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+91 70421 48991
editor@ijlar.com
www.ijlar.com

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Introduction

Welcome to the Indian Journal of Legal Affairs and Research (IJLAR), a distinguished platform dedicated to the dissemination of comprehensive legal scholarship and academic research. Our mission is to foster an environment where legal professionals, academics, and students can collaborate and contribute to the evolving discourse in the field of law. We strive to publish high-quality, peer-reviewed articles that provide insightful analysis, innovative perspectives, and practical solutions to contemporary legal challenges. The IJAR is committed to advancing legal knowledge and practice by bridging the gap between theory and practice.

Preface

The Indian Journal of Legal Affairs and Research is a testament to our unwavering commitment to excellence in legal scholarship. This volume presents a curated selection of articles that reflect the diverse and dynamic nature of legal studies today. Our contributors, ranging from esteemed legal scholars to emerging academics, bring forward a rich tapestry of insights that address critical legal issues and offer novel contributions to the field. We are grateful to our editorial board, reviewers, and authors for their dedication and hard work, which have made this publication possible. It is our hope that this journal will serve as a valuable resource for researchers, practitioners, and policymakers, and will inspire further inquiry and debate within the legal community.

Description

The Indian Journal of Legal Affairs and Research is an academic journal that publishes peer-reviewed articles on a wide range of legal topics. Each issue is designed to provide a platform for legal scholars, practitioners, and students to share their research findings, theoretical explorations, and practical insights. Our journal covers various branches of law, including but not limited to constitutional law, international law, criminal law, commercial law, human rights, and environmental law. We are dedicated to ensuring that the articles published in our journal adhere to the highest standards of academic rigor and contribute meaningfully to the understanding and development of legal theories and practices.

DEEP SEABED MINING AND MARINE ENVIRONMENTAL PROTECTION: A LEGAL ANALYSIS UNDER UNCLOS AND INTERNATIONAL ENVIRONMENTAL LAW

AUTHORED BY - KHUSBU PASBOLA & NIKITHA SURESH

ABSTRACT

Deep sea mining has a potential source of Mineral which act as important source for energy transition and advanced technologies. The increase in demand of minerals as enhanced the interest in deep seabed mining as part of the blue economy. It is a wide source of economic opportunities, but it a serious critical zone for fragile and largely unexplored marine ecosystem. This paper mainly examines the exploitation of the marine environment for economic purpose and what are the current legislative provisions governing under International Environment Law. It analyses the framework of “UNCLOS United Nations Convention on the Law of the Sea” and the function of “International Seabed Authority (ISA)”, reflecting the contention of protection and development. This study also deals with key principle of environment protection such as common heritage of mankind, sustainable development, and the precautionary approach. The paper follows the doctrinal and analytical research where the legislative provision are critically examine and analysed with respect to contemporary situation. It even argues the existing regulation lacks due to weak enforcement of “International Environment Law” and suggest certain reform institutions to enhance the ISA’s ability of independent surveillance and to create a tight financial mechanism.

Keywords: Deep-Sea Mining, UNCLOS, ISA, Common Heritage of Mankind, Environment Law, Code of Conduct for Mining in the Area.

INTRODUCTION: THE DEVELOPMENT OF DEEP SEABED MINING

“The rush to mine this pristine and unexplored environment risks creating terrible impacts that cannot be reversed. We need to be guided by science when faced with decisions of such great environmental consequence.”

- Sir David Attenborough

Deep sea mining was began in 1873, during the HMS Challenger Expedition, when polymetallic nodules were first discovered on the ocean floor¹. The economic importance of later recognised in 1960's, which attract the global attention. By 1967, the issues started arising and become the topic of discussion at the United Nation. There seem to be requirement of legal frame work². Therefore, he final outcome of the long-lasting negotiations was pt XI of the 1982 United Nations Convention on the Law of the Sea ('Convention'). The disagreement was the regarding the provisions due to which there was 1994 modification was held to the agreement.

The “International Seabed Authority ('ISA')” was established upon pt XI's entry into force in 1994, and came into operation in 1996. They are empowered under the convention ‘organize and control activities in the Area, particularly with a view to administering the resources of the Area’³. The main responsibility of ISA is to manage and regulate the mining activities. Currently they have signed 26 contracts related to international seabed area. Private companies begin participating in 2011, beginning with Nauru Ocean Resources Inc. They mainly focused on polymetallic nodules. They have made this sea mining more inclined to commercial purpose. The developing countries suggested stagnancy to mining stage as they expect the share in the benefits under the idea of “common heritage of mankind.” There are major challenges on the face of nations that reflects the transition phase of deep-sheep mining. These challenges are limited scientific knowledge about the deep sea, technological difficulties, unstable metal markets, and incomplete mining regulations⁴.

