Coastal Ecosystem-based
Rehabilitation Guide

People working with Nature

Introduction

Erosion is a problem on many Pacific Island beaches, threatening coastal villages. Local communities can make beaches more resilient to erosion.

This guide helps communities understand the pressures people may place on beaches, and suggests how natural processes or "ecosystem based approaches" can be used to encourage sand to come back and stay put. Beaches have important values for local communities, such as for fishing, tourism, recreation, and low tide gathering and gleaning. Local communities are an essential part of keeping beaches healthy and can use low cost, natural ways to make beaches stronger.

While beaches undergo a natural cycle of erosion and deposition over time, many beaches can erode and not recover, causing loss in island area and beach width. Beaches become eroded where they lose more sediment alongshore, offshore or inland than they receive from various sources.

There are natural processes that work to build up beach sand. Sand comes from reef and lagoon corals and algae as they break up and get washed ashore. Beach vegetation on a beach traps and stabilises the sand. If these ecosystems are managed and protected and better allowed to do this natural accretion or sediment trapping work, then beach erosion can be much reduced or even stopped.

A wide healthy beach is backed by a strand vegetation of trees, shrubs and a ground cover of vines and grasses that allow sand accumulation and provide habitats for a diverse group of animals. Wide beaches have important values in reducing wave energy impacting the island. Good beach vegetation can help promote wide and healthy beaches and also reduce vulnerability of beaches to erosion by impacts of sea level rise.

A healthy beach profile has a convex-up shape to the surface of the beach from the land to the sea; this is typical of building and accreting beaches. Following human impacts, an unhealthy and eroding beach profile has a concave-up shape to the surface of the beach from the land to the sea. As the volume of beach sediment is reduced by beach erosion, the beach shape is lowered and cut back, then a convex-up beach becomes a concave-up shaped beach, often backed by a low erosional cliff in the sand. The "profile" is the shape of the beach when viewed from the side; identification of the shape of the beach profile helps us to assess beach condition.

CONTENTS OF THIS BOOKLET

About healthy and eroding beaches

	SIGN 1	SIGN 2		**What communities can do to care for their beaches**						
						ACTIVITY A	ACTIVITY B	ACTIVITY C	ACTIVITY D	SIGN 3
Page 2	Page 3	Page 4	Pages 5-6	Pages 7-8	Page 9	Page 10	Page 11	Page 12	Page 13	Page 14
Healthy versus eroding beach	Benefits of a healthy beach	Causes of damage to beaches and beach vegetation	Examples of impacts on healthy beaches	How to assess and monitor beach condition	How to choose activities to rehabilitate beaches	How to minimise impact by controlling access	How to replant a beach edge tree	How to revegetate a beach	How to assist beaches to rebuild using brush protection	Ways people can work with nature to improve beach condition

A healthy beach

Healthy indications are the convex shape of the beach surface, the vines trapping sand and the healthy growing tips spreading over loose sand.

Individuals and local communities can help to keep their beaches healthy.

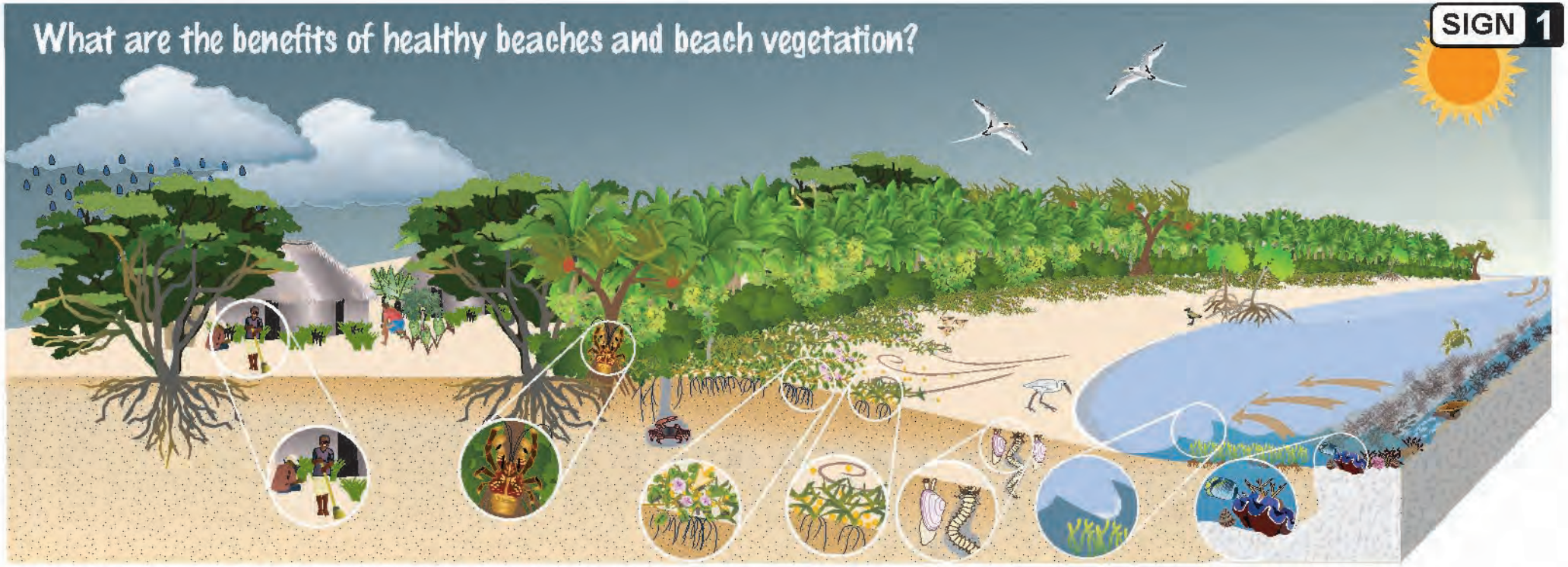
An eroding beach

Eroding indications are the concave shape of the beach surface, lack of vines and broken vegetation cover, and a small cliff of sand at the back of the beach.

