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Need for Deep Sea Diving and Exploration Regulation in India

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ABSTRACT

Diving and deep-sea exploration have become essential activities globally, providing opportunities for scientific discovery, resource exploitation, and tourism. With its vast coastline and strategic maritime interests, India is poised to exploit its ocean potential. This research paper delves into the importance of regulating deep-sea diving and exploration in India emphasizing the balance, between progress and environmental preservation. Over the years deep sea activities in India have experienced significant growth. Firstly, these endeavors bring breakthroughs by uncovering unknown species, ecosystems, and geological formations. India's vast marine biodiversity, unexplored holds value for global scientific research and ecological conservation. Secondly, as India's energy and resource demands increase, exploring and extracting minerals, hydrocarbons, and rare metals from the seabed provides opportunities for economic growth and energy security. Thirdly India's coastal regions and underwater landscapes offer potential for tourism by attracting enthusiasts to explore marine ecosystems. However, these prospects are accompanied by challenges. Unregulated deep-sea activities can harm marine ecosystems, disturb habitats, and put species at risk. Security may be a concern due to the perils related to such exercises. Deficiently asset administration can lead to overexploitation and consumption of assets jeopardizing both the environment and jobs. Although India has endorsed agreements on conservation and resource management specific regulations are currently lacking. This research emphasizes the need for India to establish its framework that specifically addresses challenges unique, to deep sea activities while prioritizing safety concerns. By taking these actions India can support long-term exploration in a way that protects marine ecosystems and preserves its treasures. This approach allows for both growth and scientific progress while maintaining a relationship, with the ocean.

I. INTRODUCTION

Exploring the sea has become increasingly important worldwide providing opportunities, for research, resource utilization, and tourism. India's extensive coastline and access to the Indian Ocean, Arabian Sea, and Bay of Bengal uniquely position it to tap into this potential. However,

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it is essential to handle this potential by implementing a regulatory framework that safeguards marine ecosystems. In years deep sea diving and exploration have gained attention globally and in India. The mysterious depths of the ocean hold territories that promise discoveries of unknown species, ecosystems, and geological formations. India's diverse marine biodiversity remains largely untapped. Offers possibilities for pioneering research. From the abyss of the Indian Ocean to the coral reefs of the Andaman Sea these underwater realms present opportunities to uncover valuable insights into Earth's history and future. As India's energy demands continue to rise there is growing interest in extracting minerals, hydrocarbons, and rare metals from the seabed. However important economic growth and energy security may be derived from these resources; and their sustainable management is critical, for utilization. India's national strategy includes a focus, on exploring deep-sea resources which are crucial to its interests. Exploring the depths of the ocean and engaging in adventures not only offers thrilling experiences but also contributes to the growth of local economies, through tourism, job creation, and economic stimulation. Safety is also a priority in deep sea activities due to their hazards necessitating rigorous safety measures and emergency response protocols. Proper resource management is equally crucial in order to avoid exploitation and resource depletion. Without regulations and sustainable practices, we risk facing fisheries collapse, ecosystem disruption, and economic losses. While India has signed agreements pertaining to conservation and resource management there remains a need for specific regulations governing deep-sea diving and exploration within the country's jurisdiction. This research underscores the requirement for India to establish tailored regulations that prioritize preservation enforce strict safety standards and promote responsible resource management. Deep sea diving and exploration carry the potential for progress, economic development, as well as environmental sustainability in India. This research paper highlights the importance of striking a balance, between progress and environmental preservation through customized regulation. India faces the challenge of balancing deep-sea activities with the protection of marine ecosystems and the preservation of its heritage, for generations.

RESEARCH DESIGN

- **Research Problem:**

India, with its coastline and to the Indian Sea, Middle Eastern Ocean, and Cove of Bengal is encountering a developing intrigued in profound ocean plunging and investigation for financial and recreational purposes. However, there is a pressing need for crafted regulations that specifically cater to these activities. This need for rules can result in hurt to the environment,

security risks, and a fumble of assets. The research at hand focuses on addressing these challenges by developing frameworks that are tailored to the unique context of deep-sea diving and exploration in India. The research aims to identify gaps in the existing structure and evaluate the safety risks associated with unregulated deep-sea activities while drawing insights, from international best practices and conventions. These findings will inform the development of regulations that align with India's interests.

