Title:	**Groyne system to control coastal erosion**
Sector	**Coastal Resources**
Sub-Sector	**Coastal Zone Management**
Technology Characteristics	
Introduction	Groynes are wooden structure but can also be made of concrete and/or rock barriers or walls perpendicular to

	the sea. Beach material builds up on the updrift side, where littoral drift is predominantly in one direction, creating a wider and a more plentiful beach, therefore enhancing the protection for the coast because the sand material filters and absorbs the wave energy. However, there is a corresponding loss of beach material on the downdrift side, requiring that another groyne to be built there. Groynes are extremely cost-effective coastal defense measures, requiring little maintenance, and are one of the most common coastal defense structures. Groynes are common in The Gambia and have done well in the past. Lack of wood for their construction has limited their use but this can be overcome with the use of concrete, which is relatively more expensive.
Technology characteristics/Highlights	Groynes are cross-shore structures designed to reduce long-shore transport on open beaches or to deflect near-shore currents within an estuary. On an open beach they are normally built as a series to influence a long section of shoreline that has been nourished or is managed by recycling. They trap beach material and cause the beach orientation to change relative to the dominant wave directions. Sand is carried in temporary suspension during higher energy wave or current conditions and will therefore tend to be carried over or around any cross-shore structures. They mainly influence bedload transport and are most effective on shingle or gravel beaches. Groynes can also be used successfully in estuaries to alter nearshore tidal flow patterns. In an estuary they may be single structures. Rock is often favoured as the construction material, but timber or gabions can be used for temporary structures of varying life expectancies (timber: 10-25 years, gabions: 1-5 years). Groynes are often used in combination with revetments to provide a high level of erosion protection. Groynes along a duned beach must have at least a short "T" section of revetment at their landward end to prevent outflanking during storm events. The revetment will be less obtrusive if it is normally buried by the fore-dunes. Beach recycling or nourishment is normally required to maximize the effectiveness of groynes. On their own, they will cause down-drift erosion as beach material is held within the groyne bays[8].
Institutional and Organization requirements	Monitoring of the coastal environment is the responsibility of the Coastal Working Group at the National Environment Agency. Design, construction and management of coastal defense structures are the responsibilities of the Technical Services Department of the Ministry of Works and Infrastructure Development. At the municipality level, Mayoral offices of Banjul and Kanifing are involved in the decision making.
Operation and maintenance	The residual life of a groyne on a sand beach is approximately 20-25 years[9]. Maintenance equipment has become more specialized with time, and is worth about £25,000. Groynes which reach 25 years need to be dismantled and assessed. Groyne piles need to be replaced every 25 years, and planks every 15-20 years.
Endorsement by experts	Experts at the Ministry of Works and the municipalities have long endorsed groyne systems as they have saved the city of Banjul for more than 30 years. Lack of materials to replace broken timber made the systems to collapse. Use of rock and concrete will solve this problem.
Adequacy for current climate	Groynes are adequate for current climate and for the projected climate in The Gambia. Adequate supply and appropriate materials (timber or rock) are required.
Scale/size of beneficiary group	The Gambian shoreline is in a highly dynamic sandy coast and groynes can be installed all along the coast.
Advantages and Disadvantages	Rock groynes have the advantages of simple construction, long-term durability and ability to absorb some wave energy due to their semi-permeable nature. Wooden groynes are less durable and tend to reflect, rather than absorb energy. Gabions can be useful as temporary groynes but have a short life expectancy. They are good on exposed shorelines with a natural shingle upper beach. Can also be useful in estuaries to deflect flows. Unlimited structure life for rock groynes. Disadvantages include disruptions in natural processes and public access along upper beach; causing down-drift erosion as they starve beaches further down the coast of sediment which can result in coastal erosion; and the resultant down-drift erosion could destroy buildings or private land and lead plummeting of housing prices in the region making it difficult for affected homeowners to move out. They are also quite expensive.
Capital Costs	
Cost to implement adaptation technology	Cost of installation of groynes is moderate, but must include for recycling or nourishment. Hence the cost is in the range £10,000-£100,000 per structure, plus recycling. Construction costs are mainly dependent on structure dimensions, but can be heavily influenced by the availability of suitable rock (or other material), transport and the associated costs of recycling or nourishment. Rock structures can be assumed to have an unlimited life with respect to economic assessments.
Development Impacts, direct and indirect benefits	
Direct benefits	Groynes reduce dependency on regular recycling or nourishment, and therefore reduce future disturbance of the shoreline environment. Localized accumulations of beach material will encourage new dune growth. If constructed in conjunction with a revetment, recycling, fencing and transplanting will help to keep the revetment sections buried, thereby enhancing habitat regeneration. Groynes encourage upper beach stability and reduce maintenance commitment for recycling or nourishment.
Indirect benefits	
Reduction of vulnerability to climate change impacts	Coastal erosion is reduced as sediment is trapped by the groyne.
Economic benefits: employment, growth and investment	As groynes trap sediment from long-shore drift the beach builds up supports tourism, and creates a positive multiplier effect on the local economy (good for retail, catering and transport jobs).
Social benefits: Income	
Environmental benefits:	Timber used for groyne construction should be derived from sustainably managed forests. Fencing and transplanting should be undertaken to establish a new line of fore-dunes along the stabilized upper beach. These dunes will enhance the coastal landscape, provide additional erosion protection and re-establish a

[8] ***Summary 12: GROYNES*** **- A guide to managing coastal erosion in beach/dune systems: *www.snh.org.uk/publications/on-line/.../erosion/appendix_1.12.shtml***

[9] *Minutes of the SCOPAC Timber Groyne Workshop 24th March 2010*

	natural succession of dune habitats from the shoreline to the backshore.
Local context	
Opportunities and Barriers	Groynes have a significant impact on the landscape and can create barriers to the recreational use of the upper beach. They often cause down-drift erosion unless there is a long term management commitment to beach recycling or nourishment. Downdrift erosion may well lead to pressure for further defense works. Timber groynes must be built from hardwood to endure the harsh shoreline environment. Much hardwood comes from tropical sources, making it both costly and potentially environmentally unacceptable. Timber groynes tend to reflect, rather than absorb, wave energy making them significantly less effective than rock on exposed coasts. They are also more likely to structural failure due to formation of scour channels around their seaward ends.
Market potential	The groyne systems in The Gambia have been constructed out of matured rhun palm trees with do well in saline conditions. There is acute shortage of these trees in The Gambia but there is abundant supply in neighbouring Senegal and Guinea Bissau. Business entities can take advantage of the market potentials. Concrete groynes also provide business entities with potential to procure concrete materials from the construction of the groynes.
Status	Both timber and rock groynes have performed very well in The Gambia. As a general rule, groynes should not be built on an open beach unless construction is accompanied by a commitment to regular recycling or nourishment. Without this commitment the groynes are likely to cause down-drift erosion as the upper beach becomes starved of sediment.
Timeframe	Because of salinity levels along the coast of The Gambia, rock and timber groynes stay longer before repairs are required. Beach recycling or nourishment is normally required to maximize the effectiveness of groynes.
Acceptability to local stakeholders	Coastal stakeholders have accepted groynes.

Images of Groyne Systems