Technology Fact Sheet for Adaptation

Dune restoration [i]

Technology: Dune Restoration	
Sector : Coastal Zone	
Subsector :	
Technology characteristics	
Introduction	Coastal environments are considered among the most vulnerable to changes from climate change, including direct changes (e.g. changes of temperature and precipitation) and indirect changes (e.g. sea level rise, wind and water circulation, increasing storm events). With rising sea levels, there will be more frequent and more serious flooding of low-lying coastal areas by extreme tides, storm surges, and wave effects. Coastal dunes offer a buffer against storm extreme tides and storm surges. This buffering capacity, however, is minimized and potentially eliminated when dunes are over-stabilized by invasive plant species or other alterations brought about by urbanization and development. Over-stabilization makes dunes more susceptible to loss from erosion by not enabling them to move or migrate naturally in response to sea level rise and changes in erosion patterns.
Technology characteristics/highlights	Technologies used here are quite low tech and most of the time rely on the local natural material and community volunteering and monitoring services. Dune restoration involves: • Removal of exotic vegetation (e.g. Casuarina trees) that dramatically reduces dune effectiveness. • Filling and re-grading the slope with bulldozers. • Installing sprinkler or drip systems • Constructing dune walkovers to protect from erosion caused by human access • Re-vegetating with native dune plants. Additional research might also be needed to identify key vegetation species that need to be produced. • The application of fences to stabilise bare sand, encourage dune growth and protection. • Monitoring and maintaining the dune.
Institutional and organizational requirements	Dune restoration projects could involve many volunteers that require hands on training about effectiveness of different grass species in dune restoration. In case of community based dune restoration programs – this is seen as a part of an education process that raises awareness of likely coastal hazards if dunes are not preserved. At a larger scale, it is useful for governments to adopt proactive coastal management plans to protect, enhance, restore and create marine habitats, and through that align the dune restoration projects around the country.
Operation and maintenance	Movement and reshaping of the material is achievable with limited

	technology requirements. The use of a bulldozer or other earth moving equipment is sufficient to undertake ad-hoc operations to reshape or repair dunes. Sediment may even be bulldozed from dune crests and placed in lower areas if the dune crest height exceeds design specifications.
Endorsement by experts	Dune protection meets multiple management objectives, such as habitat protection, public access to environmental and recreational resources and hazard mitigation. Because of these benefits and the fact that they are less expensive and more aesthetically pleasing than some engineering solutions, dunes have found broad public support in United States, Australia, Canada, New Zealand, United Kingdom, Spain and Netherlands. The Baird Report (2003) specifically mentions in the case of Mauritius that healthy dunes must be vegetated with endemic species, which have evolved over thousands of years, are able to survive sand accumulation, flooding, salt spray, sandblast, wind and water erosion, temperature fluctuations, drought and low nutrient levels.
Adequacy for current climate	Fits well, both for present and expected (future) climate change.
Scale/Size of beneficiaries group	Beneficiaries groups include residents, beach users and industries dependant of healthy coastal ecosystems (e.g. fisheries and tourism).
Disadvantages	Reconstruction of dunes may receive local opposition if it affects communities' direct access to beaches and views straight onto the sea. Land loss is another issue; dunes have a reasonable sized footprint. It could be controversial to use land with development potential for dune restoration if the full benefits are not made clear. There might also be an opposition to restoring natural dunes as they could sometimes be seen to be untidy and aesthetically not pleasing.
Capital costs	
Cost to implement adaptation technology	Since the most basic sand dune construction projects consist simply of the deposit of *dredged* material onshore, followed by shaping using bulldozers, simple dune construction costs are not expected to be significantly different from beach nourishment costs in terms of cost per cubic meter of sediment used. Expert information obtained from the ICZM Division of the Ministry of Environment and SD shows that the cost of dune restoration will be of the order of **Rs 2,500 per m^3 of sand refilled**. The cost of beach nourishment has been estimated at an average of **Rs75,000/m** (please see corresponding Technology Fact Sheet). Additional costs may however, be introduced through the requirement for dune grass planting, fencing, board walks, and

	establishment of appropriate demonstration sites and development of realistic guidelines and protocols for restoration: important steps in convincing stakeholders that return to a more natural system is achievable and desirable. Typically, dune restoration is accompanied with revegetation for better impacts. The cost associated with the regeneration of coastal vegetation has been estimated at **Rs 444/meter** of beach. Please see the relevant Technology Fact Sheet for more details. Factors which are likely to influence the unit costs of dune construction are: • Whether dredged material is required for dune construction/restoration or whether fences or vegetation can be used to promote sand accumulation • Availability and proximity of appropriate construction material from onshore or offshore sites • Dredger type, size and availability • Requirement to fence newly constructed dunes to prevent erosion • Requirement for planting new dunes with vegetation • Frequency with which the dune needs to be artificially replenished or whether the structure naturally accumulates sand • Project size and resulting economies of scale
Additional cost to implement adaptation technology, compared to "business as usual"	There is no additional cost to implement the technology since it is the same cost without or with climate change.
Long term cost (i.e. 10, 30, or 50 years) without adaptation	Erosion of beaches, damages to coastal real estate by waves.
Long term cost (i.e. 10, 30, or 50 years) with adaptation	Ongoing dune maintenance.
Development impacts, direct and indirect benefits	
Direct benefits	Dune stabilization, maintenance of a buffer zone and restoration of healthy coastal ecosystem.
Reduction of vulnerability to climate change, indirect	Reduction in physical damage to property and lives lost during storms.
Economic benefits, indirect Employment Growth & Investment	 Restoration of dunes will preserve the beaches ecosystems the tourist and fishery industries depend on. Increased market value for traditional and industrial economies (residences, resorts, mines). Can create investment in specialist study for the combination of native plants best suited for dune environment.
Social benefits, indirect Income	 Job security and maintenance of current quality of life, as the beach is

Education Health	maintained Dune restoration projects can be practical activities for environmental education initiatives. Dunes provide sites for active recreation, have aesthetic, psychological, therapeutic opportunities.
Environmental benefits, indirect	Provision of nesting sites, habitable substrate, refuge areas for wildlife and food for higher trophic levels of the food chain. Dune systems also filter pollutants and in some cases contain groundwater reservoirs.
Local context	
Opportunities and Barriers	**Opportunities:** Dune restoration can be much more than mitigation or reparation, in that it can lead to increased understanding and appreciation of a threatened ecosystem. Restoration programs can be linked to environmental education initiatives aimed at re-establishing an appreciation for naturally functioning coastal landscapes. This may increase the likelihood of implementing similar programs elsewhere. **Barriers:** See acceptability to local stakeholders.
Market potential	Not a market technology. Generally technology initiated by government incentives and carried out by NGOs and volunteers.
Status	Mauritian Ministry of Environment conducted a study on coastal erosion. 21 public beach sites were identified as potential erosion sites, 15 of which were found to be in need of beach stabilization. The technology is presently being implemented at some locations.
Timeframe	Can be implemented immediately with adequate communication measures to ensure public cooperation. Maintenance must be continued over the medium and long term.
Acceptability to local stakeholders	A possible barrier could be local opposition and competition with development plans and interests (see Disadvantage box). A particular concern is that private landowners and hotels undertake their own remedial measures (usually trying to save a beach using seawalls) that are poorly informed, leading to adjacent beach loss.

[i] **This fact sheet has been extracted from TNA Report – Technology Needs Assessment Reports For Climate Change Adaptation – Mauritius. You can access the complete report from the TNA project website http://tech-action.org/**