North Brazil Shelf Mangrove Project

Nature Based Solutions

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1 Executive Summary

This report synthesizes the current understanding of the physical processes, hydrodynamic mechanisms, and anthropogenic activities that influence mangrove condition and associated flood risk across the North Brazil Shelf Large Marine Ecosystem (NBS-LME), specifically in Guyana and Suriname. A Coastal Vulnerability and Adaptation Framework is presented to provide technical support in resilience building of coastal communities and built infrastructure while persevering or restoring natural ecosystems.

The dynamic NBS-LME coastal plain is driven by migration of enormous mud banks that flow northwest as slow-moving waves along the shore from the Amazon river, Brazil to the Orinoco river, Venezuela. Mangroves grow seaward as mud banks pass and erode the mudflats. Landward from the shoreline, the coastal plain has existed in relative stability. Land conversion for agriculture and settlement is most intense in Guyana, progressively decreasing in intensity through Suriname, French Guiana, and Brazil. Lands drained for settlement and the associated economic, social, and mobility infrastructure is often situated below sea level, requiring drainage channels and levees for protection from riverine and coastal flooding. Extensive areas of farmland have been abandoned due to flooding and acidic soils. Ongoing discussions about coastal plain management recognize the importance of ecological conservation, the demand for land conversion to agriculture and settlement, and the growing frequency and scale of flooding from sea level rise.

Mangroves (saline tidal forested wetlands) and coastal swamps (freshwater forested wetlands) are interconnected components of the coastal plain landscape that are at, or just above, sea level. The presence of vegetation both helps to buffer wave energy that drives erosion and to bind soft sediment, although the capacity for mangroves to bind sediments is limited to the upper reaches of the tidal range (and is therefore sensitive to rapidly rising sea levels). Established vegetation also provides some attenuation of coastal storm surge which can drive widespread inland flooding, reducing high flood velocities and trapping damaging debris.

In the dynamic mudbank environment, mangroves are subject to periods of erosion and accretion with the passage of mud waves. Infrastructure built within the dynamic fringe of the mangroves is subject to periodic erosion threats as passing mud wave troughs lower the elevation of the mudflat shoreline. Existing “gray” engineered structures (e.g., levees and seawalls) further exacerbate erosion by enhancing wave energy and hindering sedimentation on adjacent mudflats. The deployment of nature-based solutions (e.g., green infrastructure, ecosystem-based adaptation, ecosystem focused governance policies) can strike a balance between coastal hazard protection for the built inland development and preservation of a natural shoreline that supports the ecologically rich character of the NBS-LME. An outcome of this study is a Coastal Vulnerability and Adaptation Framework, a tool to identify shoreline segments vulnerable to coastal hazards and the potential consequences to communities and the built environment from these hazards (an outcome of the Coastal Vulnerability and Adaptation Framework is a Coastal Vulnerability-Consequence Index that aggregates this information). The Coastal Vulnerability-Consequence Index allows for a deep dive into the vulnerability and consequence of each shoreline segment and highlights potential regional scale vulnerabilities that may require cross-jurisdiction adaptation strategy planning.

Nature-based solutions can vary across the spectrum from 100 percent green to hybrid green-gray solutions that are more engineered. Selecting the appropriate solution may be governed by the existing shoreline typology, for example shorelines with adjacent built infrastructure may require more engineered solutions than shorelines with settlements that are set back from the shoreline. In some instances, setting back infrastructure can help create space to restore or sustain mangroves. The NBS-LME region is sediment rich; therefore, mangroves can likely build vertically to sustain themselves in the face of high rates of sea level rise. However, mangroves will likely retreat landward with sea level rise. Where engineered coastal flood protection measures exist, landward mangrove migration will be squeezed between rising waters and hard infrastructure. With thoughtful planning, mangrove restoration and enhancement can be an important component of nature-based solutions for climate adaptation, flood risk reduction, and for ecosystem survival.