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SEA WALL IN THE MALDIVES AND ITS SUSTAINABILITY

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Abstract

Small Island Developing States are particularly vulnerable to the peril of climate change. Sea level rise, an increase in sea surface temperature, high incidences of drought and flood are some of the challenges faced by island states. The Republic of Maldives is one such island state which has been publicly advocating for the reduction in greenhouse gas emissions. Despite being one of the least contributors to such emissions, the Maldives faces the highest impact of global warming. Being one of the lowest-lying island nations, it has been undertaking various steps to curb the egregious impacts of environmental catastrophes. One of the response measures taken by the Maldives is the construction of seawalls. This article discusses discuss the impact of environment and climate change on the Maldives Archipelago and analyse if the sea wall initiative is a pragmatic measure to address rising sea levels.

Keywords: Maldives; Climate Change; Indian Ocean Region; Sea Wall; Sea Level Rise

Introduction

The Republic of Maldives is an archipelago comprising approximately 1,200 islands, with more than 90 per cent being less than 0.5 sq km in area.[1] Being one of the world's most geographically dispersed archipelagic nations, the Maldives is, interestingly, the smallest country in Asia, with a land area of just about 300 sq km.[2] The scattered geography of the archipelago allows it to claim an Exclusive Economic Zone (EEZ) of around 923,322 sq km., accounting for more than three thousand times its land area.[3] Comprising nearly 26 atolls, located in a north to south direction on the Laccadives -

[1] MEE, "Maldives: Fifth National Report to the United Nations Convention on Biological Diversity," *Ministry of Environment and Energy, Republic of Maldives*, 2015. https://www.cbd.int/doc/world/mv/mv-nr-05-en.pdf
[2] Tariq Masood Ali Khan, Dewan Abdul Quadir, T S Murty, Anwarul Kabir, Fahmida Aktar, and Majajul Alam Sarker, "Relative Sea Level Changes in Maldives and Vulnerability of Land Due to Abnormal Coastal Inundation," *Marine Geodesy* 25, No 1-2 (2002): 133-143, https://doi.org/10.1080/014904102753516787.
[3] Ritika V Kapoor, "Climate Change Vulnerabilities of the Maldives: Implications for India," *National Maritime Foundation*, 03 April 2020, accessed 25 April 2020, https://maritimeindia.org/climate-change-vulnerabilities-of-the-maldives-implications-for-inidia/

Chagos submarine ridge in the Indian Ocean, the Maldives stretches between Minicoy Island of India's Lakshadweep group and the Chagos Archipelago (see Fig 1). The northernmost atoll of the Maldives, Ihavandhippolhu, lies about 130 km south of Minicoy while Addu, the southernmost atoll, lies north of the Chagos at a distance of 450 km.[4] The Maldives is a 99 per cent water nation[5], with 200 out of 1,200 islands being inhabited, 90 developed as tourist resorts, and the remaining either being used for agricultural purposes or left uninhabited.[6]

Figure 1: The Republic of Maldives
Source: University of Texas Libraries

The Maldives is also one of the world's lowest-lying country, with an average elevation of 1.5 m (4ft 11 in). The highest elevation is just 2.3 m (7ft 7 in) above sea level, making it the lowest naturally-occurring 'highest-point' on the planet.[7] In view of the existential threats looming large upon the Small Island Developing States (SIDS) such as the Maldives, the perpetual concerns of climate change and the island state's adaptive strategies are important to study. The issue becomes particularly grave

[4] MEE, 2015.
[5] The Republic of Maldives is a 99 per cent water nation. This implies that over 99 per cent of the island nation is made of water, with 298 sq km occupied by land and about 118,000 sq km by water.
[6] "About Maldives," High Commission of Maldives, Kuala Lumpur, Malaysia, accessed April 25, 2020, https://maldives.org.my/about-maldives
[7] "About Maldives," High Commission of Maldives, Kuala Lumpur, Malaysia

in view of the 2019 Global Risk Report of the World Economic Forum, which highlighted that 90 per cent of all coastal areas across the world will be affected, in varying degrees, by sea level rise.

Some of the major steps have been environmental approaches for designated concerns, such as the beach nourishment techniques to control beach erosion; organic solutions including planting natural and artificial coral reefs to curb coral bleaching, boosting tourism through tourism adaptation projects, etc. However, one project that aims to counter the peril of climate change through the hard-engineering way is that of building sea walls. This article will discuss the impact of environment and climate change on the Maldives Archipelago and analyse if the sea wall initiative is a pragmatic measure to address rising sea levels.

