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Balancing Wealth and Environmental Integrity: Pacific Island Countries (PICs) in the Pursuit of Deep-Sea Mining

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Abstract: The seabed within the maritime jurisdictions of the PICs is widely recognized to be rich in minerals, including copper, cobalt, nickel and rare earth elements, all of which are critical to modern technologies. The paper finds that some PICs with access to seabed mineral resources are at the forefront of deep-sea mining development, aiming to generate substantial revenue through licensing fees, royalties, and taxation on mining operations. The paper argues that the PICs are confronted with a dual challenge: advancing their economic development via deep-sea mining while conserving their fragile marine ecosystem and marine environment. The paper concludes that prior to the exploitation of seabed mineral resources, the PICs should prioritize sustainable development practices, environmental protection measures and regulatory frameworks to safeguard the ecological integrity of this unique marine ecosystem.

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1. Introduction

Deep-sea exploration across the South Pacific has gained momentum since the onset of the 21st century, driven by the global shift towards green energy transition. Several PICs and international mining enterprises are formulating plans to explore for and extract high-value mineral deposits, both in the open ocean under international jurisdiction and in the territorial seas of the PICs. The South Pacific region is home to a wealth of seabed minerals, such as cobalt-manganese crusts and mineral-bearing manganese nodules that rest on the ocean floor, and mineral-rich sulfide deposits that surround hydrothermal vents situated within and beyond national jurisdictions. Data released by the World Bank [1] shows, a number of PICs (e.g., Tuvalu, Palau, Kiribati and Samoa) have found abundant cobalt-manganese crusts within their territorial waters. Others, such as Niue, Kiribati and the Cook Islands, are rich in manganese nodules, and Papua New Guinea (PNG), Vanuatu, the Solomon Islands and Tonga are rich in sulfide deposits. The seabed within and beyond the PICs' territorial waters is widely regarded by the PICs as an untapped reservoir of mineral wealth, holding promise for their countries' economic growth and people's wellbeing.

Interest of the PICs and international mining enterprises in extracting seabed resources in the South Pacific has markedly increased in the 21st century as a result of the fast-growing global demand for minerals and the depletion of the land-based mineral resources as well as the pursuit of wealth by the aid-dependent PICs. The International Energy Agency (IEA) estimates that the global demand for critical minerals will double by 2030, and triple by 2050 [2]. This explains why several PICs and a number of mining companies adhere to the view that the revenues derived from the seabed mining of gold, copper, nickel and cobalt will yield substantial economic benefits through tax revenues and royalties. Against the backdrop of the world's growing focus on renewable energy sources and the rapid escalation in demand for critical minerals, several PICs (e.g., the Cook Islands, Kiribati, Tonga and Nauru) have emerged as proactive actors in exploring the potential for seabed mining in the Clarion-Clipperton Zone (CCZ) and within their Exclusive Economic Zones (EEZs).

The paper finds that the seabed of the South Pacific has emerged as a focal point for exploration and potential exploitation, following the rapid growth of global demand for minerals, such as copper, cobalt, nickel and rare earth elements, driven by the global green energy transition. The paper examines the significance of these seabed mineral resources and the economic implications for the PICs, as well as the governance frameworks

governing their extraction, and the environmental challenges associated with the pursuit of the seabed mineral resources. The paper argues that the deep-sea mining in the South Pacific represents the PICs with both an opportunity for wealth and a challenge to the conservation of marine ecosystem and marine environment. The outcome of the deep-sea mining initiatives undertaken by the PICs will surely shape their future trajectory and is likely to serve as a case study in the global discourse on deep-sea mining in the South Pacific and beyond. The paper concludes that sustainable development practices, rigorous environmental protection measures and stringent regulatory frameworks must be prioritized to safeguard the ecological integrity of this unique marine ecosystem.

