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ASSESSING THE EFFECTIVENESS OF ADAPTIVE MANAGEMENT STRATEGIES IN MARINE PROTECTED AREAS

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ABSTRACT
Coastal communities are facing growing danger due to massive industrialisation, not all of which is necessarily waterfront-based. As a result, these communities are already working to preserve and maintain access to their traditional fishing grounds. However, the development of ports, petrochemical complexes, energy, tourism, and other commercial operations has created a contentious environment between those who rely on coastal areas for their survival and those who are in charge of overseeing new business ventures. Therefore, any strategy aimed at establishing and strengthening new MPAs must take into account the realities of coastal regions. Assessing the Effectiveness of Adaptive Management Strategies in Marine Protected Areas (MPA) is the focus of this study. This study employs a fundamental definition of MPAs to navigate its analysis, recognising the necessity for more in-depth examination as the guidelines take shape. It acknowledges that the legal and practical impediments faced by MPAs can fluctuate depending on their location within legally stipulated ocean zones.
Keywords: Coastal communities, Marine Protected Areas, Adaptive Management Strategies.

1. INTRODUCTION

Trawling, pollution, and acidification of the ocean are just a few of the problems plaguing the marine biome all over the world [2]. To protect these ecosystems from anthropogenic pressures, many countries are increasingly using Marine Protected Areas (MPAs) as a conservation approach. The protection and regulation of the preservation of marine ecosystems, habitats, and species are the purposes of MPAs, which are designated zones within the ocean, coasts, or seas [1]. The ecological reliability and biodiversity of marine environments, as well as the responsible and long-term use of marine resources, are recognized in these areas. MPAs are similar to protected areas (PAs) on land, such as national parks, wildlife sanctuaries, and nature reserves; they aim to protect and conserve natural areas. However, MPAs differ from protected areas; they are specifically designed to conserve marine environments and ecosystems, which have different characteristics and face different threats compared to terrestrial environments [4]. MPAs can take on varying forms, spanning from entirely protected 'no-take' areas where every angling and additional resource extraction undertakings are debarred to more flexible areas that allow for some limited fishing or recreational use [11]. MPAs may also be established for different purposes, including conservation, restoration, research, education, and cultural preservation [6]. The global coverage of MPAs is currently 7.68%. While there is no dedicated global convention solely for MPAs, the establishment of MPAs are established either regional marine agreements or broader environment preservation agreements initially designed for terrestrial environments [8]. International agreements that address MPAs include UNCLOS, CBD, Ramsar Convention, World Heritage Convention, Agenda 21, and World Summit on Sustainable Development [16]. During COP 7 Decision VII/5, the Convention on Biological Diversity (CBD) endorsed the description of a MPA as provided by the Ad Hoc Technical Expert Group on Marine and Coastal Protected Areas [3]. By this definition, an MPA is defined as a particular area within or close to the marine environment. [12].

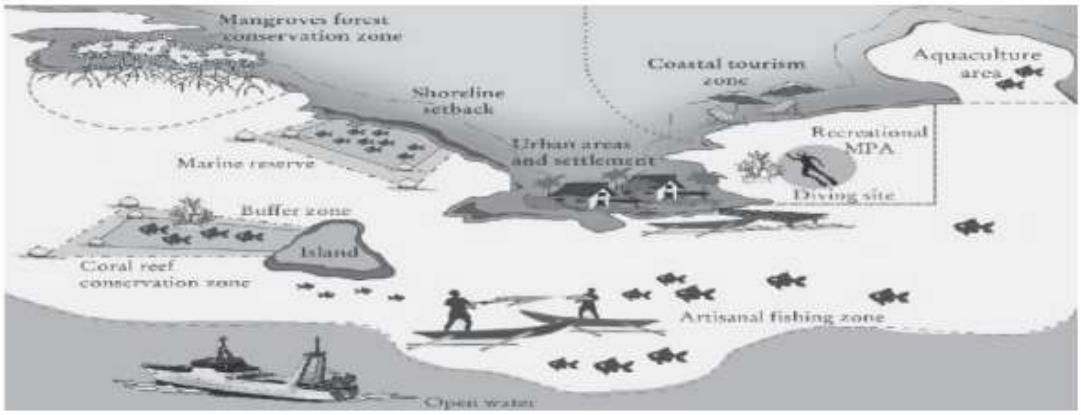

Figure 1: Marine protected areas

2. BACKGROUND

In order to tackle these problems, India requires developing a concerted legislative and regulatory scheme for its MPAs [5]. Taking a cue from effective models of Australia and New Zealand, as well as from applying international best practice from organisations such as IUCN, can provide the foundation for greater protection and management of marine environments [10]. In addition, India is obligated, as a signatory to the Convention on the International Sale of Goods, to carry out its international commitments and contribute to international efforts to preserve diverse marine biodiversity for present and future generations. [13]. The goals of the suggested projects are,

