.

Regulatory and Institutional Strengthening

- Implement policy, legislative, institutional reforms on a country-by-country basis as summarized in Table 9
- Ensure that the prescribed regime is consistent with international law and the World Bank Group Safeguards and Performance Standards
- Ensure that the legislation and regulations clearly define i) the requirements for assessing and documenting the environmental and social impacts and risks associated with the proposed DSM project, at each stage of the project, including prospecting, exploration, exploitation, closing, and post-exploitation; ii) Monitoring and compliance requirements, and iii) transparent and enforceable procedures, including public participation, at each step, and a grievance mechanism; (iv) contract administration

Opportunities for Regional Cooperation

- Recognizing DSM challenges and associated regulatory compliance monitoring costs, PICs have voiced growing interest in formalized regional cooperation in regulating DSM building on support having been provided by SPC to date and following the existing regional cooperation arrangements for the management of fisheries. Although the SPC-EU DSM Project will lapse at the end of 2016, SPC will continue to provide technical advice to PICs beyond 2016.

Activity type	Potential PIC Interventions	Outputs	Intermediate Results	Outcomes
Articulating a clear and concise DSM policy statement	Working with PIC administrators to draft a clear, holistic DSM policy in consideration of economic, environmental and social performance ➢ Wider strategic economic and resource-development planning to balance the opportunities and opportunity costs presented by engagement with the DSM sector	Draft Letter of Sector Development Policy or other policy statement ➢ taking proper account of socio-economic and environmental factors and the post-2015 sustainable development agenda	• Active stakeholder consultation • Inter-ministerial dialogue regarding terms and conditions under which DSM operations would contribute towards poverty reduction and benefits sharing	PIC governments are guided by the clear policy statement - understand the potential economic opportunity arising from DSM developments in (i) national jurisdiction and (ii) 'the Area'; - make informed decisions about State engagement with deep sea mineral developments; - encourage a participatory and multi-stakeholder approach to avoid civil society disruption and obtain a 'social license' to proceed
			Indicators › *Multi-stakeholder group guiding inclusive consultative process* › *Publication of reports / public comments / minutes*	***Indicators*** › *Decision making processes reflective of the guiding principles within the LSDP or policy statement*

Activity type	Potential PIC Interventions	Outputs	Intermediate Results	Outcomes
Strengthening DSM Legislative and Institutional Frameworks	Assessment of key regulatory and institutional frameworks to ensure appropriate sector safeguards and project performance ➢ further strengthen national policies, legal frameworks and institutional capacities for management of deep sea mineral resource in line with international requirements and best practice standards, particularly with regard the protection of the marine environment ➢ promote a regionally integrated approach	Improved guidelines for environmental / social safeguards including (a) impact assessment (b) management plans (c) procedures for permitting operations and closure, and (d) financial guarantee obligations Options for a regional DSM regulator (see also Regional Partnerships below) Inclusive consultative processes including procedures for GRMs, model benefits sharing agreements Undertake sound economic modelling and prepare robust fiscal regimes and financial management systems Strengthened fiscal policy framework aligned with understanding of investment risks and distribution of	Legislative and Institutional Frameworks having the requisite content to ensure sustainable DSM outcomes (backed by bespoke DSM indicators for each PIC) GRM systems operational Model Benefit sharing agreements being used Fiscal policy framework aligned with terms and conditions appropriate for DSM Ongoing audit of DSM operations, collection of tax and non-tax revenues owed to government(s), and transparent / effective management of DSM sector revenues ***Indicators*** › *Publication of Legislative and Institutional Frameworks including bespoke DSM sustainability indicators*	PICs are assessing / reporting the performance of the strengthened DSM Legislative and Institutional Frameworks using sustainability indicators From Regional Partnerships (below) ➢ a regional treaty setting minimum operational, environmental and financial standards for DSM across the region, and/or ➢ a regional regulator to whom Pacific Islands can sub-contract DSM licensing, monitoring and compliance processes that require specialist expertise and equipment ***Indicators*** › *Sustainability indicators for overall sector performance including published and reviewed regularly* › *DSM Transparency Initiative*