¹ “Helen M. Rozwadowski, *Fathoming the Ocean: The Discovery and Exploration of the Deep Sea* 102–05 (2005)”

² “Elisabeth Mann Borgese, *The Oceanic Circle: Governing the Seas as a Global Resource* 43–45 (1998)”

³ “Arvid Pardo, Ambassador of Malta to the U.N., Speech to the First Committee of the U.N. General Assembly (Nov. 1, 1967)”

⁴ “United Nations Convention on the Law of the Sea pt. XI, Dec. 10, 1982, 1833 U.N.T.S. 397”

Deep ocean floor have a great minerals such as polymetallic nodules, sulphides and crusts which are essential for transitions towards green and clean energy. Fulfilling the Sustainable Development Goal 7⁵. However, these Deep Ocean floor is beyond the national jurisdiction. Article 136 of the UNCLOS refereed this Area as “common heritage of mankind” and ISA is responsible for it and the protection of marine environment⁶. The implementation of this system in the commercial area is still the concerns as the legal system is not adequate. Even, toady lots of scientific investigation is going on regarding the dep-sea environment still in 2021, Nauru used the “two-year rule,” which pushed the “International Seabed Authority (ISA)” to decide the mining riles⁷. The contention lies between ‘duty to cooperate’ and ‘duty of care’. Where one side the countries are responsible for cooperation of marine resources and on other side they have to protect the marine environment. There need to be separate environment monitoring bodies, formulation and implementation of rules and responsibility and the entire system held accountable and maintain the transparency⁸.

Overview of ISA Exploration Contracts by Resource Type and Regional Distribution

Resource Type	Total Contracts	Primary Locations	Key Sponsoring States (Examples)	Estimated Resource Value (USD Trillions)
Polymetallic Nodules	19	Clarion-Clipperton Zone (Pacific), Central Indian Ocean	China, Germany, UK, Belgium, Nauru, Tonga	16.5
Polymetallic Sulphides	7	Mid-Atlantic Ridge, Central Indian Ridge	France, Russia, China, India, Poland	4.2
Cobalt-Rich Crusts	5	Western Pacific Ocean (Magellan Seamounts)	Japan, China, Brazil, Russia, South Korea	2.8

⁵ “International Energy Agency, Critical Minerals and Clean Energy Transition Report (2021)”

⁶ “U.N. Convention on the Law of the Sea arts. 136, 145”

⁷ “International Seabed Authority Council, Notification by Nauru under Section 1(15) of the 1994 Agreement (2021)”

⁸ “Responsibilities and Obligations of States Sponsoring Persons and Entities with Respect to Activities in the Area, Advisory Opinion, Case No. 17, ¶ 110 (Int’l Trib. for Law of the Sea Feb. 1, 2011)”

Total	31	Global Deep Ocean	Diverse (Developed & Developing States)	23.5
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CONCEPTUAL FRAMEWORK

Deep sea mining is the process of extracting minerals from the ocean floor, with the depth more than 200 meters the minerals include Polymetallic nodules (rich in nickel, cobalt, manganese), Seafloor massive sulphides, and Cobalt-rich crusts⁹. These resources are used in renewable energy like batteries and electronic and advanced industries. Under the UNCLOS, these seabed which are beyond the national jurisdiction called as ‘Area’¹⁰. This resources is not under the control of any country simple it for all mankind. It is contentious because it is presented in least explored places and the area is very ecological fragile. Scientific knowledge and technologies are currently limited and exploration is not completed yet. Therefore, we are unaware of the outcome and impact of deep sea mining¹¹.

Marine environment protection is major concerns to combat it various legal and policy measure to preserve the environment. UNCLOS is make state accountable for the marine pollution and environment damage and creates responsibility to protect and preserve them it include protecting biodiversity, maintain ecosystem and preventing irreversible harm to marine ecosystem¹².

The principle of “Common Heritage of Mankind” it means the Area of deep sea mining beyond the national jurisdiction of state belongs to everyone. The resources owned by humanity. No one can claim sovereignty over it and the benefits arise from will be equally share by everyone. The principle hot is recognition in UNLCOS and ISA. The major concern to emphasise this principle was to balance between ‘duty to cooperate’ and ‘duty of care’¹³.