Maldives and Climate Change

The unprecedented challenges of climate change are daunting. Maldives, is one of the least contributors of greenhouse emissions - amounting to around 0.0003 per cent of the world's total emissions[8] - is nonetheless one of the most affected, and was also the first to sign the Kyoto Protocol. The Maldives archipelago is unarguably among the most vulnerable and least defensible to climate change, particularly to the associated consequences of sea level rise.
In 2007, the National Adaptation Program of Action (NAPA), presented by the Ministry of Environment, Energy and Water of the Government of Maldives, reported that the extreme daily precipitation of 180 mm was a 100-year event, but the impact of climate change would make this event twice as often by 2050, implying that the extreme daily precipitation of 180 mm would occur twice every 100 years, i.e. it would become a 50-year event.[9] Additionally, the global average sea surface temperature is expected to rise by 1.4 to 5.8°C between 1990 and 2100, with the incidents of drought and flood increasing significantly.[10]

Vulnerabilities and Implications

The impact of sea level rise is ubiquitous. It affects livelihood and therefore influences the future of the nation. As of 2009, around 42 per cent of the Maldives' population, which was close to 353,398[11], and close to 47 per cent of all housing structures were located within 100 m of the coastline.[12] Between 2000 and 2006, more than 90 inhabited islands had been flooded at least once, with 37 being flooded regularly or at least once a year.[13] The impact of sea level rise has also been seen to have affected the

[8] "About Maldives," High Commission of Maldives, Kuala Lumpur, Malaysia
[9] MEEW, "National Adaptation Program of Action (NAPA)," *Ministry of Environment, Energy and Water, Republic of Maldives*, 2007. https://unfccc.int/resource/docs/napa/mdv01.pdf
[10] MEEW, 2007
[11] "Population, total - Maldives," World Bank, accessed May 22, 2020, https://databank.worldbank.org/reports.aspx?source=2&series=SP.POP.TOTL&country=MDV.
[12] MEEW, 2007
[13] MEEW, 2007

physical infrastructure in the island nation. Malé, the capital city of the "flattest country on earth"[14], is, under extreme distress with the maximum elevation of the atoll being 2.3 m above sea level and more than 85 per cent of the land area lying between sea level and 1m above sea level.[15] The Malé International Airport is faces a large risk with over 30 per cent of its infrastructure located within 50 m of the coastline and barely 1.1 m above the sea level.[16] The airport is an important link to the rest of the world and loss of flight operations would adversely impact the Maldives. According to a World Bank report of 2010, the impact of sea level is so catastrophic that a projected rise of 0.1 to 1 m could lead to the submergence of the state of the Maldives by the year 2100.

The tourism industry, which directly and indirectly accounts for two-third of the gross domestic product (GDP) of the Maldives, will experience the greatest ramification of climate change. The industry is already being impacted by the ongoing Covid situation, and the financial losses are high. However, the Covid situation may be temporary while the impact of Climate Change permanent. With more than 90 per cent of all resort infrastructure and 99 per cent of all tourist accommodation located within 100 m of the coastline[17], questions on design, location and construction of such critical infrastructure are now being asked. Activities such as whale-spotting, coral-reef snorkelling and scuba diving which are some of the most sought-after tourist recreations, would be halted. The repercussions of sea level rise, and flood and rise in sea surface temperature are going to affect Maldives' tourism industry considerably.

Variations in sea surface temperature are highly perilous to coral reefs. Approximately 3 per cent of the global coral reefs are in the Maldives which adds to its vulnerability to climate change.[18] The sensitivity of corals to rising sea temperatures is well known. When water is too warm, corals enter a stress response and lose the symbiotic algae that give them their distinctive colours - a process known as bleaching; if a coral is severely bleached, chances of disease and death increase. A 2017 study of the University of Exeter found that the large-scale increase in sea surface temperature, driven by the strong El Niño - Southern Oscillation (ENSO) - induced warming of 2016, led to a major coral die-off in the Maldives.[19]

The Maldivian Response to Climate Change

In response to these concerns and vulnerabilities, the island nation has been undertaking several measures to control such impacts.

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[14] "Flattest Country," Guinness World Records, accessed September 03, 2020, https://www.guinnessworldrecords.com/world-records/flattest-country/?fb_comment_id=727949320623993_793085467443711.
[15] Khan et al, "Sea Level Changes," 133-143.
[16] MEEW, 2007
[17] MEEW, 2007
[18] International Union for Conservation of Nature (IUCN), "Maldives Marine Newsletter," November 2016, 5. https://www.iucn.org/sites/dev/files/content/documents/maldices_marine_news_issue_5_november_2016.pdf
[19] Chris T Perry, and Kyle M Morgan, "Bleaching Drives Collapse in Reef Carbonate Budgets and Reef growth Potential on Southern Maldives Reefs," *Scientific Reports* 7, Article No 40581 (2017), https://doi.org/10.1038/srep40581.