- To assess the effectiveness of adaptive management strategies in marine protected areas.
- To identify the key factors influencing the success of adaptive management strategies in marine protected areas

3. SYSTEM DESIGN

The global coverage of MPAs is 8.16%. Targets like SDG target 14.5 under the UN's SDGs and the Aichi target are examples of global obligations to protect 10% of the world's oceans. These commitments include a diverse array of regional and national level protections targets, reflecting a global recognition of the urgent need to safeguard our marine ecosystem. As a result, there has been a significant acceleration MPA suggestions, establishments, and executions in the recent years. Conservation databases report the existence of nearly 18,427 MPAs worldwide,678 representing a substantial milestone in ocean conservation efforts. Many countries across the globe have implemented special legislation to enhance the management and effectiveness of MPAs. Notable examples include Australia, the US, the UK, Fiji etc. These countries have recognised the ecological importance of their marine environments and have established legal frameworks to guarantee the preservation and sustainable administration of their MPAs.

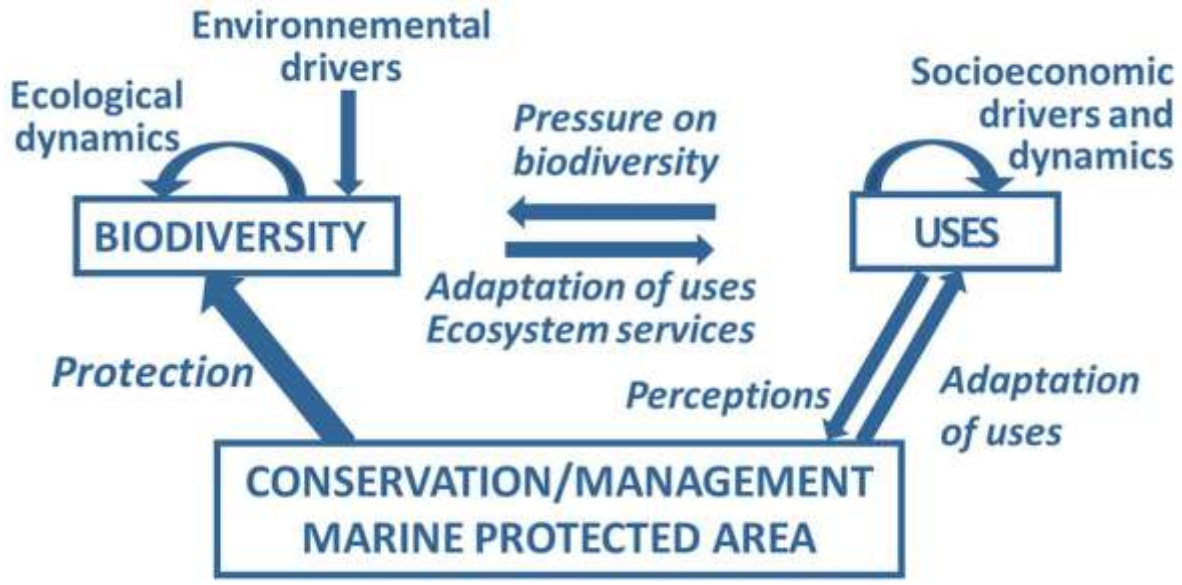

Figure 2: Marine protected areas management

While some of the countries have made significant progress and are still progressing in MPA governance, other nations (Ireland proposed a General Scheme of Marine Protected Areas Bill 2022) are actively working towards incorporating legislation for the improved management of MPAs. These efforts demonstrate a growing global awareness of the significance of protecting and managing our oceans sustainably. By establishing comprehensive legal frameworks, countries can fortify the enduring preservation of marine biodiversity and the valuable ecological aids offered by the MPAs [7].

