



COASTAL CHANGE IN THE PACIFIC ISLANDS

VOLUME TWO

A Guide to Support Community Decision-Making
on Coastal Erosion and Flooding Issues



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This guide was developed through a wide collaboration of partners in several countries and regions to support community based management or adaptation planning. In 2010 Micronesia Conservation Trust, through the Micronesia Challenge¹ Initiative, developed a climate change tool to foster community

¹The Micronesia Challenge is a shared commitment among the five Micronesian governments: the Republic of Palau, the Federated States of Micronesia, the Republic of the Marshall Islands, the U.S. Territory of Guam, and the Commonwealth of the Northern Mariana Islands to "effectively conserve at least 30 percent of the near-shore marine resources and 20 percent of the terrestrial resources across Micronesia by 2020." (www.micronesiachallenge.org)

based adaptation. MCT convened natural-resource managers, community leaders, climate scientists, and experts from various sectors to determine what a community based tool should look like. Through this collaboration a tool—*Adapting to a Changing Climate: Guide to Local Early Action Planning (LEAP) and Management Planning*—was developed in Micronesia and further adapted for the Coral Triangle Region. The LEAP tools help communities build social and ecological resilience to climate change. These tools provide a series of outreach and planning materials to explain climate change, in the context of other local threats and from the perspective of a Pacific Island community.

During training workshops and implementation of the LEAP process in the field, several communities expressed concerns over the high degree of vulnerability of their shorelines and coastal lowlands, and associated buildings and homes, to both erosion and flooding events. They also discussed the high degree of vulnerability of coral reefs and associated fisheries to various local threats, as well as climate change. Through these LEAP efforts, communities identified the need to improve the resilience of their coastlines and marine resources and identify actions to reduce the communities' social vulnerability to potential impacts to these resources.

Although many communities expressed these concerns through the LEAP process, there were few tools available to support community level decision making on increasing resilience of coastal and marine resources and understanding and addressing negative impacts of coastal hazards such as erosion and flooding. Without further understanding of coastal processes and what can be done, management strategies for shorelines tend to focus on reactive approaches; these are typically characterized by engineering approaches such as seawalls. Additionally, while there are tools developed for professional managers in order to support the design of resilient MPAs and reefs, there have been few developed that help community members understand how to design locally managed areas so that their marine resources continue to provide them with the benefits they depend on while also building resilience. Therefore, LMAs tend to lack the permanent and/or spatial protection often needed to provide long-term benefits and resilience.

To address this gap, two new guides have been developed in the Micronesia and Coral Triangle regions to complement the LEAP process. These guides provide more in-depth outreach and planning processes for communities that want to strengthen resilience of their locally managed areas, including coral reefs, fisheries, and the coastal zone. The guides are:

1. *Designing Effective Locally Managed Areas in Tropical Marine Environments: Guidance to Help Sustain Community Benefits through Management for Fisheries, Ecosystems, and Climate Change* focused on helping communities understand how to design locally managed areas (LMAs) to achieve community benefits through fisheries sustainability, biodiversity conservation, and ecosystem resilience in the face of climate change. Found at: <http://weadapt.org/knowledge-base/small-islands-and-climate-change/designing-effective-locally-managed-areas-in-tropical-marine-environments>
2. *Coastal Change in the Pacific Islands Volumes One & Two* focused on helping communities understand how coastlines work and what causes coastal change, and supporting decision-making to reduce the impacts of coastal hazards such as flooding and erosion on communities.

These guides can all be used separately or in combination with one another to support outreach and planning that ultimately builds natural and social resilience to climate change and other threats.

About This Guide

This guide responds to the emerging needs of many communities in the Pacific Islands whose members are expressing concerns about storm damage, sea-level rise, and the frequency and severity of coastal flooding events and shoreline erosion. For the purpose of the guide, the term “coastal zone” refers to the entire area from the upland forest out to the reef edge. On small low-lying islands and atolls, the entire island would be considered the coastal zone.

The term “coastal change” refers to:

1. Flooding of coastal lowlands from any, or combination, of the following: high (king) tides; typhoons/cyclones/storms; large ocean swells; and heavy rainfall leading to storm water, river, or stream flooding.
2. Gain or loss of land along the shoreline, which is the area of the coastal zone that directly interacts with the sea and is changeable (e.g. sandy beaches, mangroves, cliffs).

With existing tools, communities have been able to identify the potential impacts of threats and hazards to the coastal zone. However, understanding the complex interaction between natural coastal systems and human development in order to determine effective responses often requires further technical assistance, which is often not accessible.

Strategies to address the impacts of coastal erosion and flooding also tend to focus on reactive approaches, normally through engineering projects such as building seawalls. In many cases, these “solutions” have negatively impacted the surrounding environment and have increased conflicts with other community values. Likewise, they are typically short-term in effectiveness, ignoring the role inappropriate human development often plays as a key driver of the problem. Furthermore, these strategies often result in a false sense of security, leading to further development in hazard-prone areas. This usually results in the problem of hazards in the coastal zone becoming more significant and more complex to address over time.

PURPOSE

This document is part of a two-volume guide that provides a foundation for communities to assess local coastal processes and the impacts humans are having on coastal areas, and identify appropriate actions required to build the resilience of coastlines and communities. It is divided into 1) Volume One: Outreach 2) Volume Two: Planning. This volume (2) provides participatory processes that enable community members to use local knowledge to understand changes in their coastline and support decision-making that is best for local situations and capacity.

Both of the volumes in this guide can be used together as a step-by-step process to carry out outreach and conduct planning to select a suite of appropriate actions that, in combination, address local coastal-hazard issues. Alternately, the individual volumes can be used separately to support existing community resource-management processes such as raising awareness or completing vulnerability assessments.

AUDIENCE

This guide is designed for use by small planning teams consisting of people from communities, agencies, and organizations that normally facilitate stakeholders through community based planning and implementation processes. Stakeholders include community leaders; community members who use or depend on coastal and marine resources; and/or agencies and organizations that have jurisdiction over, or a supporting role in, these areas.

CONTEXT

This guide does not provide a process for developing a full community management or adaptation plan. However, there are several ways the volumes of this guide can support management planning or adaptation planning, including:

- For communities that are undergoing management planning or adaptation planning and have identified that their coastlines are vulnerable to flooding and shoreline change, this guide can help these communities understand how coastlines work and decide what actions are appropriate to help manage the short- and long-term changes to their coastline.
- Even if communities are not undergoing natural resource-management planning processes, this guide can support outreach activities to help communities understand how coastlines work and what causes them to change, and to foster planning processes.
- Communities that have already developed full management or adaptation plans can use this guide to modify existing plans and further develop actions to address specific coastal-change issues. The objectives and actions developed through the use of this guide should be integrated back into the larger plan to be implemented.

It is advised that a planning team or community facilitator review the guide and use components that best support existing planning processes. The actions identified by using this guide can be integrated into management or land-use plans that already exist or are under development. The full set of volumes and content are described here:

Volume One: Outreach — How Coastlines Work and What Factors Influence Coastal Change

- **Session One: How the Coastal Zone Works** — This session provides detailed information on the coastal zone, the active shoreline, natural processes that move sediment around in a shoreline, and natural components of the coastal zone that help to manage sediment in the system.
- **Session Two: Natural Events That Influence Coastal Change** — This session reviews the various natural factors that can cause coastal flooding or shoreline change.
- **Session Three: Human Activities That Influence Coastal Change** — This session reviews the various human activities to the coastline that can increase the negative impacts from coastal hazards such as flooding and shoreline erosion. It also explores how future climate change scenarios could worsen impacts of existing hazards.
- **Session Four: What Actions Can We Take to Reduce the Negative Impacts of Coastal Change on Our Community?** — This session reviews several approaches that can be taken by communities to plan for changes in the coastal zone. These include recommendations from coastal experts on actions that most effectively address existing threats, as well as ways to plan for future hazards.

Volume One also includes the following distributed throughout the document:

- **Case Studies:** Provided from around the Pacific and developed through coastal expert assessments that demonstrate specific concepts and/or provide recommended actions for specific coastal change scenarios.
- **Example Community Coastal Stories:** Developed through workshops that involved community members, governmental and non-governmental agencies, and coastal experts. These provide a sample of what can be completed through the use of this guidance document in combination with local and expert input. While community members were present for these, a more complete planning process with a broader range of stakeholders present would be needed before any recommendations can be advanced.

Volume Two: Planning (This Document) — Choosing Actions to Reduce the Impacts of Coastal Flooding and Shoreline Erosion

- **Session One: Assessing the Coastline** — This session involves a series of activities for the community to explore and understand their coastal zone. It includes mapping the area, physically walking the shoreline, reviewing coastal features and processes, reviewing historical events that impacted the coastal zone, and recording observations of change over time.
- **Session Two: Developing Actions to Reduce the Impacts of Coastal Flooding and Shoreline Erosion** — This session provides communities with steps that can help them identify actions to address coastal changes and hazards (short- and long-term). This session includes a checklist based on recommendations from coastal experts. The checklist provides a quick and simple way for communities to discuss and decide on various approaches and actions that will provide them with the best chance of effectively reducing the short- and long-term negative impacts of coastal hazards on the community.
- **Session Three: Developing Your Coastal Story** — All of the information collected through the engagement activities in Session One and Session Two can be used to write a summary about the place, or a "community coastal story." This story template includes coastal zone features and conditions, coastal uses and changes over time, future impacts to the coastal zone, and actions the community will take to build a resilient coastal community.
- **Appendix A** — Provides details on each of the recommended actions including 1) description, 2) benefits and challenges, 3) technical expertise required, 4) general cost for implementation and maintenance, 5) resources available, and 6) examples from the region.

And finally, a word of caution. While this guide makes every effort to provide information to help communities to reduce the negative impacts of coastal change, it is important to recognize that shoreline and coastal processes can be highly complex. This means there are limits to any such guide. It is always advisable to seek expert advice in situations where significant infrastructure or other assets already exist, where investment is planned, or where engineering structures may be implemented.

VOLUME TWO: PLANNING

**Choosing Actions to Reduce the
Impacts of Coastal Flooding
and Shoreline Erosion**

This section provides a planning process to develop actions that will reduce the impacts of coastal flooding and shoreline erosion. It includes a series of steps that can be carried out to help communities understand how their local coastline works, potential impacts from natural hazards and climate change, and actions they can take to strengthen the long-term health and safety of their coastal community. It also includes a checklist of actions to support community based decision-making. More detailed information about each of these actions is provided in Appendix A and can help communities decide if a particular action is right for them. Finally, the provided template can be used by the planning team to develop a work plan to guide implementation of the selected actions. Information in Appendix A can also support the development of the work plan.

Community facilitators can modify this process to best meet their needs. The process can also be integrated into previous or ongoing planning processes. Communities that have already completed a mapping or other planning steps can use the products from previous work.

However, it is recommended that the planning team review the Planning Section of this guide to determine if the existing processes should be modified to better consider coastal processes and threats.

Planning Section consists of the following sessions:

- Session One: Assessing the Coastline
 - Step 1.1: Preparing to Assess the Coastline
 - Step 1.2: Mapping Changes to Your Coastline
 - Step 1.3: Coastal Community Walk
- Session Two: Developing Actions to Reduce the Impacts of Coastal Flooding and Shoreline Erosion
 - Step 2.1: Actions Checklist
 - Step 2.2: Coastal Community Action Plan Template
- Session Three: Developing Your Coastal Story
 - Step 3.1: Coastal Story Template

Each session will provide background information and facilitation instructions on how to carry out the associated steps. A planning team that can facilitate the process should lead all of the sessions and invite community members and stakeholders where appropriate. The planning team should organize and summarize the information collected from community members to ensure the planning information is properly captured. This summary document can be shared with community members to ensure it is accurate.

