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## Annex 7: Coastal and Marine Ecosystems Sector Fact Sheet – Habitat Restoration

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| **Sector** | Coastal and Marine ecosystems |
| **Category** | Habitat Rehabilitation |
| **Adaptation needs** | Restore and repair damage to coastal habitats that have lost their potential to provide physical protection from the effects of storms, wave action, and sea-level rise, to restore their potential for protecting and enhancing the environmental and social services (livelihoods) provided by those habitats. |
| **Technology Name** | Habitat Restoration |
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| **How this technology contributes to adaptation** | Coastal habitat restoration encompasses the range of remedies that society undertakes to repair, reinvigorate, or replace parts of the coastal environment that have been lost or injured as a result of human activities or natural events. Replanting mangroves and repairing coral reefs have involved ecologists, school children, lawyers, crane operators, fishermen, divers, and engineers. This emerging discipline cannot solve all the problems confronting the nation's coasts, nor can it obviate the need for stewardship, conservation and pollution control.<br><br>Several environmentalists have started initiatives to prevent the total loss of this valuable marine ecosystem and tourism attraction. One such initiative is called Fragments of Hope, and it aims to re-seed devastated reefs with genetically robust, diverse and resilient corals farmed in man-made nurseries. Marine Biologist Lisa Carne has been at the forefront of Fragments of Hope for the past eight years, slowly restoring the reef system at Laughing Bird Caye in the Stann Creek District. Coral nurseries is practiced across the world and is a viable way to restore ecosystem functions of the reef (storm protection, fisheries habitat, aesthetic value for tourism) by out-planting corals with known bleaching history, and genetic information on both the coral host and its symbiotic algae clade (chlorophytes). To date over 11,000 fragments have been planted at Laughing Bird Caye National Park," said Carne (Fragments of Hope, 2015) (www.sanpedrosun.com).<br><br>Coastal habitat restoration can provide an effective means of redressing human impacts on the coastal environment, however, and the completion of each new restoration project improves the Nation's capability to repair the damage inflicted on the coast by a technological society.<br>URL: http://state_of_coast.noaa.gov/bulletins/html/chr_10/chr.html<br><br>The primary objective of wetland restoration can be three-fold. These projects can serve to reduce coastal flooding and erosion and can also provide new habitats and environmental benefits.<br><br>The term 'wetland' refers to a diverse range of shallow water and intertidal habitats, which occur in various locations around the world. Wetland restoration relates to the rehabilitation of previously existing wetland functions from a more impaired to a less impaired or unimpaired state of overall function.<br><br>The description of this technology originates from Linham and Nicholls (2010).<br><br>In order to protect specific species it is necessary to determine current population levels and monitor changes in that population, along with determining the driving forces behind potential changes. For example, the West Indian manatee is reliant on marine sea grass habitats along the coast of Belize, but key areas of this habitat are currently outside of designated marine protected areas (Frontier: Belize Manatee Conservation).(www.frontier.ac.uk/ProjectPDF/download) Frontier is an NGO based in Caye Caulker engaged in a project for the West Indian Manatee conservation.<br><br>Belize's habitat restoration efforts should therefore include mangroves, corals, and sea grass if possible. |
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| **Background/Notes, Short description of the technology option sourced from ClimateTechWiki, Seminars, etc** | The term *habitat restoration* refers to site-specific actions designed to improve the biological productivity or functioning of a particular ecosystem or area. Habitat restoration takes a variety of forms, depending on the project's purpose, its legal context, site characteristics, and other factors. Often, habitat restoration seeks to return an area to a *baseline condition*– for example, a particular vegetative community–that existed prior to an injurious incident such as a storm event or human induced changes. Habitat restoration seeks to improve the biological value of an area to compensate for a specific loss elsewhere–an approach to restoration known as *mitigation.* A third approach is *habitat creation,* the establishment of a habitat type in a location where it did not previously exist.