3.1. Marine Fish Resources:

Marine fishes are either pelagic or demersal. Fishes swimming in mid-water or near surface layer are called pelagic fishes, and those swimming in deep water are called demersal fishes. The pelagic fishes like hilsa ilisha, oil sardine bombay duck, ribbon fish, carangids, mackerel, seer fish, tuna etc.; and demersal fishes like cat fish, croakers, eels, flat fishes, pomfrets, perches, shrimps etc. are generally found in the specified marine fishing ground

Fishing Gear: The implements used for catching fish are called fishing gear. There are various types of fishing gear used for marine fishing in the maritime States of India. Fishing gear is broadly classified into active gear and passive gear. When the fishing boat runs the gear to catch fish, it is considered active gear. In case of passive gear, the fishes tiy to swim through the net wall and doing so they become gilled in the mesh and caught. Trawl nets, seine nets etc. are under the category of active gear, while gill nets, bag nets, hook and line etc. are the passive gear.

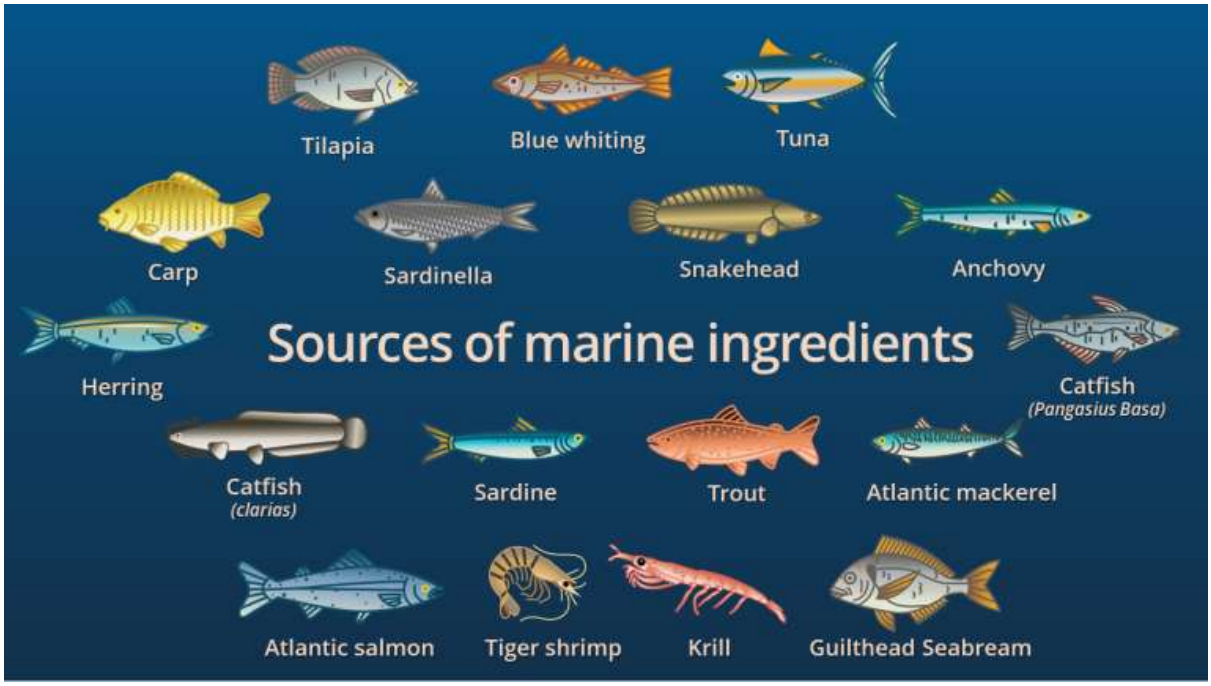

Figure 3:Marine Fish Resources

Trawl net: Trawl is a flatten bag of conical shape, which is towed through the water either at the bottom or subsurface waters. The trawl net's size varies depending on the size of the trawlers from which it is operated. The mesh size of the wings and the body vary according to the size of the net Boat seine: It is a type of surrounding gear, which surrounds a certain area and then the gear is towed over this area with both ends to a fixed point on the boat. The net is a long wall of webbing with synthetic floats along the head rope and sinkers along the foot rope. It consists of two long wings and long hauling ropes on either side attached to the wings.