Before beginning the planning process, it is critical that you involve all major stakeholders who will be impacted by management decisions. Regularly ask, “Are the right people to make these decisions in the room?” It is also important that people involved in the planning process go through the Outreach Section, which provides critical information that participants will need during the Planning Section. This is especially true for the planning team and leaders/decision-makers within the community. Because much of the information collected in these steps is historical, it is extremely helpful to invite elders of the community to participate, as they will remember more about long-term past events than will younger participants.

Finally, wherever possible a coastal expert should be included in the process to support information gathering and assessment results. Coastal processes are highly complex, and coastal experts can provide a much more detailed understanding of and guidance on the situation. If coastal experts are not available, this should not stop the community from completing the planning section. However, it is critical to adhere to the guidance of this document that recommends the use of coastal experts before taking any actions that alter coastal processes with human alterations, such as hard defenses. The expertise of a coastal engineer is required to develop an appropriate design that will minimize negative impacts.

SESSION ONE:

ASSESSING THE COASTLINE

Step 1.1: Preparing to Assess the Coastline

Prior to carrying out the planning activities, the planning team should make an effort to answer the following questions and complete preparations listed below. These preparations will greatly enhance the coastline assessment and ensure that your team has involved the right people.

1. Identify and invite those who have the authority to develop rules and implement actions on your coastline to be involved in the planning process. Consider official leaders and government agencies that may have authority.	List appropriate authority agencies or people to be invited to participate in the planning process:	Check this box once complete
2. Identify and invite any technical experts that can support the planning process. Consider coastal experts, hazard experts, engineers, natural resource experts.	List names of experts to be invited to participate in the planning process:	
3. Collect historical information about the area including photographs, aerial images of the coastline, historical maps, etc. These can be requested from the community and/or land-management agencies, where appropriate.	List specific information to collect:	
4. Identify and invite elders in the community to participate in planning activities. If they are not able to participate, it is advised to try and find a way to include their input through interviews and/or checking in with them after community activities are drafted to provide input.	List names of elders to be invited to participate in the planning process:	
5. Collect the most recent and specific climate change information possible. Projections on sea-level rise and weather patterns for the region will be particularly useful.	List where most relevant local information can be found:	

Step 1.2: Mapping Changes to Your Coastline

This step will develop a visual tool that the community can use to discuss important natural and social features of the coastline and changes observed over time. It will also be useful in exploring how future natural hazards and climate change may impact the community over time. Having a visual tool can help generate discussions about the area and develop specific actions later on in the process.

If you already have a resource map for your community, there is no need to create a new one. Just review the existing map with the participants and make any necessary modifications based on the questions below.



FACILITATOR INSTRUCTIONS

1. Hang large sheets of flip-chart paper on a wall and tape the sheets together. The sheets should provide ample space to draw the community, with both marine and terrestrial features on a large enough scale for everyone in the group to see. The location of the features in the map can be estimated, and you will have future opportunities to draw more precise maps.
2. Have the group discuss the questions below. Based on the answers, draw features on the map. Be sure to create a legend so the definitions of any symbols you use are clear. Specific written information can be captured on flip-chart paper.

Question One: What are the key natural features within your community and what is the quality of each (e.g. healthy reef areas, damaged reef areas, healthy streams, polluted streams, clear water, turbid water, etc.)? Map coastal, terrestrial, aquatic, and marine features and their quality, including these:

- a. Beaches
- b. Mangroves
- c. Seagrass beds
- d. Wetlands
- e. Coral reef flats
- f. Coral slopes
- g. Channels
- h. River mouths/estuaries
- i. Bays
- j. Streams
- k. Forests
- l. Sand dunes
- m. Currents and wave direction (where known and if they change seasonally)

Question Two: What are the key socioeconomic and cultural features of the community. Map these features, including:

- a. Homes
- b. Roads
- c. Wells
- d. Community buildings such as health clinics, churches, etc.

- e. Important cultural sites
- f. Power lines
- g. Agricultural areas
- h. Boat access/landings
- i. Others

Question Three: Mark the areas on the map where coastal changes have been observed, including these:

- a. Areas that have lost sediment
 - b. Areas that have gained sediment
 - c. Potential sediment cells of your community shoreline (areas that have clearly defined headlands, such as bays or coves)
 - d. Changes in natural coastal defenses (e.g. mangroves, wetlands, beaches, coral reefs)
 - e. Areas inundated by king tides, storms surges, or coastal/river flooding
 - f. Hard defenses that have been put in place (e.g. sea walls, breakwaters, etc.)
3. Once the map is completed, hang another piece of flip-chart paper on the wall next to the map to be used to capture written notes.
 4. Use all the historical resources you have on hand (e.g. maps, photos, etc.). Ask the group to discuss and answer the following questions. Write the answers on the flip-chart paper.

Question Four: When and where have you observed major changes to your coastline (loss or gain of sediment, flooding)? Were they associated with a specific event (human alteration, natural hazard)? Write down the general area where sediment was lost/gained or flooding occurred, the time frame, and the reason for the change (if known) on the flip chart. These areas can also be marked on the map.

Question Five: When did major development projects that impacted natural defenses or added structures to the coastline occur (e.g. clearing or filling mangroves, dredging, roads, power lines, churches, hospitals, piers, causeways, seawalls)? Mark the years when each large development project the group remembers happened on the flip chart. Also, be sure these projects are captured on the map.

Question Six: Based on an understanding of how coastlines work, which development projects and changes to natural defenses have most likely negatively impacted the sediment balance and ability of sediment to move around the shoreline? Write these at the bottom of the flip chart.

Question Seven: Based on climate change projections and reviewing historical events, how will climate change likely impact specific areas of your coastline and/or structures in the community? Write the answers at the bottom of the flip chart.

5. Keep the map and flip-chart information safe for future use. If possible, take digital pictures of the map to capture and preserve the details.

Step 1.3: Coastal Community Walk

A coastal community walk consists of physically walking the shoreline of the community to discuss what is happening, what has changed over time, and what could happen in the future. Physically walking the shoreline of the community can help community members understand important concepts and visualize important features including current flooding areas, land tenure, structures impacting sediment movement, and changes to the environment over time. This information can also be used to ground-truth the map. Because much of the information collected in this activity is historical, it is extremely helpful to invite elders of the community to participate or review the information collected, as they will remember more about long-term past events than will younger participants. If at all possible, it is ideal to include coastal scientists in this step to provide expertise. However, if it is not possible, this should not stop the planning team from completing this step.



FACILITATOR INSTRUCTIONS

1. Begin this step by asking community members, preferably elders, to give a very brief overview of the shoreline over their lifetime, using the map to point out specific features. Have them discuss the following:
 - a. How the community values and uses this shoreline.
 - b. Changes in development on the low-lying coastal area and shoreline over time.
 - c. Changes in the physical shoreline (areas that have gained or lost sediment).
 - d. Specific areas and concerns to the community for coastal change (e.g. erosion and flooding).
2. Bring the group down to the shoreline to slowly walk the area. Start with the areas that have been identified as those of most concern. It's okay if these are the only areas that are viewed.
3. For each area of the shoreline you visit, walk with the group and ask them to answer the questions in the next page. ***It is important to take good notes about each area so that they can be used to modify or develop the community map.***
4. Once the group returns to the classroom or meeting area, they should make any needed adjustments to the community map to accurately reflect the results of their coastal assessment.

Community Assessment Walk Questions for Facilitators – TAKE GOOD NOTES!

Note-taker Name:

Date:

Location Name/Description:

Background

1. How does the community value and use this shoreline?
2. What are the major coastal-change concerns in this area (e.g. erosion, flooding)? Provide details about specific areas.

Assessment

3. Where does shoreline sediment come from (for example, sand from near shore areas, broken coral and shells from the reef, or sediment from land)?
4. What is the direction of the long-shore movement, and where is the sediment going?
5. How the shoreline shape changed over time:
 - a. What areas gained sediment? Why?
 - b. What areas lost sediment? Why?
6. Shoreline vegetation: New vegetation can be a sign of newly accreted land. Old vegetation can help explain what area of the shoreline has been stable over time and allowed trees to grow older.
 - a. What areas have new vegetation?
 - b. What areas have old vegetation?
7. Changes in natural defenses:
 - a. What natural defenses are present?
 - b. Are there any areas where there have been changes to natural defenses over time, such as reefs, seagrass, beaches, mangroves, streams, swamps, or upland forest?
8. Shoreline development:
 - a. When did major coastal development take place? Why?
 - b. Take note of any hard structures such as seawalls, piers, groynes, etc. This includes natural hard structures such as beach rock and rocky headlands. Notice any local impacts, such as erosion on one side and accretion on another.
9. What areas of the coastline have experienced major flooding? Why (e.g. king tides, storms, river flooding)?
10. For this area, what coastal change issues are you most concerned about for the future, given climate change predictions? Be specific with the answers by discussing exact areas and impacts of concern.

Preliminary Ideas for Actions

11. Are there actions that could be taken to improve natural defenses such as reefs, seagrass, beaches, mangroves, streams, swamps, or upland forest?
12. What actions can be taken to keep people, food sources, water sources, and infrastructure safe from natural hazards and loss of land? This includes where and how to build.

SESSION TWO:

DEVELOPING ACTIONS TO REDUCE THE IMPACTS OF COASTAL FLOODING AND SHORELINE EROSION

Now the community should have a good understanding of how their coastline works and have observed changes over time, seen how human alterations and natural events may have impacted the coastline over time, and discussed what coastal changes they are most concerned about in the future. With this information in hand, you are now ready to develop actions to reduce the impacts of coastal flooding and shoreline erosion. This section provides a list of recommendations, developed by coastal experts, that should be considered when developing actions. Remember that there is no single solution, so it's important to consider all actions and decide if they are appropriate for your situation. Communities will need to use the information they collected in their Coastal Assessment to guide them in choosing the most appropriate actions. A checklist of actions is provided to support this decision-making process, along with a work-plan template for developing details about how actions will be implemented.

Step 2.1: Actions Checklist

This step provides a quick and simple checklist to review the actions recommendations by coastal experts. Communities can decide which of the actions they want to pursue based on the information they collected in their coastal assessment. Community members should review the full suite of potential actions in this list to determine which ones are right for them. Additional actions can be added if necessary. After deciding which actions are most appropriate for their community, the planning team can complete the template in the next step to develop a more specific work plan, including how actions will be implemented. Appendix A should also be used at this time to review more details about proposed actions and to support development of the work plan.



FACILITATOR INSTRUCTIONS

1. Tell the group that they will now use the information collected in the coastal assessment to decide on the most appropriate actions to take to reduce the impacts of coastal flooding and shoreline erosion.
2. Hang the map on the wall. Have the group review the map and information from the assessment if it's been a while since it was completed.
3. Go through each of the questions and actions listed in the checklist below. Take time to discuss each action and decide if the community wants to pursue it. Many actions have little cost but require political will. Be sure you have the right people in the room to determine what challenges or opportunities may be in place with a particular action. If more information is needed on a specific action, more details are provided in the Appendix A for each action and should be used to assess if it's an appropriate action to include in the work plan. You can refer to the page number in Appendix A associated with that action to get more information.
4. Use the map regularly throughout the discussion to capture details for specific actions. For example, if the community is deciding if they want to carry out mangrove restoration, they may look at the map to determine 1) where mangroves historically grew, 2) the human alterations and natural hazards that have impacted them over time, and 3) specifically where restoration efforts will take place, which can be marked on the map.