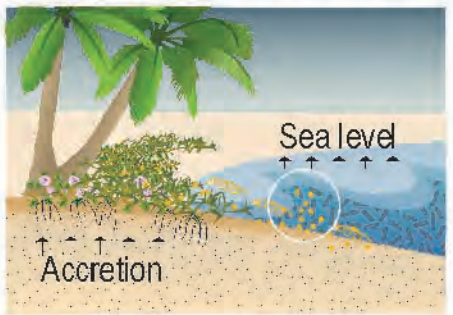
Individuals and local communities can prevent beach erosion and keep beaches healthy.

What are the benefits of healthy beaches and beach vegetation?

SIGN 1



1. Beach vegetation builds the land and holds and protects it from erosion.



Beach vegetation is a dynamic buffer between land and sea, clinging to sand and soil, and protecting it from wave energy.

As sea level rises, beach vegetation builds up sand and soil, keeping pace with sea level rise and protecting the land from erosion.

The upward-curved shape of the beach shows that it is building up (accreting).

Broken off seagrass, sand and shells are deposited onto beaches during storms.

Beach soil is formed from trapped sand and from small pieces of broken-down plant matter.

Beach vines and grass lift strong winds away from the ground, holding the sediment safe from erosion.

As waves reach the shore, their energy is reduced by seagrass and by the upward-curved shape of the beach, helping to prevent erosion and allowing the beach to keep building as more sand is trapped by plants.

2. Beaches and coral reefs support each other.

Coral reefs supply sediment and organic matter that are needed to build up the sand.

A healthy beach filters polluti from the land and helps to ke the reef healthy and producti

3. Beaches are productive in ways that benefit people and the environmer

Beach vegetation is a living place for many plants and animals including unusual species.

Beaches are an abundant source of food and bait for people. These beach life forms are also a food source for fish and birds.

Beaches are places for people to live, and a source of pride, comfort and enjoyment in community life.

Beaches are important habitat for resident and migratory birds.

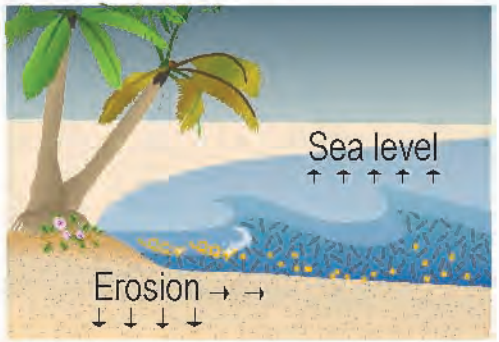
Beaches provide nesting places for turtles.

Beach vegetation protects coastal communities from storm waves and tsunami by reducing the energy of these destructive waves a they cross the shoreline.

What causes damage to beaches and beach vegetation?

SIGN 2

1. Damage to beach vegetation increases the impact of sea-level rise.



When beach vegetation is thin or damaged, sand and soil are exposed to wave energy and will wash away.

The downward-curved shape of the beach shows that land is eroding. Waves have more energy and the tide reaches further up the beach.

2. These actions damage beach vegetation, leading to erosion.

Walking on beach grasses and vines along the edge of the beach destroys the delicate growing parts of the plants, stops them from thriving and eventually kills them.

Pigs under trees at the edge of the beach uproot beach vines and grasses, and dig up the roots of trees, making them more likely to fall with wave action or strong winds.

3. These actions damage beach values and cause erosion.

Pig and other manure acts as a fertiliser. Beach vines and grasses do not need this fertiliser, which then washes down to the sea, causing algae to grow along the water's edge.

If this fertiliser gets into the water and reaches the coral, it will encourage algae to grow there and can kill the coral.

Garbage on the beach and in the beach vegetation is ugly and discourages tourists. It may break down to release toxins.

Mining sand from the beach reduces the supply available for natural land-building processes that protect the shore from sea-level rise.

Structures such as causeways and groins may reduce the amount of sand available to the beach and interfere with natural land-building processes.

Sea grass and coral are a source of sediment to the beach. Trampling and killing them reduces the amount of sand available for natural land-building processes.

Examples of impacts on healthy beaches

Footsteps

Eroding beaches can get a cliff that forms in the sand.

People walking over this edge push more sand down and make the erosion problem worse.

Beach sand is angular and hard.

The new leaf growing tip of plants is easily broken and killed by peoples' feet grinding the sand.

This causes plants to die back and exposes the sand to erosion.

Pigs

Pigs disturb protective ground cover vegetation and undercut roots of beach edge trees.

This increases erosion of the upper beach leading to loss of land.

Sand Removal

Taking sand off the beach (mining) leaves less beach sand to protect the upper beach from waves.

Sand mining can also damage and kill vegetation at the back of beaches that protects the land from erosion.

What communities can do to care for their beaches (Step One)

Assess the condition of the beach

The health and density of beach vegetation, the shape of the profile of the beach and the width of the dry beach above normal high tide mark are all features of the beach which can be used to assess beach condition. This assessment helps us identify impacts occurring upon a beach and leads us to easily prioritise actions to stabilise and repair any damage.