<br><br>The most commonly restored wetland ecosystems for coastal protection are salt marshes and mangroves. Sea grasses may also be employed as a coastal defense, to dampen waves but on their own they are seldom considered an adequate shore protection alternative (USACE, 1989). Wetland habitats are important because they perform essential functions in terms of coastal flood and erosion management. They induce wave and tidal energy dissipation (Brampton, 1992) and act as a sediment trap for materials, thus helping to build land seawards. The dense root mats of wetland plants also help to stabilize shore sediments, thus reducing erosion (USACE, 1989). Wetland restoration re-establishes these advantageous functions for the benefits of coastal flood and erosion protection.<br><br>Restoration is required because many of the world's wetlands have become increasingly degraded through both natural and human activities. The 2015 Mesoamerican Reef Report Card describes the status of 248 sites along 1000km of the coast of Mexico, Belize, Guatemala, and Honduras (Healthy Refs, 2015) (www.healthyreefs.org). Techniques have been developed to reintroduce coastal wetlands to areas where they previously existed and to areas where they did not. The diversity of wetland types means there are numerous methods for restoring wetlands. In Belize, as stated above, this would address mangrove, coral, and possibly sea grass restoration. The method adopted will depend on the habitat which is being restored.<br><br>For mangrove restoration, it is necessary to collect plant propagules (a structure, such as a cutting, seed or spore that propagates a plant) from a sustainable source, prepare the restoration site for planting and directly plant propagules at regular intervals at an appropriate time of year (de Lacerda, 2002). In re-establishing mangroves, it may also be desirable to establish nurseries to stockpile seedlings for future planting (de Lacerda, 2002). The efforts to plant mangroves in Belize have largely used propagules collected from the wild. Mangrove re-establishment can also be achieved by planting dune grasses. These grasses provide a stable, protective substrate for mangroves to establish their root systems in. However, as the mangroves grow, they will eventually overshadow the dune grasses, causing them to die. Thereafter, the mangrove becomes the dominant species (USACE, 1989). (Source: www.climatetechwiki.org)<br><br>Mangrove planting was an inexpensive and simple activity designed to directly increase local mangrove stocks and provide a tangible rallying point for local groups interested in mangrove conservation. Red mangrove propagules were obtained from local forests from May to December when propagules are readily available (Mangrove Conservation: A Case Study, 2011). |
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| **Implementation assumptions, How the technology will be implemented and diffused across the subsector?** | In terms of climate change adaptation in the coastal zone, the main benefit of habitat restoration is the reduction of incoming wave and tidal energy by enhancing energy dissipation in the intertidal zone. This is achieved by increasing the roughness of the surface over which incoming waves and tides travel (Nicholls et al., 2007b). This reduces the erosive power of waves and helps to reduce coastal flood risk by diminishing the height of storm surges.<br><br>A reduction in installation and maintenance costs of sea defenses may occur when such structures are located behind large areas of salt marsh. A similar effect exists for mangroves which absorb the energy and slow the water flow of storm surges (Barbier, 2008). Evidence from the 12 Indian Ocean countries affected by the 2004 tsunami disaster suggested that coastal areas with dense and healthy mangrove forests suffered fewer losses and less damage to property than those areas in which mangroves had been degraded or converted to other land use (Kathiresan & Rajendran, 2005). Observations indicate that a mature mangrove stand will reduce the costs dike maintenance by 25-30% assuming a stand width at least comparable to the characteristic wavelength of incident waves (Tri et al., 1998).<br><br>In contrast to hard defenses, wetlands are capable of undergoing 'autonomous' adaptation to SLR, through increased accumulation of sediments to allow the elevation of the wetland to keep pace with changes in sea level (Nicholls & Klein, 2005). Provided wetlands are not subjected to coastal squeeze, and the rate of SLR is not too rapid to keep pace, wetlands are capable of adapting to SLR without further investments.<br><br>Coastal wetlands also provide a number of important ecosystem services including water quality and climate regulation, they are valuable accumulation sites for sediment, contaminants, carbon and nutrients and they also provide vital breeding and nursery ground for a variety of birds, fish, shellfish and mammals. They are also a sustainable source of timber, fuel and fibre (White et al., 2010). The restoration and recreation of wetlands can also reduce or even reverse wetland loss as a result of coastal development. This is important in terms of maintaining the global area of wetlands and in sustaining wetlands in the face of climate change. Wetland creation may also fulfill legal obligations for the compensation of habitats lost through development. Seven sites within the Belize Barrier Reef System comprise the Belize World Heritage Site which obliges Belize to protect and preserve these habitats under the UNESCO status. |