⁹ “International Seabed Authority, *Deep-Seabed Mineral Resources* (2023)”

¹⁰ “United Nations Convention on the Law of the Sea art. 1(1)(1), Dec. 10, 1982, 1833 U.N.T.S. 397”

¹¹ “Duncan Currie et al., *Deep-Seabed Mining: Key Obligations in the Current Regulatory Framework*, 114 *Marine Policy* 103–08 (2020)”

¹² “United Nations Convention on the Law of the Sea arts. 192, 194”

¹³ “Responsibilities and Obligations of States Sponsoring Persons and Entities with Respect to Activities in the Area, Advisory Opinion, Case No. 17, ¶¶ 110–117 (Int’l Trib. for Law of the Sea Feb. 1, 2011)”

LEGAL FRAMEWORK UNDER INTERNATIONAL ENVIRONMENTAL LAW

Dispute settlement Framework in Deep Sea Mining is *Sui Generis*, which means it is unique in its nature. Various participants like states, international organization, and even private contractor.

“United Nations Convention on the Law of the Sea (UNCLOS), 1982”, specifically Part XI, Section 5. This section has established special judicial body known as the Seabed Dispute Chamber¹⁴. SDC functions under “International Tribunal for the Law of the Sea (ITLOS)” and have jurisdiction above those cases which deals with dispute regarding the Deep Sea Mining¹⁵. The key feature of this system is that it recognises *Locus Standi* for states and non-state factors such as ISA and private prospective mining contractors¹⁶. Part “XV, Section 1 of UNCLOS” applies to DSM dispute which provides general dispute mechanism such as Negotiation, mediation, arbitration and judicial settlement¹⁷. Conciliation under “Annex V, Section 1 of UNCLOS”, in this an independent commission examines the dispute and proposes the solution. **Statute of ITLOS**, contained in “**Annex VI of UNCLOS**”, it define the structure and composition of Seabed Dispute Chamber¹⁸. Explains the jurisdiction and power of the tribunal. The rules of the tribunal especially **Part III, Section F**, it explains the detailed procedure and rules for handling contentious cases before SDC. “UNCITRAL Arbitration Rules” applies as a default procedure if there is any commercial dispute between the contactors and ISA. ISA has the binding nature it includes mining codes, environment regulation and contractual obligation¹⁹.

UNCLOS has introduced the Two-Tier System of Judicial Settlement system.

1. First Tier – Peaceful Settlement (Section 1, Part XV) in which it focuses on diplomatic method. It include negotiation, exchange of views and mediation and conciliation. **Article**

¹⁴ “United Nations Convention on the Law of the Sea art. 186, Dec. 10, 1982, 1833 U.N.T.S. 397”

¹⁵ “Id. arts. 186–191”

¹⁶ “Id. art. 187”

¹⁷ “Id. arts. 279–283”

¹⁸ “Id. annex V, § 1”

¹⁹ “Id. annex VI; Rules of the Tribunal, Part III, Section F”

286 of UNCLOS, it as precondition over the parties that they have to resolve dispute in a peaceful manner before moving to formal adjudication²⁰.

2. Second Tier – Compulsory Judicial Settlement, it consists of (a) General System (Part XV, Sections 2–3) which includes “International Tribunal For the Law of the Sea 9 (ITLOS) , International Court of Justice(ICJ) and Arbitral tribunal”. (b) Special DSM System (Part XI, Section 5) in this case the jurisdiction lies with Seabed Dispute Chamber (SDC) Of ITLOS²¹. Under Article 266, of there is no settlement must have been reached through peaceful manner before accessing the second tier²². This requirement is interpreted in cases such as

“MOX Plant Case(2001)”²³ ITLOS stated that parties must expressed their views under Article 283 before of initiation of proceeding. Failure will affect the jurisdiction.

“Land Reclamation (Straits of Johor) Case(2003)”²⁴ in this case ITLOS held that even during proceedings parties can go for negotiation and cooperation.

“M/V Louisa Case(2013)”²⁵ held that jurisdiction only exist of the dispute concerns UNCLOS provisions.

“Southern Bluefin Tuna Case”²⁶ - Tribunals have examined whether parties to the case have fulfilled the obligation under Article 283 before the imitation of any proceeding. The reason behind two tier system is given under Article 280 of UNCLOS which provides freedom to choose method for their peaceful settlement of dispute.