Assess the condition of the beach using this criteria guide

0 No Impact (Good Condition)

- Coastal vegetation has an even canopy with no gaps
- Intact herb and vine coverage of the upper beach
- No evidence of human impact
- Beach is wide and convex-up in profile
- High tide mark has considerable dry beach above it below the vegetation

1 Some Impact

- Even canopy of coastal vegetation with no gaps
- Herb and vine coverage of the upper beach has some gaps
- Evidence of some human impact
- Beach is wide and convex-up in profile
- High tide mark has considerable dry beach above it below the vegetation

2 Moderate Impact

- Broken canopy of trees
- Some regrowth and recruitment
- Herb and vine coverage of the upper beach has gaps, with evidence of damage from footsteps
- Evidence of several types of human impact
- Beach is flat in profile
- High tide mark is approximately 5 m in front of beach trees

3 Rather High Impact

- Tree canopy is uneven, the majority of the area is not showing regrowth
- Some recruitment of small trees
- Little herb or grass zone, mostly bare sand under the trees
- Evidence of human impact such as sand mining, footsteps causing erosion and herb vegetation damage
- The beach is flat to concave-up in profile
- High tide mark is at the top of the beach

4 High Impact (Degraded)

- Only a few trees remain at canopy height
- Significant disturbance to coastal vegetation
- Large areas of bare sand with footprints at the top of the beach
- Evidence of human impacts such as sand mining, garbage, pig diggings
- The beach is concave-up in profile with a more vertical section in the upper beach
- High tide mark is at the top of the beach

5 Severe Impact (Very Degraded)

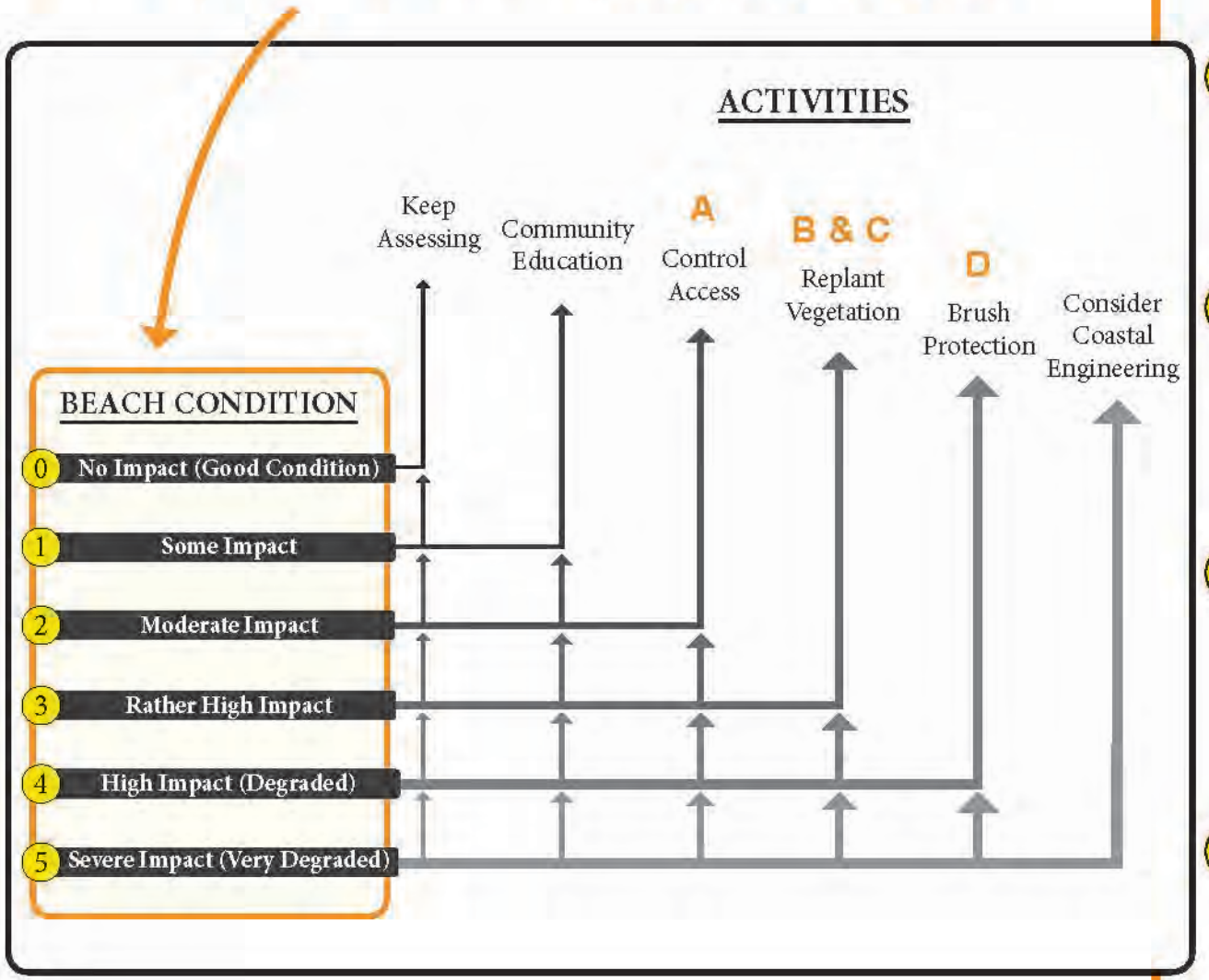
- Extensive absence of vegetation (just isolated trees)
- No recruitment of trees or shrubs
- No vines or herbs
- Beach is eroded back to hard confinement such as the road edge, and there is little sand
- The beach is concave-up in profile with a cliff or scarp in the upper to lower beach
- High tide mark is at the top of the beach

