

Impact of Climate Change on Coral reef and Marine Life of the Lakshadweep – A Short Review

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Abstract: Lakshadweep, a group of islands with one of the least studied coral atolls enclosing lagoons, submerged reefs and banks situated in the Arabian Sea, is now vulnerable due to *rapid erosion, turbulent seas and rising ocean temperatures by climate change*. Moreover, rising global sea levels have gradually become a critical threat that is going to impact small islands in the upcoming years. This study depicts the present status of the coral reef and the marine life of the Lakshadweep and how climate change might pose a major threat to the islands in the near future.

Keywords: Coral; Marine life; Climate change; Lakshadweep.

Introduction

Lakshadweep islands comprise of the coral islands in the Arabian Sea, and is the smallest union territory of India. The word ‘Lakshadweep’ in Sanskrit means one lakh (Laksha) islands (dweep). The union territory of Lakshadweep, a group of 36 islands is located 200-400 km off the southwest coast of India. They are located in the Northern part of the Laccadive-Chagos ridge and consist of 11 atolls with 36 islands and several coral atolls with vast lagoonal areas. These islands are usually distinguished by the presence of major coral reefs around them with sandy beaches and seagrass meadows in the lagoons. The coral reefs are regarded as one of the most critical resources of the coastal area for various ecological and socio-economic reasons among these islands. Around 2-5% of global fishery production comes from this habitat. Coral reefs act as barriers against wave action along coastal areas, thus preventing coastal erosion and reducing the impacts of storms and cyclones. Hence, the health of the corals acts as an indicator of climate change (Nobi et al., 2009).

Recently, according to a group of scientists, water temperatures are increasing faster in the Arabian Sea when compared with other oceans. More alarmingly, there are often spikes in the sea temperatures that lead to mass bleaching of corals. Lakshadweep reefs suffer from anthropogenic activities and nutrient enrichment. Large-scale deterioration and bleaching of coral reefs were encountered in the Lakshadweep islands. Variations in physical parameters can cause severe impacts on the coral reefs. A recent study says that sea-level will rise around Lakshadweep Islands by 0.4 mm/year to 0.9 mm/year. As per the study, the worst possible inundation scenarios projected for Lakshadweep Islands are similar under different emission scenarios projected. All the islands in the archipelago would be vulnerable to the impact of sea-level rise. Smaller islands like Chetlat and Amini are expected to have major land loss. It is expected that about 60%-70% of the existing shoreline would experience land-loss in Amini and 70%-80% in Chetlat. Larger islands Minicoy and Kavaratti are also vulnerable to sea-level rise. They will experience land-loss, which is about 60% along the existing shoreline

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(Nihal et al., 2021). Some studies on global climate change have shown higher possibilities for an increase in extreme climatic conditions including hot days, heavy rainfall and drought over these small fragile islands.

Descriptive Features of Lakshadweep

The Lakshadweep islands, located 200 km off the coast of Kerala, are distinct for many reasons. The union territory of Lakshadweep is an archipelago situated in the Arabian Sea between 08°00' N and 12°30' N and 71°00' E and 74°00' E longitude and at a distance of 220-440 km from the west coast of India. There are different types of atolls that differ in shape from circular, sub-circular to elliptical. Some enclose lagoons, some with islands, some are without islands, and some are partially inundated.

Each Lakshadweep islands are of coral origin and some of them like Minicoy, Kiltan and Chetlai are considered typical atolls. The archipelago comprises 12 atolls, three reefs and five inundated banks. There are 36 islands and islets, enclosing an area of 32 sq. km, which are geographically isolated and separated from the mainland, about 200-400 km from the Malabar coast and the coral formations rise from depths ranging from 1500-4000 m. The reefs are in fact atolls, although mostly submerged, the inundated banks present are also sunken atolls. Hydrobiology of the lagoons indicated surface water temperature ranged between 32 and 38°C, salinity 36 and 39.39‰ and dissolved oxygen 2 and 6 ml per litre. Among the uninhabited islands, Suheli is a coconut growing and fishing centre (Malik, 2017).