Actions Checklist

Protect and Enhance Natural Defenses: Nature provides the best protection from coastal flooding and erosion. Actions that protect and enhance natural defenses are optimal and can provide long-term benefits to the community through coastline protection as well as benefits derived from these habitats, such as fisheries and other marine resources. Many of these can be implemented with relatively small costs and little-to-no drawback. These actions are recommended by coastal scientists as a high priority for actions to be taken by communities. *Check the box (under short- or long-term priority) to mark the actions that your community will take to protect and enhance natural defenses, or to note if your community already does this action but it should be modified.*

Potential Action	Short-term priority	Long-term priority	For more details, see
Raise awareness of community members to ensure that all stakeholders have a good understanding of 1) the benefits of natural defenses in helping to manage the sediment balance and protect coastlines, and 2) the differences they can make by avoiding activities that impact on these natural defenses.			Volume One: Outreach
Develop community agreements or rules, where needed, to prohibit destructive practices and other threats to natural defenses including: 1. damaging coral reefs (e.g. destructive fishing practices, pollution, sedimentation) 2. nearshore dredging or beach mining 3. clearing or filling mangroves/wetlands 4. clearing upland forests 5. blocking or changing natural waterways			Appendix A page 30
Develop a Locally Managed Area (LMAs) and LMA networks that are multi purpose, not only to protect and enhance local marine resources but also to protect and enhance coastal protection from natural defenses such as reefs, mangroves, seagrass beds, wetlands, and upland forests. LMAs can also be used to enhance fisheries' benefits to communities.			Appendix A page 34
Develop buffer zones along the coast by planting native coastal vegetation (including mangroves) in areas where it historically grew. Allow space landward of mangrove areas to enable them to adapt naturally to sea-level rise. Enhancing native vegetation in areas it previously grew can help to stabilize coastlines and reduce the loss of land.			Appendix A page 38
Develop buffers of natural vegetation around rivers and streams and protect the natural functions of river and stream catchments and wetland areas.			Appendix A page 38
Ensure Resilient Development Practices: Raising awareness and establishing community agreements or development rules that consider where and how to build are effective ways to build resilience to existing and future coastal hazards such as flooding and loss of land. These ensure that development occurring now will not be impacted by coastal hazards and sea-level rise over the long term (over the next two to four generations). These actions are recommended by coastal scientists as a high priority for actions to be taken by communities. <i>Check the box (under short- or long-term priority) of the actions that your community will take to ensure resilient development practices, or to note if your community already does this action but it should be modified.</i>			
Raise awareness of community members to ensure that all stakeholders have a good understanding of 1) the benefits of developing in safe areas, away from low-lying coastal areas or the active shoreline, 2) the differences they can make by consider long-term coastal changes in choosing where and how to build.			Volume One: Outreach

Potential Action	Short-term priority	Long-term priority	For more details, see
Develop community agreements or rules to ensure that development activities consider long-term changes in coastal zones. These includes agreements on where to build new developments to avoid hazardous areas such as those that experience erosion or flooding (or will in the next one or two generations). It also includes guidance on how to build structures so they are safe from hazards and do not disturb natural processes.			Appendix A page 43
Develop a long-term managed retreat plan that helps community members discuss and identify which buildings, homes, infrastructure, water resources, and agriculture may be further impacted by coastal change and should be relocated away from hazardous areas. The plan would include where relocation could occur over the next few generations and incentives for people to move to these safer areas.			Appendix A page 45
Use Hard Defense Options Wisely: There are situations when hard defenses are necessary and have to be put in place to protect critical infrastructure that cannot be move elsewhere (e.g. a road that cannot be moved inland due to steep land). Coastal scientists only recommend hard defenses as the last option, and usually only for critical infrastructure that cannot be moved. Consider the following actions for using hard defenses. <i>Check the box (under short- or long-term priority) of the actions that your community will take to ensure that hard defenses are built safely and with the least amount of impact as possible.</i>			
Develop an outreach program to ensure that all stakeholders participating in the decision-making process have a good understanding of benefits, costs, limitations, and potential negative impacts of hard defense options, AND assess all other options before considering implementation hard defenses.			Volume One: Outreach
Develop rules to ensure that hard defenses are designed, implemented, and maintained wisely when there are no other options determined to be sufficient to protect critical infrastructure that cannot be moved. Rules should ensure that hard defenses are 1) designed by an expert, 2) implemented to have the least impact to natural coastal processes, and 3) maintained over the long term.			Appendix A page 48
Monitor and Record Coastal Change: Monitoring the coastline over time will help the community understand how the coastline is changing. By viewing and recording what is happening in the same locations of the shoreline over long periods of time (several years minimum), communities can better determine if sediment is truly being lost or moving to another area. These include very easy/low-tech approaches (e.g. photo documentation) or more scientifically based approaches that require more technical expertise but yield more accurate results (beach profiling). <i>Check the box (under short- or long-term priority) of the actions that your community will carry out to understand coastal change over time.</i>			
Photo documentation: take photos of the shoreline over time, from the same location.			Appendix A page 50
Beach Profiling: will help the community understand how the amount of sediment in specific areas of the coastline is changing over time.			Appendix A page 51

Step 2.2: Coastal Community Action Plan Template

This step provides a template for the planning team to use to develop a more detailed action plan, and a work plan for the actions chosen in the checklist process. This step can be completed with the planning team only and then reviewed with the community for approval. The planning team should use the Appendix A to support work plan development and ensure actions are feasible, appropriate, and have a good chance of success.



FACILITATOR INSTRUCTIONS

1. Use the list of actions the planning team chose from the checklist. Discuss each one by one and develop more specific details that are particular to your area. If needed, use your map to discuss location of specific actions. For example, if the group decided to replant native coastal vegetation they should consider specifically where they will plant vegetation, and possibly what vegetation might be planted. Alternately, if the group decided to prohibit destructive activities to natural defenses, those destructive activities should be specifically listed (e.g. clearing of mangroves, sand-mining, etc.).
2. With your planning team, fill out the following elements for each of the actions chosen by the community and write them in the template below. Be sure to use Appendix A to develop these details for each action.
 - **Outcome:** Specify the final outcome you want to achieve through this action. Be specific.
 - **Timeframe:** Specify when this action will be completed (provide month/year).
 - **Responsibility:** Specify who will be responsible for completing this action. List all those involved and their role.
 - **Resources or Support Needed:** Specify any funds, technical expertise, equipment, or any other resources needed to ensure this action can be completed.
 - **Priority:** Specify if this action is high, medium, or low priority for the community, based on the following rankings:
 1. **HIGH** = early actions: These are optimal actions. They are actions that will benefit the community in the long term for various reasons (e.g. mangroves provide coastal protection and habitat for important food fish). They have low cost and high support, and the community can begin right away. They are also critical for protecting highly threatened targets (natural resource and social targets).
 2. **MEDIUM** = medium-term actions: These are very important for addressing coastal change, but may have higher costs and require more technical support. These actions may require time to mobilize the community and resources in order to be implemented.
 3. **LOW** = long-term actions: These are not as critical to addressing urgent coastal-change issues (e.g. moving a community building) or may not be as immediately feasible because they require many more resources.

Note: even if your priority actions require extensive resources and support, it is still important to identify and include them in your plan because your community will need to find a way to implement them over time to reduce vulnerabilities. Be sure to also include “quick wins” that the community can begin with little-to-no resources or support. These actions can be optimal actions, which mean that under any future climate scenario (e.g. negative or not) these actions can provide benefits to the community. For example, protecting mangroves from development can provide benefits to local fisheries and provide shoreline protection. These actions, although they may not be the highest priority, will help engage people and keep up things moving.

Coastal Community Action Plan Template						
Protect and Enhance Natural Defenses						
Action	Outcome	Timeframe	Responsibility	Resources Needed (Funding and Technical Expertise)	Priority (High/ Medium/Low)	
Ensure Safe Development Practices						
Action	Outcome	Timeframe	Responsibility	Resources Needed (Funding and Technical Expertise)	Priority (High/ Medium/Low)	
Plan for Long-Term Managed Retreat						
Action	Timeframe Current Generation (5-10 years) One Generation (10-20 years) Two Generations (20-40 years)	Responsibility	Resources Needed (Funding and Technical Expertise)	Priority (High/ Medium/Low)		
List opportunities and/or incentives for relocation of homes, buildings, and infrastructure.						
List homes and crops that are currently threatened or will be threatened in the future, and whose families would like to relocate over time.						
List all infrastructure and community buildings that are currently threatened or will be threatened in the future and should be relocated over time.						
Using Hard Defense Options Wisely						
Action	Outcome	Timeframe	Responsibility	Resources Needed (Funding and Technical Expertise)	Priority (High/ Medium/Low)	
List critical infrastructure that cannot be relocated and type of hard defense most appropriate for this situation.		Current Generation (5-10 years)				
Monitoring and Recording Coastal Change						
Action	Outcome	Timeframe	Responsibility	Resources Needed (Funding and Technical Expertise)	Priority (High/ Medium/Low)	

SESSION THREE:

DEVELOPING YOUR COASTAL STORY

The objective of this session is to develop a community coastal story which explains how the local coastline has changed over time, what events have the biggest impact on the coastline, and which future events and impacts the community is most concerned about managing over time. This information can also be used as a documentation tool to understand the history of the area, to include in existing management or adaptation plans, and to support fundraising and development of partnerships with local agencies.

Step 3.1: Coastal Story Template

This activity will pull together all the information collected from the planning activities to develop the community coastal story. The story is a short description of how the local coastline works, how it's changed over time from human alterations and natural events, what climate change impacts the community is most concerned about for the future, and what actions they will take to address these changes.



FACILITATOR INSTRUCTIONS

1. This activity can be completed with a small planning team using the information collected with the community in the previous three activities, and with the assistance of coastal-processes expert.
2. Use the template below to write three paragraphs that will make up your community coastal story.
3. After the story is complete, it should be shared with the community to review, modify, and approve. Explain that the community coastal story will be used to find support for implementing actions to take to manage for existing and future coastal change.

Community Coastal Story Template

Coastal Value and Uses: Write a paragraph about how the community values the coastline, and its main uses.

Coastal Features and Conditions: Write a paragraph about the natural features of the coastline, including sources of sediment, current directions, natural defenses, and seasonal changes.

Coastal Changes Over Time: Write a paragraph about how the coastline has changed over time. Include shoreline areas that have had sediment gain or loss, or changes in coastal flooding. Note natural hazards and impacts to the coastline. Also include when major development occurred, including when natural defenses were lost, and any hard structure put in place.

Current and Future Coastal Impacts: Write a paragraph about what current and future coastal hazards you are most concerned about and why. Include specific ways that these hazards have or will impact the people, infrastructure, and natural resources of the community.

Coastal Management Actions: Write a paragraph about the actions the community will take to reduce the short- and long-term impacts of coastal flooding and shoreline erosion. Include high- and medium-priority actions.

References

de Lange, Jenks. (2007). *Effectiveness of dune restoration for the management of coastal hazards and biodiversity*. Tauranga: NZ Coastal Society Conference.

Climate Change Adaptation for Coral Triangle Communities: Guide for Vulnerability Assessment and Local Early Action Planning (LEAP Guide). (2013). U.S. Coral Triangle Initiative Support Program.

Gombos, M., Ramsay, D., Webb, A., Marra, J., Atkinson, S., & Gorong, B. (Eds.). (2014). *Managing for Coastal Change in the Pacific Islands: A Facilitators Guide to Support Community Understanding and Decision-Making on Coastal Erosion and Inundation Issues*. Pohnpei, Federated States of Micronesia: Micronesia Conservation Trust.

Mangrove Action Project. (2007). *Ecological Mangrove Restoration* [Poster]. Indonesia: Lewis III, R.R.