3 IMPORTANT THINGS TO REMEMBER

1. *With continued and increasing human impact, a beach will deteriorate in its condition, moving from impact level 0 to impact level 5.*
2. *As impact levels increase from levels 0 to 5 more rehabilitation activities are needed to improve the beach condition.*
3. *It is much easier to improve a beach from impact level 1 to impact level 0 than it is to improve a beach from impact level 5 to impact level 4. Therefore it is important to reduce or prevent threats and damage to beaches as early as possible so they do not further deteriorate.*

What communities can do to care for their beaches (Step Two)

Use the results from the beach condition assessment to identify activities needed to rehabilitate the beach



WHAT TO DO

0 If you assess the beach to be in good condition, continue to assess it over time and start community education on beach values and human impacts, using Signs 1 and 2.

1 If you assess the beach to have some impacts, use Sign 2 to work with the community to identify what are the direct impacts, and make a plan to reduce these. Use Sign 1 for community education on the beach values objectives. Consider access control measures where useful. Continue assessing beach condition over time.

2 If you assess the beach to have moderate impacts, consult with the community and construct access control using guide in Activity A, and replant beach vegetation using guide in Activity B. Use Sign 1 for community education on objectives, and Sign 2 for community education on human impacts in beaches, and continue assessing beach condition over time.

3 If you assess the beach to have rather high impacts, then undertake access control (Activity A and replant vegetation (Activity B), following the beach plan in Activity C. Use Sign 1 for community education on objectives, and Sign 2 for community education on human impacts in beaches, and continue assessing beach condition over time.

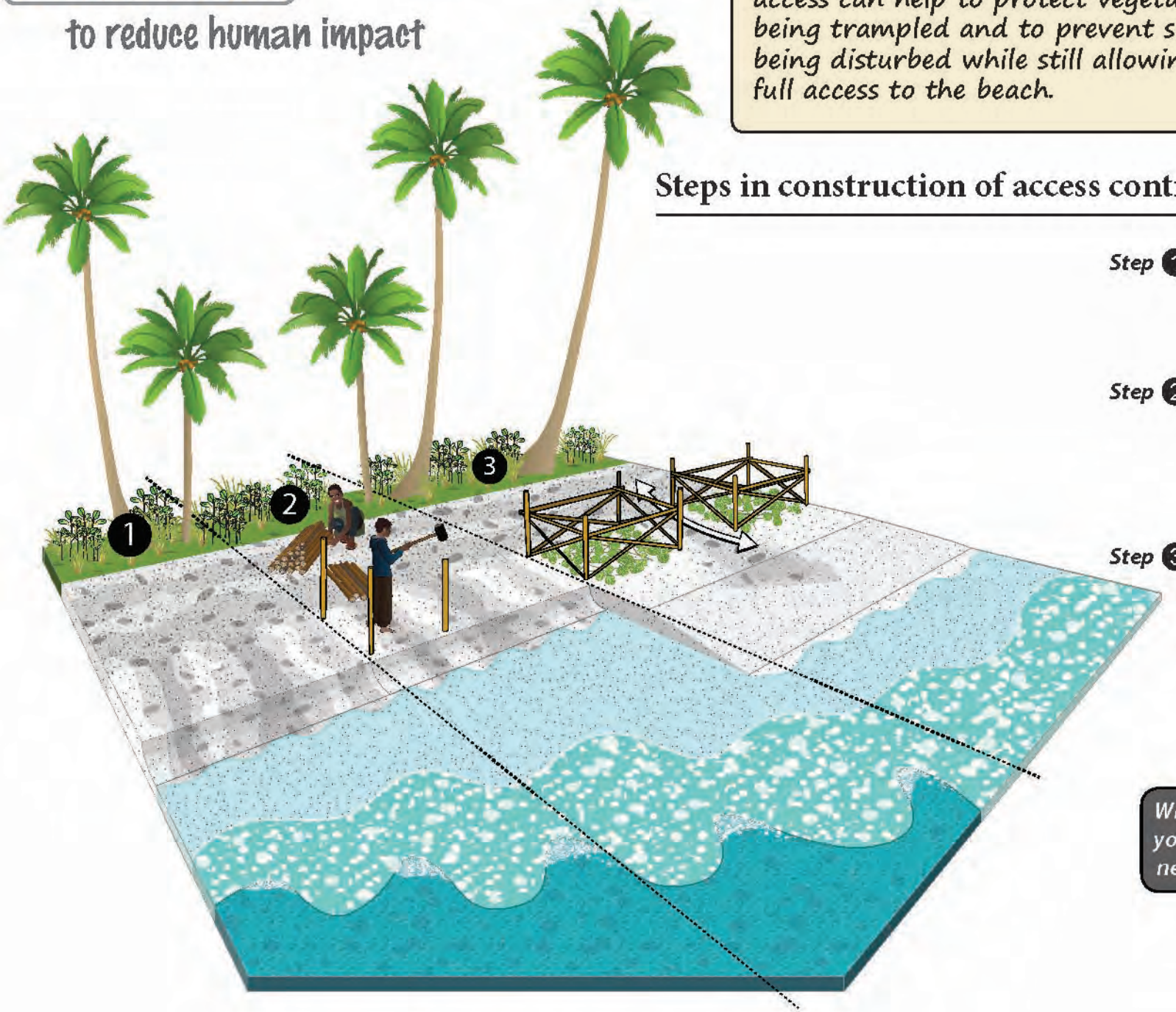
4 If you assess the beach to have high impacts, then undertake brush protection on cliff eroded areas of the beach (Activity D), along with access control (Activity A) and replanting of vegetation (Activity B), using the beach plan in Activity C. Use Sign 1 for community education on objectives, and Sign 2 for community education on human impacts in beaches, and continue assessing beach condition over time.