²⁰ “United Nations Convention on the Law of the Sea art. 283”

²¹ “Id. art. 287”

²² “Id. art. 187”

²³ “MOX Plant Case (Ir. v. U.K.), Provisional Measures, Case No. 10, ¶ 60 (Int’l Trib. for Law of the Sea Dec. 3, 2001)”

²⁴ “Land Reclamation by Singapore in and Around the Straits of Johor (Malay. v. Sing.), Provisional Measures, Case No. 12, ¶ 92 (Int’l Trib. for Law of the Sea Oct. 8, 2003)”

²⁵ “M/V Louisa (St. Vincent v. Spain), Judgment, Case No. 18, ¶ 53 (Int’l Trib. for Law of the Sea May 28, 2013)”

²⁶ “Southern Bluefin Tuna Cases (N.Z. v. Japan; Austl. v. Japan), Award on Jurisdiction and Admissibility, ¶ 54 (Aug. 4, 2000)”

ENVIRONMENT PRINCIPLE

1. Precautionary Principle- The earliest world codification of the precautionary approach was Principle 15 of the Rio Declaration²⁷, which states, In order to conserve the environment, the precautionary approach shall be extensively used by the States within their capabilities. In cases where threats exist of serious or irreversible harm, absence of complete scientific certainty will not serve as an excuse to delay cost effective actions in the prevention of environmental degradation.
2. Polluter Pays Principle- According to this principle, the initiators of the process of pollution will be the ones to pay the cost of its management and prevention such that it does not negatively affect the environment and human beings²⁸. The polluter pays principle has been recognised by the Rio Declaration of 1992. The main field of this principle is the land, air, and water. We are all aware of the impacts of greenhouse gases on our environment. This can be extended to greenhouse gases. A price on carbon can be used to achieve the principle.
3. Principle of Sustainable Development- Theory of sustainable development was outlined by the Brundtland Report of 1987 as development that is in a way that fulfils the present needs without compromising the capacity of the future generations to experience their needs as well²⁹. This theory is alleged to put boundaries on the capacity of the environment to meet the current and potential needs. There are three components to sustainable development:
 1. Intergenerational Equity
 2. Use of Natural Resources in a Sustainable Way
 3. Development and the environment are inextricably related.
4. Intergenerational Equity- the present generation has a responsibility to preserve the environment for future generation³⁰.

²⁷ “Rio Declaration on Environment and Development princ. 15, June 14, 1992, 31 I.L.M. 874”

²⁸ “Rio Declaration on Environment and Development princ. 16, June 14, 1992, 31 I.L.M. 874”

²⁹ “World Comm’n on Env’t & Dev., *Our Common Future* 43 (1987)”

³⁰ “Edith Brown Weiss, In Fairness to Future Generations, 11 *Envtl. L.* 495, 498–500 (1981)”

5. Ecosystem-Based Approach- managing human activities in a way that maintains the health, structure, and functioning of entire ecosystem.

Legal Conflicts and Tensions in Deep Seabed Mining (DSM) is jurisdictional ambiguity between international waters and areas within national Exclusive Economic Zones (EEZs) which extend to 200 nautical miles from the coastal line. ISA have regulated over high sea. Dispute arise if the mining take place near EEZ which impact marine environment or fisheries of a neighbouring coastal state³¹. Deep sea mining law were made by many countries for their own domestic region but it conflict with ISA guidelines causes legal undercity³².

Modern technology development made mining project easily accessible yet lead to additional legal uncertainties. Microscopic technology known as “Autonomous Underwater Vehicles (AUVs) and Remotely Operated Vehicles (ROVs)” are made to collect ocean minerals without continuous human intervention. Arises question regarding the responsibility of the over the environment damage. When an AUV creates environmental damage which entity bears responsibility between the developer and the operator and the contracting state³³.

CASE STUDIES AND GLOBAL DEVELOPMENTS

ISA Exploration Licenses (Pacific Ocean Regions)-It has issued exploration licenses to state and private contractors, particularly in the “Clarion-Clipperton Zone (CCZ)” in the pacific region. It’s granted for polymetallic nodules, sulphides, and cobalt crusts. Clarion-Clipperton Zone (CCZ) is the most resource rich areas. The Area is high ecological sensitivity, hosting unique deep-sea species. However, it resultant in long term ecological consequences remains uncertain and Environmental Impact Assessments (EIAs) are often limited in scope³⁴.

³¹ “United Nations Convention on the Law of the Sea arts. 56, 57, 136, 157”

³² “Duncan Currie et al., Deep-Seabed Mining: Key Obligations in the Current Regulatory Framework, 114 *Marine Policy* 103–08 (2020)”

³³ “Responsibilities and Obligations of States Sponsoring Persons and Entities with Respect to Activities in the Area, Advisory Opinion, Case No. 17, ¶¶ 110–121 (Int’l Trib. for Law of the Sea Feb. 1, 2011)”

³⁴ “Duncan Currie et al., Deep-Seabed Mining: Key Obligations in the Current Regulatory Framework, 114 *Marine Policy* 103–08 (2020)”

Role of Nauru and the “Two-Year Rule”- the major legal reform took after the small pacific island state, Nauru, invoked the “Two-Year Rule” under UNLCOS by early commencement of mining”. The two years rule is that if any state approached and request ISA to finalise mining regulation than ISA must take it priority and should do within 2 years³⁵. This create economic urgency in conflict with environment caution.