2. The Riches of the PICs' Seabed

The deep-sea minerals generally refer to those that occur in the 'deep' ocean, where 'deep' is typically defined as the depth range between 500 and 6000 meters beneath the ocean surface [3]. The deep-sea minerals are generally classified as polymetallic sulphides, polymetallic (manganese) nodules and cobalt rich crusts [4]. One area is of particular interest for polymetallic nodules within the international waters in the Pacific Ocean: the 'Clarion-Clipperton Zone' or CCZ, which extends east–west between Mexico and the Line Island Group of Kiribati. The region covers approximately 4.5 million square kilometers, whose seabed is broadly recognized to be rich in polymetallic nodules. The region is estimated to contain billions of tons of polymetallic nodules that are composed of valuable metals, such as nickel, copper, cobalt, manganese and zinc, making it a focus of deep-sea exploration and future mining activities by mining companies and local governments [5].

Specifically, the region hosts an estimated 270 million tons of nickel, exceeding global land-based reserves, 234 million tons of copper, 46 million tons of cobalt, more than five times the total land-based reserves, and 6 billion tons of manganese and abundant zinc and rare earth elements. These minerals are critical to manufacturing of electronic products, renewable energy technologies, and military equipment [6]. Many seabed deposits in the region have a higher mineral content than the land-based deposits that are being mined. For example, the average grade of copper minerals has declined from over 4% in 1900 to less than 1% today whereas polymetallic sulphide copper grades can often be over 7%, involving much less mining waste [7]. Much worse, the number of new finds of high-grade copper deposits in the world has greatly reduced with time (ibid). A substantial portion of the CCZ is under exploration licences with a range of mining companies (private sector and state owned), mainly from the developed countries, which are exploring the deep-sea floor in detail and delineating areas with particularly high mineral grades. The World Bank [8] predicts that net government revenues from one seabed-mining operation could average about $42 million a year.

Located in the central Pacific Ocean, the PICs possess a distinctive marine ecosystem teeming with biodiversity and marine resources, including the seabed minerals. The seabed around the PICs is believed to be rich in minerals, including rare earth elements that are vital for modern technologies, such as smartphones and renewable energy solutions. The EEZs of PNG, Solomon Islands, Vanuatu, Fiji, Marianas Islands and Tonga are rich in sulphides [9]. Solwara 1 that is situated close to New Ireland and New Britain in PNG is a deep-sea polymetallic deposit, containing copper and gold, and found within a seafloor massive sulfide formation. It is probably the site of the world's first deep sea mine, at an average sea depth of 1600 meters (Solwara Project 1 2025). Polymetallic nodules are particularly prevalent in the deep waters (>4500 m) of the Cook Islands and Kiribati. Cobalt rich crusts are present in the Federated States of Micronesia, Marshall Islands, Kiribati and French Polynesia [3].

The appeal of seabed minerals has attracted the attention of the PICs, particularly the Cook Islands, Nauru, Kiribati, and Tonga, whose seabed within the EEZs contains of mineral deposits, notably polymetallic Nodules enriched in nickel, copper, manganese and cobalt. The metal content makes them essential for technology manufacturing, particularly in batteries for electric vehicles. The potato-sized nodules that rest on the ocean floor can be harvested through deep-sea mining techniques. The hydrothermal vents in the region are sources of seafloor massive sulfides that are formed by volcanic activities on the ocean floor, containing high concentrations of valuable metals, such as gold, silver, copper and zinc [10]. The cobalt-rich ferromanganese crusts that rest on the seamounts are rich in cobalt and rare earth elements, and essential for high-tech industry. The potential economic benefits of seabed mineral extraction are substantial, with profound economic implications. These minerals are critical to the production of batteries for electric vehicles and other green technologies. If harnessed sustainably, the minerals could support industries, such as electronics and renewable energy, where metals like cobalt and nickel are critical components.

The global transition to renewable energy and electric vehicles has fueled demand for these minerals, positioning deep-sea mining as a potential economic driver for the PICs and rendering CCZ increasingly appealing for mining activities. The International Energy Agency (IEA) declares that "the production of minerals critical to clean energy technologies, such as batteries, may need to quadruple over the next two decades to achieve the Paris Agreement warming limit of 'well below' 2C, or to expand by as much as six times to reach net-zero globally by 2050" [11]. Global push for sustainable energy solutions and the increasing production of electric vehicles require significant amounts of nickel and cobalt, which makes the CCZ and the EEZs of the PICs emerge as a significant economic opportunity for both the PICs and the international mining companies. It is widely accepted that the seabed mineral extraction in the region can yield the critical minerals required to support the development of green energy

technologies. A report published by the Mining Technology claims that "the vast potential for minerals in the CCZ is thought to be unmatched" [12].