5 If you assess the beach to have severe impacts such that infrastructure is threatened, then coastal engineering is needed, in combination with community education (Signs 1 and 2).

Access control

to reduce human impact

Providing paths and walkways for beach access can help to protect vegetation from being trampled and to prevent sand from being disturbed while still allowing people full access to the beach.



Steps in construction of access control on an eroding beach

Step **1** Assess causes of beach erosion and consult with the community.

Step **2** Bring poles and tools and build a barrier on the upper beach where vegetation may grow.

Step **3** Maintain the access control barrier and educate the local community and visitors regarding its purpose.

What you'll need

- Poles
- Cross beams
- Sledge hammer
- Rope (or sennit)
- Hammer and nails
- Wire fencing for pigs or cattle

ACTIVITY B

Replanting a beach edge tree

to stabilise sand

What you'll need


Shovel


Seedling


Fresh water (6 litres)


Coconut husks & dead tree trunk matter


Old tin cans (rusty & non-rusty)


Fresh green leaves


Leaf litter


Scissors (or a knife)

Step 1 Dig a hole 80 - 90 cm deep and 45 cm x 45 cm wide.

Step 2 At the bottom of the hole add mature coconut husks and crumbled dead tree trunk matter to make a base.

Step 3 Place 4 cans (including both rusty and non-rusty cans) on top of the base.

Step 4 Add 40 cm of leaf litter.

Step 5 Add a 1 cm layer of fresh green leaves.

Step 6 Add about 5 litres of fresh water.

Step 7 Add 30 cm of littoral topsoil and create a depression in the centre of the topsoil then add about 1 litre of water into the depression.

Step 8 Add water to the sack containing the seedling and then place this seedling (still in sack) into the hole in position.

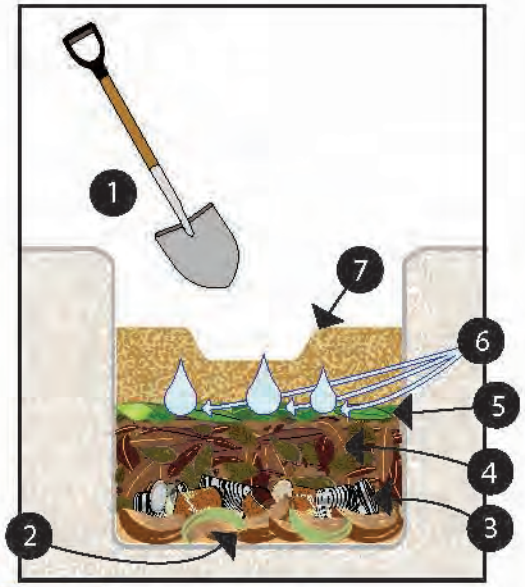
Step 9 Cut the sack down one side and while supporting the root bole of the seedling, gently remove the sack.

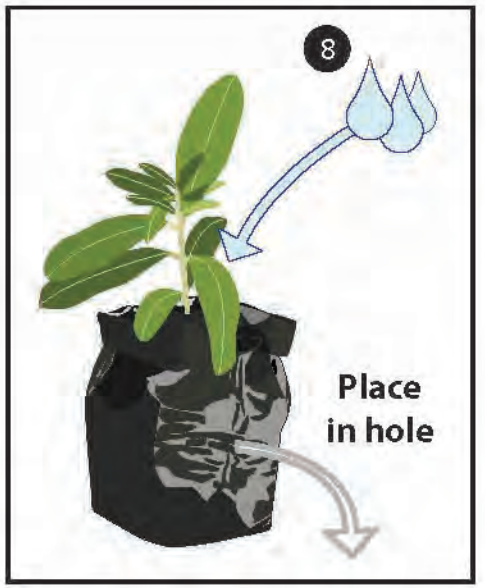
Step 10 Add topsoil around the seedling root bole.

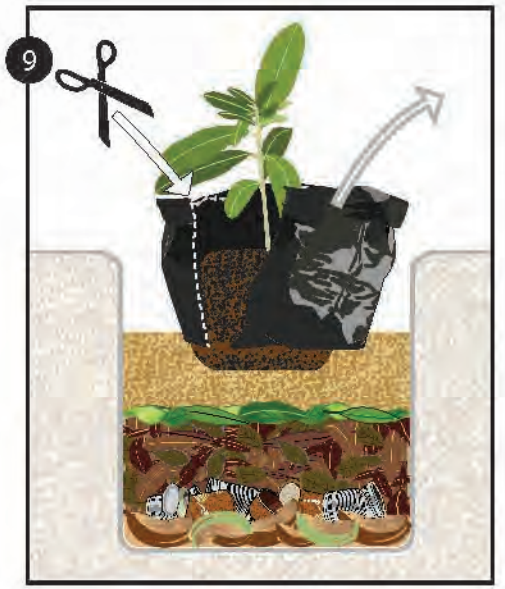
Step 11 Fill the remaining space in the hole with the sand dug out to make the hole.