Growing Global Calls for a Moratorium- many states have initiating a stoppage or Moratorium on DSM activities. The state were France, Germany, Chile, Costa Rica and many other. The reason behind Moratorium is that we have very less understanding of deep sea and scientific knowledge at present will not able to explain the actual long term effect deep sea mining. There is constant concern about irreversible damage. This clearly implements the precautionary principle.

NGO and Civil Society Responses- NGO like Greenpeace and WWF, scientific communities and indigenous people. They raised concerns regarding the marine ecosystem and future consequences, lack of transparency in ISA decision making and serious threat of exploitation of global common. Therefore a global level Moratorium and demand for reformation in ISA has taken place³⁶.

What plays the Role of Sponsoring States? Part XI of the UN Convention on the Law of the Sea (“UNCLOS”) provides that a cooperation can only engage in deep sea mining when in contact with ISA. Private cooperation have to get sponsored by state part to UNCLOS than only they have right to explore or exploit. Dismissal of sponsorship also exists “termination of sponsorship shall become effective six months following the date of receipt of the notification [carried out by the state] by the Secretary-General] and that under such circumstances the contractor shall find another sponsor within the six months (ISA polymetallic nodules regulations, regulation 29).

Possible Legal Claims Arising from Deep Seabed Mining Statutes

“Legislation was developed by five pacific nation, namely Fiji, Kiribati, Nauru, Tonga and Tuvalu. Under Sec 97 of Tuvalu's Seabed Minerals Act 2014 states”:

³⁵ “Agreement Relating to the Implementation of Part XI of the United Nations Convention on the Law of the Sea of 10 December 1982, § 1(15), July 28, 1994, 1836 U.N.T.S. 3”

³⁶ “Responsibilities and Obligations of States Sponsoring Persons and Entities with Respect to Activities in the Area, Advisory Opinion, Case No. 17, ¶ 110 (Int’l Trib. for Law of the Sea Feb. 1, 2011)”

*“The Authority may vary, suspend or revoke any Sponsorship Certificate— where the variation or revocation is in the reasonable opinion of the Authority necessary to: (i) prevent serious risk to— (a) the safety, health or welfare of any persons; or (b) the Marine Environment; or (ii) avoid a conflict with any obligation of Tuvalu arising out of any international agreement or instrument in force for Tuvalu... ”.*³⁷

Similar legislation is developed in section 39 of Nauru’s International Seabed Minerals Act 2015 and in section 88 of Tonga’s Seabed Minerals Act 2014. They emphasize on the principle of proportionality. In *Duzgit Integrity (Malta v. Sao Tomé and Príncipe)*³⁸ argued that:

“The exercise of enforcement powers by a (coastal) State in situations where the State derives these powers from provisions of the Convention is also governed by certain rules and principles of general international law, in particular the principle of reasonableness. This principle encompasses the principles of necessity and proportionality” (para 209)

Also investment tribunals have affirmed that “there needs to be an appropriate correlation between the state’s public policy objective and the measure adopted to achieve it” (*AES v. Hungary*, para 10.3.9)³⁹. Accordingly, state authorities must be able to point to a legitimate objective and there must be some “evidential basis for a measure, if it is not to be considered as arbitrary or disproportionate” (see Harrison, at p. 498). In “*Crystallex v. Venezuela*⁴⁰”, for example, the denial of a mining permit was held to violate international law because it was based upon reasons that had not been raised before by the state, whilst ignoring the scientific evidence that had been submitted by the mining company (see paras 591 - 597). Additionally, in “*Infinito Gold v. Costa Rica*⁴¹”, the tribunal held a mining ban to be disproportionate because it retroactively prohibited a gold mining project which national courts had considered to be environmentally sound (para 561 - 563).