Mangrove Action Project. (2006). *Five Steps To Successful Ecological Restoration of Mangroves* [Brochure]. Yogyakarta, Indonesia: Ben Brown.

APPENDIX A:

**Detailed Information to Help
Develop Work Plans That
Reduce the Impacts of Coastal
Flooding and Shoreline Erosion**

This section provides detailed information on all of the actions described in the Outreach and Planning sections. This information is aimed at providing communities with more specific information about actions that can be used when deciding on appropriate actions to take and developing work plans.

The actions are organized under five categories:

1. Good Community Planning
 - Action One: Complete Outreach, Stakeholder Engagement, Coastal Assessment, and Action Development
2. Protect and Enhance Natural Defenses
 - Action Two: Develop Community Agreements or Rules, Where Needed, to Prohibit Destructive Practices and Other Threats to Natural Defenses
 - Action Three: Develop Locally Managed Areas (LMAs) And LMA Networks
 - Action Four: Develop Buffer Zones of Native Coastal and Riparian Vegetation, Including Mangroves
3. Ensure Resilient Development Practices
 - Action Five: Create Community Agreements or Rules to Ensure That Development Activities Consider Long-Term Changes in Coastal Zone
 - Action Six: Develop A Long-Term Managed Retreat Plan
4. Use Hard Defense Options Wisely
 - Action Seven: Develop Rules to Ensure That Hard Defenses are Designed, Implemented, and Maintained Wisely
5. Monitor and Record Changes
 - Action Eight: Photo Documentation of Coastal Change
 - Action Nine: Beach Profiling

Specific information about each of the actions listed above are provide in the following pages. Each action page includes the following details:

- General Description
- Action Details
- Benefits and drawbacks
- Situations where the action is appropriate and inappropriate
- Cost for implementation and maintenance
- Technical expertise
- Time required
- Examples from the region

GOOD COMMUNITY PLANNING

ACTION ONE: COMPLETE OUTREACH, STAKEHOLDER ENGAGEMENT, COASTAL ASSESSMENT, AND ACTION DEVELOPMENT

GENERAL DESCRIPTION

This action is aimed at providing outreach and engagement activities to share information that can inform planning for coastal change. Good planning that includes outreach and engagement activities can help your community develop actions that provide the community with the most long-term benefits and success, including:

- Improved safety from natural hazards and climate change impacts,
- Improved ecosystem services such as habitat for fisheries and protection from storm surges, and
- Long-term peace of mind. Planning now for future impacts to the coastline can reduce the need for future generations to undergo stress about safety and health hazards from living in areas highly prone to natural-hazard impacts.

ACTION DETAILS

Raising Awareness

Many people do not understand how shorelines work and how their actions can impact coastal zones. As a result, when people are concerned about erosion or flooding problems, many think that seawalls or other hard defenses are the best answer. However, very few know that these types of structures can actually make the problem worse. Before making any decisions on what actions to take to manage your coastline, it is critical to ensure key stakeholders have sufficient awareness about coastal processes including:

- How shores in your location work,
- What causes shores to change (natural processes, human alterations, and climate change),
- What actions can be taken to manage for coastal change and which ones are recommended by coastal scientists and why, and
- How to monitor coastal change over time.

Consider carrying out specific awareness activities for the following groups:

- Coastal landowners, especially if they are experiencing coastal change on their property or considering any new development.
- Developers who are working in the community and will influence where and how structures are built.
- Community leaders who can influence policy or rule making for community development or protected areas.

Assessment and Planning

Additionally, it is important for community members to use their own knowledge and experience of the coastline to assess what is happening and what should be done. This includes:

- How you value and use your coastline,
- How your coastline works and where your sediment comes from,
- How natural defenses have changed over time,
- How development has changed over time,
- What weather, seasonal, and natural-hazard events have the biggest impact on the coastline, and
- How climate change might impact your coastline.

Prior to developing actions, communities should assess and better understand their coastline by:

1. Collecting historical photos, maps, and knowledge about their coastline.
2. Mapping key features of their coastline and changes over time.
3. Physically walking the community to discuss changes over time and collect information, which can help determine appropriate actions.
4. Reviewing historical and seasonal events that changed the coastline.
5. Reviewing climate change projections for their area and discussing how it may impact their coastline in the future.
6. Gathering detailed information on specific complex actions to ensure they are the best choice for their community.

Benefits of This Action	Challenges of This Action
• Good planning provides guidance that will help ensure the health and safety of community members over many generations. • Good planning can help decrease reactionary approaches (such as seawalls) to erosion and flooding issues, and therefore decrease potential negative impacts from those approaches. • Good planning can prohibit activities that have negative long-term impacts on the broader coastline and community. • Good planning provides a way for communities to engage in important discussions and develop solutions based on local needs.	• Good planning requires a committed planning team, including community facilitators that can lead outreach and engagement activities. • Good planning can take time at the community level to ensure stakeholders are adequately involved and supportive of the process.

TECHNICAL EXPERTISE NEEDED

Some technical expertise is needed to carry out good planning. The main skill required is a good community facilitator who can carry out outreach and engagement activities as well as capture community input and write the actions or plan.

COSTS FOR IMPLEMENTATION AND MAINTENANCE: \$

Community outreach and engagement cost very little. Funds may be required for a venue, flip-chart paper, markers, tape, and some other meeting materials. However, activities can be completed with very few associated costs.

TIME REQUIRED

This tool was designed to carry out the outreach and planning in around two days. However, more or less time may be taken depending on how much time the community can meet for and how much planning has already been done.

RESOURCES

This document was developed specifically for the purpose of carrying out outreach and planning related to coastal change issues in communities. In addition to this document there are other general community based natural resource-management planning guides which include:

Gombos, M., Atkinson, S., & Wongbusarakum, S. (2013). *Adapting To A Changing Climate: Guide To Local Early Action Planning (LEAP) And Management Planning*. Pohnpei, Federated States of Micronesia: Micronesia Conservation Trust. Found at: http://pimpac.org/images/Adapting%20To%20A%20Changing%20Climate_FINAL_Dec.%202013.pdf

Govan, H., Aalbersberg, W., Tawake, A., and Parks, J. (2008). *Locally-Managed Marine Areas: A Guide to supporting Community-Based Adaptive Management*. The Locally Managed Area Network. Found at: <http://www.lmmanetwork.org/files/lmimaguide.pdf>

EXAMPLES FROM THE REGION

See **Kosrae Shoreline Management Plan Case Study** on page 72 of *Coastal Change in the Pacific Islands Volume One*.

PROTECT AND ENHANCE NATURAL DEFENSES

ACTION TWO: DEVELOP COMMUNITY AGREEMENTS OR RULES WHERE NEEDED TO PROHIBIT DESTRUCTIVE PRACTICES AND OTHER THREATS TO NATURAL DEFENSES

GENERAL DESCRIPTION

Natural defenses are critically important to protecting and maintaining healthy shorelines. There are several natural defenses that help slow the rate of shoreline change and help reduce impacts from coastal flooding. These include coral reefs, which both are a source of sediment and weaken wave energy before waves hit the shoreline; sea grass beds, which help to retain sediment and absorb wave energy; beaches, which are repositories of coastal sediments and protect coastal areas from waves and flooding; coastal vegetation and mangroves, which help to retain sediment and also slow wave energy and protect against flooding; wetlands and swamps, which retain sediment and hold water during storm events; and upland vegetation, which stabilize and retain sediment and absorb water during rain events, thus reducing the impact from heavy rains. By protecting and restoring these natural defenses, communities can go a long way to helping maintain natural healthy shorelines. Additionally, healthy coastal ecosystems provide several other benefits to communities, including fisheries that support local sources of food and income, medicine, tourism, and cultural and recreational areas.

Rules and actions that protect or enhance natural defenses will help slow the rate of coastal change and maintain the sediment balance. These actions are considered optimal as they provide several benefits to communities with little to no drawbacks.

ACTION DETAILS

There are a number of destructive practices that contribute to declines in natural defenses. These include:

- Damage to coral reefs including blast fishing, fishing with poison, bottom trawling that destroys the substrate, harvesting of coral to sell or make lime or for building materials, anchoring, dredging, and land-based pollution that can damage or kill reefs.
- Clearing of coastal vegetation, particularly mangroves, for building materials or for development.
- Clearing of upland forests for agriculture and development.
- Alien species overtaking upland forests, as these are typically not as effective at absorbing water and retaining sediment.

As much as possible, rules to protect natural defenses should prohibit or limit practices such as these that degrade natural ecosystems. For activities that are potentially destructive but are essential to the local community such as agriculture, sustainable management approaches should be used to minimize the damage caused by these practices. These can include multi-cropping, maintaining native forest buffer zones along water courses, and avoiding clearing of steep or unstable land.

In planning and managing for coastal change, it is important for communities to consider 1) the condition of their natural coastal defenses, 2) if the condition has changed over time and how and why these changes have happened, 3) any destructive practices that currently or have potential to impact these natural defenses, and 4) what rules can be put in place or strengthened to prohibit destructive practices.

To develop set of rules to eliminate practices that destroy natural defenses, you should consider the following:

1. What are the area's natural defenses, including coral reefs, seagrass beds, coastal vegetation, beaches, upland forests, and any others?
2. What is the current condition of each natural defense? Has the condition changed over time and if so, how and why?
3. Identify destructive practices that have or could negatively impact each of the natural defenses.
4. Discuss if these any of these destructive practices are already prohibited in local, provincial, or national law.
5. Discuss if it's possible to prohibit each of the destructive practices from the entire area that you manage. For example, most communities and some entire countries have fully prohibited fishing with explosives and poisons, while several communities and some entire countries have banned the cutting of mangroves.
6. Since destructive practices can have negative impacts beyond the areas where they are practiced, it's important not only to work with your own community but with neighboring communities and the provincial or state and national government to work toward prohibiting them over as large an area as possible. For example, mangrove or forest clearing in one area may result in increased sedimentation that effects an entire coastline. To the degree possible, destructive practices should be eliminated from as large an area as possible.
7. While it is important to eliminate destructive practices as much as possible, some practices may still be necessary to the local economy and may need to be allowed in certain areas. For example, some communities may still require the use of mangrove poles for some critical building projects. However, the use of these resources should be restricted as much as possible and only be allowed in limited areas, with strict controls on the methods used and the amount of the resource taken or the location and amount of land devoted to a particular practice such as agriculture.
8. While rules are important to eliminating destructive practices, it is also important to discuss if these rules are being adequately complied with and/or enforced. If it is determined that there are people who are not following the rules, it's important to discuss why they aren't and what can be done to enhance compliance. It may be important to start with a better education and outreach effort; in cases where deliberate violations persist, it may be important to consider increasing enforcement efforts.

Benefits of This Action	Challenges of This Action
• Most stakeholders can relatively easily understand the value of eliminating destructive practices, so the process of generating support may be relatively straightforward. • Rules against destructive practices will help to protect ecosystems and features that provide natural defenses that can reduce impacts from storm surges and higher sea levels. • The rules will support other community benefits including sustainable fisheries, tourism, maintenance of water supplies through upland forest protection, and several others. • Low to moderate cost to develop and implement. • Allows for natural coastal processes to remain more intact, which ultimately provides longer-term protection to inland development at little to no cost. • Since national legislation may already prohibit many destructive activities, there may not be a need to develop new rules but instead to focus on encouraging compliance and enforcement.	• Some organized outreach efforts are important for stakeholders to understand the importance of prohibiting destructive practices. • It is common that considering rules on destructive practices will be part of a larger planning process for an area and therefore may require significant time to be fully developed. • Perpetrators of destructive practices may be from outside, and therefore enforcement may be necessary.

