



PRELIMINARY STUDY OF THE IMPACTS ON SALT MARSH IN KANDAKULIYA-KALPITIYA

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Salt marshes are part of the coast and one of the most productive and valuable ecosystems, rich in biodiversity from various flora and provide habitats for fauna. They are considered as a blue carbon ecosystem, and therefore this coastal ecosystem will greatly help mitigate the effects of global warming that we are currently facing. Presently, these valuable coastal ecosystems are mostly destroyed by direct and indirect activities by human and natural incidents. This study has investigated the impacts on the salt marsh ecosystem in the Kandakuliya-Kalpitiya area. The main purpose of this research is to study the possible effects on the salt marsh ecosystem due to human activities and natural events and to understand the value of salt marsh ecosystems. The information was collected from 23rd March 2023 to 22nd April 2023 at Kandakuliya-Kalpitiya. The primary data were obtained mainly through direct field observation, field surveys, structured interviews, and photographs. According to observations, human activities have had the greatest impact on salt marshes. According to the counted field survey results, humans used 23% of these ecosystems for salt pans, 20% for unplanned and planned constructions such as hotels, 15% for roads, 13% for waste disposal, 12% for shrimp farms, 9% for playgrounds and 8% to use as off-road vehicles. Due to these human impacts, the places where the vegetation of salt marsh was destroyed have become empty lands nowadays. Donkeys also affect the salt marsh ecosystem by grazing on salt marshes as food. In addition to that natural impacts are caused on the salt marshes in the study area. According to the observations and structured interviews, the natural impacts are climate change, monsoon, inter-monsoon periods, and others. Species of the *Salicornia* genus: *S. brachiata* and *S. bigelovii* restoration, conservation, and management can be further improved with the designation of protected areas under stronger legislative protection, more effective enforcement, and community involvement. The time has come to protect these salt marsh ecosystems at the national level. Keywords: Ecosystem, Human impact, Kandakuliya-Kalpitiya, Saltmarsh

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INTRODUCTION

Salt marshes are salt-tolerant rooted vegetation at the upper margins of the intertidal landscape and in a low-energy transition zone between submerged and emergent environments (Banerjee et al. 2017). Salt marshes are a coastal ecosystem that is an important traditional habitat between ocean and land that provides important services to marine flora, fauna, and other animals. Salt marshes provide nursery ground, feeding and nesting areas, and breeding grounds for organisms of terrestrial origin such as angiosperms, mammals, insects, and birds, and organisms of marine origin such as algae, molluscs, crustaceans, and fish. Other important services under the services of salt marshes are, blue carbon sequestration, coastline stabilization, reducing flood by slowing and absorbing rainwater, and saltmarsh protects the water quality by filtering runoff and retaining excess nutrients, toxic chemicals, and disease-causing animals and they remove nitrates and phosphates from wastewater effluents in rivers and streams etc. (Topke et al. 2023) Salt marsh are halophytes and some salt marsh plants such as *Salicornia branchiata* is rich in bioactive components and contain very important nutrients (amino acids, proteins, and minerals) and this *Salicornia branchiata* is also used as a traditional medicine to treat hepatitis. (Alfheaid et al. 2022)

Although salt marsh ecosystems provide important services to us, these salt marsh ecosystems are being increasingly acute by human activities as well as natural events, but are currently being destroyed primarily by human activities. This study has investigated the impacts on the salt marsh ecosystem in Kandakuliya-Kalpitiya. This area borders the sea and the Puttalam lagoon in the Puttalam district in the northwestern province of Sri Lanka, and as it is located on the Kandakuliya coast, saltmarshes are widely spread towards that area. This research study aims to study the possible effects on the salt marshes ecosystem which will destroy due to human activities as well as natural incidents. So another objective is to identify the adverse effects of these valuable salt marsh ecosystems and make people understand their value and make these salt marshes a valuable ecosystem like mangrove ecosystems and protect them at the national level. The Kandakuliya-Kalpitiya site is usually flooded by water. The saltmarshes of *Halosarcia indica*, *Puccinella maritime*, *Heliotropium curassavicum*, *Salicornia branchiata*, *Suaeda maritime*, and *Salicornia portulacastrum* could be identified from this Kandakuliya-Kalpitiya area and here mainly discusses the impacts on these saltmarshes plants. (Lekamage et al. 2022)