Activity type	Potential PIC Interventions	Outputs	Intermediate Results	Outcomes
	to deep sea mineral regulation ➢ promote integrated management of marine space (adopting the ecosystem approach)	resource rents associated with DSM A DSM Transparency Initiative -- transparent tax administration systems backed by strong capacity to audit operations, collect tax and non-tax revenues, and management of sector revenues	› *Publication of GRM registration of complaints and decisions* › *Publication of Model Benefit sharing agreements negotiated* › *Publication of DSM fiscal policy framework* › *Publication of project audit reports, payments of tax and non-tax revenues and evidence of DSM sector revenue management*	› *Uniform (regional) application of Standardized DSM Regulations*
Regional Partnerships	Formalize regional coordination ➢ establish a State's maritime boundaries in accordance with UNCLOS provisions (See 2014 WB report Annex 4 for country specifics) ➢ Reinforce the SPC, the (Pacific regional) Forum Fisheries Agency, the Australia Attorney General's Office and the	From the Pacific Plan (2013): Recommendation 33: A Pacific Island Forum Secretariat policy to establish a body to provide commercially focused advice on maximizing revenue from seabed mining modelled on the self-funding secretariat that supports the Parties to the Nauru Agreement on fishing	Pacific Island Forum Secretariat has agreed with relevant [regional organizations] a plan for establishing a self-funding secretariat to assist PICs with the development of seabed mining. ***Indicators*** › *PIC commitments to a self-funding Secretariat, based on the plan*	Functioning regional partnership for resolution of DSM boundary disputes facilitated by a self-sustaining Pacific Island Forum Secretariat Resolution of outstanding (i) boundary delineation in areas of abundant DSM potential, and (ii) where joint extended Continental Shelf claims have been made. See Above a regional treaty setting minimum operational, environmental and financial standards for DSM across the region, and/or

Activity type	Potential PIC Interventions	Outputs	Intermediate Results	Outcomes
	Commonwealth Secretariat regarding (i) boundary delineation in areas of abundant DSM potential, and (ii) where joint extended Continental Shelf claims have been made.			(ii) a regional regulator to whom Pacific Islands can sub-contract DSM licensing, monitoring and compliance processes
Administering Award of Licenses and Sector Activity	• Review of the licensing processes, regulations and cadastre system supporting exploration and exploitation • Tracking of key sector investments to determine the level of interest in any one jurisdiction	➢ assessment of the licensing regulations ○ Exploration ○ Exploitation • Assessment of the cadastre system • Exploration expenditures ➢ Mining expenditures	• Gaps and deficiencies are identified, recommendations made • Assistance is in place to remedy deficiencies and build capacity • PIC's are tracking, collecting and publishing relevant sector activity data ***Indicators:*** › *# of exploration license applications* › *# of exploitation license applications* › *# and nature of license disputes* › *publication of sector activities*	• PIC's licensing systems are strengthened ***Indicators:*** › *PIC's using a transparent, non-discretionary cadastre system for administration of sector activities* › *PIC's are capacitated to??*

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Annex 1. Key points and criticism of the Nautilus Solwara 1 Environmental Impact Statement

An environmental impact statement (EIS) was issued in 2008 (Coffey Natural Systems, 2008). The EIS reports to be based on a number of physical, chemical and biological baseline studies by leading scientists in the fields.

The EIS discussed and proposed mitigation measures for damage from offshore mining activities to seafloor communities, and coastal, shallow and mid-water environments. The EIS also discussed the possible environmental, social and cultural impacts and mitigation measures associated with onshore facilities and proposed mitigation measures. With regard to seafloor communities, the EIS recognizes that the Seafloor Mining Tool "will directly remove seafloor substrate, including active and inactive areas, causing loss of habitat and associated animals" (p.26), including fauna communities that are dependent on chemoautotrophic micro-organisms for energy rather than on energy from the sun. The EIS stated that the "active venting field will remain, chimney structures will reform and the underlying hydrothermal energy basis will still exist for the potential reestablishment of vent-dependent and associated communities" within a few years (p.26). The EIS proposed three mitigation measures "to maximize the recovery success", including "protection (from current mining) of a nearby reference area at South Su, the retention of temporary unmined refuge areas within Solwara 1, and the enhancement of recolonisation by translocation of animal communities from areas about to be mined to areas where mining is complete." (p.29)