TECHNICAL EXPERTISE NEEDED

- Rules to prohibit destructive practices can be developed locally without the need for outside technical expertise. However, if the prohibitions do not cover the whole area and communities decide to still allow some practices in certain areas, it is important that technical experts help to ensure that the rules are adequate to maintain natural ecosystem processes.
- However, it will be important to have a good facilitator to help guide the rule-development process. The facilitator may be local or a visitor, as long as they are skilled enough to guide the process and handle any difficult negotiations and there are sufficient resources to keep them engaged during the entire rule making process.
- It is recommended that primary stakeholders first develop their proposed set of rules and then ask that this set of rules be reviewed by technical experts to help ensure that they will be sufficient to protect natural ecosystem processes.
- Once the rules are developed, technical expertise may be needed to develop and support implementation of effective outreach and enforcement efforts to help ensure the rules are followed.

COSTS FOR IMPLEMENTATION AND MAINTENANCE: \$ - \$\$\$

- Overall, costs for developing rules to prohibit destructive activities are low to moderate.
- Potential expenses for developing rules to limit activities that can destroy natural defenses include:
 - Costs of meetings for community members and primary stakeholders to discuss the rules.
 - Costs of technical experts to review the proposed rules to help ensure they are adequate to protect natural ecosystem processes and natural defenses.
 - Costs for carrying out outreach to community members to gain compliance.
 - Costs for enforcement.

TIME REQUIRED

- In most cases the time required to develop rules to prohibit destructive practices will be relatively little. This is primarily because in many countries these activities are already prohibited on the national level, and also because most stakeholders can easily understand the need to eliminate such practices.
- It may become more time consuming if some practices such as certain types of fishing, such as bottom trawling, are used regularly by local stakeholders.

RESOURCES

Gombos, M., S. Atkinson, and, S. Wongbusarakum 2013. *Adapting To A Changing Climate: Guide To Local Early Action Planning (LEAP) And Management Planning*. Micronesia Conservation Trust: Pohnpei, Federated States of Micronesia. 99 pp. Found at: <https://static.weadapt.org/knowledge-base/files/1344/5342cc6b82c1dadapting-to-a-changing-climate-final-dec.-2013.pdf>

Gombos, M., Atkinson, S., Green, A., & Flower, K. (Eds.). (2013). *Designing Effective Locally Managed Areas in Tropical Marine Environments: A Booklet to Help Sustain Community Benefits through Management for Fisheries, Ecosystems, and Climate Change*. Jakarta, Indonesia: USAID Coral Triangle Support Partnership. Found at: <http://www.coraltriangleinitiative.org/library/training-material-designing-effective-locally-managed-areas-tropical-marine-environments-0>

Govan, H., Aalbersberg, W., Tawake, A., and Parks, J. (2008). *Locally-Managed Marine Areas: A guide to supporting Community-Based Adaptive Management*. The Locally Managed Area Network. Found at: <http://www.lmmanetwork.org/files/lmماغuide.pdf>

The Locally-Managed Marine Area (LMMA) Network. (n.d.). Retrieved September 7, 2014, from <http://www.lmmanetwork.org/>

EXAMPLES FROM THE REGION

Several countries and communities in Micronesia and other parts of the Pacific have banned destructive practices that damage habitats ecosystem functions as a strategy to maintain biodiversity and retain ecosystem health. This in turn is a key to maintaining coastal defenses that help to keep shorelines intact. Examples come from FSM States and Palau, which have both banned the cutting of mangroves, made it illegal to use any explosive devices for fishing, and banned the poisons or chemicals for fishing. American Samoa has banned spearfishing on SCUBA while in Hawaii it is illegal to take any sand from public beaches. In most countries of the Asia Pacific regional net trawlers and commercial fishing medium to large scale commercial fishing boats are not allowed to fish in near-shore waters as their fishing techniques tend to be both destructive to shallow habitats and deplete reef fish populations.

In many cases communities create laws against destructive practices that are more stringent than national or State laws. For example, in the Padaido Islands in Indonesia communities have limited fishing gear that they believe is too efficient and therefore becomes destructive to healthy marine ecosystems. These include no use of small mesh nets in certain areas, no dragging nets on the bottom, no breaking or collecting of corals, and no cutting of mangroves. These rules are more restrictive than national rules against destructive practices.

Combined with marine reserves and locally management areas regulations against destructive practices that cover as large of an area as possible help to maintain natural defenses that are important to sustaining healthy coastlines.

ACTION THREE: DEVELOP LOCALLY MANAGED AREAS (LMAS) AND LMA NETWORKS

GENERAL DESCRIPTION

Developing Locally Managed Areas and LMA networks is one of the most effective ways to protect natural ecosystems, which in turn provide numerous natural defenses for coastlines.

LOCALLY MANAGED AREAS

Locally Managed Areas are defined as “all area of coastal lands and marine water that are managed by a local community and, where appropriate, in collaboration with government or non-governmental organizations. LMAs can also include areas managed by local governments in collaboration with local stakeholders.” This definition was developed to be inclusive of other commonly used terms for this type of locally based management, including:

1. Locally Managed Marine Areas (LMMAs);
2. Territorial Use Rights in Fisheries (TURFs);
3. Community Based Resource Management (CBRM); and
4. Community Managed Marine Areas (CMMAs).

LMAs can be a tool for any or all of the following: fisheries management, biodiversity conservation, threatened-species management, ecotourism development, and climate change adaptation (Gombos, 2013).

While there is sometimes a tendency to think of LMAs as being similar to Marine Protected Areas (MPAs) or a managed zone that is located within a larger territory, LMAs are actually considered to be all the land and water area that a coastal community or stakeholder group owns or manages. An LMA is not a zone within a territory but instead is all of the territory. This area itself can then be zoned and managed for different uses. Some rules may apply to the entire area, where there may also be one or more zones with specific rules that are applicable only within that zone.

LMAs and LMA networks typically create community based rules and zones to protect key habitats and populations of target species that are important to local communities for subsistence or small-scale commercial use. These may include rules against destructive practices such as those discussed in Action One above, as well as specific zones and rules to encourage healthy populations of target species to support sustainable fisheries and others uses. These may include fisheries-replenishment zones that prohibit fishing in certain areas to encourage reproduction in populations of target species, protection of spawning aggregations during key spawning times, limitations on the types of fishing gear that may be used, restrictions on the size of individuals that may be harvested, restrictions on the numbers of individuals that may be harvested, and other rules as relevant. Collectively, these rules help to maintain the natural ecosystems and marine resources that are important to local communities for their quality of life, subsistence, and income.

By helping to maintain natural ecosystems and healthy populations of key species, both for ecosystem conservation and for sustainable community use, LMAs and LMA networks help to sustain natural processes that in turn sustain natural coastline defenses.

ACTION DETAILS

Major considerations that should be taken into account to develop an LMA include:

1. Ensuring that community members and key stakeholder groups fully understand the possible benefits, short-term costs, and limitations of establishing an LMA. These groups should be supportive of establishing an LMA, or through outreach and awareness raising become supportive over time.
2. What are the target resources, ecosystems, and socio-economic features (management targets) that the community would like to protect, and why?
3. How will protecting these management targets contribute to protecting natural defenses for shorelines?
4. What is the current condition of these management targets?
5. What are the major threats or problems that impact these management targets, and how can they be addressed?
6. What specific zones and rules can be put in place to help to manage the major threats to the management targets?
7. How can the community best encourage compliance with these zones and rules?
8. What other activities—including outreach, monitoring, enforcement, and others—are needed to maintain the LMA zones and rules?
9. Should these zones and rules be created and maintained only at the community level, or should they be proposed for review and approval to another governance level such as district, provincial, state, national, or another level of government?
10. Should the rules prohibiting destructive practices (discussed under Action One above) be developed as part of the LMA-development process?
11. Should the community consider working with other communities to develop an LMA network? Major considerations in this decision include whether or not the community's area is large enough to manage the management targets by itself, and whether or not neighboring communities are a major threat to LMA management. In either case, the community alone will not be able to achieve its objectives. For example, the community may wish to manage a species that requires a larger territory than the community has authority over, or if threats are constantly coming from neighboring communities it may be a better strategy to work with them to develop a LMA network than to constantly focus on enforcing against violations by outside groups. Likewise, in many cases as a community develops and benefits from LMA management, they may like to share their successes to assist their neighbors to achieve similar benefits; the neighboring communities may become very interested in pursuing LMA management as they observe their neighbor's success. In any of these situations, it may be very important to work with neighboring communities to create LMA networks.

Benefits of This Action	Challenges of This Action
• LMAs will help protect ecosystems and features providing natural defenses that can reduce impacts from storm surges and higher sea levels. • LMA rules and zones will support other community benefits including sustainable fisheries, tourism, maintenance of water supplies through upland forest protection, and several others. • Low to moderate cost to develop and implement. • The LMA development process may be appropriate to include development of rules to prohibit destructive activities (as discussed under Action Two). However, if the area for application of these rules is different it may be best to pursue separate processes. • LMAs allow for natural coastal processes and defenses to remain more intact, which ultimately provides longer-term protection to inland development at little to no cost.	• It can be challenging for some communities to devote the needed time and resources to provide sufficient outreach about the value and benefits, as well as the limitations, of LMAs. However, it is very important that stakeholders understand how LMAs may benefit them, be aware of any short-term sacrifices that may need to be made as the LMAs are put in place, and understand the limitations of LMAs. • Some community members who directly depend on fishing for their income may oppose LMA development, as they may feel that it will negatively affect their income. However, since one of the main goals of LMA management is to improve fishing sustainability in the long term, this challenge can be overcome with good communication and compromise. • There are some basic ecological principles that need to be understood in order for LMAs to be well designed. This may require the support of a biologist or fisheries management. • Ensuring compliance with LMA rules can be challenging. In many cases, outsiders may continue to break rules because they are not aware of them. As a result, considerable education efforts are important. Likewise, deliberate violations may require an enforcement presence.

TECHNICAL EXPERTISE NEEDED

LMAs can be developed using local knowledge only. However, it is recommended where possible to also apply marine biological science and technical expertise. For example, it is important to understand where particular species live, the amount of territory that they require, and where they spawn or breed. Gathering this information may require a combination of local knowledge and technical expertise in marine biology. Communities can design LMAs without the input of marine biologists; however, they should understand that even if they don't have a marine biologist to assist them, they should still follow the basic ecological principles for good LMA design using their local knowledge.

There are several planning processes that have been developed to help support LMA design. It can be very helpful to have facilitation assistance from someone who is experienced in LMA planning to support this process. However, if such a person is not available it is very possible for local communities to plan their LMAs without outsider facilitation. Local communities and stakeholder groups have

both traditional and contemporary ways in which they plan and manage their local affairs. As a result, with some basic guidance on things they should consider in designing an LMA, they can pursue this process themselves without outside facilitation. What is needed is a motivated community leader or group of individuals who can take the time to understand some of the basic principles and considerations in LMA planning and then guide their community through the necessary consultations. However, if a community does not have individuals who can take on this role, it is important to have an outsider resource person to assist them.

