

REVIEW



Bio-shield of Sunderban Mangroves, Tropical Cyclone Remal and thereafter: Mitigating Climate Stress through Blue Carbon Storage and Sequestration

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Received July 8, 2024

Sundarban mangrove ecosystem, the largest mangrove ecosystem in the world consists of freshwater swamp forests forming one of the world's largest coastal wetlands. Named after the dominant mangrove tree species, *Heritiera fomes*, known as 'sundari' in Bengal, it forms a bio-shield protecting the densely populated coastal areas of India and Bangladesh from the severe impact of tropical cyclones like Amphan, Yaas, Remal and others. The mangroves store 'blue carbon' and thus play a crucial role in carbon sequestration. Protection, conservation and restoration of this unique coastal mangrove ecosystem may go a long way in combating and mitigating the effects of climate change.

Key words: climate change, mangrove ecosystem, blue carbon, carbon sequestration

SUNDERBANS AND TROPICAL CYCLONES

Sundarbans, a unique estuarine mangrove eco system covering over 10,000 sq. km in India and Bangladesh acted once more as a protective bio-shield lessening the destructive impact of cyclone Remal in May 2024. The Sunderbans have always played this crucial role against cyclones like Sidr 2007, Aila 2009, Fani 2019, Bulbul 2019, Amphan 2020, Yaas 2021 on previous occasions too (Sen, 2021). The mangrove forests acting as a buffer zone slowed down the wind speed absorbing the energy of the cyclones thus saving countless lives (Liu *et al.* 2013).

The frequency of cyclone occurrence in West Bengal, a densely populated state has increased manifold since the 1970s. The time span of 1970-2019 witnessed a five time increase in tropical cyclone occurrence.

Mangroves, occurring in tropical and sub-tropical regions are known for their resilience as they survive in high temperatures as well as low oxygen levels. Majority of South Asia's mangrove forests are found in India while the largest mangrove forest lies in West Bengal. Healthy mangrove ecosystems serve as breeding grounds for marine biodiversity and 80% global fish population.

BLUE CARBON STORAGE AND SUNDERBAN MANGROVES

Over half, nearly 55% carbon is trapped by mangroves, saline marshes, sea grasses and marine organisms known as 'blue carbon' and hence form the majority of the earth's blue carbon sinks. Blue carbon is the carbon stored and sequestered from coastal ecosystems of mangroves, tidal marshes and sea-grass meadows. Any damage or degradation to any of these will release the stored blue carbon, thus adding to the woes of climate change. These coastal vegetations sequester carbon nearly 100 times more and with greater stability than terrestrial forests. Additionally, studies have revealed that per hectare, mangrove ecosystems store up to five times more carbon than

most other global tropical forests. This capacity of mangroves and other coastal vegetation to capture huge amounts of carbon is partly due to the deep, organic matter rich soils in which they exist.

The entwined root systems of mangroves, which attach the plants into underwater sediment, diminish incoming tidal waters, allowing organic and inorganic matter to settle down. The sediments beneath such ecosystems are typically characterized by poor oxygen conditions, slowing the rates of decay, resulting in much larger amounts of carbon accumulating in the soil. Thus, it may be strongly recommended that mangrove ecosystems along with coastal zone protection and restoration would be far more cost effective than concentrating on terrestrial forests and ecosystems. Besides protection and restoration of coastal mangrove forests would also prove beneficial to fisheries and other associated means of livelihood of local inhabitants and communities (Sen, 2018). Damage and destruction to coastal mangroves result in drying up of wet soil with the release of stored carbon leading to climate stress. Reports from studies reveal 150 million to 1 billion tonnes of CO₂ emission globally per year due to mangrove destruction and depletion.

RESTORATION OF MANGROVES AND COASTAL ZONES

Mangrove ecosystems are efficient players in carbon sequestration, capable of storing ten times greater carbon amount per hectare than terrestrial forest ecosystems, thus establishing their worth in carbon emission control and climate change. Our country joined MAC or Mangrove Alliance for Climate initiated by UAE and Indonesia at COP27 in Egypt in the year 2022. MAC seeks to promote conservation, restoration and growth of mangrove ecosystems for global benefit in mitigating the effects of climate change. India definitely has a significant role in mangrove conservation, restoration and carbon sequestration for abatement of the impacts of climate change (Sen, 2021).

Efforts are now on to restore more than 16 million mangroves along the coastal areas for protection of embankments, biodiversity conservation and ensuring livelihood to local communities. Community-based

mangrove restoration initiatives not only set up a natural barrier to cyclones and over flooding but employed local women in biodiversity conservation (Pal and Sen, 2017). Women and environment have a firm foundation globally and under their monitoring and surveillance marine biodiversity in terms of fish, birds, shrimps, crustaceans improved significantly.