³⁷ “*Seabed Minerals Act 2014 (Tuvalu) § 97; International Seabed Minerals Act 2015 (Nauru) § 39; Seabed Minerals Act 2014 (Tonga) § 88*”

³⁸ “*The Duzgit Integrity Arbitration (Malta v. São Tomé and Príncipe)*, Award, ¶ 209 (Perm. Ct. Arb. 2016)”

³⁹ “*AES Summit Generation Ltd. v. Hungary*, ICSID Case No. ARB/07/22, Award, ¶ 10.3.9 (2010)”

⁴⁰ “*Crystallex Int’l Corp. v. Venezuela*, ICSID Case No. ARB(AF)/11/2, Award, ¶¶ 591–597 (2016)”

⁴¹ “*Infinito Gold Ltd. v. Costa Rica*, ICSID Case No. ARB/14/5, Award, ¶¶ 561–563 (2021)”

ENVIRONMENTAL IMPACTS OF DEEP-SEA MINING

Biodiversity loss

Unless mining in the deep-sea is prohibited, it is bound to cause the loss of biodiversity. Deep-sea communities are a deep-sea habitat and deep-sea organisms create deep-sea pockets of life, a large percentage of which are not found anywhere on Earth, and even those species that are only seen on polymetallic nodules. When such communities are lost due to mining, there might be extinction of unique species that cannot be regained resulting in irreversible loss of biodiversity. This is even more worrying since the suggestion to compensate the loss of biodiversity as a result of deep-sea mining is thought to be impossible or scientifically meaningless⁴².

Habitat destruction

The long-term impact of habitat destruction will add to the immediate harm brought about by the mining extractors. The mineral deposits give rise to hard substrate and structures which take millions of years to develop which offers vital habitat to the marine life. The elimination of the substrate will render the settlement and recolonisation of the damaged sites by the larvae of marine organisms impossible. Long-term studies of the effects of deep-sea mining demonstrate that numerous bottom-dwelling organisms occur in excessive low abundance in previously mined areas. As an illustration, organisms attached to hard substrate had virtually died out on mined areas after seven years, and 26 years later suspension feeders remained at 40% of their initial abundance. Living in or on the soft sediment also have difficulty in recovering when the sediment is perturbed, such as deposit feeders (sea cucumbers), smaller organisms (worms and crustaceans), and microbial communities, which are also important in the biogeochemistry of the sediment. Unstable seabed communities may require several decades or centuries to recuperate, with some possibly never recuperating. Deep-sea species are especially challenging to recover, as in many cases they have low fecundity and slow growth rates. The Greenland shark, the longest-lived vertebrate in the world, is a sexually active female when she is approximately 150 years old. The killing of

⁴² “Lisa A. Levin et al., Defining “Serious Harm” to the Marine Environment in the Context of Deep-Seabed Mining, 74 *Marine Pol’y* 245, 247–50 (2016)”

people, or destruction of their habitat, can make sure that the species will never be able to recuperate again⁴³.

Large-scale impact of sediment plumes and toxic compounds

Deep-sea mining will have far-reaching effects. Sediment plumes caused by wastewater release in the middle of the water column may travel with the ocean currents over long distances, 100 km in the case of coarse sediment and more than 1,000 km in the case of finer particles and may cover an area of several million square kilometres. Although the probability of burial and smothering is lower with greater dilution of the sediment in the distance of the discharge point, the finest particles may persist in suspension over years and continue to lead to considerable destruction to the delicate filter feeders such as mussels. In addition, the toxic heavy metals and other substances in the plume may cause extreme harm to marine fauna even at low levels. As an illustration, corals that come in contact with copper intoxication can die within 13-27 days in case of contact with sediment plumes. Even sub-lethal levels of toxic metals have the ability to influence the behaviour of marine organisms⁴⁴.

Noise and light pollution

Deep-sea mining will result in noise and light pollution that will impact the behaviour of a variety of marine organisms, further straining already endangered wildlife. As an example, the marine mammals will not be able to communicate and find their prey and predators because of noise caused by underwater mechanical vibrations disorienting endangered migratory whales. Marine larvae which use phonic cues to settle may also be disoriented by noise pollution. There is disturbance in light as well. Bright light will obscure bioluminescence in the deep sea where bioluminescence is used by many organisms to capture prey, protect themselves and communicate, resulting in the blindness of animals and disruption of vital behaviour. Surface support vessel light will also cause fish to migrate towards the surface to find light, thereby interfering with day-night migration patterns, schooling and foraging behaviour, and reproduction⁴⁵.

⁴³ “Daniel O. B. Jones et al., Biological Responses to Disturbance from Simulated Deep-Sea Polymetallic Nodule Mining, 9 *PLoS ONE* 1, 4–8 (2017)”

⁴⁴ “Matthias Haeckel et al., Effects of Deep-Sea Mining on the Ocean System, 26 *Annu. Rev. Mar. Sci.* 1, 8–12 (2022)”

⁴⁵ “Diva J. Amon et al., Assessment of Scientific Gaps Related to Deep-Seabed Mining, 8 *Mar. Pol’y* 99, 105–08 (2022)”

Disruption of ecosystem functions

Deep Sea mining harms marine ecosystem by reducing the biodiversity, disturb the entire food web, and damaging essential ecological function of ecological function. The result may disturb the ecosystem consequences the collapse of the biodiversity, weakens productivity and nutrient cycles, and its negative impact on water quality and impact fisheries⁴⁶.