A Glimpse of the Marine Ecosystem and Wildlife Present on These Islands

There is a vast diversity of species distributions among the islands. In some areas, the corals were rejuvenating and support many species of flora and fauna. In the Lakshadweep islands, the presence of 148 species of corals, 296 species of ornamental fishes, 126 species and 601 families, 68 species of crustaceans, 227 species of molluscs, 91 species of sponges, 2 species of mangroves, 114 species of seaweeds, 78 species of echinoderms, 6 species of sea grasses, 4 species of sea turtles, 101 species of birds and 12 species of cetaceans has been recorded. Altogether 114 species under 62 genera of seaweeds were reported from Lakshadweep. Seaweeds have also been cultured at Minicoy Island in the past. However, siltation, erosion, effluent discharge, grazing fish and overexploitation have been known to cause threats and damage to them. Moreover, mangroves are limited to Minicoy Island only, on the southeastern

and south western sides of the island (MOEF, 2008).

Livelihoods and Anthropogenic Activities of the Localities and Community of Lakshadweep

One of the main exports of the Lakshadweep is tuna fish and coconuts. Originating in the Maldives and traditionally exercised in Minicoy, pole and line tuna fishing are sustainable basic fishing methods that especially aim in capturing resilient fishes like skipjack tuna. Oceanic tuna fishing has been the major economic activity of the local communities. So, Lakshadweep has immense potential for marine fisheries. However, there have been prospects of overexploitation of ornamental fishes within a short period of time which might also impact and damage the corals and the marine environment. So, in order to reduce this harmful effect, there is a need for the adoption of non-destructive fishing techniques like trap fishing and hand net fishing by diving for the capture of ornamental fishes.

The islands and the reefs have provided livelihoods for people, giving them food, income, employment, home and protection. But the rise of economic development in these islands over the years has led to several anthropogenic vulnerabilities in the islands. Therefore, the fragile and unpolluted ecosystems had to face increasing developmental activities. Moreover, land is very scarce but the seas surrounding the islands are expansive. It means it would be more imperative to carefully deal with land resources as well as develop water resources sustainably. Terrestrial activities like agriculture, deforestation, raising livestock, road construction and laying and runoff from land has led to the destruction of these coastal ecosystems. Thus, the development of land use practices has brought threatening consequences on ecosystem health (MOEF, 2008).

Natural Calamities and Environmental Sensitivities of the Islands and the Coral Reefs

Coastal erosion is gradually becoming one of the most critical natural problems being faced by Lakshadweep. About 200 running km of seashore is exposed to severe erosion according to the Centre for Earth Sciences Studies (CESS), Thiruvananthapuram. Moreover, the Lakshadweep islands are affected by South-West monsoon winds. During the southwest monsoon, the maximum height of waves is 5 m and in non-monsoon time, it is usually 1.4 m (CESS study). The various coral reefs and atolls of the entire Union Territory were mapped by the Space Application Centre (SAC). Lakshadweep is often accompanied by southwest

monsoon winds. During the southwest monsoon, the maximum height of waves is 5 m and in non-monsoon time, it decreases to 1.4 m (CESS study). Data from the India Meteorology Department has estimated that the mean wind speed in Lakshadweep in May-Sept. ranges between 6.10-9.25 knots in Minicoy and 7.35-12.54 knots in Amini. The average annual rainfall is determined to be about 1640 mm (Minicoy) and 1504 mm (Amini).

Bleaching of corals occurs under stress due to environmental conditions, like high-water temperatures, due to global warming. Corals usually live in a symbiotic relationship with zooxanthellae which give them a peculiar colour but expel them under stress. The corals get a lighter colour or become completely white (also known as coral bleaching). They continue to bleach even if the stress is removed, taking weeks or months to retain it. Moreover, in the past, the reefs of Lakshadweep have suffered threatening consequences of coral mining, coral collection, groundwater pollution and mechanical damage due to dredging. Other ecological causes that trigger bleaching in corals according to the study include seawater temperature drops or increases, solar irradiance, subaerial exposure, low tides, sea level drops, freshwater dilution, inorganic nutrients, diseases, etc. Coral diseases are also assumed to be a vital threat to the coral reefs of the Lakshadweep Islands. Diseases like black band, white band, necrosis, etc have been reported from the Lakshadweep islands over the last few years.