In in May 2020, the Government of Maldives and the World Bank signed a USD 16.5 million project to support the expansion of climate resilient urban infrastructure and disaster preparedness.[20] This project will also fund a sewage treatment plant in Hulhumalé, whose relevance has increased more than ever, in view of the hygiene levels required to control the COVID-19 pandemic. This plant, by reducing the release of untreated wastewater into the sea, will protect fisheries and the tourism industry from the impacts of pollution.[21]

The World Bank has also been assisting the Maldives in reducing its expenditure on imported diesel and encouraging the use of renewable energy by investing in a USD 16 million solar power project on the islands of Malé and Hulhumalé. The United Nations has also created a Green Climate Fund (GCF) that aims to "scale up the integrated water supply system for the archipelago based on rainwater, groundwater and desalinated water into a low-cost delivery system for vulnerable households, which currently rely on emergency water deliveries for at least three months every year".

Seawalls: A Measure in Addressing Rising Sea Levels

A sea wall is a heavily engineered inflexible structure, which aims to hold or prevent sliding of the soil, while providing protection from wave action by acting as a coastal flood defence.[22] The sea wall initiative began in Malé in September 1988, by way of reclaiming land.[23] However, the project gained traction when environmental catastrophes began to occur recurrently. The 2016 El Niño, which is considered to be one of the strongest El Niño incidents to have occurred since 1950, left Maldives severely impacted, having recorded one of the most disastrous episodes of mass bleaching, as discussed above.[24]

In view of the tragic loss to the coral life around the world, particularly in the Maldives, the International Union for Conservation of Nature (IUCN) Maldives carried out some 64 informal interviews with the communities residing in Maalhos and Feridhoo, North Ari Atoll.[25] The team found out that the level of awareness amongst the communities on coral reefs was remarkably low.[26] When asked about ways to improve the future of coral reefs as also to adapt to climate change-induced environment, the communities propounded four measures: awareness programs; proper waste management; elimination of sand mining; and construction of seawall.[27] Considering the need to

[20] "Maldives to Improve Resilience Through Urban Development," Press Release, The World Bank, 06 May 2020, accessed May 22, 2020, https://www.worldbank.org/en/news/press-release/2020/04/30/maldives-improves-resilience-urban-development.
[21] World Bank, "Maldives Urban Development."
[22] "Sea Walls," Climate Technology Centre & Network, accessed September 03, 2020, https://www.ctc-n.org/technologies/sea-walls
[23] MEEW, 2007
[24] Perry and Morgan, "Maldives Reefs."
[25] IUCN, 2016
[26] IUCN, 2016
[27] IUCN, 2016

protect valuable infrastructures as also the lives of coastal population, seawalls were considered to be a pragmatic solution.

In 2017, Nenad Jaric Dauenhauer[28] reported that a Maldivian state-owned company was "pumping sand from surrounding atolls" so as to build the City of Hope on an artificial island called Hulhumalé, near the capital Malé, and surrounding it with walls 3 m above sea level. This expensive yet crucial development of sea defenses and elevated buildings in the reclaimed island of Hulhumalé is slated to be finished by 2023, and will be able to accommodate close to 130,000 people.[29]
Japan has been instrumental in providing various kinds of assistance to the Maldives. For 15 years, between 1987 and 2002, Japan had implemented a system against storm surge in Malé, which included a 6 km long seawall. This seawall hugely protected Malé Island from the 2004 Indian Ocean Tsunami.[30]

Seawalls: A Counter Argument

The concept of sea walls, forming part of the 'hard' infrastructure projects, invites more complications rather than benefits, particularly for SIDS such as the Maldives. One of the impediments in the sea wall initiative is that of financial resources. Building resilient infrastructures is a costly business, especially for SIDS. In most cases, construction of a seawall in a small low-lying island states (such as Marshall Islands, Tuvalu, Kiribati and Maldives) has been seen to consume a fair share of the country's GDP, further proving it as an unsustainable approach.[31] It is, in this view, that such countries opt for external assistance. However, the presence of an external player in a region assisting a nation, especially in close proximity to India, brings in a new set of security concerns.