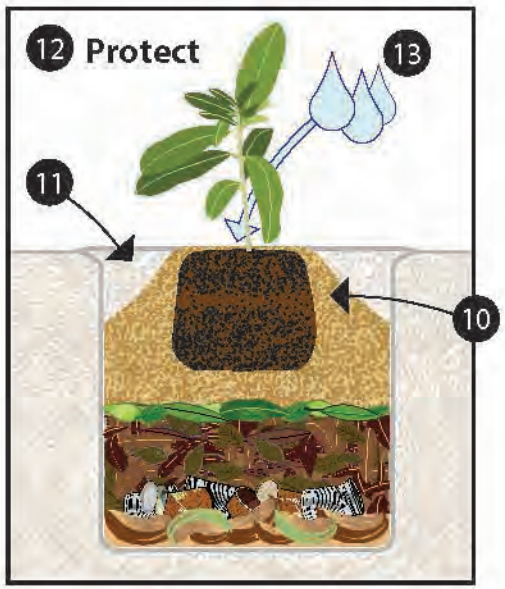
Step 12 Add protection for the young plants, including palm frond cover and sticks to reduce wind stress and stop damage by people, pigs and dogs.

Step 13 Water seedlings over the next few months as they start to grow.







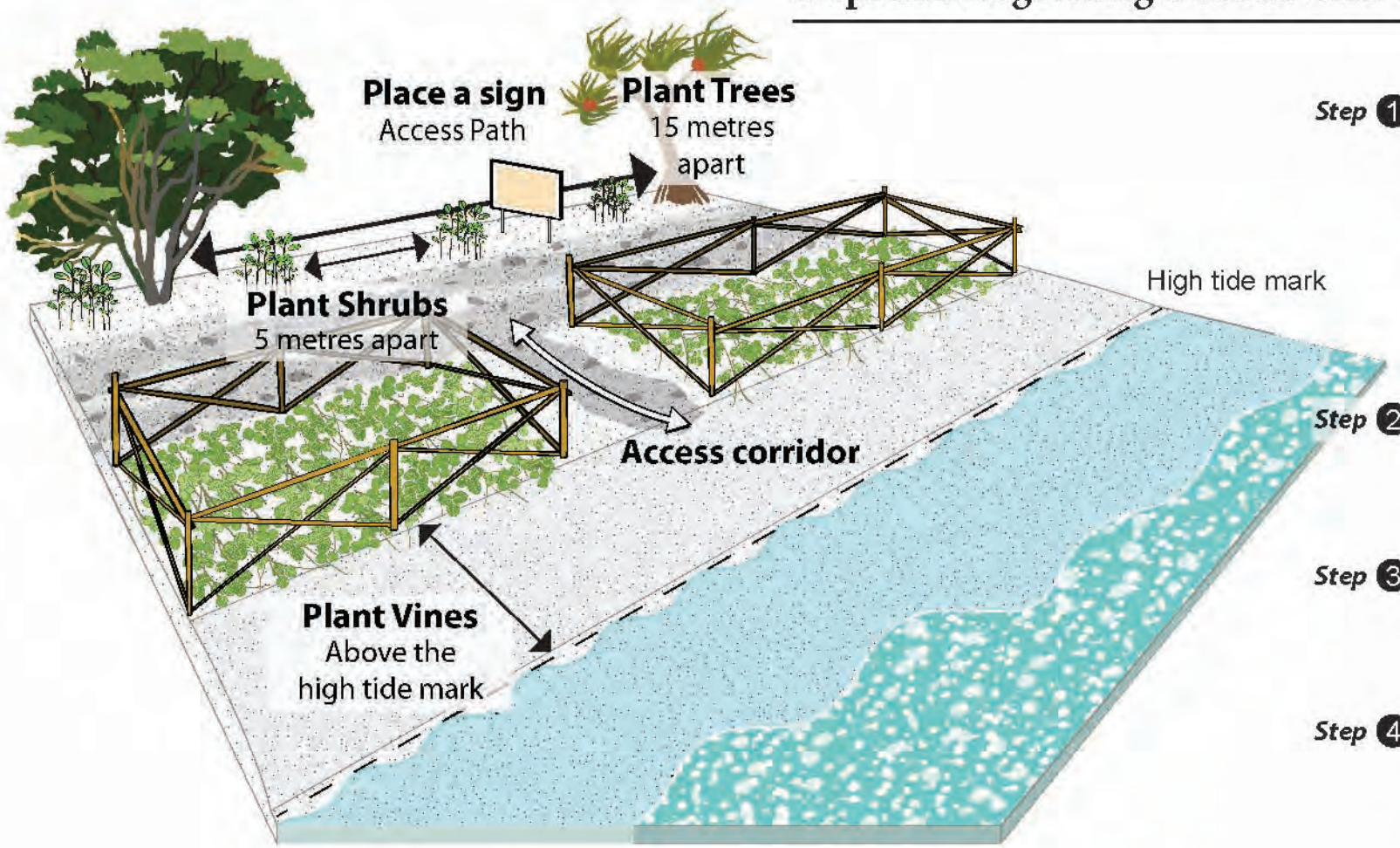


Beach revegetation

to help beaches become healthy ecosystems again

Healthy beach vegetation stabilises the sand and protects the beach from being eroded by wind and waves. Vegetation provides habitat for animals, maintaining life and promoting a healthy ecosystem.

Steps in revegetating a beach with vines, shrubs and trees



Step 1 Plant vines 5 metres up the beach from the high tide mark if the beach is wide enough. If the beach is frequently accessed by people, build access control to minimise impact from footsteps.

Step 2 Plant shrubs behind the area of vines with a spacing of 5 metres between each shrub.

Step 3 Plant trees behind the shrubs with a spacing of 15 metres between each tree.