COSTS FOR IMPLEMENTATION AND MAINTENANCE: \$ - \$\$\$

- The main costs involved in designing an LMA are the costs of meetings and possible costs of having outside experts, such as biologists and/or facilitators, support the community process. The overall costs for LMA planning and design are moderate, typically ranging from a few thousand dollars to 30,000 USD depending on how much outside expertise is used.
- The costs associated with maintaining an LMA can also be modest, particularly if the LMA primary zones are close to where the community lives so that they can encourage compliance and undertake any necessary enforcement as part of their daily activities. Also, if there is a high degree of support for the rules and zones, costs for LMA implementation can be very modest. An LMA like this may be implemented for just a few thousand dollars a year or less.
- LMAs that are remote or very large may have considerable higher implementation costs as they may require more costly patrolling and/or surveillance, using technology such as radar. LMAs that have significant poaching by foreign vessels or armed individuals require formal enforcement and therefore may have significant costs.
- Even in the case of LMAs that are large or remote, communities may elect to keep costs low by developing patrolling approaches that integrate with their normal fishing activities. Also, period joint patrols with formal enforcement agencies can help to strengthen compliance without requiring constant patrolling. However, it is important to note that remote LMAs may experience increased poaching over time, and communities should work towards a collaborative system with key agencies to help them understand and deter poaching.

TIME REQUIRED

- Communities that have strong leadership, are cohesive, and have a history of working well together will generally take a relatively short amount of time to develop an LMA. This will typically range from six months to one year, although the time frame may vary depending on how actively the community members are pursuing LMA development. Also, if there are a number of stakeholder groups that are outside the community, but have a legitimate stake in the area, it may take longer to develop the LMA.
- Communities that don't have key features such as good leadership and community cohesion generally need to build these up before they venture into LMA development. It is difficult for a community that does not have a collective spirit to make important management decisions that affect most, if not all, aspects of community life. In some communities it can take years to build the necessary trust and cohesion to allow management activities to proceed. For communities that are not yet ready to engage in an entire LMA-development process, they should at a minimum consider enacting rules to prohibit activities that are destructive to natural defenses (as discussed in Action One above).

RESOURCES

Gombos, M., Atkinson, S., Green, A., & Flower, K. (Eds.). (2013). *Designing Effective Locally Managed Areas in Tropical Marine Environments: A Booklet to Help Sustain Community Benefits through Management for Fisheries, Ecosystems, and Climate Change*. Jakarta, Indonesia: USAID Coral Triangle Support Partnership. Found at: <http://www.coraltriangleinitiative.org/library/training-material-designing-effective-locally-managed-areas-tropical-marine-environments-0>

Govan, H., Aalbersberg, W., Tawake, A., and Parks, J. (2008). *Locally-Managed Marine Areas: A guide to supporting Community-Based Adaptive Management*. The Locally Managed Area Network. Found at: <http://www.lmmanetwork.org/files/lmguide.pdf>

The Locally-Managed Marine Area (LMMA) Network. (n.d.). Retrieved September 7, 2014, from <http://www.lmmanetwork.org/>

EXAMPLES FROM THE REGION

LMAs have been one of the most successful approaches for local communities to manage their marine resources, with significant success in Indonesia, Papua New Guinea, Palau, the Philippines, FSM, Fiji, the Solomon Islands, and several other countries in the Asia Pacific region. Data from several LMAs demonstrates improvements in both ecosystem conditions and the status of species that are targets for management, as a result of LMA management.

In recent years, there has been an increased effort to move from individual LMAs to networks of LMAs that are socially and ecologically linked. In some cases these LMA networks are very large. For example, in the Padaido Islands in Papua Indonesia an LMMA network covering four islands has now reached more than 110,000 hectares. A similar LMMA network in Papua New Guinea in Milne Bay Province has now reached more than 149,000 hectares. These networks are able to improve both ecosystem health and support sustainable fisheries. In the Padaido Islands, Catch Per Unit Effort (CPUE) monitoring of target fish species was undertaken between 2010 and 2013 and showed an increased catch per unit of fishing effort in four out of seven species, with stable catch levels in three additional species. Community members also expressed a high degree of satisfaction with the improvements in their catch. Similar monitoring in a growing LMA network in Tanah Merah Bay in Papua, Indonesia showed an increase in three of four target species between 2010 and 2013. Likewise, fishing families expressed their belief that both fishing and ecosystem health has improved since they started managing their LMAs. (Personal Communication, the Indonesian Locally Managed Marine Area Foundation and Conservation International, 2014)

ACTION FOUR: DEVELOP BUFFER ZONES OF NATIVE COASTAL AND RIPARIAN VEGETATION, INCLUDING MANGROVES

GENERAL DESCRIPTION

Native coastal vegetation naturally help retain sand and therefore maintain beaches. After significant storm events sand may be washed off beaches, but typically remains offshore and is then redeposited onto the beach when conditions are right. The presence of native shoreline vegetation such as *Spinifex* grasses helps to retain sand as it is redeposited on the beach.

Additionally, native vegetation that grows along river or stream banks also helps to retain sediment. Without vegetation, heavy rains can cause flooding of rivers and wash sediment out to sea, where it can cause damage to seagrass beds and coral reefs.

In many areas of the Pacific, native coastal and riparian vegetation has been removed or lost for various reasons such as 1) purposeful removal for development, 2) grazing by livestock, 3) planting of agriculture near streams, and 4) competition by non-native species. In several coastal communities, younger generations have come to understand the degraded condition of coastal and riparian vegetation as normal and are not aware that different, more natural species complexes once dominated these areas.

Enhancing native vegetation can help to stabilize beaches and reduce beach erosion. It can also help to form a protective barrier to reduce the impact of wave action on the coast. Additionally, native coast vegetation can help to trap sand, thus helping to rebuild beaches and trap sediment originating from upland areas and to reduce the amount of sediment that enters the ocean and ends up on the reef. Similarly, enhancing native riparian vegetation can help to stabilize stream and river banks, keeping the sediment from washing offshore. Sediment on reefs has been shown to be a cause of significant coral mortality. This in turn contributes to further impact on shorelines, as the role that healthy reefs play in mitigating wave action is reduced.

Maintaining or restoring native coastal and riparian vegetation is one of the best and most cost-effective ways to reduce erosion and reduce sedimentation.

Important natural coastal vegetation in the Pacific includes all species of mangroves, species of Spinifex grass, vedever grass, Purple Beach Bean (*Canavaliarosea*), Yellow Beach Bean (*Vigna marina*), Beach Morning Glory (*Ipomoea pes-caprae*), Beach vitex (*Vitexrotundifolia*), naupaka (*Scaevolasericea*), Hau (*Hibiscus tiliaceus*), and several species of salt-tolerant trees and palms that grow on the coast such as califilium (*Calophylluminophyllum*), coconut palms (*Cocos nucifera*), pandanus (*Pandanustectorius*), Iron wood (*Pemphisacidula*), and many others.

Mangrove Restoration: Mangrove restoration is a specific category of coastal restoration that requires specific expertise. As a result, we have provided some specific points that should be taken into account when considering mangrove restoration. Mangroves tend to grow well in estuarine habitats including mudflats, tidal lagoons, salt marshes, rivers, and streams. Restoration of mangroves is a way that communities can assist in the recovery of a coastline ecosystem that has been damaged over time. While re-planting mangroves may seem like an easy approach, there are a number of factors that need to be considered to ensure success. Many restoration efforts have failed because they were not well planned and were carried out in a way that was bound to fail (for example, inappropriate species or location was used). It is critical to have technical support to assist in these efforts, as there are several factors that need to be determined for each specific location.

ACTION DETAILS

There are several important factors that must be taking into consideration when planning an effort to protect or restore native coastal and riparian vegetation.

1. Given the cost effectiveness of restoration of coastal vegetation compared to other options such as hard defenses, restoration and maintenance of coastal vegetation should be thoroughly explored as a primary option before considering hard options, which also have potential negative impacts.
2. In many cases, native coastal and riparian vegetation can restore itself if a sufficient population of the specific species are still intact and the area is protected. For example, mangroves produce thousands of seeds annually. If an area that once had mangroves has a sufficient source of seeds, in many cases the area can restore itself if any further degradation is halted. Allowing for natural recovery is the least costly and most efficient approach to coastal restoration.
3. When an area that may have once naturally included native vegetation, including mangroves, is too degraded for natural recovery to occur, active restoration can be important.
4. There are many examples where concerted action of large groups of volunteers have been able to successfully restore and maintain coastal vegetation.
5. For restoration projects to be successful, it is important to understand the ecology and hydrology of the area as well as the specific needs of the plants being restored. Important information to gather includes:
 - What species naturally occurred in the area, and specifically where were different species located? This information may be available through historical knowledge of community members, as well as through aerial photographs and other records.
 - Why was the natural vegetation degraded or removed?
 - Does the area still have sufficient ecological and hydrological features to allow for restoration of key coastal plans and riparian areas, or can these features be restored? For example, in many areas of Southeast Asia mangroves were removed to build shrimp ponds. In some cases, the changes made to the soil, including height of the substrate, may not be conducive to restoration and the area may need to be actively graded for restoration to be possible.
 - It is extremely important that community members and their partners make a long-term commitment to not only the restoration of coastal and riparian vegetation but to its maintenance. This should include a commitment to tending restored areas until natural processes are able to maintain the vegetation, and ensuring that the vegetation is not further degraded by grazing, trampling, or overexploitation by people.
 - Many communities engage in coastal rehabilitation without expert advice and follow a common sense approach which often includes using local species that are known to already grow well in the area, using local planting methods, combining replanting with conservation areas or rules to protect the plantings, and securing support of materials and finance from government or NGOs. While these approaches can be successful, several community efforts have had poor results that could have been improved with some expert advice. Common causes of low success in restoration efforts include: selecting ecologically incorrect areas or species, utilizing poor-quality seeds or plantings, not maintaining the vegetation after planting with proper watering and fertilizer, not committing sufficient time to long-term care of the plantings, giving up too early before the natural vegetation starts to establish itself, and not sufficiently protecting plantings from trampling or grazing.

Benefits of This Action	Challenges of This Action
• Low to moderate cost. • Volunteers can carry out most of the labor needed to restore coastal areas. • In many areas, vegetation can restore itself once the causes of its degradation are managed. • Native coastal species retain sand and reduce beach erosion. • Native coastal and riparian species reduce the amount of sediment that runs off from the land to reef areas. • Natural beaches and vegetation provide a buffer from wave action and storm surges. • Long-term coastline protection that requires little to no maintenance over time. • Mangroves provide habitat for important food fish and commercial species.	• Technical knowledge of species requirements and appropriate restoration techniques should be used to avoid approaches that will fail. • Land owners must agree to restoration actions. • Restoration can take several years to provide benefits. • Mangroves are not appropriate for all sites and should only be planted where they historically grew. • Restored vegetation can be quickly degraded if the causes of degradation—such as grazing, harvesting, and competition from alien species—are not managed.

TECHNICAL EXPERTISE NEEDED

- Technical expertise should be used to carry out restoration of coastal and riparian vegetation—especially mangroves, which have very specific ecological and hydrological needs. Technical experts can help with:
 - Identifying areas that are suitable for restoration and what species historically grew in the area. Don't try to restore native plants in areas where they never grew, unless the ecological characteristics of the area are determined to be appropriate.
 - Identification of the native species that can be used for re-planting, and access young plants or seeds if needed.
 - For mangroves, review tidal range and water flow of the area to determine the best species to use in the restoration site.
 - Providing advice on how to plant and care for restored vegetation.
 - How to balance restoration with ongoing social and economic needs.
 - Identifying existing stressors (or root causes) that may prevent natural growth of native vegetation. For example, structures that block tidal flow or soil that lacks fresh groundwater or is too salty. These stressors may need to be removed before restoration occurs, as they can limit success.
- If technical expertise is not available, communities can proceed with restoration efforts but should utilize appropriate guides for the restoration efforts and focus on restoration of plants that they knew naturally occurred, as well preventing further degradation. There are numerous guides available for the restoration of mangroves and other native plants.