The large-scale death rate of corals caused due to El Nino in 1998 and 2010 across the globe, including Lakshadweep, require rejuvenation, recolonisation and restoration of these coral habitats since the sustenance of people of the islands are dependent on the assets of the atolls. Various plans are required to be taken up to restore the lost grounds for the artificial propagation of corals (James, 2011).

Moreover, it has been estimated that smaller islands like Chetlat and Amini are more likely to suffer a major land loss. Projection mapping has also shown that around 60-70 per cent of the existing shoreline would go through land loss in Amini and about 70-80 per cent in Chetlat. Even though the maximum sea surface height values for the period of 2080–2100 estimated by the models, i.e., 0.78 m, is less than the global sea-level rise as projected by the IPCC (0.8–2.0 m), it does not mean that the islands will be out of harm's way from rising sea levels. The projections acquired from the best performing models were then used to map the potential

inundation which might occur under RCP 2.6, 4.5, and 8.5 scenarios (Jennath et al., 2021).

In Lakshadweep, the coral reefs suffered a disaster in 1998, which resulted in 90% of the corals being demolished. Recent studies have shown that the shape and composition of the corals got altered and by 2017, only 11% of the reef cover was left. This had laid a huge impact on marine diversity, which is important for the livelihood of the local people of the islands (Sarkar, 2018).

Being oceanic, small and geographically isolated from the mainland and exposed, the environment could be severe for these islands at times. Since they are bordered by the vast open ocean, they are exposed directly to storms, cyclones and heavy rains. Their low level makes them exposed to sea level rise as an effect of the potential global warming and climate change. The island also faces the risk of inundation by seawater due to storm surges as well as tsunami waves. Since the islands are often exposed to storms and cyclones, one of the earlier natural calamities was recorded in April 1847. During this cyclone, Kalpeni was the first island to be struck by it and then it gradually moved to Androth and Kiltan, where many deaths have been reported. In 1891, a violent storm occurred in Kavaratti, creating mass destruction to the coconut plantations (Mannadiar, 1997).

Lakshadweep is a fragile coral ecosystem and is deteriorating due to both natural and anthropogenic causes. So, conservation measures must be crucially implemented in these islands in order to conserve and protect these habitats on a scientific, cultural and economic basis. Instigation of marine sanctuaries and national parks in islands with rich biodiversity like Minicoy, Kavarathi, Kadamath and Chethlath can be quite productive in the conservation of the biodiversity of Lakshadweep. However, it should be clear that the objective of implementing protected area status on some of these islands is to safeguard the corals and the associated fauna and not the prevention of entry of local people and fishermen whose livelihood depends solely on the marine ecosystem. Therefore, there is a need for the safety of lagoons and marine biodiversity of Lakshadweep to preserve the ecosystem as well as the local community that depends on the marine environment (Tripathi, 2022; Velmurugan et al., 2008).

Conclusion

The Lakshadweep archipelago which is among the thirteen marine hotspots identified in India's oceanic

space is under threat. This study recommends spreading awareness among the local community including the elders, youth and children and even the tourists who visit the islands and to educate them about the coral reef and its associated ecosystems. Their contribution to the locality and the need for preserving and managing these critical island resources and biodiversity can also be crucial. Simultaneously, government bodies and NGOs have to take inventiveness to protect this natural resource. Moreover, recolonisation and ecosystem improvement depend on several factors like ocean currents, moderation of habitats and scale of damage to the corals. In order to rejuvenate and recolonise the corals, dredging in these areas should be abandoned, erosion should be effectively put under control and damage to living corals should be avoided and minimised. Proper coastal protection structures should also be implemented to save the land from further inundation and reduce the wave impacts and erosion of the coasts as well. Furthermore, ceasing deforestation, reducing of utilisation of fossil fuels, implementing of rainwater harvesting, incorporating renewable energy sources and waste management, influencing corporates to act on climate-related risks, increasing the strength of local community inclusivity in policy making along with representation and holding the government accountable is required to be done to combat climate change and effectively contribute towards its mitigation.

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