4. STATISTICAL ANALYSIS

Due to their unpopularity with the majority of fish eaters, many marine fish species do not offer lucrative prices. The stench of these species is primarily to blame for their unpopularity. These low-value fish are frequently discarded. If, however, such fishes are properly processed it can reduce the odour, and they can augment our protein food resource. As the demand for more ready-to-prepare / server products have been increasing day by day, use of separated meat from low priced varieties of fish would assume considerable importance. Separated meat from many inexpensive varieties of lean and stable type fish could be utilized for sausages. Separated meat, an intermediary product for further processing, offers wide scope for preparation of many delicious fish. There is still no opportunity in this region to process such low-priced fish for value addition, with the exception of sun-dying a substantial quantity of bombay duck and others. As a result, low-cost fish caught in this region can greatly increase in value. [14].

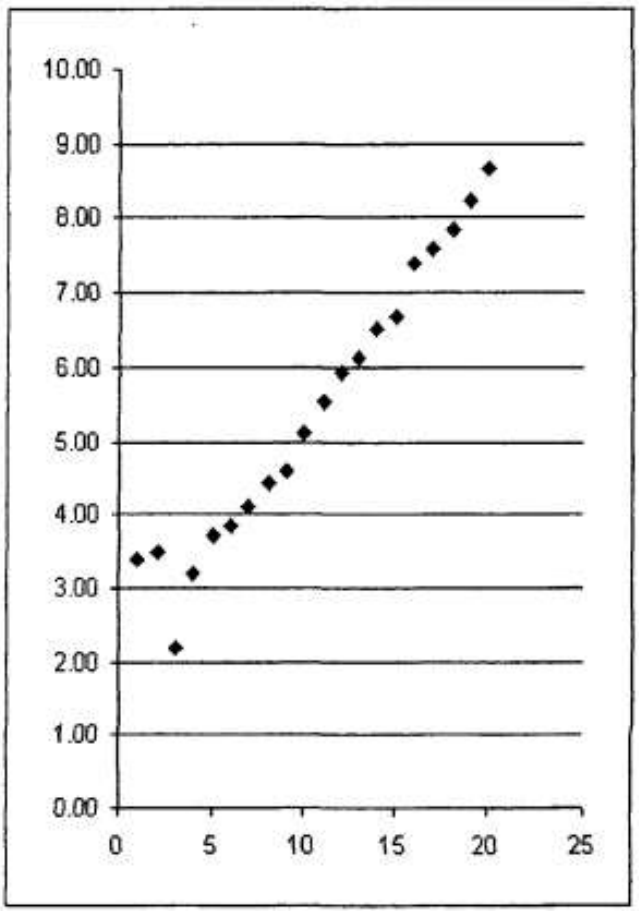

Figure 4: Scatter plot

For example, MPAs can help to protect and conserve important habitats such as coral formation, seagrass meadows, and mangrove. Besides, such regions are vital as major reproduction and feeding grounds for many marine creatures. Furthermore, these ecosystems offer vital services to the environment, e.g., carbon sequestration, nutrient cycling, and coastal protection [9].

Table1:Resultofchi-squaredistributionbetweenthevariables

Description	ChiSquareTest(X^2)		
	PearsonChi Square	Likelihood Ratio	Linear By LinearAss.
How can adaptive management strategies be scaled up to address the global challenges facing marine ecosystems and the services they provide?	15.096	14.536	4.812
What are the key challenges and limitations of implementing adaptive management strategies in marine protected areas, and how can these be addressed?	0.001	0.001	0.028
How can adaptive management strategies be used to balance the conservation of marine biodiversity with the needs of human communities that depend on these	2.248	2.027	2.233