Under "Coastal, Shallow and Mid-water Environments", the EIS acknowledged the significance of tuna fishing in the Bismarck Sea for the local economy. It further reported "the local coastal people have expressed most concern for the quality of the marine environments and the protection of the reefs and fisheries upon which they depend, as well as on the well-being of the larger animals that are present such as whales, sharks and turtles. The maintenance of health of the marine environment is not a matter for negotiation and the Project must demonstrate that shallow water animals are not exposed to the mineralised materials of the seafloor to which they have not adapted, so that there is no risk to daily subsistence and traditional local activities, such as shark calling." A review under the EIS concluded that "in the offshore oceanic environment, surface schooling pelagic fish species such as tuna frequent the area". Furthermore, "the surface and mid-water levels are also known to be habitats for various species of plankton, small shrimps, fish and squid, many of which make migrations through the water column between day and night time and form the basis of the food chain. Species of tuna and squid were observed during Remotely Operated Vehicle dives indicating depths (to hundreds of meters) to which some surface species (e.g. yellow fin tuna) can go in search of prey." (p.23) The EIS identifies plumes of mineralized water from the dewatering as the key source of impact on such species and proposes to discharge such water no higher than 25 to 30 meters from the seafloor, based on modelling results showing that plumes from discharge under these conditions would not rise above 1,300m in the water column. It concludes that the "processes of mining and dewatering will therefore not affect the pelagic tunas, tuna fisheries or nearshore coral reefs including traditional reef fishing activities such as shark calling." (p.23)

With regard to possible impacts and risks associated with the Mining Support Vessel (MSV) and ore transfer, the EIS proposed “an exclusion zone of 500m around to MSV at all times to avoid risks of collisions.” It further states that “this is a minor area of fishing exclusion for mainly commercial tuna fishing, but the Project area is not one from which catch return statistics indicate there would be any significant impact. Normal maritime navigational and communications procedures will apply for all shipping in the area to maintain safe distances. Being so far offshore, the recorded frequency of inshore vessels such as canoes and small vessels occurring at Solwara 1 is low.” (p.31) The EIS asserted that “the risks of major losses of equipment or spills of ore or fuel oils (during operational and abnormal conditions) will be extremely low with the implementation of best practice vessel and equipment maintenance procedures, navigational procedures, safety plans, environmental management plans, and emergency response plans.”(p,31)

Regarding onshore issues with regard to the proposed temporary holding facility in the Port of Rabaul, the EIS proposed to use best environmental practices to prevent spills or discharges of ore, hydrocarbons or contaminated water to the land or marine environment. In terms of social and cultural impacts it proposed:

- “Establishing a cultural awareness program for employees that will include a formal community awareness program induction on arrival at the workplace and distribution of a community awareness booklet that emphasises the rules for employees and contractors.
- Minimising the potential for interaction between outsider employees and the local communities by arranging direct transfer of fly in/fly out employees from airports to the crew boat or vessel.
- Increasing employment opportunities for local labour by implementing a Training Associated Plan that provides general principles for employment and training.” (p.37)

Finally, the EIS proposed to establish a Community Development Fund of an estimated USD 2.2 million over the life of the project (funded form the proceeds of the project) to provide health and education services to local communities.

Public Consultations. The EIS reported to have had intensive consultations with PNG national government, PNG provincial governments, landowners outside but near Solwara 1, NGOs, industry groups, and academic and research organizations.

The EIS did not include an environmental management plan or a monitoring plan and stated that these would be forthcoming (the monitoring plan is to be included in the EMP).

Critics of the EIS pointed mainly at insufficient treatment of damage to highly valuable endemic benthic fauna, some of which is yet to be discovered; impact on pelagic (water column) fauna; risks of leakage from the riser or discharge pipes and of spills from the Mining Support Vessel, shuttle barges to Rabaul or ore freighters from Rabaul; vertical and horizontal currents transporting sediment plumes and pollutants shorewards and into contact with marine food chains; and impact on fisheries and other livelihoods; and cumulative impacts (Steiner, 2009; Ocean Foundation, 2015).

Annex 2. Cook Islands Manganese Nodules

Manganese Nodules are polymetallic concretions formed in deep sea beds usually at a depth of 4 to 5 km. These nodules contain manganese and smaller amounts of nickel, copper, titanium, cobalt and rare earth elements. They are potato like shaped and size ranges from 2 to 10 cm in diameters. The nodules are found lying loosely on the sediment covered abyssal plains of the world's deep sea basin. Manganese nodules are formed when dissolved metal compounds in the sea are deposited in solid form around a core. This process is extremely slow and can take millions of years (SPC, 2013). During the formation of the nodules several metals are collected from the seafloor but the majority of the metals are found in very low concentrations for economic recovery (Imperial College London Consultants, 2010).