- **Research Questions:**

1. What are the dangers and difficulties connected with unregulated deep-sea diving and exploration, within the Indian context and how can customized regulations help reduce these risks while encouraging sustainable practices?
2. What are the economic and scientific prospects presented by deep sea diving and exploration, in India? How can we create frameworks that maximize these opportunities while ensuring the distribution of resources and conservation?
3. How can India utilize expertise? Established norms regarding deep sea operations to shape the creation of inclusive regulations that prioritize safety, environmental preservation, and responsible management of resources specific, to India.

- **Research Objective:**

1. ***To assess the environmental impact:*** The objective is to conduct, in-depth research to identify and measure the dangers and difficulties linked to deep sea diving and exploration in India. This encompasses assessing the damage, to marine ecosystems, endangered species, and disturbance of habitats resulting from these endeavors.
2. ***To analyze economic and scientific opportunities:*** The point of this examination is to investigate the logical conceivable outcomes of profound ocean plunging and investigation in India. This includes assessing the worth of assets, minerals, and hydrocarbons found on the seabed well as considering the potential, for logical breakthroughs and financial development related to tourism.
3. ***To develop tailored regulatory frameworks:*** The objective is to develop frameworks that are tailored to India and can effectively tackle the risks and challenges while also promoting economic growth and scientific advancements. These frameworks should give importance to safety standards, management of resources, and protection of the environment. It is essential that they align with recognized practices and conventions.

LITERATURE REVIEW

- **History of Human Exploration of Deep Seas**

In this paper (*Human Exploration of the Deep Seas: Fifty Years and the Inspiration Continues*³) the author gives an insight on how fascinating it is to explore underwater mysteries and how human beings have developed new ways to explore deep waters from generation to generation for the past century. The article explains the development of the Trieste bathyscape, concurrent activities around the world, the effects necessary to accomplish safer dives, and the effects of this deep dive on the advancement of submersibles. This paper looks back at the history and flow of such ideas that involved submersible vehicles, It gives an overview of the evolution of submarines from the very first 1800s NAUTILUS to the modern ATLANTIS tourism submarine. It details the success, the difficulties, and occasionally, the good fortune required to accomplish their triumphs.

- **Deep Ocean Exploration in India**

Annual Report From (*The government of India Ministry of Earth Sciences*⁴) mentions the need for more underwater exploration in India as about 2.2 million sq. km of deep-sea ocean beds lie “unexplored and unutilized”. “Understanding the seas would also go a long way in mitigating the crisis of climate change” states the article. In 2019, the government initiated an 8000-crore plan to explore the depths of the ocean. The report provides various analytical data through graphs and charts as well as pictorial presentations which provide useful information for the research. The report has detailed information about India's deepwater exploration in comparison to other leading deepwater exploring countries like China, France, Japan, South Korea, and Russia, as well as international cooperation with UNESCO, Japan, Sweden, (IODP) U.S.A, and Argentina to conduct missions.

- **Autonomous underwater vehicles (AUVs)**

The article (*Autonomous Underwater Vehicles (AUVs): Revolutionizing Ocean Exploration and Research*⁵) explains how autonomous underwater exploration vehicles are revolutionizing the whole concept of deepwater exploration as they work without the need for human intervention. They are equipped with advanced technology which includes a variety of sensors, sonars as well as communication tools. The *article* (*The Advantages and Limitations of*

³ William Kohlen, *Human Exploration of the Deep Seas: Fifty Years and the Inspiration Continues*, Winter 2009

⁴ Annual Report (Government of India Ministry of Earth Sciences, 2020-2021) https://psa.gov.in/CMS/web/sites/default/files/publication/MoES_AR_20-2021%20english2_0.pdf