With the rapid global surge in demand for these minerals, the exploration and exploitation of seabed resources hold substantial potential to significantly boost the PICs' economy, while generating employment opportunities and fiscal revenue for local populations. The PICs with access to seabed minerals are expected to be able to generate significant revenue through licensing, royalties, and taxes on mining operations [13]. Driven by the expectation for these economic benefits, several PICs, such as the Cook Islands, Tonga, Kiribati and Nauru, are at the forefront of the initiatives on deep-sea mining initiatives, aiming to reap economic dividends for their people. Some PICs are collaborating with international enterprises (e.g., The Metals Company, formerly DeepGreen Metals) to advance the exploration and development of seabed resources, aiming to secure seabed-derived revenue to create more jobs and boost their economic and social development.

3. The Pursuit of Deep-Sea Wealth

The Cook Islands is in possession of significant reserves of seabed manganese nodules within its EEZ, which is around 2 million square kilometers and holds immense potential. These manganese nodules are particularly rich in cobalt, which is the fourth richest resource of its type in the world and potentially valued at up to $10 trillion, making them a unique asset for addressing the global transition to clean energy. The Cook Islands nodule field is a world-class metal resource for critical metals, such as Co, Ni, Ti, total rare earth elements, yttrium and Zr [14]. The abundance of deep-sea resources positions the Cook Islands as a key player in the transition to green technologies as exemplified by its hosting of the 2023 Underwater Minerals Conference (UMC), themed "Going Deep: Getting the Science Right for Informed Decisions". This is the second time in UMC's 52-year history that a South Pacific country takes the spotlight, which highlights the role of the Cook Islands in leading the way in seabed mineral exploration and global deep-sea mining industry. It is estimated that a single mining operation of the seabed minerals for 20 years could provide the country about 150 jobs and 15% of its GDP (around US$43 million) [15]. The estimated enormous benefits explain why the island country takes the lead in deep-sea mining.

Albert Henry, the country's first Prime Minister, addressed the United Nations in 1974, envisioning how these seabed resources could secure the future of his country. Subsequently, the Cook Islands conducted over 20 expeditions to assess the potential of its seabed, and established in 2009 the world's first Seabed Minerals Authority, providing a legal framework for managing these resources. The efforts of the Cook Islands were further enhanced in 2017 with the Marae Moana Act that introduces protections across the country's entire EEZ. Exploration activities resumed in 2019 after a decade-long pause and the Cobalt Seabed Resources Limited (CSR)

launched a research campaign with a collection of 120 samples from depths of 5,000 meters (The Cook Islands Investment Corporation 2024). The Seabed Minerals Authority granted exploration licenses to three companies in 2022, allowing them to conduct scientific research aimed at gaining a better understanding of deep-sea mining and the resource potential of seabed nodules. In early 2025, the Cook Islands entered a Memorandum of Understanding for Blue Partnership in the Field of Seabed Minerals Affairs with China, reinforcing a shared commitment to the exploration, management, and utilisation of seabed mineral resources (Seabed Minerals Authority 2025). The first step of their cooperation includes:

(1) Capacity building and technology transfer - Enhancing expertise and knowledge exchange in seabed minerals exploration and environmental management.

(2) Environmental stewardship - Conducting research to better understand and mitigate potential environmental impacts on deep-sea ecosystems.

(3) Logistical support for exploration activities - Facilitating collaboration on surveys, expeditions, and research projects.

(4) Seabed minerals exploration and research - Advancing scientific understanding and sustainable utilisation of deep-sea mineral resources.