METHODOLOGY

Study area

The Kandakuliya-Kalpitiya (Figure 1) site used for our study was located in the Puttalam district of the North-West Province on the northwest coast of Sri Lanka. Geographically, this area is located in the dry zone of Sri Lanka. The land is at sea level and flat, with no steep rocky areas or mountains. The average annual temperature is 26.8°C and is characterized by seasonal rainfall during the monsoon season. The average annual rainfall is 1129mm. A semi-diurnal tidal pattern occurs in the lagoon. The average tidal range is about 25 cm and the maximum recorded tidal range is 79 cm.



Figure 1- The location of the study area in Kandakuliya-Kalpitiya



Data collection

This study was all about the impacts on the salt marsh ecosystems, which are natural resources in selected areas of the Kandakuliya-Kalpitiya area. Primary and secondary data as well as qualitative data methods were used in data collection to conduct this study. Firstly, primary data were obtained by direct field observation, field survey, and interview methods and secondly, photographs were taken. The camera was used as a material and through interviews with several people living in the area, accurate information could be obtained about the salt marshes as well as the weather in this area. As secondary data, research, and websites were used. For the impact study, data was collected three times every month in the Kandakuliya area. The study was carried out from 23rd March 2023 to 22nd April 2023 at Kandakuliya. Data collected mainly focused on the impacts and possible hazards due to those impacts.

RESULTS AND DISCUSSION

Salt marsh habitats are found in coastal intertidal zones between land and open salt or brackish water and are regularly flooded by the tides, and here studied the impacts on salt marsh ecosystems in the Kandakuliya-Kalpitiya area. Salt marsh species like *Halosarcia indica*, *Puccinella maritime*, *Heliotropium curassavicum*, *Salicornia branchiata*, *Suaeda maritime*, and *Salicornia portulacastrum* were found in this Kandakuliya-Kalpitiya area. (Lekamage et al. 2022) According to observations, human activities have the greatest impact on salt marshes. People use a piece of land in this area where there was a high population of *Salicornia brachiata*, as their playground, and because of this, the land has now become a sandpit with a very small amount of *Salicornia brachiata*. (Figure 2) Because people do not know the value of salt marsh vegetation, they use and destroy these coastal ecosystems for their daily activities. At present, the Sri Lankan government has identified this area as a tourism development zone, and because of this, the salt marshes have been destroyed and many tourist hotels have been built in those places. (Figure 3) This is another reason for the decrease in the spread of salt marshes in Kandakuliya-Kalpitiya.



Figure 2 - Previous condition of the salt marsh land and present condition of the salt marsh land

And the salt marshes in the Kandakuliya-Kalpitiya area are currently becoming shrimp breeding farms. (Figure 4) Thus, the animals that used to live in salt marshes have also lost their habitats. In this way, the release of wastewater from shrimp farms into the surrounding environment of salt marshes can lead to the dirty of groundwater and coastal water bodies, loss of habitats, damage to biodiversity, spread of toxic algae and pathogens, increase erosion, and eutrophication, etc. A decrease in salt marsh patch sizes affect food web dynamics and makes rare and specialized species more vulnerable.



Figure 3 - A hotel created by removing salt marsh



Figure 4 - A salt pan created by removing salt marsh



Salt pans are also found in the Kandakuliya-Kalpitiya area. (Figure 5) These lands were formerly salt marshes, and the effects of salt pans on salt marsh ecosystems can result in continued loss of salt marshes in many areas, contamination of soil, groundwater, and surface water, and loss of biodiversity.



Figure 5 - A shrimp farms created by removing salt marsh



Figure 6 - A road created by removing salt marsh

Also, while creating roads leading to hotels, salt pans, industries, and shrimp farms, and the salt marsh ecosystems have been destroyed and roads have been created. (Figure 6) So these precious coastal ecosystems are being destroyed in the present. Thus, construction on salt marshes results in the loss of upland buffers and new exposure of these lands to various human pollutants and disturbances. These upland buffers are nesting, breeding, or feeding areas for many molluscs, crustaceans, and mammals, and removal or alteration of upland buffers will harm salt marsh habitats.