There are four main locations where manganese nodules can be found at a density that is commercially attractive: (1) the Clarion Clippertone Zone; (2) the Peru basin; (3) the Penrhyn basin in the Cook Islands; and (4) the Indian Ocean. The reason for the high nodule density in these areas is similar environmental conditions. The manganese nodules in Penrhyn basin in the Cook Islands have been know for over a century. These deposits are known to have a high concentration over a very large area with concentrations varying but sometimes greater than 25kg/m2 covering approximately 124,000 km2 containing 3.6 billion tons in wet nodules. (Hein at al. 2015, Cardno 2015). Considering that the commercially interesting density for such deposits is 5kg/m2 the Cook Islands resources are among the most commercially attractive.

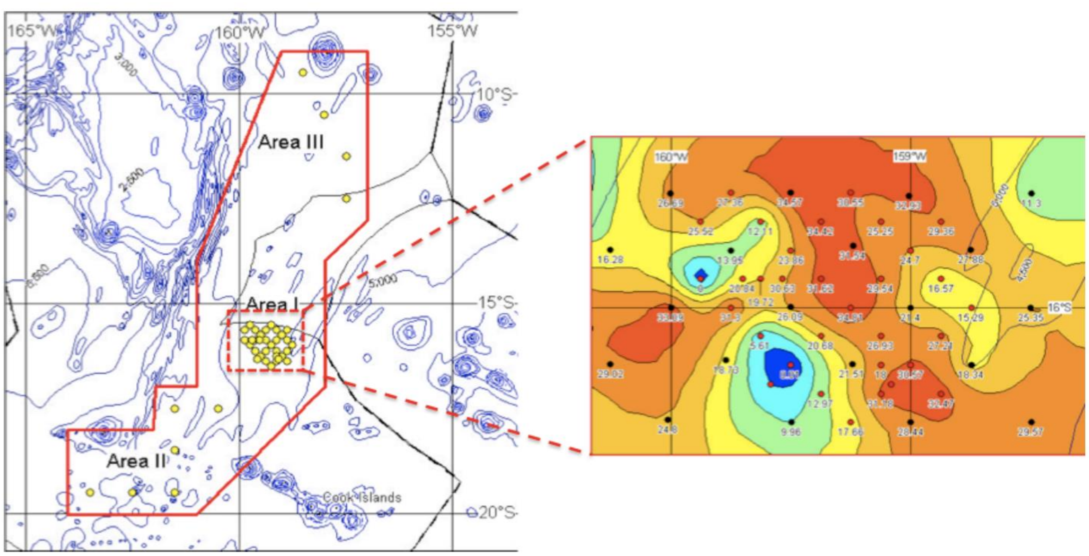
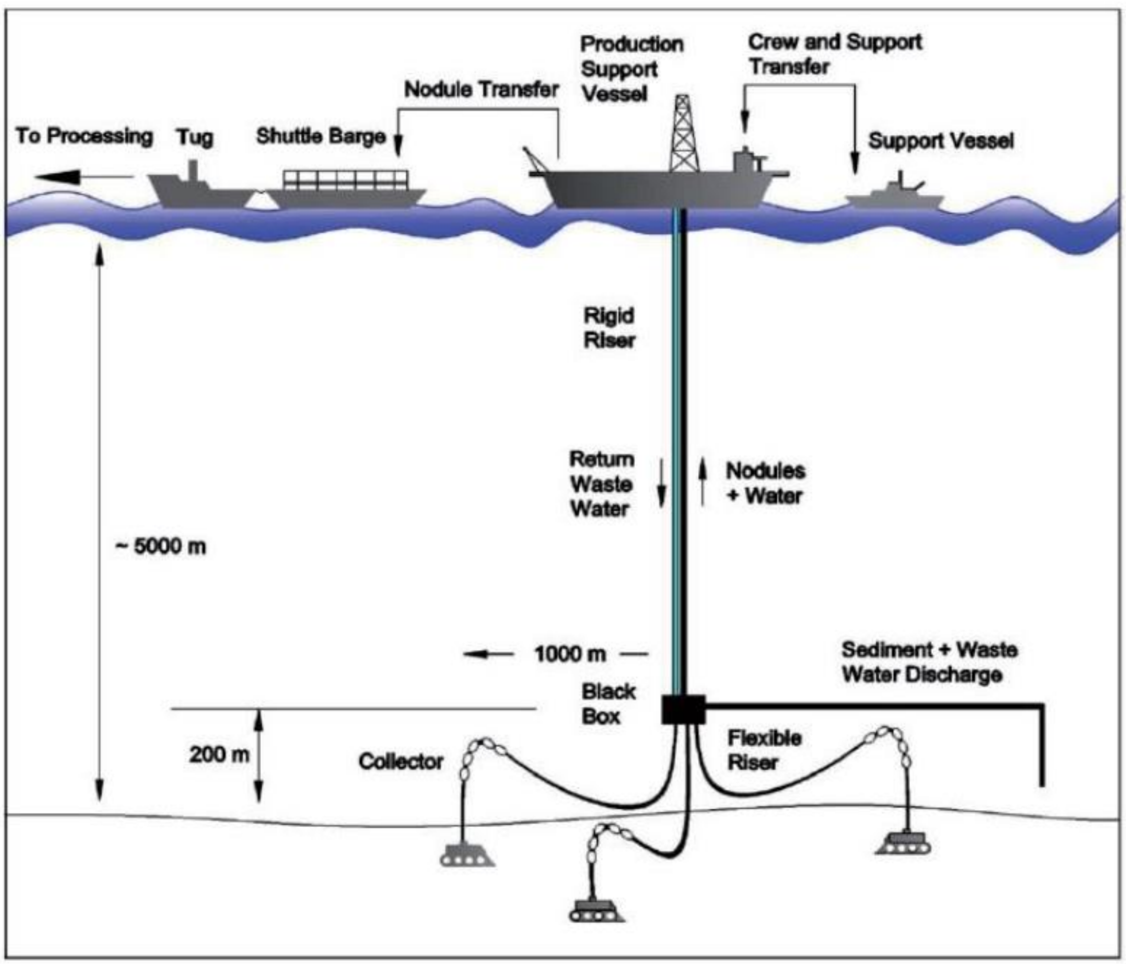