Impact on fisheries

Deep sea mining can disturb food-webs and create sediment pollution. damaging habitats, lowering phytoplankton production, and exposing marine life to toxins that accumulate through the food chain which may reduce the population of fish. The impact may change the fish behaviour and reproduction, which may cause huge financial loss to those countries which dependant on solely on fisheries.

Disruption of the carbon cycle

It disturb the carbon cycle by releasing the carbon from the seabed, which increase to CO₂ and lead to acidification of ocean water. It reduce the ocean ability to store the carbon. The effect has long last for years and contribute to global warming.

Deep Sea Mining And Biodiversity Preservation In The Blue Economy

In Article written by John O. Oladipo, as the article explains. Deep-sea mining will provide 5-10% of the world minerals, with yearly turnover across the world increasing from virtually zero to an estimated 10 billion Euro between 2020 and 2030.⁴⁷

Blue Economy has emerged as a key concept for economic development through the sustainable utilization of marine resources. States are exploring these resources for their national benefits, including activities such as fisheries, offshore energy, extraction of non-renewable source resources and marine mining. It encompasses sustainable practises that aim for economic growth, improves livelihood, and generate employment, while balancing ecological ecosystem. However,

⁴⁶ “Matthias Haeckel et al., supra note 3, at 14–16”

⁴⁷ “Edwin Egede, *Embedding Deep Seabed Mining into Africa’s Blue Economy Policy*, Cardiff University, <https://www.cardiff.ac.uk/law-politics/research/impact/embedding-deep-seabed-mining-into-africas-blue-economy-policy>”

this arise serious concerns regarding economic growth while environment protection. The research aims to study the legal dimension of the blue economy particularly how laws regulate the use of oceans for economic activities which preserving the environment and to fulfilling the sustainable development goal 14. Deep sea mining refers to the mining of the ocean floor minerals and geological materials. It The need to supply these resources, which is motivated by the increased low carbon technology like electric cars and wind turbines is out of this world. Polymetallic nodules, potato-sized lumps of nickel, cobalt, copper and manganese are especially desired. These nodules which are located 4-6km into the Pacific, Clarion-Clipperton Zone are considered to be the key to our power in the future. Although it has economic potential, it has been questioned as to its effect on the biodiversity and the environment. The studies indicate that deep-sea mining will most probably lead to the loss of biodiversity. The process of extraction that includes trawling the ocean floor and dumping waste sediment in the sea may destroy marine life and ecosystem. The discharge of heavy metals toxic sediment plumes may have an impact on the ecosystem and in other countries by ocean currents. Moreover, studies indicate that the number and variety of biological species in the deep sea are much greater than it was believed. Mining activities might destroy these species of which many are unique to certain regions.

It is argued that till the time Deep Sea is not studies properly and technology are well sufficient till then will call for moratorium on deep sea. The balancing between economic values of deep-sea mining and the necessity to preserve the biodiversity is a challenging issue, which is going to define the future of the blue economy.

RECOMMENDATIONS

Strengthening Environmental Regulations particularly under United Nation Convention on the Law of Sea and ISA regulation. Need for the development of standardized Environmental Impact Assessment. Mandate the use of scientific and technological methods.

Institutional Reform of ISA: It reflects that ISA is not effective in implementation its responsibility such as protecting the marine environment and fairly distributing the resources to everyone.

UNCLOS made is mandatory to review its system in every five years. However, it is delayed since 2017⁴⁸.

Structural issues and potential conflicts of interest: ISA is accused for being bias and there arise serious conflict of interest. The future possibility of having economic benefit from the deep sea mining consequences it lack focus on having stringent regulatory system. The adjudication body is also influenced by the powerful countries. The process of approval is weak LTC hold more significant position in approval and once it passed it is difficult to reject them. The transparency and independence as the private players have influenced in the meetings. It raised concerns as ISA is capable of regulating deep sea mining and simultaneously protecting the interest of humankind with marine environment safety.

“The [ISA] provided data identifying some of the most valuable seabed tracts, and then set aside the prized sites for the company’s future use.”

Eric Lipton, New York Times

Procedural lack of transparency and accountability.