Figure 7 - Eutrophication and polythene litter in saltmarsh



Figure 8 - Plastic litter in salt marsh

Materials such as polythene, plastic, beer cans, discarded fishing nets (nylon), glass shells, broken sandals, polystyrene, etc. have been added to this salt marshes area by man, which has greatly affected this coastal ecosystem. The most dangerous thing about people adding polythene (Figure 7) like shopping bags, biscuit covers, etc. to these salt marshes is that the polythene does not decompose. Degradation of this polythene through processes such as thermal oxidation harms the microorganisms and invertebrates. Damage to these organisms affects the growth of salt marshes to some extent. The major impact of plastic bottles on the salt marsh ecosystem is that it takes many years for them to decompose. In addition, poisonous substances are released into the soil when plastic bottles (Figure 8) perish under sunlight and this affects the growth of the salt marsh ecosystem, which is a very sensitive ecosystem. Nylon (Figure 9) is plastic and it does not decompose and releases a considerable amount of toxic chemical compounds to the soil so salt marshes are threat by these nylon fishing nets. And these waste materials gives negative effects not only on the salt marshes but also on other living organisms like donkeys, cows, birds, and macro benthos.



Figure 9 - A section of removed nylon fishing net



Figure 10 - Off-road vehicle patches

Also, the use of off-road vehicles in the salt marsh ecosystem poses a threat to this ecosystem. (Figure 10) Off-road vehicles used in this more sensitive communities can cause vegetation height loss, biomass reduction, and shifts in species composition, and off-road vehicles can also be linked to



changes in soil conditions. According to the field survey results, humans used 23% of these ecosystems for salt pans, 20% for unplanned and planned constructions such as hotels, 15% for roads, 13% for waste disposal, 12% for shrimp farms, 9% for playgrounds and 8% to use as off-road vehicles.

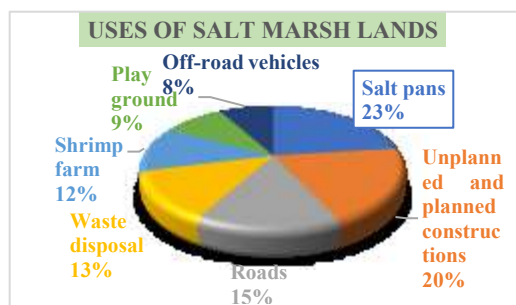


Figure 11 - Uses of salt marsh lands

Climate change also effect this area’s salt marshes. According to the collected data, the salt marsh of *Salicornia brachiata* is less prevalent during the rainy months and one of the reasons for this is the reduced salinity.

Salicornia brachiata grows quickly during the warm months of February and March. Due to the temperature of those times, water evaporates from the soil and salt is remain, and this situation creates a favourable environment for salt marsh growth. According to the information obtained from the people of that area, a children’s playground will soon be created in this salt marsh ecosystem. Destruction of valuable wetlands for the future purpose of the people will affect society adversely. According to the studies we are doing in the Kandakuliya area, the main reason for the destruction of salt marshes is anthropogenic activities.

CONCLUSION

The salt marsh is a very important coastal ecosystem and they also provide services to marine flora and fauna as well as humans. This study reports the impacts on salt marsh in the Kandakuliya-Kalpitiya area. Observations indicate that there are both anthropogenic and natural influences on salt marsh vegetation. At present these precious ecosystems are being destroyed mainly due to human activities. Salt marsh are considered blue carbon ecosystems, they can absorb and store large amounts of the greenhouse gas carbon dioxide in the atmosphere, thereby releasing large amounts of oxygen into the atmosphere and reducing the effects of global warming. These valuable salt marsh ecosystems provide so many services like habitats, medicine, nutrients, and ecological services so we should be protected these ecosystems like the mangrove ecosystem. Furthermore, by awareness among the people at the national level about the value of the salt marshes, the threats to the salt marshes can be reduced and these valuable coastal ecosystems can be protected. 95% of the impacts can be reduced by protecting the salt marsh ecosystem by introducing salt marsh ecosystems through social media and bringing strict government regulations.

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