COSTS FOR IMPLEMENTATION AND MAINTENANCE: \$\$ - \$\$\$

- Overall, costs for restoring native coastal and riparian vegetation are low to moderate, depending on the situation. Many countries have government agencies or non-governmental organizations focused on forestry or conservation, which can provide technical guidance, provide plantings or seeds, and in some cases provide funding support.

- Expenses for restoration of native coastal-vegetation restoration include:
 - o Cost of technical expertise.
 - o For mangroves, potential costs to restore water flow to the area (man-power, equipment, materials).
 - o Potential cost for seedlings.
 - o Support for volunteer efforts including tools and food and drinks for volunteer events.

TIME REQUIRED

Restoration efforts can take roughly a year to implement, but may require several years (five plus) to determine if actions are successful and to begin provide benefits of coastal protection.

RESOURCES

Mangrove Action Project. (2006). *Five Steps To Successful Ecological Restoration of Mangroves* [Brochure]. Yogyakarta, Indonesia: Ben Brown. Found at: http://www.mangroverestoration.com/pdfs/mangrove_restoration.pdf

Spalding, M., McIvor, A., Tonneijck, F.H., To, I.S., and Van Eijk, P. (2014). *Mangroves for Coastal Defence. Guidelines for Coastal Managers & Policy Makers*. Published by Wetlands International and The Nature Conservancy. 42 p. Found at: http://www.wetlands.org/Portals/0/publications/Book/Mangroves%20for%20Coastal%20Defence_A%20Decisionmakers%20Guide_Web%20Version.pdf

EXAMPLES FROM THE REGION

Restoration of Coastal Beach Vegetation:

Working together with a common goal, management agencies and caring community members in New Zealand have taken many local beach systems from disaster to restoration. The program partners are now funding 100,000 native dune plants each year with a total over 1,000,000 plants (equivalent to about 140 km of frontdunes), all planted by community volunteers. The restored beaches provide improved protection from tsunami, storm-surge flooding, and coastal erosion, and all of the restored sites are showing a significant trend of accretion, despite climatic conditions favoring erosion. In fact, the measured rates of accretion are an order of magnitude larger than would be required to adapt to even the worst IPCC sea-level rise predictions.

Important lessons can be learned from the New Zealand experience, including:

- The scale of rehabilitation work is immense, and as a result any one group, community, ministry, or agency cannot tackle it alone. Success can be achieved through strong and effective partnerships with passionate members of the affected communities.
- Public knowledge of the scope for restoration is an important first step.
- Many people still believe the poor condition of their beaches is natural or normal, and something that cannot easily be solved. The eroded state of beaches/dunes has been their lifetime experience, and so many people have no reference point to judge the immensity of the change or the losses. “It all happened so long ago...” (de Lange, 2007).

Restoration of Mangroves — See **Druadrua Island, Fiji Case Study** on page 39 of *Coastal Change in the Pacific Islands Volume One*.

ENSURE RESILIENT DEVELOPMENT PRACTICES

ACTION FIVE: CREATE COMMUNITY AGREEMENTS OR RULES TO ENSURE DEVELOPMENT ACTIVITIES CONSIDER LONG-TERM CHANGES IN THE COASTAL ZONE

GENERAL DESCRIPTION

Good planning can keep people, food sources, water sources, and infrastructure safe from natural hazards and loss of land. This includes where and how to build in your community. It is much easier to avoid negative impacts over the long term that we know will get worse over time, than to deal with them after they have become a problem. Developing community “zoning and building rules” can help community members make smart decisions about where to place development. Communities and local governments can also provide incentives for smart development. The following rules are recommended by coastal scientist to manage for long-term coastal change.

ACTION DETAILS

- I. **Coastal “setbacks”:** Coastal setbacks are areas or zones in the community where only certain approved development can occur (often it means excluding permanent dwellings, infrastructure, water wells, or some types of agriculture). Temporary or “mobile” structures used for occasional or recreational purposes may be appropriate within setback zones, as they can be moved during hazardous times. Areas outside of setback zones should not be considered “risk free,” but risk should be significantly reduced if zones are developed with a good understanding of the area and future climate scenarios such as sea-level rise.

Setback areas usually aim to avoid development in the active shoreline zone, where natural coastal processes move sediment around and are not stable. It also includes areas that are low lying and have experienced, or will experience, flooding during storms and in the future with sea-level rise. Any areas that are already experiencing erosion or flooding will likely get worse over time and therefore should be considered for inclusion in setback zones. Setbacks should include:

- Areas where sea-level rise and storm surges will impact. If the design life of the building is 50 years, then consideration of the sea level in 50 years' time would be the minimum guidance for design.
- On the storm or beach berm.
- On low reclaimed land near the shoreline.
- In mangrove areas.
- In coastal saltwater or freshwater swamp areas.
- Any other areas currently affected by coastal erosion or flooding from wave overwashing.
- Areas close to mangrove vegetation line, top of seawall structures, or any river/stream waterway. This includes areas prone to river or stream flooding or with current water-logging or drainage issues.

2. Rules to ensure smart development outside of setback zones: In addition to setback areas, other development rules can help ensure that new development is completed in a way that building that does not interfere with sediment movement and the sediment balance, and also prepares for future natural hazards (keeping people and resources safe). These rules include:
 - Rules to place new homes that are located just outside the setback zone on stilts. Raising homes up can allow water that may reach the area in extreme events to do less damage to the structure and potential harm to people and their assets. Additionally, raising homes up allows for water and sediment to flow more naturally, rather than blocking it and possibly causing more erosion nearby from scouring.
 - Rules to prohibit clearing of, or construction on, steep land or on land with a potential landslip risk. If upland areas are too steep and vegetation is cleared, the roots that hold soils together will be lost and the area can have a higher risk for landslides.
 - Rules to prohibit fixing of non-critical structures (old homes/buildings/seawalls) that are damaged and are currently within the setback zone. As structures that are currently placed with the setback zone become old and weak, it is wise to prohibit them from being fixed and they should eventually be removed. These structures will be exposed to more and more hazards over time, making them weaker and weaker. If structures are not removed, they can become safety hazards in times of storms and storm surges.

Benefits of This Action	Challenges of This Action
• Can help protect people from health and safety hazards as well as prevent losses of property and even lives. • Low to moderate cost to implement. • Provides a way to engage community members in understanding risks of living in hazard-prone areas, both now and into the future. • Allows for natural coastal processes to remain more intact, which ultimately provides longer-term protection to inland development at little to no cost.	• While not required, technical expertise is advised to develop more accurate setback zones. • Outreach is critical for landowners to understand the risks of placing structures in unsafe areas or designing structures with higher risk for future damage. • Compliance and enforcement are critical for setback zones and rules to be effective, and therefore require either strong local buy—in from community members or enforcement capacity through community government.

TECHNICAL EXPERTISE NEEDED

- Setbacks can be developed using local knowledge (guidance below) combined with considerations of long-term climate scenarios (e.g. sea-level rise predictions). However, technical expertise should be used if possible to help communities develop more accurate results of hazardous zones. Coastal scientists can support the following:
 - o Identification of flood/flooding zones
 - o Identification of erosion zones
 - o Identification of landslide-risk zones
 - o Sea-level rise mapping to determine different zones under different climate scenarios

- Technical expertise may also be useful for developing specific building codes that ensure new structures are designed to endure weather or climate extremes (e.g. placing homes on stilts or reinforcing roofs). Professional engineers can support the development of design features that have the best chance of withstanding extreme events.

COSTS FOR IMPLEMENTATION AND MAINTENANCE: \$ - \$\$\$

- Overall, costs for developing rules to ensure smart development is low to moderate, depending on the level of expertise used and level of support by community members for rules.
- Potential expenses for ensuring smart development include:
 - o Cost of technical expertise for setback-zone development and recommendations for building design.
 - o Cost of removal of old structures that are disrupting natural sediment movement or are safety hazards.
 - o Cost of upgrading building/infrastructure design to withstand climate extremes, such as placing homes on stilts or reinforcing roofs.
 - o Cost of outreach to community members to gain compliance.
 - o Cost of enforcement of development rules and setback zones.

TIME REQUIRED

Time required to ensure smart development practices varies based on the level of support for rule development and setback zones, which can influence the level of compliance and the enforcement efforts needed over time to change behavior.

RESOURCES

Ramsay, D.L., Gibberd, B., Dahm, J., & Bell, R.G. (2012). *Defining coastal hazard zones and setback lines. A guide to good practice*. National Institute of Water & Atmospheric Research Ltd, Hamilton, New Zealand. Found at: <http://www.envirolink.govt.nz/PageFiles/31/Defining%20coastal-hazard%20zones%20for%20setbacks%20lines.pdf>

EXAMPLES FROM THE REGION

See **Atafu, Tokelau Case Study** on page 66 of *Coastal Change in the Pacific Islands Volume One*.

ACTION SIX: DEVELOP A LONG-TERM MANAGED RETREAT PLAN

GENERAL DESCRIPTION

Erosion and flooding of coastlines from storm surges and extreme high tides will only get worse over time due to sea-level rise. However, this will happen over many generations (e.g. two to four). This is why it is critical that communities in low-lying coastal areas begin to plan for long-term changes to the coastal zone and prevent future safety and health hazards by developing a managed retreat plan. These long-term plans describe when and how new development of family homes, community buildings, infrastructure, agriculture, and natural resources that are currently in hazard-prone areas may be relocated over the course of two generations. Planning for these changes now can save a significant amount of time and money, as well as reduce the level of stress placed on future generations.

ACTION DETAILS

Approaches and actions that should be included in developing a managed retreat plan include:

1. Begin and maintain the discussion with communities. Making decisions on relocating takes time and consideration.
2. Create a sense of hope. Relocation discussions are always difficult and often seen as a negative activity. Work with the community to identify options and develop choices for them.
3. Create an enabling environment for relocation to happen. This may require support and an integrated approach from all levels of government and communities. Thus may involve activities such as:
 - Identifying land swap opportunities.
 - Availability of freehold or government land.
 - Funding mechanisms and incentives.
 - Planning and relocating critical infrastructure, such as roads, or community buildings such as schools and churches may make it easier for community residents to move over time.
4. Prioritise only where necessary but ensure that communities understand their present exposure to coastal hazards, the impacts that may occur and how this may change over the foreseeable future. Give community members control over how and when they relocate. Most relocation does not need to happen tomorrow but can be conducted over time or generations as buildings, community facilities, or infrastructure are either built, replaced, or upgraded.
5. Managed retreat plans can consider the following guidance on how the community can relocate over time:
 - Create incentives for people to move to safer areas (e.g. support for reconstruction after a storm in safer areas, infrastructure placed in safer areas, etc.)
 - Families and critical infrastructure located in areas where there may be flooding from the largest storm surges and predicted sea-level rises should consider relocation within about 10 years.
 - Families and structures currently located in the active shoreline where washover/debris is located should consider relocation within the next generation (20-25 years).
 - Families and structures currently located in areas where there may be flooding from largest storm surges and predicted sea-level rises should consider relocation over the next two generations (40-50 years).

Benefits of This Action	Challenges of This Action
• Is a long-term solution that can help protect people from health and safety hazards, as well as prevent losses of property and even lives. • Can be carried out over time by moving critical or high-risk infrastructure first, and then slowly moving other assets over time. • Allows for natural coastal processes to remain more intact, which ultimately provides longer-term protection inland development at little to no cost. • If community governments plan for long-term change, costs for moving infrastructure to safer places is cheaper than replacing it if it is damaged or destroyed regularly from hazards.	• Outreach is critical for landowners to understand the risks of placing structures in unsafe areas and agreeing to move to safer areas. • In some cases, finding new land where individuals or communities can move is difficult. This is especially true in low-lying islands or atolls. • Costs for developing incentives such as installing infrastructure (e.g. roads, power lines) can be an expensive up-front investment.