The seabed of Tonga is abundant in polymetallic nodules, which contain high concentrations of valuable metals, including nickel, cobalt and rare earth elements. Tonga's pursuit of seabed minerals has gained significant momentum since the onset of the 21st century, which is primarily driven by the growing global demand for minerals and by the country's desire for wealth, economic growth and job creation. The International Seabed Authority (ISA) that regulates seabed mining activities to ensure sustainable practices has facilitated Tonga's entry into this lucrative sector, marking a pivotal moment in the country's economic development. Tonga Offshore Mining Limited (TOML) in cooperation with The Metals Company signed a 15-year contract with the ISA to secure exploration rights in a 74,153 km² block within the CCZ, an area deemed to hold an inferred resource of 756 million wet tons of polymetallic nodules [16]. The contract with ISA positions Tonga as one of the key players in the global seabed mining sector and pushes it to unlock a treasure trove of minerals that lie beneath its territorial waters. It is a well-established truism that many PICs lack the infrastructure, capacity, expertise and financial resources required to conduct independently exploration of seabed minerals [17]. Consequently, partnerships with third-party firms specializing in seabed mining are often formed [9]. Tonga is actively seeking partnerships with international stakeholders, such as The Metals Company, to ensure the responsible management of its seabed resources.

Kiribati, situated across the central Pacific Ocean, possesses substantial mineral wealth potential within the waters of its EEZ. Reports indicate that the fishing sector in Kiribati has contributed significantly to the country's GDP as exemplified by its fishing license revenue in 2015 when the Kiribati's

government generated $207.1 million from such licenses, accounting for approximately 91% of the country's GDP. Overall, fisheries revenue accounted for 85% of the country's total revenue growth between 2011 and 2018, which is widely assumed unsustainable [18]. The International Union for Conservation of Nature (IUCN) warns that climate change is impacting food security in the Pacific islands with harvests from fisheries expected to fall between 10-30% by 2050 [19]. With its population expanding and traditional resources, particularly fisheries, confronting increasing pressure, the exploration and extraction of seabed mineral resources have emerged as critical pathways for Kiribati's economic diversification. Explorations in the country's EEZ have indicated promising deposits of these minerals, suggesting a potential boon for the country's economy [20].

Nauru, one of the world's smallest nations with a total land area of only eight square miles, is a diminutive island country whose economic landscape has been precarious since the depletion of its phosphate reserves in the late 20th century. Thus, the island nation has been seeking new avenues for revenue generation and setting its sights on the ocean floor that is believed to harbor valuable minerals, such as nickel, cobalt, and rare earth elements. Nauru is ranked as having the largest undeveloped nickel deposit in the world [21]. In 2011, the ISA granted a polymetallic nodule exploration contract in the CCZ to Nauru Ocean Resources Inc. (NORI), a company sponsored by the government of Nauru. Since then, NORI has progressed with a seabed-to-surface research program, in partnership with leading researchers and institutions. NORI has completed dozens of offshore research campaigns and monitored the impacts of the pilot collection system test. NORI expects to submit an application to the ISA for an exploitation contract prior to the ISA's 2025 session. Nauru is becoming one of the first countries among the PICs to collect nodules at commercial scale in collaboration with the developed countries.

4. Developmental State?

Consensus has been reached by researchers that states should play a role in economic development, a role widely debated by two groups of thought: the developmental state and dirigiste [22]. It is plausible to argue that the governments of the PICs should be involved in local economic development by creating, protecting and nurturing key industries that are deemed important for economic growth and national security [23]. It is widely recognized that the pursuit by certain PICs of the seabed minerals is primarily driven by economic imperative, reflecting their pressing economic needs and a broader trend of resource exploitation. The governments of the PICs have identified seabed mining as a pathway to stabilize their economies, generate sustainable revenue, and create jobs through royalties and investments, and support environmental conservation [24].

It is true that the deep-sea mining projects can create ample employment opportunities both directly in local exploration and extraction

and indirectly in supporting sectors, such as transportation, logistics, services, and other mineral processing and transportation-related industries. With fisheries as their primary resource, seabed mining can support PICs' economic diversification, boost economic resilience, and drive local economic benefits through investment inflows. In conclusion, the potential revenues from seabed mineral extraction will provide crucial funding for the PICs' development initiatives. Some governments of the PICs have pledged to use these funds for national sustainable development, including public services and infrastructure development.