Figure6: MAP VIEW ILLUSTRATING THE ABUNDANCE OF NODULES SURROUNDING THE COOK ISLANDS (EXTRACTED FROM THE JAPANESE SURVEY IN THE COOK ISLANDS IN 2001)

Table 4-5 Basic Assumptions used in Cook Islands Mining Scenario

Category	Assumptions Used
Total mineable area	2,705 km^2
Distance from nearest island	>300 km
Nearest processing facility[1]	Mexico (8,000 km)
Total estimated resource potential (dry tons)	50,000,000
Annual estimated resource potential (dry tons)	2,500,000
Duration of mining operation	20 years
Area mined per year	135 km^2
Collection efficiency	80%
Metallurgic Processing	Assume both three-metal and four-metal extraction technologies available
Note 1: The CBA assumes the nearest existing processing facility is in Mexico based on conversations with Cook Islands Seabed Mineral Authority. It is possible that a suitable processing facility could also be located in China or Korea.	

Table A1. Proposed Nodule Mining System (from Cardno 2015)



Source: Agarwal et al., 2012

The Cardno CB analysis provides the annual employment, income and value added (GDP) estimates for a DSM operation in the Cook Islands. It is estimated that a total of 80 local jobs will be directly supported by DSM operations. Overall, considering other indirect economic activities, a total of 147 jobs would be supported by the DSM operations each year. In total, it is also estimated that DSM operations will support $3.4 million in local income and a total of $43.2 million of GDP each year of operation (SPC, 2016).

Table A2: Annual Mine Operating Impacts for Cook Islands DSM Mining (in millions USD)

Impact Type	Direct	Indirect	Induced	Total
Employment	80	65	2	147
Income	$2.4	$0.9	$0.1	$3.4
Value Added (GDP)	$39.3	$3.7	$0.2	$43.2
Totals may not sum due to rounding Monetary values are in 2015 dollars Note 1: Based on the average value added per US ‘other metal ore’ mining employee from IMPLAN model				