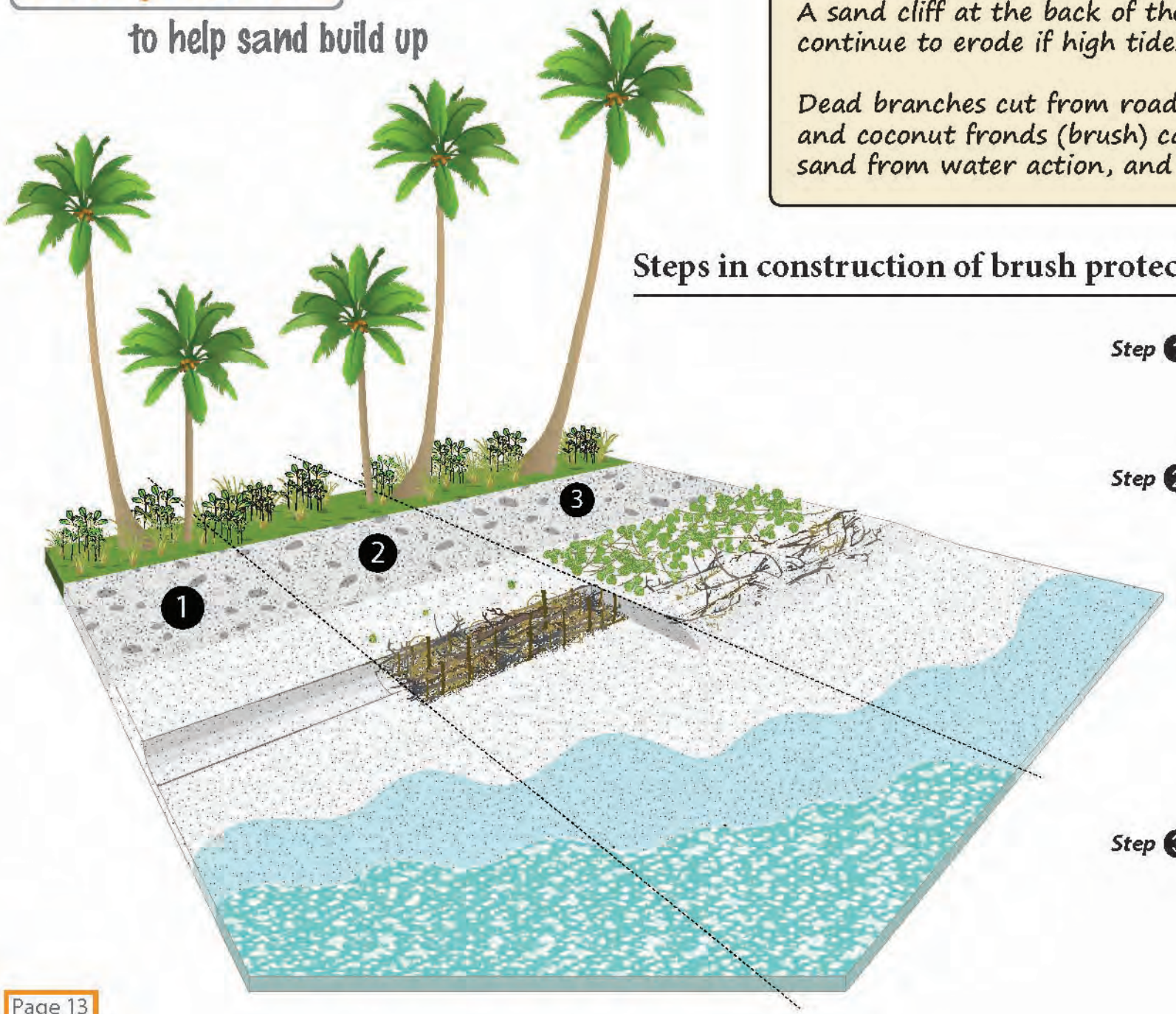
Step 4 Place signs in the area to inform the community of the rehabilitation effort.

Brush protection

to help sand build up

A sand cliff at the back of the beach will continue to erode if high tides touch it.

Dead branches cut from roadside bushes and coconut fronds (brush) can protect the sand from water action, and also trap sand.



