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The Role of Salt Marshes in Climate Change Mitigation

The Silent Killer of the Ocean

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A Dying Unsung Hero: The Role of Salt Marshes in Climate Change Mitigation

By Varuna Jayasinghe, Ovini Dissanayake and Dr. Renuka Ratnayake

Climate change has been a subject of much debate and controversy throughout the years, with some even sceptic of its existence and calling it a hoax. But with rising global temperatures, melting ice caps and sea levels rising at an alarming rate, climate change is now a universally accepted reality and a threat that is in dire need of attention.

Climate change is here and now

It has been revealed that the past 18 years have been the warmest ever recorded in history, and that sea levels have risen nearly 178 mm over the past 100 years. The main cause of this? Global warming - a phenomenon concerning long-term rise in the average temperature of the Earth's climate system. Global warming is induced by the "**Greenhouse Effect**", where high concentrations of gases such as water vapour, carbon dioxide (CO_2) and methane (CH_4) warm the lower atmosphere and surface of the planet. An immense increase in CO_2 emission and accumulation in the atmosphere has been seen after the Industrial Revolution, and ironically, much of this is produced by anthropogenic activities including burning of fossil fuels and deforestation.

Climate Change mitigation and Carbon Sequestration

Fortunately, humanity has opted to undo their wrongs by taking initiatives to mitigate climate change with the aim of reducing or slowing down accumulation of CO_2 in the atmosphere. **Carbon sequestration** is a natural process proposed to do just that. It involves the capture of atmospheric CO_2 or other forms of carbon through biological, chemical and physical processes, where after it is stored for indefinite periods within **"carbon sinks"**.

Carbon capture is mainly done via photosynthesis by terrestrial plants, where CO_2 is absorbed from the atmosphere to facilitate their growth. Plant litter would then decompose and accumulate as organic matter in **soils**. For this very reason, soils contain more carbon than all terrestrial vegetation and the atmosphere combined and is one of the most active carbon sinks on Earth, second only to oceans. In this manner, soil ecosystems also provide economic benefit to a country. If it is proven that such ecosystems of a specific country help reduce overall emission of CO_2, they would be able to sell permits to other countries providing them the right to emit more CO_2 under **Carbon trading**.

Blue Carbon

While oceans and terrestrial forests were thought to have been the major natural carbon sinks in the past, new research has revealed that vegetated coastal ecosystems too have potential in being highly efficient carbon sinks. Carbon captured by the ocean and such coastal ecosystems have been termed "**Blue Carbon**" and are stored in the form of biomass within soil sediments. Concerned vegetated coastal ecosystems include mangroves, salt marshes and sea grasses. The nature of these habitats also makes them an important coastal filter for oceans, preventing coastal erosion and retaining toxins from polluting the oceans. Despite their high carbon sequestration potential, these habitats have very little coverage, making up only 0.05% of plant biomass on land.

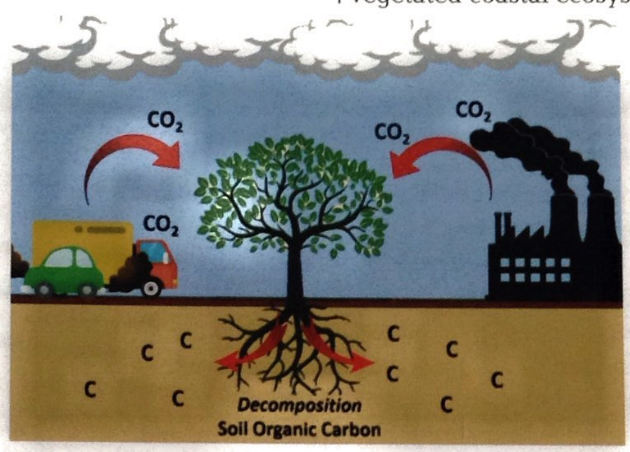

Image 1. Soil Carbon Sequestration as a means of reducing atmospheric accumulation of CO_2 emissions

Salt Marshes and their Carbon sequestration potential

Salt marshes are coastal ecosystems typically located between land and open saltwater or brackish water that is regularly flooded by the tides. These include areas such as bays, estuaries and lagoons. These habitats are dominated by dense stands of salt-tolerant plants or halophytes such

Image 2. Salt Marsh habitat in Mannar district, Sri Lanka, dominated by Halosarcia, a genus of salt-tolerant plants

as herbs, grasses, or shrubs. Salt marshes are often compared with mangroves, which differ in that instead of herbaceous plants of short stature, they are dominated by tall salt-tolerant trees.