Annex 3. Mining Impacts by Mineral Deposit Type

<table>
<tr><th rowspan="2">Impacts</th><th colspan="3">Effects</th></tr>
<tr><th>SMS</th><th>MN</th><th>CRC</th></tr>
<tr><td>Scale of impact</td><td>~ 0.1 km^2 for the life of the site</td><td>~100- 300 km^2 per year for multiple years</td><td><10 km^2 for the life of the site</td></tr>
<tr><td rowspan="2">Seafloor operations to remove mineralised material</td><td>Destruction and complete removal of chimney structures and associated animals.
Seafloor topography will change from being raised and 'proud' of the seafloor to being flattened or depressed.
The habitat may change from being dominantly hard-substrate (rock and chimney) to higher proportions of soft-substrate (sediment).
Active sites: Alteration of fluid flow and potential for transient (unknown duration) changes in fluid chemistry, thereby altering the environmental conditions for any recovering vent ecosystems.
Dormant sites: Potential to renew fluid flow.
Direct effects localised</td><td>Complete removal of nodules and associated animals.
Seafloor topography unlikely to change, however sediments may be compressed by weight of machines.
Hard-substrate (nodules) will be removed changing the habitat to be completely sedimented.
Direct effects over very large areas</td><td>Removal of the thin layer of crust from the seamount in strips or patches. Destruction of habitat and attached animals.
Seamount will remain largely intact, with minimum change to topography. Reduction in habitat complexity of impacted strips/patches.
Resultant habitat will remain hard-substrate.

Direct effects may be localised or cover a wider combined area of multiple seamounts.</td></tr>
<tr><td colspan="3">Lights attached to the machines on the seafloor will introduce light into an environment that is otherwise pitch black. These lights may repel or attract some animals, and could blind some species.
Noise and vibration may also attract or repel some animals and could cause masking effects on marine mammals that use the similar frequencies for communication/navigation.</td></tr>
<tr><td rowspan="2">Operational plume and sediment re-suspension at the seafloor by machines</td><td colspan="3">These plumes of suspended sediment will likely smother/bury seabed animals, and disorientate and choke motile animals and suspension feeders.
Additional sedimentation may impact ability of larvae to settle on hard substrates.
Plumes may spread to areas outside of the direct mining site, and will have a gradient of impact, reducing with distance from the activity. Extent of plumes will depend on mining process and water current speed and direction.
Metals associated with plumes may become bioavailable and toxic.</td></tr>
<tr><td>This will be of particular concern if side-casting or removal of sediment is required for machines to access the minerals underneath.
Plumes could reach up to kilometres from the mine site.</td><td>Plumes could reach up to 100 kilometres due to large footprint of the mine site.</td><td>Plumes and settling sediments are likely to flow down the flanks of seamounts.
Particular attention will need to be given to upwelling and eddies.</td></tr>
</table>

<table>
<tr><th rowspan="2">Impacts</th><th colspan="3">Effects</th></tr>
<tr><th>SMS</th><th>MN</th><th>CRC</th></tr>
<tr><td rowspan="2">Returned seawater plume</td><td colspan="3">The returned seawater plume is unlikely to be as heavily loaded with suspended sediments as the operational plume. Compared to the surrounding water it is released into is it is likely to have changes in characteristics such as; temperature, dissolved minerals, salinity, suspended sediment etc.
Due to the removal of the mineralised material from the seawater, surface water may need to be used to ‘make up’ the appropriate volume to be returned - this could further change the characteristics of the plume.
If the returned seawater is released in the surface waters (Photic Zone) it could: reduce light penetration, reduce plankton growth, inhibit feeding of zooplankton, over stimulate primary production (and of different species than those normally occurring in the area), reduce localised dissolved oxygen etc.
Plumes will have a gradient of impact, reducing with distance from the discharge location.</td></tr>
<tr><td>Discharge and return of seawater to the seafloor (from where it came) should be possible.
Plumes could reach up to 10’s of kilometres from the mine site.
Some settlement of sediment is expected, however if the water is filtered to remove suspended sediments as far as practicable, it is not expected to be significantly greater than background sedimentations rates.</td><td>Due to the significant depths of MN mine sites, it may be cost prohibitive to release the discharge water back at the seafloor.
A higher discharge point may lead to a more extensive plume in the water column.</td><td>Discharge and return of seawater to the seafloor (from where it came) should be possible.
Plumes could reach up to 10’s of kilometres from the mine site.</td></tr>
<tr><td>Standard vessel operation and discharges</td><td colspan="3">It is likely that ocean-going vessels engaged in DSM activities will make operational discharges of ballast water, treated sewage, grey water, macerated food waste, and highly salinated water from desalination plants. Such vessels will also make atmospheric discharges from engine and incinerator exhausts. However, the nature of such discharges will vary depending of the location of the vessels from the shore and existing marine protected areas (as stipulated in MARPOL).
As mining vessels, unlike regular ocean-going vessels, will be somewhat stationary, it is expected that the discharges, where allowed, may dilute less effectively and hence, present a slightly higher risk to the environment.
Surface animals (ie. marine mammals) may be effected from the constant noise and vibrations produced by the mining vessels, impeding their communication/navigation.
The mining vessel could act as a ‘fish aggregating device’ particularly as it will produce significant light throughout the night. Animals such as fish, sharks, seabirds, whales, dolphins and turtles may be attracted to the vessel.</td></tr>
</table>