⁵ Perle Systems <https://www.perle.com/articles/autonomous-underwater-vehicles-auvs-revolutionizing-ocean-exploration-and-research-40196984.shtml> (last visited 21st August 2023)

*Autonomous Underwater Vehicles (AUVs)*⁶) mentions the limitations of these autonomous vehicles when compared to manned vehicles which include depth limitations, with most of them designed for shallower depth; sensor restrictions impacting data collection, limited manoeuvrability and constant dependence for navigation. Acknowledging these limitations is crucial in mission planning and tool selection.

- **Deep Sea Mining Impacts**

The article (*Environmental Issues of Deep-Sea Mining*⁷) mentions the impacts of extensive deep-sea mining and the equipment used in conducting these operations. There are various metals that are found in the seabed that are difficult to find offshore or are getting relinquished. It provides a graphical as well as pictorial presentation of the negative impacts of the heavy mining of these resources and the disturbances caused to the coral life. The author emphasizes how the leftover sediments cause serious damage to the underwater species when they come in contact with these foreign objects as they are not immune to contact with these minerals as marine biological communities survive in a fragile ecosystem by maintaining a very delicate balance with their environment. The article (*Environmental Impact Assessment process for deep-sea mining in 'the Area'*⁸) emphasizes on Environmental Impact Assessment (EIA) as a key aspect of planning and environmental of commercial and industrial projects. The article has a brief explanation on how (EIA) process can be implemented to anticipate better deep-sea mining regulations and expects a proper investigation from the government as well as the mining authorities to conduct practical investigations on how these mining activities are affecting the coral's lives.

- **Dangers to Unregulated Deep-Sea Tourism**

The article (*The Titan Sub and the Dangers of Unregulated Deep-Sea Tourism*) The article throws light on the recent underwater disaster of the Titan Submarine Implosion which left the world shocked. The submarine consisted of 5 crew members one of whom was CEO of the ocean gate program. The article states that the submarine was not crafted according to the certified regulations. The article (*Experts Question the Safety of Titan Submersible and Deep-sea Tourism*) also states that the people onboard were true explorers and had paid a hefty amount to explore the unexplored deep-sea wreckage of the Titanic by common men. The article

⁶ Defensebridge <https://defensebridge.com/article/the-advantages-and-limitations-of-autonomous-underwater-vehicles-auvs.html>. (last visited 20th August 2023)

⁷ Rahul Sharma, *Environmental Issues of Deep-Sea Mining*, *Procedia Earth and Planetary Science*, Volume 11, 2015, Pages 204-211, ISSN 1878-5220

⁸ Jennifer M. Durden et al, *Environmental Impact Assessment process for deep-sea mining in 'the Area'*, *Marine Policy*, Volume 87, 2018, Pages 194-202,

(Titanic Sub: How is submersible tourism regulated and what's next for the industry?) also mentions the high risk that comes along with the thrill of exploring the deep waters as if the submersibles on which the lives of these explorers are dependent is not designed and engineered according to the basic regulations then it would result in a future catastrophic disaster like the ocean gate implosion disaster. Carbon steel or Titanium is mostly used to build conventional submarines which are used by the forces. Titanium is better for stealth but cannot perform many multiple dives as the metal tends to get brittle as mentioned by the experts.

- **HYPOTHESIS**

1. The lack of customized frameworks, for deep sea diving and exploration in India has led to environmental degradation, safety issues, and unsustainable exploitation of resources, in marine ecosystems.
2. Developing frameworks specifically tailored to India's deep-sea diving and exploration while drawing upon globally recognized practices and conventions will contribute to a more sustainable economically feasible and environmentally conscious approach, to marine activities, within the Indian context.

