



The Impacts of Human Activities and Climate Change on Coastal Lagoon Water Quality and Ecology

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DESCRIPTION

Coastal lagoons are shallow water bodies that are separated from the sea by a barrier such as a sandbar, a coral reef, or a spit. They are found in different climatic regions and geomorphological settings, and they host a rich biodiversity of plants and animals. Coastal lagoons provide important ecosystem services such as food production, water purification, flood protection, recreation, and cultural heritage. However, coastal lagoons are also facing multiple threats from human activities and climate change that affect their water quality and ecology.

One of the main human activities that impact coastal lagoons is aquaculture. Aquaculture is the farming of aquatic organisms such as fish, shellfish, seaweed, and microalgae. Aquaculture can provide food security, income generation, and employment for coastal communities, but it can also cause environmental problems such as nutrient pollution, organic matter accumulation, habitat degradation, disease transmission, and invasive species introduction. Aquaculture can also compete with other uses of coastal lagoons such as tourism, fishing, and conservation.

To ensure the sustainability of aquaculture in coastal lagoons, it is essential to select suitable sites that can support the production without compromising the ecological integrity of the lagoon. Site selection can be done using spatial analysis tools such as Geographic Information System (GIS) and Multi-Criteria Decision Support (MCDS) that can integrate multiple factors such as physical characteristics, environmental conditions, social preferences, and economic feasibility. For example, a case study from Muttukadu Lagoon in India used 13 factors to assess cage site suitability for aquaculture using GIS and MCDS. The study found that only 11% of the lagoon area was suitable for cage aquaculture, and that water depth was the major limiting factor. The study also suggested some management measures to improve the water quality and maintain the health of the lagoon.

Another major threat to coastal lagoons is climate change. Climate change can affect coastal lagoons through changes in

temperature, precipitation, sea level, storm frequency and intensity, and ocean acidification. These changes can have direct and indirect effects on the water quality and ecology of coastal lagoons. For instance, higher temperatures can increase the metabolism and respiration of aquatic organisms, leading to higher oxygen demand and lower dissolved oxygen levels. Higher temperatures can also facilitate the growth of harmful algal blooms that can produce toxins and reduce light penetration. Higher temperatures can also affect the distribution and phenology of aquatic species, altering the food web structure and function.

Sea level rise can cause coastal erosion and inundation of low-lying areas, affecting the morphology and hydrology of coastal lagoons. Sea level rise can also increase the salinity and tidal range of coastal lagoons, affecting their biogeochemical processes and biological communities. Storms can cause physical damage to coastal lagoons and their infrastructure, as well as increase sedimentation and turbidity. Storms can also alter the exchange of water and nutrients between coastal lagoons and the sea, affecting their productivity and stability. Ocean acidification can reduce the pH and carbonate availability of coastal lagoon waters, affecting the calcification and growth of organisms such as corals, mollusks, and crustaceans.

To cope with the impacts of climate change on coastal lagoons, it is necessary to adopt adaptation strategies that can enhance their resilience and reduce their vulnerability. Adaptation strategies can include monitoring and assessment of water quality and ecological indicators; restoration and conservation of habitats such as mangroves, seagrasses, salt marshes, and coral reefs; management of nutrient inputs from land-based sources; regulation of aquaculture practices; promotion of sustainable use of resources; awareness raising and education; stakeholder participation; and policy integration.

Coastal lagoons are valuable ecosystems that support human well-being and biodiversity. However, they are also under pressure from human activities and climate change that affect their water quality and ecology. To ensure their sustainability, it

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is important to select suitable sites for aquaculture using spatial analysis tools; to monitor and adapt to the effects of climate

change using adaptation strategies; and to manage them in an integrated way involving multiple stakeholders.