Impacts	Effects SMS	MN	CRC
Potential for recovery	Active SMS sites in some circumstances are expected to be able to recover as mining operations will not 'turn off' the underlying 'plumbing' of the hydrothermal system. The animal communities may recover in 10s of years, however the geology and creation of substantial SMS deposits will take 1000's of years. Dormant SMS sites are unlikely to recover. Mining may potentially open up new vents – changing the nature of the environment.	MN sites will not be able to recover to their prior environmental condition. The removal of the nodules will prevent animals requiring hard substrate to repopulate. It is likely that the animal communities in the sediments will recover but not for a long time.	As mining will only remove patches of the seamount's surface layer, not the whole seamount or significantly change the substrate, it is expected that animals will be able to repopulate the site. Slow-growing animals such as cold water corals, recovery could take 100's of years.
Worst case scenarios	Accidental events and natural hazards could induce worst case scenarios such as possible spills (i.e., of recovered mineralised material) and oil leaks from the vessel, which then enter the sea, and leaks from the lifting system or mining equipment (i.e. hydraulic oil leaks). Vessel collisions or capsizing, whilst unlikely could also occur.		

Source: Table 5.1 in SPC 2015

Annex 4. The SPC-EU Deep Sea Minerals Project. Objectives and Outputs[33]

With financial support from the EU, the SPC Geoscience[34] Division implemented the Deep Sea Minerals Project from 2011-2015 in 15 Pacific Island Countries[35]. The project's specific objective was to strengthen the system of governance and capacity of Pacific ACP States in the management of deep-sea minerals through the development and implementation of sound and regionally integrated legal frameworks, improved human and technical capacity and effective monitoring systems.

The project's produced the following outputs under its four Key Result Areas:

1. Regional legislative and regulatory framework (RLRF) for offshore minerals exploration and mining

- Held regional deep sea mineral consultation workshops to share deep sea minerals information with all stakeholders (representatives of government, civil society, private sector, local communities) in the region. Renowned world deep sea mineral experts were in attendance.
- Fifteen national deep sea minerals stakeholder consultation workshops were held, one for each of the 15 Pacific ACP States.
- Developed, reviewed and finalised the "Pacific ACP States Regional Legislative and Regulatory Framework for Deep Sea Minerals Exploration and Exploitation" (RLRF). The RLRF was officially launched during the 43rd Forum Leaders Meeting in Rarotonga Cook Islands in August 2012.
- In consultation with Pacific Island Countries and Territories, develop, review and finalise the "Regional Cooperation Agreement for Responsible Deep Seabed Minerals Management", and to table the Agreement to SPC Annual Session and subsequently to Pacific Forum Leaders for consideration.

2. National policy, legislation and regulations

- Fiji International Seabed Minerals Decree was promulgated in July 2013. The Mineral Bill and Seabed Minerals Policy are currently under review.
- Tonga National Seabed Minerals Act was enacted in August 2014. The Seabed Minerals regulations have been drafted and are currently under review.
- Tuvalu National Seabed Minerals Act was enacted in December 2014
- Niue National Seabed Minerals Policy and Legislation and Regulations have been drafted and sent to government and are currently under review.

[33] Source: SPC
[34] Formerly known as SOPAC
[35] These are: the Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Marshall Islands, Nauru, Niue, Palau, Papua New Guinea, Samoa, Solomon Islands, Timor Leste, Tonga, Tuvalu and Vanuatu.