- **RESEARCH METHODOLOGY**

The research approach used to examine the necessity of regulating deep-sea diving and exploration, in India involves a research design to understand the current state of these activities and the requirements for regulations. To gather data, we will conduct interviews with stakeholders and distribute surveys to divers, submersible operators, and tourists. Through analysis of interview responses, we will identify themes while quantitative analysis of survey data will help us uncover patterns and correlations. We will prioritize considerations by obtaining consent ensuring confidentiality and adhering to research ethics guidelines. However, we acknowledge that there may be limitations such as bias and difficulties in accessing data from remote deep-sea environments. This research methodology aims to provide insights for developing customized frameworks that strike a balance between economic growth, scientific advancement, and environmental preservation, in India's deep-sea activities.

II. ENVIRONMENTAL IMPACTS OF DEEP-SEA DIVING AND EXPLORATION

Exploring the sea through diving and underwater exploration can affect the delicate ecosystems found in the ocean depths. When submersibles, operated vehicles (ROVs), and diving equipment are present they can be directly. Potentially harm fragile habitats like cold-water coral reefs and hydrothermal vent communities. Other activities like anchoring and trawling

during exploration also pose threats by causing destruction and disrupting the balance of marine ecosystems. Additionally, chemicals released, noise pollution, and sediment stirred up during exploration can negatively impact life. These effects may extend beyond the exploration sites affecting species in surrounding areas well. Since deep-sea ecosystems often take time to recover from disturbances these consequences can be particularly severe. To minimize these impacts it is crucial to have regulations for comprehensive assessments of environmental impacts and the adoption of sustainable practices in place, for responsible deep-sea exploration that prioritizes the preservation of marine biodiversity.⁹ Indian Ocean maritime history atlas¹⁰ portrays the fact that Exploring the depths of the Indian Ocean can have consequences for the delicate coral reefs that serve as homes to numerous marine creatures. These reefs play a role, in maintaining the equilibrium of the ecosystem so any harm inflicted upon them can disrupt the entire marine world. Moreover, fishermen and other individuals who rely on the ocean may encounter difficulties as a result. Additionally, disagreements between countries over access to ocean resources may arise. To ensure the preservation of an ocean and safeguard those whose livelihoods depend on it nations, including India must establish regulations, for deep sea exploration and collaborate in its protection. Some of the backing pointers on the environmental impacts can be:

a. Physical Disturbance: Diving activities can have an impact, on marine ecosystems like coral reefs and underwater formations potentially causing irreversible damage.

b. Pollution: When we explore the ocean the release of substances like oils, chemicals, and debris can directly harm life. Disrupt the integrity of their habitats.

c. Species Disruption: activities that cause disturbance can result in changes, to behaviors, migration patterns and breeding cycles of marine species, which ultimately affects their well being.

d. Ocean Acidification: Increased carbon dioxide absorption by the oceans from human activities contributes to ocean acidification, impacting marine life and ecosystems.

e. Temperature Changes: Climate change-induced temperature variations in the oceans affect the distribution and health of marine species, potentially leading to the loss of biodiversity.

⁹ Eva Ramirez-Llodra, "Deep-Sea Ecosystems: Biodiversity and Anthropogenic Impacts," in *The Law of the Seabed: Access, Uses, and Protection of Seabed Resources*, ed. Catherine Banet (Brill, 2020), 36–60.

¹⁰ Peter Ridgway, "Indian Ocean Maritime History Atlas," *The Great Circle* 27, no. 1 (2005): 34–51.