Steps in construction of brush protection on an eroding beach

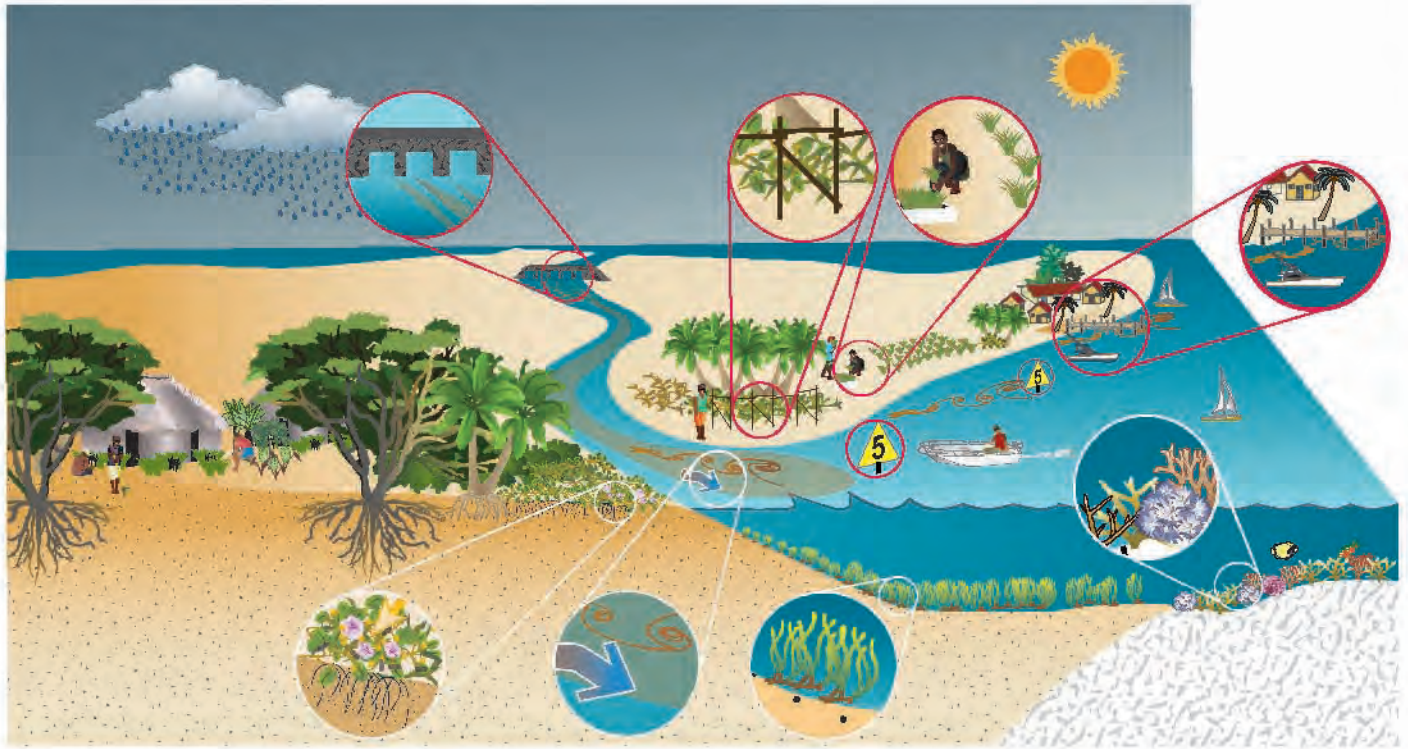
Step 1 Assess causes of beach erosion and consult with the community.

Step 2 Bring cut branches from roadside bushes and coconut fronds, and fix as a barrier on the upper beach where erosion is occurring, using wooden stakes to hold them in place. Wedge brush between the stakes and the sand cliff, taking care not to cover any living grass or vines.

Step 3 Maintain the brush barrier, and replant with vegetation particularly vines, and educate the community regarding its purpose.

Ways people can work with nature to help improve beach condition

SIGN 3



Natural factors promoting beach accretion

Sediment moving naturally from offshore and from other parts of the coastline helps supply sediment to build up beaches.

Healthy seagrass promotes accretion by damping the energy of waves and tides. Seagrass is also a source of organic matter that helps build sand and soil.

The expansion of beach vegetation root mats is a major contributor to accretion.

Healthy coral protects beach vegetation and supplies sediment.

Management actions promoting beach accretion

Control boat wakes to reduce erosion.

Design shore structures to allow longshore sediment drift, which is an important source of sediment for beaches in down-coast areas.

Design causeways to allow sediment to pass through.

Access control at eroding beaches allows revegetation recovery and sand accretion.

Rehabilitation of degraded beach vegetation promotes the growth of deep root mats and sediment accretion.

This book was written for governments, community groups and NGOs to address coastal protection and erosion issues through ecosystem based adaptation interventions. The work was developed as a partnership between the Secretariat of the Pacific Regional Environment Programme (SPREP) and the University of Tasmania with funding from Australian Aid and the participation of the governments of Kiribati, Samoa, Vanuatu and Tonga. We acknowledge and thank MELAD, MNRE, Vanuatu Fisheries and Tonga MEECCDMMIC who participated and guided work at the field sites in these countries.

This guide was written by Joanna Ellison of the University of Tasmania, Paul Anderson of SPREP, Vainuupo Jungblut of SPREP, with graphics and layout by Michael Helman, Jan Tilden and Carlo Iacovino. Some graphical symbols contributed by IAN Symbols. Peer reviewers included Amber Carvan, Stuart Chape, Carlo Iacovino and Seema Deo from SPREP.

SPREP
Secretariat of the Pacific Regional Environment Programme

UNIVERSITY of TASMANIA
AUSTRALIA

Australian Aid

SPREP Library/IRC Cataloguing-in-Publication Data

Ellison, Joanna. Anderson, Paul. Jungblut, Vainuupo.

Coastal ecosystem based rehabilitation guide. – Apia, Samoa : SPREP, 2015.

16p. 21cm.

ISBN: 978-982-04-0536-3 (print)
978-982-04-0537-0 (e-copy)

1. Coastal zone management – Oceania. 2. Re-vegetation –- Oceania. 3. Soil degradation – Control – Oceania. 4. Plants for soil conservation – Oceania. I. Anderson, Paul. II. Jungblut, Vainuupo. III. Ellison, Joanna. IV. Pacific Regional Environment Programme (SPREP) V. Title.

630.5

Secretariat of the Pacific Regional Environment Programme (SPREP)
PO Box 240, Apia, Samoa, sprep@sprep.org, **www.sprep.org**

Our vision: The Pacific environment, sustaining our livelihoods and natural heritage in harmony with our cultures.

The publication was made possible through the support of the Australian Department of Foreign Affairs and Trade. The contents of this report are the sole responsibility of SPREP and do not necessarily reflect the views of the Australian Government or the Australian Department of Foreign Affairs and Trade.