In this context, the PICs have partnered with advanced countries and international mining companies (e.g., the Metals Company) to offset their lack of expertise, technology and capital, and boost their capabilities of exploring the rich seabed resources and managing marine resources. Some governments of the PICs and mining companies argue that careful planning, community involvement, and a commitment to sustainability will enable their partnerships with international deep-sea mining enterprises to usher in economic growth while protecting the marine ecosystem [25]. The cooperation between the PICs and mining companies is not merely a venture into the ocean depths, but a strategic initiative to harness the untapped potential of the underwater resources.

Nauru and Tonga have been particularly proactive in granting licenses to international mining companies, and are poised to exploit their seabed mineral wealth, a development that has triggered considerable controversy within the region due to unresolved environmental uncertainties and divisions among regional nations [26]. Several neighboring nations like Fiji and Palau call for a moratorium on deep-sea mining, while civil society and legal experts in Tonga itself have raised objections over environmental risks and insufficient transparency of related agreements. As seen, Tonga has sponsored Offshore Mining Limited partnered with The Metals Company, which is seeking approval for a contract to explore polymetallic nodules in the reserved area. Nauru has established partnerships with Nauru Ocean Resources Inc., a subsidiary of the Metals Company, to secure seabed exploration licenses and exploit its mineral deposits.

Kiribati has formed partnerships with private mining enterprises for deep-sea resources exploration. The Marawa Research and Exploration Ltd., a key partner in these collaborations, is leading exploration efforts and has secured contracts from the ISA to evaluate the mineral potential of designated seabed areas [27]. In partnership with the PICs, several mining companies (e.g., the Metals Company) have conducted exploration in the CCZ with the aim of tapping into the seabed mineral wealth, thereby laying the groundwork for potential commercial exploitation. The Metals Company boasts marine geology expertise and cutting-edge technology, emerging as a key player in deep-sea mining. The company has a long-standing history of exploration in the CCZ, and has made significant progress in evaluating the economic viability of mining operations within the region.

In contrast to Nauru and Tonga, Kiribati and other PICs remain cautious toward deep-sea mining, with their populations holding mixed sentiments regarding the trade-off between environmental implications and economic incentives (Asia-Pacific Strategy). Obviously, the deep-sea mining presents considerable economic potential while posing significant environmental and social challenges that must be addressed. In this context, the PICs and deep-sea mining companies must conduct thorough assessments of the seabed ecosystems and utilize advanced techniques to minimize environmental impacts with a commitment to responsible resource governance.

5. Environmental and Ecological Risks

While proponents of deep-sea mining argue that it is needed to meet future demand for energy transition minerals, concerns remain about the ecological and environmental risks posed by this activity to the planet. Worse still, the actual economic returns are likely to be considerably lower than the promises extended to the PICs, as highlighted by the *Report of Planet Tracker*. The authors were recently invited to deliver lectures to trainees of a climate change program co-sponsored by the Chinese government and the UN. Several trainees from the PICs' governments raised a thought-provoking question: the industrialized countries have engaged in extensive mining activities since the British Industrial Revolution, which has contributed substantially to their economic development and prosperity. Do you think it is equitable to demand the PICs, the disproportionate victims of climate change and transboundary industrial pollution, to bear the full brunt of such environmental aftermaths? Do you think it is fair to restrict our right to develop resources within our jurisdiction, including both territorial waters and exclusive economic zones? These are questions hard to answer. This is why it is critical to clarify that should PICs decide to extract seabed resources within their sovereign territorial waters, they must strike a balance between the immediate economic gains and the long-term integrity of their marine ecosystems.

The economic allure originating from the deep-sea mining is accompanied by pressing ecological and environmental concerns that have produced divisions among the PICs and among the countries around the globe with some viewing it as an economic opportunity, and others cautioning against the ecological risks. Long-standing divisions have persisted among the PICs, with Kiribati, Tonga, the Cook Islands and Nauru pursuing deep-sea mining, while Fiji, Palau and Vanuatu advocate for a moratorium on operations in international waters. The divisions are challenging the PICs' shared commitment to environmental conservation and climate change. Public sentiment is divided as well between economic development and the environmental impacts of the mining industry. The issue of deep-sea mining is not just a technical or scientific issue. Rather, it is a human rights issue. In this context, the conversations on deep-sea mining in the region cannot exclude the local people, whose voices deserve to be

heard in the debate. The civil society organizations in the Pacific Islands should be invited to be involved in the debate and the decision-making process.