B K Sovacool,[32] in his study on climate change adaptation in Maldives, expresses his discontent with the Maldivian community leaders "being obsessed with seawalls and hard infrastructure" and having a tendency to focus less on 'soft' measures such as beach nourishment, strengthening community through education and awareness, enhancing institutional resilience by training policy makers, etc. The Institute for Water Resources of the US Army Corps of Engineers defines beach nourishment as, "a system which allows sand to shift and move with waves and currents, thereby acting as a buffer between storm waves and landward areas, in order to prevent destructive waves from reaching the

[28] Nenad J Dauenhauer, "On Front Line of Climate Change as Maldives Fights Rising Seas", *NewScientist*, 20 March 2017, accessed April 26, 2020, https://www.newscientist.com/article/2125198-on-front-line-of-climate-change-as-maldives-fights-rising-seas/
[29] Dauenhauer, *NewScientist*.
[30] Ministry of Foreign Affairs of Japan, "Outline of Japan's ODA to Maldives", *Ministry of Foreign Affairs of Japan, Japan*, September 2009. https://www.mofa.go.jp/policy/oda/region/sw_asia/maldives_o.pdf
[31] Benjamin K Sovacool, "Expert Views of Climate Change Adaptation in the Maldives," *Climatic Change* 114 (2012): 295-300, https://doi.org/10.1007/s10584-011-0392-2.
[32] Sovacool, "Climate Change Adaptation."

shore".[33] Beach nourishment, in contrast to hard infrastructure, is, considered to be an "effective and appropriate" shoreline protection response system.[34]

One of the other reasons why seawalls are not sustainable is their ability to harm the beaches more than protecting them. Despite being protective structures, seawalls are reported to aggravate the problem of beach erosion[35], rather than reducing it. Furthermore, beach erosion poses a direct impact on wildlife, like the nesting of sea turtles by preventing their access to nesting sites and reducing the area available for nesting from both the seaward as well as terrestrial sides of the beach.[36] In some cases, sea turtles were even seen getting trapped behind such hard structures. An example of such an impact is Florida in the United States, where almost one-half of the state's beaches have critically been eroded and 25 per cent of the shorelines have been fortified by seawalls, deterring sea turtles from nesting.[37] This has brought serious questions from the environmentalists upon the continuation of the process of constructing seawalls as protective against sea level rise.

Nevertheless, the need for the construction of seawalls is repeatedly being underscored during ministerial addresses, in lieu of highlighting long-term sustainable environmental approaches. Apparently, the states are failing to realise the importance of beach-protecting measures over shore-protecting options and, in need of faster yet short-term results, are still endorsing the hard-engineered options through a top-down approach, while overlooking the long-term benefits of community-led bottom-up response systems.

Way Forward

While the Maldives is currently seeking finances for the construction of seawalls around the capital, Maldivian policy makers must realise the need to look forward to long-term sustainable initiatives in the form of soft infrastructure projects, such as the steps being taken by the UN Green Climate Fund, beach-nourishment techniques, organic solutions to prevent coral bleaching, etc. Community-led participation is another such approach which could be adopted by the archipelago, moving beyond expensive yet unviable propositions.

The other significant aspect of dealing with the increasing impact of climate change is the need for holistic participation. As SIDS face some of the worst consequences of global warming and climate change there is a growing need for intervention by the developed and developing countries calling for

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[33] "Beach Nourishment," US Army Corps for Engineers, accessed April 27, 2020, https://www.iwr.usace.army.mil/Missions/Coasts/Tales-of-the-Coast/Corps-and-the-Coast/Shore-Protection/Beach-Nourishment/

[34] Sovacool, "Climate Change Adaptation."

[35] Balaji Ramakrishnan, Sathish Kumar S, and Ankita Misra, "Understanding the Effects of Seawall Construction Using a Combination of Analytical Modelling and Remote Sensing Techniques: Case Study of Fansa, Gujarat, India," *International Journal of Ocean and Climate Systems* 8, No 3 (2017): 153-160, https://journals.sagepub.com/doi/pdf/10.1177/1759313117712180.

[36] Balaji et al, "Seawall Construction."

[37] Scott Eastman and Gary Appelson, "Coastal Armoring and Rising Seas Put a Squeeze on Turtles", *The State of the World's Sea Turtles (SWOT)*, 01 February 2017, 12. https://www.seaturtlestatus.org/articles/2017/coastal-armoring-and-rising-seas-put-a-squeeze-on-turtles

reduced greenhouse emissions and integrating towards a common goal that affects humanity must be embraced.

About the Author

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