- Kiribati National Seabed Minerals Policy and Legislation have been drafted and sent to government for review and consultations.
- RMI National Seabed Minerals Policy and Legislation have been drafted and sent to government for review and consultations.
- FSM National Seabed Minerals Legislation has been drafted and sent to government. The Bill has been reviewed and presented to congress.
- Vanuatu National Seabed Minerals Policy has been drafted and is currently under review.
- Solomon Islands National Seabed Minerals Policy has been drafted and is currently under review.
- Nauru National Seabed Minerals Legislation has been drafted, reviewed, and finalised. The Legislation was recently passed by Parliament.
- Cook Islands Seabed Minerals Regulations has been developed, reviewed and finalised.

3. Building national capacities – supporting active participation of PICs nationals in the offshore mining industry

- In collaboration with the International Seabed Authority (ISA), "The International Workshop on Environmental Management Needs for Exploration and Exploitation of Deep Sea Minerals" was held in Nadi Fiji in late 2011.
- The 1st DSM Project Regional Training Workshop was convened in Nadi Fiji in August 2012. The theme of the workshop was "Geological, Technological, Biological and Environmental Aspects of Deep Sea Minerals".
- The 2nd DSM Project Regional Training Workshop was held in Nuku'alofa Tonga in March 2013. This theme of the workshop was "Deep Sea Minerals Law and Contract Negotiations".
- The 3rd DSM Project Regional Training Workshop was held in Port Vila Vanuatu in June 2013. The theme of the workshop was "Social Impacts of Deep Sea Mineral Activities and Stakeholder Participation".
- The 4th DSM Project Regional Training Workshop was held in Nadi Fiji in December 2013. The theme of the workshop was "Environmental Perspectives of Deep Sea Mineral Activities".
- The 5th DSM Project Regional Training Workshop was held in Rarotonga Cook Islands in May 2014. The theme of the workshop was "Financial Aspects of Deep Sea Minerals Development".
- The 6th DSM Project Regional Training Workshop was held in Apia Samoa in May 2015. The theme of the workshop was "Deep Sea Mineral Policy Formulation and Legislative Drafting".
- The 7th DSM Project Regional Training Workshop was held in Nadi Fiji in August 2015. The theme of the workshop was: Development of Appropriate Fiscal Regime and Revenue Management Options for Deep Sea Mining".
- The 8th DSM Project Regional Training Workshop was held in Nadi Fiji in October 2015. The theme of the workshop was "Environment Management of DSM Activities".
- A national Timor Leste deep sea Minerals workshop was held in Dili in November 2014.

- Financial support provided to selected PIC candidates to attend short term DSM courses, and international workshops and conferences.
- Provided funding and technical support to 11 Pacific ACP States to attend and participate in the International Seabed Authority (ISA) in the last three years.
- A legal internship programme was established in early 2012 as part of the project capacity building. A total of eighteen young Pacific lawyers have participated in the internship programme to date.
- A total of ten Pacific government lawyers trained on legal aspects of DSM and participated in the development of DSM policy and law.

4. Effective management and monitoring of offshore exploration and mining operations

- Archived manganese nodule samples from Cook Islands and Kiribati were sent to various research institutions [USGS, University of Leicester (UK), Victoria University (NZ)] for geochemical analyses and environmental studies.
- Technical assessment reports on manganese nodule potential within the EEZ of Cook Island and Kiribati have been completed and delivered.
- The assessment report on the state of knowledge of Pacific marine minerals has been completed by UNEP/GRID-Arendal. The report (comprising five booklets) was finalised and officially launched in December 2013 and has been distributed to the 15 Pacific ACP States and other stakeholders.
- Initiated and funded a Cost-Benefit Analysis (CBA) for deep sea mining in the Pacific. The final CBA report has been finalised and delivered to SPC.
- Develop, review and finalise the "Regional Fiscal and Revenue Management Framework for Deep Sea Mineral Activities".
- Formulate, review and finalise the "Regional Deep Sea Minerals Scientific Guidelines.
- Prepare, review and finalise the "Regional Environment Management Framework for Deep Sea Mineral Activities".
- Establish and maintain the Regional Marine Minerals Database (RMMD).

5. Other Activities

- As part of the stakeholder awareness and information sharing of the DSM Project, nineteen information brochures have been completed and distributed to stakeholders in the Pacific Islands region and beyond.
- A Communication Strategy for the Project has been developed and implemented resulting in increasing communication and stakeholder engagement.
- Three DSM documentaries prepared and completed, and distributed to stakeholders in the region and beyond.