Salt marshes are known to accumulate blue carbon at high rates relative to their surface area thanks to their high productivity and many other environmental characteristics. They have thus been put forth as a potential means for enhanced CO_2 sequestration. As with all coastal ecosystems, salt marshes show extremely high sequestration rates and carbon storage capacity in comparison to terrestrial ecosystems. Recent studies have shown that salt marshes contain about **8.5 tons per hectare** of vegetative carbon and **250 tons per hectare** of soil carbon. Their soils contain as much carbon stocks as mangroves within half as much surface area. Though mangroves still contain more total carbon at a global scale due to having a greater geographic extent. mangroves, which differ in that instead of herbaceous plants of short stature, they are dominated by tall salt-tolerant trees.

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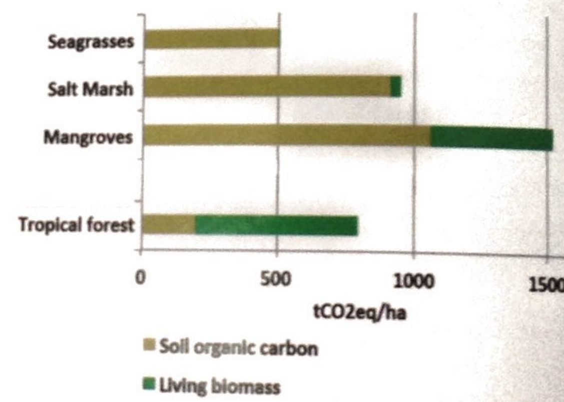

Graph 1. Comparison of living biomass carbon and soil organic carbon of coastal and terrestrial ecosystems represented by amount of reduced CO_2 equivalent emissions per hectare (Source – Conservation International)

Degradation of Salt Marshes and its implications towards Climate Change

One of the main concerns with blue carbon is that the rate of loss of these important coastal ecosystems is much higher than any other ecosystem on the planet. Salt marshes considered; it is estimated that **35%** of their historical global range has already been lost and are still being lost at a rate of **2% per year**. Degradation of these habitats is mainly due to human activity, and it comes at a cost. Being extremely sensitive habitats, once they are destroyed, their blue carbon stores are released as CO_2 and sequestration decreases due to loss of vegetation. Land use and coastal development also affect the tidal flow, resulting in less water content, more oxygen availability and enhanced microbial activity. This leads to an increase in methane production and emission, as well as microbial decomposition causing the carbon that is sequestered by growth to be re-emitted into the atmosphere. As such, the destruction of these habitats contributes to global warming and climate change in more ways than one. Even though the carbon burial rate of salt marshes is 2.18 tons per hectare per year, the yearly loss of habitat accounts for **0.06 billion tons** of CO_2 per year. To put into perspective, this is equivalent to the sum of emissions of 12.6 million passenger vehicles.

The current state of Salt Marshes in Sri Lanka

The fate of salt marshes and other coastal ecosystems isn't any much better when considering Sri Lanka specifically. In fact, one can argue that it is even worse. Most of Sri Lanka's salt marshes are confined to the northern region of the country including Mannar, Killinochchi and Jaffna districts. The aftermath of the civil war that plagued the country for 30 years had affected these habitats harshly and the damage to salt marshes within the Northern Province can be clearly observed. These areas had been caught in crossfires with its land being under warfare – indents made to create bunkers can still be seen.

Image 3. Roads built intercepting Salt Marshes in the Mannar district have obstructed the flow of water

Now, years later, coastal development has begun within these areas which only further degrades these habitats. As of today, salt marshes in even the Southern regions of the country like the Hambantota district are all virtually gone as a result of coastal development. Unlike mangroves, salt marshes do not have much public awareness. For this reason, they do not receive the much-needed attention and conservation measures despite being highly threatened ecosystems. The most effective means of addressing the challenge of these degrading habitats is through research. Ongoing research at the **National Institute of Fundamental Studies, Kandy** aims to provide information on soil carbon storage capacity and nutrient status of coastal Blue Carbon ecosystems in Lanka. The project has been initiated, beginning with the assessment of salt marshes. By highlighting the carbon sequestration and storage potential of these ecosystems and identifying disturbed from non-disturbed areas, this research can shed some light on which areas must be conserved and which are in need of restoration; all in hopes of mitigating the dangers of climate change in the inevitable future.

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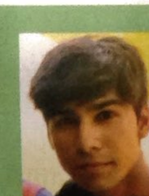

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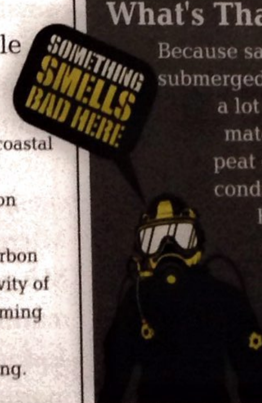
What's That Awful Smell?



Because salt marshes are frequently submerged by the tides and contain a lot of decomposing plant material, oxygen levels in the peat can be extremely low—a condition called hypoxia. Hypoxia is caused by the growth of bacteria which produce the sulfurous rotten-egg smell that is often associated with marshes and mud flats.