III. HOW UNCONTROLLED AND UNREGULATED DEEP-SEA EXPLORATION CAN LEAD TO CLIMATE CHANGE

The rapid growth of deep-sea diving and exploration, in India has become a pressing issue with implications for climate change. These activities harm marine ecosystems through disturbance, pollution, and disruption of species making vulnerable ocean environments even more susceptible. The release of pollutants and disturbance to delicate marine habitats intensify the impacts. The transportation and equipment associated with exploration contribute to a carbon footprint, while chemical usage and accidental spills can lead to pollution. Physical disturbance of the seafloor, habitat destruction, and the extraction of resources further impact deep-sea ecosystems. To mitigate these environmental impacts, stringent regulations, environmental assessments, and sustainable practices are essential, along with international collaboration to address the global implications of deep-sea exploration on climate and marine ecosystems.¹¹ Establishing a framework that includes zoning, protected areas, strict licensing procedures, and environmental impact assessments is crucial. By doing so, India can protect its marine biodiversity and contribute to global endeavors to mitigate the effects of climate change on our oceans. *The deep sea plays a vital role in carbon sequestration, and the release of methane hydrates due to climate change poses additional greenhouse gas concerns. Responsible regulation and sustainable exploration practices are essential to mitigate the potential environmental consequences and contribute to our understanding of the intricate relationship between deep-sea ecosystems and climate change. Public awareness campaigns and educational initiatives play a role in promoting deep-sea exploration practices that strike a sustainable balance, between scientific discovery and environmental preservation*

Atmospheric CO₂ concentrations have increased from about 280 parts per million (ppm) before the industrial revolution to 407 parts per million today due to fossil fuel burning, deforestation, and removal of other carbon-storing habitats. With continued use of fossil fuels into the 21st century, atmospheric CO₂ levels are expected to exceed 900 ppm by 2100 (according to Representative Concentration Pathway (RCP) 8.5; b), but the exact levels are Much depends on the emissions scenario. This increase in the concentration of greenhouse gases in the atmosphere will cause the global average temperature to rise by approximately 0.2 degrees Celsius every 10 years, much of which will be absorbed by the oceans. has changed significantly. ocean

¹¹ Levin, Lisa A., "Sustainability in Deep Water: The Challenges of Climate Change, Human Pressures, and Biodiversity Conservation," *Oceanography* 32, no. 2 (2019): 170–80

surface pH¹²

*The most spectacular example of this was the aftermath of the 2010 Deepwater Horizon oil spill in the Gulf of Mexico. It was assumed at the time that much of the millions of barrels of oil released by the faulty offshore drilling rig would float; they did not. It was assumed that the dispersant would neutralize the oil; in fact, it was more toxic to deep-sea corals than the oil itself.*¹³

IV. ECONOMICAL IMPACTS OF DEEP-SEA DIVING AND EXPLORATION

The exploration of the sea is filled with mostly unexplored depths, which has significant implications, for global economies. Deep sea diving and exploration have become essential in industries due to advancements and the pursuit of valuable resources. These endeavors bring benefits in ways, such, as extracting precious minerals developing cutting edge technologies and promoting tourism related activities. However it is crucial to balance these gains with considerations to ensure the sustainable management of these oceanic frontiers. This exploration not promises prosperity but also challenges us to adopt responsible practices that protect the delicate balance of deep sea ecosystems on which these economic opportunities rely upon. Here are some of the key economic impacts associated with deep-sea diving and exploration.

1. **1.Mineral Resources:** Discovery of valuable minerals and metals in the deep sea: Some minerals such as polymetallic nodules, manganese, and rare earth elements have the potential to significantly contribute to the country's mineral wealth.
2. **Oil and Gas Exploration:** Deep Sea exploration often involves the search for oil and natural gas reserves. Successful discovery and extraction of these resources can reduce dependence on imported energy sources.
3. **Advancements in Technology:** The difficulties faced in sea research are pushing the boundaries of development and equipment. These advancements have implications that extend beyond the industry and can potentially drive progress in robotics, materials science, and various other fields.
4. **Advances in Scientific Research:** Exploring the depths of the ocean contributes significantly to our knowledge of ecosystems, biodiversity, and geology. The findings

¹² Major impacts of climate change on deep-sea benthic ecosystems <https://online.ucpress.edu/elementa/article/doi/10.1525/elementa.203/112418/Major-impacts-of-climate-change-on-deep-sea> (last visited 20th November 2023)

¹³ Human Activities Are Taking Their Toll in the Deep Ocean <https://www.climatecentral.org/news/human-activities-toll-in-deep-ocean-21527> (last visited 20 November 2023)

from this research have applications, in medicine, environmental monitoring, and several other areas. This is not fostered. Also promotes economic development.