Several PICs are committed to deep-sea mining endeavors, and the international community watches closely the developments, seeking to discern whether the pursuit of seabed wealth will culminate in prosperity or precipitate ecological peril. Deep-sea mining occurs in environments that are unique on earth, supporting unique ecosystems. As noted by WWF (2025), comprehensively evaluating all the potential environmental risks associated with such activities has proven challenging [28]. A number of academics and critics [29] contend that the destructive nature of deep-sea mining operations threatens biodiversity and may result in irreversible harm to underwater habitats and the loss of unique species that inhabit the seabed [30]. Moreover, deep-sea mining activities will inevitably produce sediment plumes capable of smothering marine life, deteriorating water quality, disrupting food chains and affecting habitats far from the seabed mining sites, all of which will most likely produce cascading effects on local fisheries and marine life [31].

From a developmental perspective, deep-sea mining is likely to enhance the economic vitality and social well-being of the South Pacific countries. Harnessing economic gains from deep-sea mining requires best-practiced government regulation, capacity development, and open and transparent community engagement, which pose considerable difficulties for the PICs given their inherent resource and institutional constraints. Moreover, the PICs have to navigate the complexities of seabed mining by balancing the immediate economic benefits with the long-term health of their marine ecosystems. It is easy said than done. It is widely recognized that the impacts of deep-sea mining on marine ecosystems remain incompletely understood to date, making rigorous environmental impact assessments and long-term monitoring frameworks essential for the conservation of marine biodiversity. In this context, to engage scientists in deep-sea mining and marine ecosystem protection is indispensable for evaluating the long-term ecological impacts of seabed mining activities, with ongoing investment in targeted research, monitoring, and environmental assessments deemed critical.

It is evident that the deep-sea mining is fraught with ecological and environmental risks that warrant rigorous consideration in the context of marine resource development. As David Attenborough, Vice-president of the Fauna & Flora International [32] warns: The fate of the deep sea and the fate of our planet are intimately intertwined. That we should be considering the destruction of these places and the multitude of species they support – before we have even understood them and the role they play in the health of our planet – is beyond reason. It is reasonable to conclude that the seabed mining in the South Pacific depends on the responsible practices of the PICs and the deep-sea mining companies, which must prioritize environmental health alongside economic development [33]. Sustainable practices, guided

by the frameworks established by the ISA, will be crucial in ensuring the PICs to reap the rewards of their seabed resources without compromising the health of marine ecosystem and environmental integrity. The PICs and the ISA are tasked with the mission to ensure that any extraction processes do not compromise the delicate marine ecosystems that thrive in their waters.

6. The Legislative Framework and Regulation

The increasing interest of the PICs and international mining companies in deep-sea mining particularly in the Pacific region underscores the crucial need to establish regulatory frameworks and robust guidelines to oversee exploration activities. However, the international legal framework (e.g., rules and regulations) for deep-sea mining is not perfect, and the mining provisions have not been issued [34]. Legislative frameworks must evolve to reconcile the inherent tension between resource extraction and environmental conservation, ensuring that the deep-sea mining does not inflict irreparable harm on marine ecosystems. The governance of seabed minerals in the South Pacific region is multifaceted, involving national regulations and international frameworks [35]. The ISA should play a crucial role in regulating deep-sea mining activities to ensure that both the economic interests of the developing countries and the marine eco-system are taken into consideration. For the PICs, it is imperative to intensify efforts to enhance governance and regulation frameworks, ensuring that sustainable practices are championed in the extraction of seabed minerals, and that the integrity of marine ecosystems is safeguarded for future generations [36]. The PICs are standing at the forefront of the transformative era with the opportunity to set a standard for sustainable deep-sea mining activities. It is noted that Nauru proposed the "two-year rule" in 2021 to force the ISA that oversees mineral exploration in areas beyond national jurisdiction to finalize regulations governing seabed mining by July 2023 [37]. The rule stipulates that the ISA must adopt exploitation regulations within two years after a member state applies for a mining contract.