“Because current ISA practices do not generally reflect international best practices in transparency, ensuring accountability from either the institution or its contractual parties engaged in mining will be difficult.”

Ardron et al. (2018)

Legal and Technical Commission (LTC), it is the approval commission which approved mining plans, but its lack transparency. Once it approved then it is difficult for council to reject it. LTC decision are very confidential and it is not disclosed to member state and public. With question the creditably of the commission.

⁴⁸ “Responsibilities and Obligations of States Sponsoring Persons and Entities with Respect to Activities in the Area, Advisory Opinion, Case No. 17, ¶ 131 (Int’l Trib. for Law of the Sea Feb. 1, 2011)”

“Rather than acting on behalf of all of humankind, the ISA continues to demonstrate a deep-rooted industry driven agenda. Silencing voices that question the path to extraction, including NGOs and scientists, during negotiations illustrates the Authority’s clear and inherent conflict of interest.”

Emma Wilson, representing OceanCare throughout negotiations

“On the whole, ISA practices appear to operate below expected UN standards, and there remains a need for clearer, more predictable and more advanced procedures for open and inclusive public participation, in line with human rights norms. In effect, the ISA should arguably set higher public participation standards than other international organizations because of its unique powers (regulatory and monitoring), its mandate to benefit humankind, and its lack of accountability within the UN system.”

Morgera and Lily (2022)

Adoption of a Precautionary Moratorium as there is scientific uncertainty and potential damage. Therefore, need for temporary stoppage in moratorium DSM activities. Integration of Legal Regimes such as UNCLOS, convention on Biological Diversity and Paris agreement. The solution is that it coordinated with legal framework and it align DSM regulation with biodiversity conservation goals and climate change commitments. It will reduce legal inconsistencies. Inclusion of Developing Countries and cooperation of the principle of Common Heritage of Mankind in which all the nation should participate and get benefits from seabed resources. The current problem lies in the hegemony of developed nation in terms of technological and financially.

CONCLUSION

Deep seabed mining is one of the most complicated modern issues in the field of international environmental law since it presents two conflicting global priorities in the face of the law: the increasing economic need in such vital resources as minerals needed to transition to energy and the development of new technologies, and the legal obligation to preserve vulnerable marine ecosystems that are scientifically underexplored. The international legal framework, which is mainly created by the United Nations Convention on the Law of the Sea and executed by the International Seabed Authority, tries to reconcile these conflicting interests, by declaring the seabed beyond the national jurisdiction as the common heritage of the mankind. Nonetheless, the

current regulatory framework shows major institutional and normative flaws as it is used in the context of potential commercial abuse.

Despite the principles offered by UNCLOS like precaution, sustainable development, equitable sharing of benefits, and safeguarding of the marine environment, the practical aspect of the stated principles is not clear yet due to the lack of scientific knowledge about the deep-sea ecosystems. The current legal system tolerates exploration to a large extent as the environmental impact of further exploitation is not yet clear, which poses a legal paradox between environmental protection and economic licensing. This paradox is more apparent in the cases like the two-year rule, where procedural requirements can hasten mining regulation in the case when environmental protection is not fully developed.

The role of ISA is also questionable as the institution is carrying out both promotional and regulatory roles at the same time. This dual role causes issues about conflict of interest, poor transparency, poor accountability and ineffective independent environmental oversight. The operations of the Legal and Technical Commission, the secret vote-making practice, and the lack of involvement of the population only reduce the trust in the ability of the current institutional model to protect marine biodiversity and have the right to extract activities in the future.

Deep seabed mining also presents questions that have not been resolved in law such as the liability, responsibility of the sponsoring states, contractor liability, compensation, transboundary environmental damages, and the responsibilities. Principles that are in place, like polluter pays, precautionary principle, ecosystem-based management and intergenerational equity need to be further operationalised by introducing enforceable standards as opposed to general normative statements. In the absence of well-articulated environmental limits, harmonised impact evaluation, autonomous compliance structures and proper dispute resolution, the current legal framework may end up allowing irreparable ecological harm in a region that is supposed to be used by all humanity in a legal manner.

Thus, deep seabed mining should be approached with the utmost caution in the future concerning international environmental law. A pre-emptive moratorium or deferral commercial exploitation

is legally justifiable until sufficient scientific confidence, institutional changes as well as enhanced environmental protection have been put in place. International law should transform beyond just facilitating the availability of marine resources to extraction to making sure that exploitation, should it ever occur, does not harm biodiversity, climatic stability and the collective interests of the current and future generations. Finally, it will not be economic potential in itself that will determine the legitimacy of deep seabed mining but whether international law has the capacity to enforce environmental justice in the global commons.

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