TECHNICAL EXPERTISE NEEDED

Managed retreat plans can be developed using local knowledge combined with considerations of long-term climate scenarios (e.g. sea-level rise predictions). However, if technical expertise is available it could be used to help communities develop more accurate results of hazardous zones. While this is ideal, communities should not feel that technical expertise is needed to begin identifying areas that are already experiencing erosion and flooding and planning for relocation of people, structures, and other resources in these zones. However, in developing plans communities must take care to relocate to long-term safe areas.

COSTS FOR IMPLEMENTATION AND MAINTENANCE: \$\$ - \$\$\$

Developing a managed retreat plan has very little cost involved other than engagement of community members and leaders. However, implementing relocations of homes and infrastructure identified in the plan can be moderately to highly expensive, as they will need to be newly developed in many cases. Once they are relocated, maintenance costs should be lower over time because they will be less impacted by coastal hazards in the future than if they remained in hazardous areas.

TIME REQUIRED

A managed retreat plan can be completed within a month, which includes time to complete general outreach to stakeholders and a basic assessment of the coastline. However, the plan does not need to be implemented all at once. One of the benefits of this type of plan is that it can be implemented over two to three generations, with the most critical and/or at-risk structures being relocated first.

RESOURCES

There are no guidance materials specifically aimed at developing community based long term managed retreat plans. This guide can be used to begin this process as well as general community planning processes that engage stakeholders in discussing issues and developing approaches for future actions. Where possible, it would be useful to include coastal experts to support this process.

EXAMPLES FROM THE REGION

See **Torres Islands, Vanuatu Case Study** on page 34 of *Coastal Change in the Pacific Islands Volume One*.

USE HARD DEFENSE OPTIONS WISELY

ACTION SEVEN: DEVELOP RULES TO ENSURE HARD DEFENSES ARE DESIGNED, IMPLEMENTED, AND MAINTAINED WISELY

GENERAL DESCRIPTION

Hard defenses can be considered as any “hard” object that is placed in the active coastline that is aimed at protecting land and reducing rates of erosion. These include seawalls, groynes, and breakwaters. Hard defenses are then often used to protect structures from erosion and flooding; however, they typically increase erosion problems nearby and do not solve any long-term problems. As a rule of thumb, hard defenses should only be used as a last resort and only for protecting critical infrastructure that cannot be moved. As such, hard defense construction should mostly be carried out through large-scale government infrastructure projects which have high levels of funds for proper design, implementation, and maintenance that can protect critical assets such as airport runways, piers, or roads that cannot be moved inland.

Hard defenses, if not designed well, can disrupt sediment movement and the sediment balance, often making erosion worse in nearby areas. The negative impacts of linear coastal defenses are well understood:

- Defenses are constructed, which lead to negative environmental impacts (usually more erosion). Then larger defenses are constructed and it becomes a cycle.
- The result of hard defenses is usually more erosion and the loss of beach at the ends of the defense.
- Once structural responses to erosion control have been started, it's hard to stop. Hard structures get bigger and impact on larger sections of coast.

ACTION DETAILS

If all other options have been determined to be insufficient to protect critical infrastructure and it cannot be moved, ensure the following principles are followed:

1. Ensure experts are used to design and implement hard defenses that allow the beach to continue to respond in as much of a natural manner possible, both during storm events and over the long term.
2. Prohibit hard defenses where structures can be relocated.
3. Remove old hard defense structures that have fallen, are not maintained, and are no longer effective to ensure they do not become a safety hazard.

Benefits of This Action	Challenges of This Action
Where all other options have been determined not to be sufficient to protect critical infrastructure (e.g. airport runways, roads) and they cannot be moved, hard defenses can have a role to play in protecting these structures. In this case, a hard defense designed by a coastal expert that has the smallest impact on natural coastal processes is needed. If designed and implemented well, these structures can provide medium-term protection for structures behind them but will need to be continually maintained.	- They can be a very expensive approach. Most communities can't afford to protect everything-in fact, it's usually difficult to afford to protect very much properly. - The expectation that the protection provided will be continually maintained leads to an ever-increasing financial commitment to maintain and upgrade such defenses in the long term. Therefore, hard defenses require a lot of financial resources to maintain over time. - They are only a short- to medium-term solution, even if well built. They will not be capable of dealing with the types of coastal change and flooding that will occur by the latter part of this century. Beyond that, they are increasingly ineffective or unaffordable.

TECHNICAL EXPERTISE NEEDED

A high level of expertise is required to determine if hard defenses are the best option and to design a structure that will protect adequately and have minimal impacts to natural processes. It is advised that any needed hard defenses be considered by and designed with expert assistance.

COSTS FOR IMPLEMENTATION AND MAINTENANCE: \$\$\$ - \$\$\$

Hard defenses require a moderate to extremely high level of financial resources. As a first step, funds are needed to hire technical expertise to first assess the shoreline processes and assist the community in considering artificial defense options. If hard defenses are appropriate, then they must be properly designed so that they protect during a range of conditions and have the least negative impact. Funds for development of the structure can be high for materials, labor, and ensuring the design is well implemented. The cost will vary depending on the size of the project. Finally, many people forget that hard defenses require ongoing maintenance to continue to do their job and not become hazardous. Therefore, it is important for communities to consider the long-term costs associated with maintenance, repairs, and potential upgrades to the structure in order to meet the needs under climate scenarios such as sea-level rise.

TIME REQUIRED

Time required varies based on the size of the project and availability of materials.

RESOURCES

Using hard defenses wisely must include technical expertise from coastal engineers to be successful. As such, there is no general guidance on how to carry out these efforts. Technical support should be sought to complete this work.

EXAMPLES FROM THE REGION

See **Sandy Beach Hotel in Kosrae, Federated States of Micronesia Case Study** on page 51 of *Coastal Change in the Pacific Islands Volume One*.

MONITOR AND RECORD COASTAL CHANGE

ACTION EIGHT: PHOTO DOCUMENTATION OF COASTAL CHANGE

GENERAL DESCRIPTION

Photo documentation of coastal change is a simple approach to monitoring changes over time by capturing photos from the same exact location over weeks, months, and years. Visual images can help to tell your coastal story and provide some of the most convincing evidence of changes over time.

ACTION DETAILS

To capture photos that are the most useful in accurately documenting changes, it is important that you first decide on a set of "fixed" points along the coast where you can take photos from each time. Fixed points can be things like an old tree, a building or structure, or other feature on the landscape that will not move. For example, on a beach which is about 100 m long, you would need at least three regular locations: one at each end and a third somewhere near the center. The bigger the beach, the more fixed points you need.

Once your fixed points are chosen you should take photos on a regular basis; capturing the beach at both high and low tide is very useful. Photos should be taken regularly even if there seems to be no change—for example, at least once a month—and record the dates each time. It is good to take photos if there are any unusual conditions as well, such as unusual wind conditions, storms king tides, or high wave activity. Remember to record the time and date, even if it is simply written on a piece of paper.

Finally, it is good to capture changes to shorelines before and after human alterations have been made: for example, activities that destroy natural defenses (clearing mangroves), activities that can change sediment movement (seawalls), or activities that support natural processes (mangrove restoration or removal of hard structures). Over time your photos can show how the coastline is changing shape (or staying stable) in different areas, and possibly show trends such as a loss of land in one area and a gain of land in others. Monitoring the coast over time is a very good way to help understand how your shoreline works and what areas are experiencing more change—and why.

Be sure that the photos are stored on a computer that is backed up, and that files are properly named to include photographer, site location, date, and event (if any).

Benefits of This Action	Challenges of This Action
• A simple method that requires very little to no expertise and low cost. • Can help communities understand how their coastlines work and change over time through visual "evidence."	• Requires dedicated persons to take photos on a regular basis from the same locations. • Requires a digital camera (or phone camera) and computer to store photo files so they can be accessed and used for community outreach and planning.

TECHNICAL EXPERTISE NEEDED

Little to no technical expertise is needed to carry out this method, except in the use of a digital camera and the ability to download files onto a computer.

COSTS FOR IMPLEMENTATION AND MAINTENANCE: \$

Costs associated with this monitoring approach are for a digital camera or phone camera and a computer onto which to download and store camera files. There is little to no maintenance cost associated with this approach.

TIME REQUIRED

Time required will depend on the number of sites chosen to be monitored and the number of volunteers taking the photos. However, each site will only require that one to three photos be taken roughly once per month and after extreme events.

ACTION NINE: BEACH PROFILING

GENERAL DESCRIPTION

Beach profiling is a survey technique used to measure the contour of a beach. Very basic equipment, made from two 1.5-meter boards/poles (emery boards) connected by a three-meter rope, is used to create a line of sight with the horizon. The difference in elevation between the two poles defines the topographic change on that segment of the beach. The number resulting from this change is recorded as a single data point. These data points are recorded at regular intervals down the beach, from the frontal dune (or a hard structure) to the low-water mark. When these data points are connected, they create a graphic depiction of the contour of the beach or the "beach profile." Taking several shore profiles over time allows you to examine shoreline erosion and accretion trends and provides you with a means for assessing beach recovery after a storm. Long-term beach monitoring data is the first step to understanding complex beach processes.

You must always return to the same starting point, so a permanent marker such as the corner of a building or a permanent rock outcrop can be used to start the profile. The profile, just like photographs, must be taken regularly and it's good to collect more data when there are any unusual conditions. Keep good records!

ACTION DETAILS

Detailed directions on how to carry out a low-tech version of profiling called the "emery method" can be found in Appendix A of the *Climate Change Adaptation for Coral Triangle Communities: Guide for Vulnerability Assessment and Local Early Action Planning (LEAP Guide)*—website listed below under "Resources." Things to consider:

1. Profiles should be collected once per month at low tide.
2. The materials needed: two pieces of wood or bamboo poles of equal in length and a rope of known length—boards/poles of 6-8 feet length and approximately three meters of rope will work well; a small level is also helpful to ensure that the rope is taut and level, but is not necessary; pen; paper (datasheet); and graph paper or computer spreadsheet program for recording and analyzing data.

3. It is good to have roughly two or three people to collect data for each profile.

Benefits of This Action	Challenges of This Action
Is simple and “low tech” but provides accurate results of changes to the beach profile over time.	Requires commitment from an individual or team that can complete the profiles regularly and in a consistent manner, as well as analyze the data.

TECHNICAL EXPERTISE NEEDED

This exercise can be carried out with school students and community members. However, one to two leaders are needed who understand the method and who are part of the profiling team each time the monitoring is done, so that it is carried out in a consistent method.

COSTS FOR IMPLEMENTATION AND MAINTENANCE: \$

Very little cost is associated with this method of beach profiling. Materials are cheap and most of it can be made easily with things on hand (e.g. boards, ruler, pen, rope).

TIME REQUIRED

The time necessary to profile will be dependent on the expanse of beach you choose to profile and the experience level of those doing the profile. An hour or two may be necessary the first time, but subsequent profiles can be done more quickly. Also factor in time for the data to be processed and graphed.

RESOURCES

U.S. Coral Triangle Initiative Support Program. (2013). *Climate Change Adaptation for Coral Triangle Communities: Guide for Vulnerability Assessment and Local Early Action Planning (LEAP Guide)*. Prepared with support from the United States Agency for International Development.

Found at: http://www.uscti.org/uscti/Resources/LEAP_Final_complete.pdf



Actions that protect and enhance natural defenses are optimal and provide long-term benefits to the community through coastline protection and protection of natural habitats, resources, and fisheries.

Nature provides the best protection from coastal flooding and erosion.