Nauru's proposal exerts substantial pressure on the ISA to create a regulatory framework for overseeing deep-sea mining operations, while expediting debates concerning the ethical and environmental ramifications of deep-sea mining activities. The Tongan Parliament has implemented regulatory measures to govern seabed mineral exploration via the Seabed Minerals Act of 2014, which emphasizes responsible seabed mining practices [38]. The Act is explicitly designed to reconcile economic benefits with environmental conservation, ensuring that the economic gains derived from deep-sea mining do not come at the cost of environmental degradation. This legislation establishes a legal framework for the sustainable governance and exploitation of seabed resources while ensuring that environmental protection measures are in place.

Kiribati passed the Seabed Minerals Act of 2017 to govern the exploration and management of seabed minerals, which is explicitly stated

to aim at ensuring the sustainable management and regulation of mining activities both within and beyond its national jurisdiction, in alignment with its international obligations [17]. The Act emphasizes environmental protection and sustainable resource use, signaling that the Kiribati's awareness of responsible mineral extraction practices. Hu'akavameiliku, former Prime Minister of Kiribati, calls on Pacific partners to collaborate on the sustainable governance of seabed mineral resources, emphasizing the importance of collective regional action. The collaborative action initiatives are pivotal for the sharing of best practices and technological expertise in deep-sea mining, which can contribute to mitigating potential environmental impacts. The PICs are poised to harness its seabed resources after their conclusion of exploration contracts with international companies and their creation of legal frameworks. A key insight emerging from the discussion is that the enforcement of the regulatory frameworks constitutes a potentially seminal challenge even when such regulations are in place. Against this backdrop, there is an urgent imperative to conclude comprehensive international agreements aimed at safeguarding the fragile marine ecosystems of the South Pacific.

7. Conclusion

For the PICs, the seabed minerals in the South Pacific embody both an economic development opportunity and a challenge to the conservation of marine ecosystem and the broader marine environment. As they are poised to harness the deep-sea resources, the PICs confront a dual challenge: advancing national prosperity and social well-beings while safeguarding the region's fragile marine ecosystems and marine environment. Due consideration must be accorded to the long-term implications of deep-sea mining as the PICs navigate the complexities of balancing economic prosperity, social progress, ecosystem conservation and environmental protection. The potential economic benefits derived from seabed mineral extraction are significant, as are the associated environmental risks, including habitat destruction, marine pollution and biodiversity loss. The deep-sea ecosystems of the South Pacific are uniquely fragile, and hence, the economic benefits of deep-sea mining must be carefully weighed against its associated ecological and environmental impacts. A rigorous and balanced approach is imperative to ensure that the resources in the South Pacific can be exploited without compromising the region's fragile marine ecosystems and environmental integrity. Against this backdrop, the deep-sea mining in the South Pacific must be pursued with due caution, ensuring that both ecological conservation and economic interests are balanced to foster the region's sustainable development.

The PICs must navigate the complexities of regulatory frameworks, ecosystem conservation, and environmental protection as they pursue economic benefits derived from the deep-sea mining. As the PICs navigate these uncharted waters in harnessing the economic potential of deep-sea mining, the international community closely monitors their mining

operations, with concerns centered on the associated environmental and ecological implications. It is reasonable to conclude that sustainable development practices, rigorous environmental protection measures and strict regulatory frameworks must be prioritized to safeguard the ecological integrity of this unique marine ecosystem. The potential for irreversible harm to the region's marine environment and ecosystem necessitates rigorous environmental assessments prior to the initiation of deep-sea mining operations. Investment in deep-sea mining-related research and monitoring initiatives is of considerable significance in achieving this goal. Among others, research should focus on the capacity building of the PICs governments and advancing sustainable development to ensure that the benefits of deep-sea mining are equitably distributed among stakeholders.

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