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EIA BASED PROPOSED MITIGATION TO OVERCOME OCEAN ACIDIFICATION AND ITS EFFECTS ON CORAL REEFS AND MARINE LIFE IN 2025: TO ACHIEVE SDG14 (LIFE BELOW WATER)

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ABSTRACT

Ocean acidification is a phenomenon which is driven by huge atmospheric carbon dioxide (CO_2) absorption by the oceans which is a major threat to marine ecosystems. This process modifies ocean chemistry by making seawater more acidic which rigorously impacts coral reefs, shell-forming organisms and marine biodiversity. This proposal mainly inspects the implications of ocean acidification on coral ecosystems especially in the Arabian Sea near Pakistan and focusses its cascading effects on coastal communities that relies on marine resources. Mitigation strategies emphasis on reducing global CO_2 emissions, strengthening marine protected areas and restoring degraded coral reefs. Adaptation effort's goal to boost resilience among marine species and protect human livelihoods. Through proactive measures the diverse impacts of ocean acidification can be mitigated, preserving biodiversity and ecosystem services for future generations.

KEY WORDS: Environmental impact; Coral reefs; Marine; Acidification; Sustainability.

INTRODUCTION

Background

Ocean acidification signifies one of the most severe yet underappreciated consequences of climate change [1]. As carbon dioxide emissions enhances due to industrial activities nearly one-third is absorbed by oceans which in result causing chemical reactions that decreases the pH of seawater. This process has strengthened since the Industrial revolution with ocean acidity growing by 30% [2]. The projections indicates that by the end of the century the oceans may become 150% more acidiccausing a level that could be catastrophic for coral reefs and marine ecosystems [3].

Purpose and Scope

The primary aim and objectives of this assessment includes:

- **Understanding Ocean Acidification**: By monitoring and analyzing the chemical processes which contributes to the acidification of the ocean [4].
- **Impact Assessment**: By evaluating how acidification of the ocean affects coral reefs, marine biodiversity and dependent human communities [5].
- **Mitigation Strategies**: By Identifying actions that can address the CO_2 emissions and bolster ecosystem resilience [6].
- **Geographical Focus**: Emphasizing the Arabian Sea including Karachi and the Churna Island Marine Protected Area as a case study for the regional impacts [7].

To Understand Ocean Acidification there are some factors such as:

- **Chemical Reactions**: Atmospheric CO_2 dissolves in seawater which forms carbonic acid. This carbonicacid dissociates into bicarbonate and hydrogen ionswhichlowers pH levels and reduces carbonate ion availability which is essential for calcifying organisms like corals and shellfish [8].
- **Historical Trends**: The pre-industrial ocean surface pH was near to 8.2 but it has now decreased to 8.1 which represents a significant change in a short period of time [9].

Geographical context is also important as in the Arabian Sea, mainly near Pakistan such as those which are around Churna Island. These reefs are crucial for marine biodiversity, fisheries and coastal protection which makes them a key point for studying and understanding acidification's regional impacts [10].

Baseline Environmental Conditions

1. **Coral Reefs in the Arabian Sea**

- **Biodiversity**: Coral reefs in the Arabian Sea plays an important role in balancing and supporting a rich diversity of fish, crustaceans and mollusks [11].
- **Economic Role**: They mainlycontribute to the local fisheries, ecotourism and coastal protection against erosion [12].

2. **Current Trends in Ocean Acidification**

- The pH of seawater in this region has declined significantly which threatens the calcification processes that are crucial for reef formation.
- Seasonal upwelling events in the Arabian Sea intensify acidification which makes this region particularly vulnerable [13].

Environmental Impacts

1. **Impacts on Coral Reefs**

- Corals rely on calcium carbonate to build their skeletons and for their development. Acidification reduces carbonate ion concentration which slows down the skeletal formation and leads to the weaker structure and development [14].
- Acidic conditions enhance the stress on coral symbionts (zooxanthellae). When stressed these algae are expelled that causes coral bleaching and depriving corals of energy derived from photosynthesis [15].
- Weakened coral skeletons are more vulnerable to erosion, storms and breakage that reduces their role as protective barriers for coastlines [16].

2. Impacts on Marine Biodiversity

- Shell-forming species like mollusks, crustaceans and certain plankton face difficulties in keeping their structures which makes them more susceptible to the predators and environmental stressors [17].
- Acidification disturbs the survival of foundational species like plankton by affecting higher trophic levels including fish and marine mammals [18].
- Acidified water harms fish sensory perception by reducing their ability to evade predators, locate prey and navigate habitats [19].

3. Socio-Economic Impacts

- Diminishing reef health and fish stocks jeopardize livelihoods in coastal communities reliant on fishing [20].
- Degraded reefs lose their capacity to buffer coastlines from wave action in a resultthe increase in risks of erosion, property damage and storm surges takes place [21].
- Coral bleaching and reef degradation lessen the aesthetic and ecological appeal of marine tourism destinations [22].

Mitigation Measures

1. Reducing CO_2 Emissions

- Shift to the renewable energy sources like solar, wind and hydroelectric power to limit the emissions [23].
- Enhance carbon sequestration phenomenon through reforestation and carbon capture technologies [24].
- Boost countries around the world to work together and agree on stronger plans to cut down pollution that causes climate change like the Paris Agreement [25].

2. Marine Protected Areas (MPAs)

- Expand MPAs to cover susceptible coral ecosystems.
- Enforce severe regulations on overfishing, tourism and pollution within these areas.
- Engage local communities in the management and conservation of MPAs to ensure long-term success [26,27].

3. Coral Restoration

- **Coral Gardening**: Cultivate healthy coral fragments in nurseries and plant them in degraded areas [28].
- **Artificial Reefs**: Create structures to support coral growth and provide habitats for marine species [29].
- **Selective Breeding**: Emphasis on breeding coral species that show resilience to acidic conditions [30].

4. Public Awareness and Research

- Educate communities about the importance of coral reefs and sustainable practices.
- Fund research initiatives to monitor ocean chemistry, study adaptive mechanisms in

marine species and develop groundbreaking solutions [31].

Environmental Management Plan

1. **Implementation Strategies**

- Advocate for national and international policies targeting CO_2 emissions and marine conservation(Policy Measures) [32]
- Invest in technologies for carbon capture, renewable energy and marine ecosystem restoration(Technological Innovations) [33]

2. **Monitoring and Reporting**

- By conducting assessments of reef health and water chemistry regularly.
- By developing indicators for detection of acidification effects at early stages such as changes in coral growth rates or biodiversity loss [34].
- By establishing public reporting systems to increase transparency and accountability for the better understanding [35].

Conclusion

Ocean acidification poses a severe and rising threat to coral reefs and marine ecosystems. This EIA based report highlights the urgent need for balancing action to address this issue through mitigation, protection and restoration efforts. By implementing these strategies we can safeguard marine biodiversity, sustain ecosystem services and enhance resilience against future environmental challenges.

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