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An integrated approach to coastal rehabilitation: Mangrove restoration in Sungai Haji Dorani, Malaysia

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ABSTRACT

To achieve an efficient method of coastal rehabilitation, a coastal structure was applied in combination with the mangrove restoration scheme in Sungai Haji Dorani where coastal forest over-cutting associated with erosion has resulted in severe coastline retreat. Such an attempt provides the opportunity to mitigate erosion as well as improve ecological and socio-economic aspects of coastal areas, both of which are of great importance to local communities and authorities. Beach morphological changes were monitored for an eight-month period of time. The results indicate that the attempt has been successful in retaining sediment on the beach and consequently raising the elevation of the site. While the monitoring schedule is required to continue for several years to evaluate long-term performance of the rehabilitation effort, approximately 30% of the transplanted mangrove saplings' survival after eight months shows that the project was moderately successful. Since the general conditions of the selected site represent the majority of the eroded shorelines on the west coast of Peninsular Malaysia, the method applied in this study can be replicated as an appropriate cost-effective alternative for the same cases.

1. Introduction

One of the most important problems in the coastal areas all over the world is erosion which has threatened human activities in the areas exposed to such hazard. Coastline retreat could result in very serious economic, environmental, and social impacts depending on the eroded area.

Over the past decades, as development has taken place in Malaysian coastal states, overlogging and clear-cutting of mangroves along coastlines has made coastal areas exposed to natural phenomena such as tidal inundation, storm surges, currents, and wave action. These pressures have resulted in severe coastline retreat. It has been generally proved that mangroves can decrease the wave energy (Kathiresan and Rajendran, 2005). Although mangroves may not completely halt the coastal erosion, the presence of mangroves reduces the erosion rate (Thampanya et al., 2006). Department of Irrigation and Drainage (DID) of Malaysia (2006) reported that 1414.5 km, 29%, of Malaysian shorelines face erosion impacts. The area of mangrove forests continues to decline at a rate of 1% per year (Gong and Ong, 1990) which means natural rehabilitation process is not capable of effectively recovering mangroves from degradation.

Rehabilitation efforts may be more successful at sites where mangroves previously existed, but the topography of a degraded site may be changed due to erosion/accretion and consequently the hydrologic regime could be altered. Therefore, normal hydrology assessment (depth, duration, and frequency of inundation) of target mangrove species is the most important factor in a mangrove restoration project (Lewis, 2005). In designing a successful restoration project, special attention must be paid to environmental conditions (e.g. hydrology, wave energy, salinity regime, soil and water pH, soil texture, nutrient concentration, elevation, and slope) required by existing natural mangrove species in an adjacent reference site (Elster, 2000; Gilman and Ellison, 2007).

The primary objective of mangrove rehabilitation projects is often to restore structure and functionality of degraded mangroves to a "least disturbed condition" (Lewis, 2005; Gilman and Ellison, 2007). The term "functionality" is taken to mean the ability of restored mangroves to stabilise shoreline, trap sediments, improve shoreline protection, offer suitable habitat for animals, provide timber and firewood, and promote aesthetic value of coastal areas, in a similar way to natural mangroves (Bosire et al., 2008). The current study is aimed to present an integrated approach to mangrove restoration, and its key objectives are: (1) to improve sediment deposition on the restoration site in order to raise the sea floor (datum recovery) to the elevation that provides the correct hydrologic regime; and (2) to restore mangroves to create a sustainable ecosystem that functions at an equivalent level to the adjoining natural mangrove ecosystem. To

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