| **Costs** | One study in Vietnam estimated planting, capital and recurrent costs at approximately US$41 per hectare of mangrove planted, at 2009 price levels.<br><br>Both World Wide Fund for Nature CA and Southern Environmental Association have financed mangrove restoration projects in Belize. In 2011, Adrian Vernon estimated a cost of US$6100.00 to rehabilitate the failed Crimson Park development project site with mangrove. The cost was US$300/foot with volunteer labour (Roots and Reef, 2011) |
| **Country social development priorities** | • Growth and Sustainable Development Strategy 2014 – 2017: Coastal and Marine Ecosystems serve as buffers, offering some degree of protection from wave and storm action for the lives, properties, and infrastructure behind them. Proper management of these resources translate to maintenance of the quality of life of that area. More than half of Belize's population occupy the coastal zone benefitting from the presence of these ecosystems. |
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| **Country economic development priorities – economic benefits** | The Vision of the *National Sustainable Tourism Master Plan for Belize 2030*, (BTB, 2008) describes "Belize is an exclusive multicultural sustainable destination in the Central American Caribbean. It is a destination where the authenticity and friendliness of its people, coupled with the uniqueness of an exotic natural environment can be actively experienced within a conserved world". Application of the technology should ensure the resources maintain this status. |
| **Country environmental development priorities** | *Belize's National Environmental Policy and Strategy Action Plan – 2014-2024:* Belize has made great efforts in the sustainable management of its natural resources base and the protection of its environment. As such, it continues to enjoy a relatively healthy environment with many areas still considered pristine.<br><br>The Strategy focuses on addressing those issues related to the management of the natural resources and has as its long- term objective, a Belize where its natural resources, including land, forests, coastal and marine and water resources, are sustainably managed and conserved to improve the quality of life of present and future generation (National Environmental Policy and Strategy 2014-2024) (www.doe.gov.bz). |
| **Social benefits** | The implementation of wetland restoration projects not only compensates for wetlands loss through development and natural processes but also provides the additional benefits of coastal flood and erosion protection.<br>It enhances the complex marine food chain |
| **Other considerations and priorities (such as market potential)** | One of the biggest opportunities that exist to aid implementation of wetland restoration programmes is a growing concern regarding wetland loss and the associated loss of ecosystem functions such as habitat provision, food production and water quality improvement. |
| **Capital costs (per facility)** | A document entitled "Cost Estimates to Restore Riparian Forest Buffers and improve stream Habitat in Willamette, Oregon, (2010)" reported an amount of US$ 900 million for a 30,000 square kilometer basin. This is estimated at US $ 30,000 per square kilometer.<br><br>Information provided by Guadalupe Rosado, (2015) through personal communication describes mangrove reforestation costs for a 4 mile island at US $67.13 per linear meter. Establishment costs for an ongoing project are projected at US $546,025.00. (G. Rosado, 2015)<br><br>WWFCA reports costs for acquisition of propagules from the wild at US$0.02 to 0.10 each. WWF has planted over 23000 mangroves. |
| **Operational and Maintenance costs (per facility)** | Low. Once the planting of material is completed and the rooting systems are established, the habitat only requires monitoring and possible replenishment if small areas have been damaged or not survived for other reasons.<br>Maintenance costs, including monitoring and training, for the Rosado project = US $51,000.00. (G. Rosado, 2015). Operating cost are estimated as the same as maintenance costs (G. Rosado, 2015) |
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| **Daily supply capacity per facility** | The worth of mangroves is estimated at US $12,392.00 per ha when the values for collected wood, non-wood forestry products, fishery, nursery, and protection against storms are added up.<br><br>The publication "Belize's Coastal Capital" reports on additional values that are derived from coral and mangrove tourism related activities at US$150-196 million in 2007; economic benefits from fisheries at US$14-16 million/year; and avoided damages estimated at US$231 – 247 million/year.(Cooper, Burke, and Bood, 2008) , |
| **Up scaling potential** | Habitat restoration can be easily applied to localized habitats in other areas along the coast. Some cases may require behavioral change for populations to accept such interventions in from of coastal properties/communities. |
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