5. **Tourism:** Deep-sea plunging, especially in ranges with interesting submerged environments, can draw in sightseers looking for courageous and intriguing encounters. This could lead to the improvement of tourism foundations, creating employment and creating income for nearby economies.
6. **Job Creation:** The complete esteem chain of deep-sea investigation, from inquiry about and advancement to genuine jumping operations, requires a gifted workforce. This makes work openings in areas such as marine science, topography, building, and sea operations.
7. **Biotechnological Applications:** Deep-sea life forms regularly have special biochemical properties with potential applications in pharmaceuticals and biotechnology. The recognizable proof and commercialization of these compounds can make financial openings within the biotech industry.
8. **Blue Economy Development:** Deep-sea exercises contribute to the blue economy, emphasizing feasible utilize of sea assets. This incorporates fisheries, aquaculture, and other marine-related businesses that back financial expansion and supportability.

V. REGULATION REQUIREMENT AND RECOMMENDATIONS FOR DEEP SEA DIVING AND EXPLORATION IN INDIA

Regulating deep-sea diving and exploration in India is essential to ensure the sustainable management of marine resources and the protection of delicate ecosystems. Here are some suggested regulations that India should consider implementing:

1. **Zoning and Protected Areas:** Designated specific zones for deep-sea diving and exploration activities based on ecological sensitivity. Establishing protected areas where these activities are restricted or prohibited to safeguard critical habitats such as coral reefs and unique underwater ecosystems.
2. **Licensing and Certification:** Introduce a rigorous licensing system for deep-sea diving and exploration operators to ensure compliance with environmental regulations. Certify diving and exploration equipment to meet safety and environmental standards, promoting responsible practices.
3. **Environmental Impact Assessments (EIAs):** Command comprehensive EIAs for all deep-sea jumping and investigation ventures some time recently they commence. Assess

the potential natural impacts, counting physical harm, contamination, and disturbance to marine life, and require administrators to propose moderation measures.

4. **Time and Seasonal Restrictions:** Implement restrictions on the timing and seasons during which deep-sea diving and exploration can occur to minimize disturbance during critical life stages of marine species. Establish "no-go" periods for certain areas during sensitive times, such as breeding or migration seasons.
5. **Research and Monitoring Requirements:** Empower and bolster logical inquire about on deep-sea biological systems to improve understanding and educate administrative choices. Build up observing programs to track the long-term impacts of deep-sea plunging and investigation on marine situations and species.
6. **Public Awareness and Education:** Create instructive programs to raise mindfulness among the open, jumpers, and administrators almost the significance of dependable deep-sea investigation. Advance a culture of natural stewardship, emphasizing the centrality of marine preservation and the part of directions in accomplishing supportability.

VI. CONCLUSION

The exploration of the deep sea through diving and underwater activities presents both significant economic opportunities and environmental challenges for India. This research paper has explored the need for regulations tailored to deep-sea diving and exploration in India, emphasizing the delicate balance required between progress and environmental preservation. As deep-sea activities in India experience substantial growth, the paper highlights the breakthroughs in scientific discovery, economic potential in resource extraction, and the tourism opportunities offered by India's vast and diverse marine ecosystems. However, unregulated exploration poses risks such as environmental degradation, habitat disturbance, and safety concerns. The lack of specific regulations in India, despite global endorsements on conservation and resource management, underscores the need for a comprehensive framework.

The proposed regulatory measures include zoning and protected areas, licensing and certification, environmental impact assessments, time and seasonal restrictions, and research and monitoring requirements. These recommendations aim to address the environmental impacts of deep-sea activities, ensure safety, and promote responsible resource management. By establishing a tailored regulatory framework, India can support long-term exploration while protecting marine ecosystems and preserving its rich marine biodiversity. Striking a balance between economic growth, scientific progress, and environmental sustainability is crucial for

India to harness the potential of deep-sea diving and exploration responsibly and sustainably.