The first phase of Livelihoods Carbon Fund or LCF initiated in 2011 targeted a high-scale restoration of mangroves. Phases 2 and 3 launched in 2017 and 2021 respectively are based on a unique and innovative model where companies, investors and organizations came together to invest in long-standing carbon economy to support restoration of ecosystems, agro-forestry for benefit of food security to local communities and enhance farmers' revenues. But despite all efforts there is considerable migration from the Sunderban area on temporal or seasonal basis in search of work and livelihood.

RECOMMENDATIONS FOR MANGROVE ECOSYSTEMS FOR COMBATING CLIMATE STRESS

i Serious Conservation Efforts: Conserve existing mangrove forests, plan and execute afforestation programs to restore degraded parts.

ii Restrict Deforestation in the name of Development: Prevent deforestation and restriction of infrastructure development within the core forest area to maintain its natural structure and sanctity.

iii Raise Public, Local and Community Awareness: Increase public awareness about the importance of the Sundarbans and the need for its preservation (Sen, 2015).

iv Strong Government Action: Strengthen governmental policies and actions to safeguard the forest from further degradation.

v Community based natural resource management or Participatory Forest Management Plans with commitment to the environment and economy is to be promoted. The locals possess traditional and inherent resource management capabilities which must be fully utilized for societal benefits (Sen, 2014).

vi Gendered Approach and Woman Empowerment: Involving women as mangrove crusaders with emphasis on gender equity will lead to woman empowerment (Sen, 2022).

vii Policy of 'Right Place, Right Tree' should be the basis of all intelligent greening. Local indigenous species should always have a preference over exotic and introduced ones. Reports reveal that indigenous species are far better adapted to tackle climate stresses and recurrent natural disasters (Haq *et al.* 2012)

viii Integrated planning approach with systematic management will ensure regulated and organized tree management with participation of local and national planning bodies, councils and organizations, non-government organizations, academic institutions and local communities (Mitra *et al.* 2022)

ix Integrated Coastal Zone Management strategies should be taken to prevent damage from natural disasters like tropical cyclones, tsunamis as far as possible to secure human lives and their surrounding habitat.

x Performance-based incentive programmes encourage competition and result in better work output among various groups and communities (Sen, 2020).

THE WAY FORWARD

There is urgent need for holistic and technology-based approaches of mitigating climate induced stressors on mangrove ecosystems and facilitate regeneration and restoration of mangroves. By sensible fusion of local traditional knowledge and wisdom with scientific management perspectives, it can definitely be possible to minimize the climatic stress induced disasters and catastrophes.

ACKNOWLEDGEMENT

Gratefully acknowledge Saurabh Chaudhuri, IFS, Additional Principal Chief Conservator of Forests for his support and cooperation in carrying out the necessary field work

CONFLICTS OF INTEREST

The author declares that she has no potential conflict of interest.

REFERENCES

- Haq, Z. *et al.* (2012) Damage and management of cyclone Sidr-affected homestead tree plantations: A case study from Patuakhali, Bangladesh. *Nat Hazards*, 64, 1305–1322.
- Liu HuiQing, Zhang KeQi, Li YuePeng, Xie Lian (2013) Numerical study of the sensitivity of mangroves in reducing storm surge and flooding to hurricane characteristics in southern Florida. *Continental Shelf Research*, 64, 51-65.
- Mitra, A., Chaudhuri, S. and Sen, S. (2022) Survey and role of Mangroves in disaster mitigation in Namkhana, West Bengal: Protection of Coastal Zone. *Harvest*, 7(2), 21-42.
- Pal, S. and Sen, S. (2017) Gender- Based Awareness towards Biodiversity And Sustainable Development- A Survey On Rural Students. *Harvest*, 2(1), 63-74.
- Sen, S. Changing Perspectives in Biodiversity Management. (2014) *J. Environ. & Sociobiol.* 11(1), 117-122.
- Sen, S. (2015) Drivers of Changing Biodiversity, in Biodiversity: Interrelationship between Flora, Fauna & Human pp. 24-29. ISBN 978-81-929410-0-4
- Sen, S. (2018) Blue Carbon and Climate Change: Revisiting the Sunderbans Ecosystem in Sunderbans: The Endangered Ecosystem pp. 99-108. ISBN 978-93-5300-521-4
- Sen, S. (2020) Sunderban Mangroves, Post Amphan: An Overview. *International Journal of Creative Research Thoughts*, 8(6), 2751-2755.
- Sen, S. (2021) Combating Tropical Cyclones Amphan, Yaas and After: Eco-Restoration of Coastal Zones. *Harvest*, 6(1), 33-38.
- Sen, S. (2022) Eco-Entrepreneurship: Gender – Environment – Sustainability, She Empowered, ed. M. Kabi and S.Ghosh, Asutosh College Publication Cell, pp. 123-128.