ecosystems?			
What is the impact of adaptive management strategies on the resilience of marine ecosystems and the services they provide?	0.134	0.155	0.135
How can adaptive management strategies be integrated with traditional management approaches to improve the effectiveness of marine protected areas?	4.527	4.572	4.497
What are the social and economic benefits of adaptive management strategies in marine protected areas, and how can these benefits be maximized?	0.033	0.032	0.034
How can adaptive management strategies be used to address the impacts of climate change on marine protected areas?	3.565	3.552	3.541
What is the role of monitoring and evaluation in adaptive management strategies for marine protected areas, and how can these processes be improved?	0.059	0.059	0.06
How can MPAs be used as a tool for supporting the recovery of depleted fish populations and the restoration of degraded marine ecosystems?	15.096	14.536	4.812
What are the social and cultural implications of MPA establishment and management, and how can these implications be addressed through inclusive and participatory management processes?	0.001	0.001	0.028
How can MPAs be integrated into broader ocean governance frameworks to support sustainable ocean management and conservation?	0.134	0.155	0.135
What are the economic benefits of MPAs, and how can these benefits be quantified and used to support MPA establishment and management?	4.527	4.572	4.497
How can MPAs be effectively monitored and enforced to prevent illegal fishing and other human impacts, and what technologies or strategies can support these efforts?	3.565	3.552	3.541
What role can MPAs play in supporting ecosystem-based adaptation to climate change, and what strategies can be employed to enhance their resilience?	0.059	0.059	0.06

In India, although the term MPAs is not specifically referred to in the laws, attempts are being made to create and maintain MPAs with the aim of protecting and conserving maritime biodiversity and habitats [15].

Table2:Resultofchi-squaredistributionbetweenthe types

Description	SymmetricMeasures	
	Phi	Crammer'sV
How can adaptive management strategies be scaled up to address the global challenges facing marine ecosystems and the services they provide?	0.317	0.317
What are the key challenges and limitations of implementing adaptive management strategies in marine protected areas, and how can these be addressed?	0.001	0.001
How are adaptive management approaches applied to achieve a balance between the preservation of marine biodiversity and the demands of human societies that rely on the ecosystems?	-0.122	0.122
What is the impact of adaptive management strategies on the resilience of marine ecosystems and the services they provide?	0.134	0.134
How can adaptive management strategies be integrated with traditional management approaches to improve the effectiveness of marine protected areas?	-0.174	0.174
What are the social and economic benefits of adaptive management strategies in marine protected areas, and how can these benefits be maximized?	0.033	0.033
How can adaptive management strategies be used to address the impacts of climate change on marine protected areas?	-0.154	0.154
What is the role of monitoring and evaluation in adaptive management strategies for marine protected areas, and how can these processes be improved?	0.059	0.059
How can MPAs be used as a tool for supporting the recovery of depleted fish populations and the restoration of degraded marine ecosystems?	0.317	0.317
What are the social and cultural implications of MPA establishment and management, and how can these implications be addressed through inclusive and participatory management processes?	0.001	0.001
How can MPAs be integrated into broader ocean governance frameworks to support sustainable ocean management and conservation?	0.134	0.134
What are the economic benefits of MPAs, and how can these benefits be quantified and used to support MPA establishment and management?	-0.174	0.174
How can MPAs be effectively monitored and enforced to prevent illegal fishing and other human impacts, and what technologies or strategies can support these efforts?	-0.154	0.154
What role can MPAs play in supporting ecosystem-based adaptation to climate change, and what strategies can be employed to enhance their resilience?	0.059	0.059

A strong emphasis on adaptive management, regularly reviewing, and updating MPA management plans based on scientific research and changing environmental conditions. India should adopt an adaptive strategy that permits for the adjustment of MPA regulations and boundaries in response to emerging conservation challenges, climate change impacts, and new scientific insights.

5. CONCLUSIONS

MPAs are specific regions in the ocean, coastal regions, and estuaries that are designated for safeguarding and preserving marine biodiversity, ecosystems, and habitats. There are different types of MPAs that can be established, with varying levels of human activity allowed within them. The marine ecosystem, distinguished by its vital array of marine and estuarine species, plays an integral role in the global natural and cultural heritage. Oceans produce 70 percent of the Earth's oxygen and support 80 percent of its biodiversity. Among the various environmental challenges, marine pollution emerges as one of the most significant long-term threats. The sheer expanse of the oceans has fostered a widespread belief in their infinite capacity to absorb waste, resulting in the erroneous notion that they can function as a vast repository for nearly all forms of waste. While oil is a major contributor to global pollution, it is not the only pollutant impacting marine environments and their ecosystems. In certain situations, harmful substances and effluents from land and air can present even greater dangers to specific marine areas than oil. The international community has frequently concentrated on pollution from ships, often overlooking the considerable effects of pollution originating from land-based sources.

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