USAID
FROM THE AMERICAN PEOPLE

ADAPTING TO COASTAL CLIMATE CHANGE

A GUIDEBOOK FOR DEVELOPMENT PLANNERS

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Coastal Resources Center
University of Rhode Island

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acronyms

BMP	Best Management Practice
CRC	Coastal Resources Center
ICM	Integrated Coastal Management
IPCC	Intergovernmental Panel on Climate Change
IRG	International Resources Group
LDC	Less Developed Countries
NAPA	National Adaptation Programme of Action
PES	Payments for Environmental Services
SCCRF	Special Climate Change Fund
SIDS	Small Island Developing States
UNFCCC	United Nations Framework Convention on Climate Change
URI	University of Rhode Island
USAID	United States Agency for International Development
V&A	Vulnerability and Adaptation

acknowledgements

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Ellik Adler, United Nations Environment Programme

Amanda Babson, U.S. Environmental Protection Agency

Carl Bruch, Environmental Law Institute

Virginia Burkett, U.S. Geological Survey

Gillian Cambers, University of Puerto Rico Sea Grant College Program

Hannah Campbell, Conservation International, formerly with U.S. NOAA Climate Program Office

Jeff DeBlieu, The Nature Conservancy

Bill Dennison, University of Maryland Center for Environmental Science

Lesley Ewing, California Coastal Commission

Serena Fortuna, United Nations Environmental Programme

Fathimath Ghina, UNESCO

Karen Jakubowski, Clean Air Cool Planet

Zoë Johnson, Maryland Department of Natural Resources

Jeftic Ljubomir, United Nations Environmental Programme

Kem Lowry, University of Hawaii

Audra Luscher, U.S. NOAA Coastal Services Center

Elizabeth Matthews, Palau Conservation Society

Joseph Murphy, U.S. Embassy Fiji

Sandra Nichols, Environmental Law Institute

Gwen Shaughnessy, Maryland Coastal Program

Sena De Silva, Network of Aquaculture Centres of Asia

Adam Stein, NOAA Coastal Services Center

Robert Stickney, Texas A&M University

Jessica Troell, Environmental Law Institute

Jay Udelhoven, The Nature Conservancy

Lisa Vaughan, U.S. NOAA Climate Program Office

Laverne Walker, Coastal Zone Management Unit, St. Lucia

Anne Walton, U.S. NOAA National Marine Sanctuary Program

Alan White, The Nature Conservancy

preface

The challenges we all must face in adapting to climate variability and change present themselves with increasing urgency. Nowhere will these challenges be greater than in the developing world where often weak institutions and governance systems struggle to deal with mounting pressures from population growth, inadequate infrastructure, and diminishing or already depleted natural resources.

In this context, the unique ecosystem processes and extraordinary development pressures within the coastal zone require that development planners – and the donors who assist with development – give special urgency to the task of helping to build resiliency against the impacts of climate change. The changes are many and already underway. They include rising sea level, increasingly intense cyclones, altered precipitation and runoff, elevated sea surface temperature, and ocean acidification.

The decades ahead will witness increased numbers of people, infrastructure, and ecosystems at risk in the coastal zone. National and local leaders across all sectors must begin now to engage stakeholders in assessing vulnerability and designing adaptation strategies that are technically, financially, and politically achievable. Meanwhile, donors too must work to protect their investments by incorporating analyses of climate variability and change into the design and implementation of virtually every kind of development assistance program to be implemented within the coastal zone.

This Guidebook is both a tool in itself and a link to other resources to help with those efforts. The processes, tools, and resources that it contains are based on the inputs of numerous coastal planners, climate change experts, and other development professionals. It was prepared under the guidance of the Water Team and Global Climate Change Team of the U.S. Agency for International Development.

The effective application of these tools, development of new techniques and sharing of lessons will be critical to meet all of the myriad challenges of a fast evolving landscape/seascape of coastal climate change adaptation around the world. We consider this a first edition and welcome and encourage your comments, suggestions, and inputs for inclusion in subsequent editions.

Please address correspondence about the Guidebook to:

The U.S. Agency for International Development
Global Climate Change Team
Washington, DC, USA 20523-3800
climatechange@usaid.gov

summary for policymakers

Adapting to Coastal Climate Change: A Guidebook for Development Planners (the Guidebook) provides a detailed treatment of climate concerns in coastal areas. The Guidebook proposes an approach for assessing vulnerability to climate change and climate variability, developing and implementing adaptation options, and integrating options into programs, development plans, and projects at the national and local levels. This is known as a vulnerability and adaptation or V&A approach. The summary presented here is designed for policymakers and others who are interested in the Guidebook's key messages and may review the full version later or use the Guidebook as a reference document. The summary is organized by the steps in the V&A approach that is recommended in this Guidebook. References for the information provided in this summary are included in the main body of the Guidebook.

There is an unequivocal scientific consensus that the changes brought by climate change are already occurring and will intensify in the future, likely resulting in significant alteration of coastal ecosystems, coastal hazards, and lifestyle changes for fishers, coastal resource users, waterfront property owners and coastal communities. These have far-reaching impacts on a range of challenges for coastal resource managers. Dramatically stepped up efforts are needed to guide proactive adaptation actions that benefit human and natural ecosystems for present and future generations.

STEP 1. ASSESS VULNERABILITY

The assessment of vulnerability focuses on gaining an understanding of how climate variability and change will impact coastal communities, the goods and services provided by natural resources, and human-built infrastructure.

Vulnerability assessment for climate change in specific coastal regions considers three factors: 1) the nature and magnitude of climate variability and change; 2) the human, capital, and natural assets that will be exposed to and impacted by climate change; and 3) the current capacity of coastal communities and ecosystems to adapt to and cope with climate impacts.

Climate is changing in response to increased greenhouse gas emissions, and projections for the coming decades paint a somber picture.

There is scientific consensus that increases in greenhouse gases in the atmosphere drive warming temperatures of air and sea, and that the world's oceans acidify as they absorb the carbon dioxide. Warming of air and sea causes shifts in precipitation patterns and hydrological cycles, sea level rise, and more frequent and severe extreme weather events (e.g., storms and storm surge). These effects are already being witnessed in the world's coastal regions and are projected to intensify in years to come.

Climate change will impact the health, function and productivity of coastal ecosystems, thus impacting the health and welfare of coastal communities and the billions of people that depend on these natural resources.

Climate changes will have significant and immediate consequences for the world's coasts, the goods and services provided by coastal ecosystems, and coastal inhabitants. This includes accelerated coastal erosion and loss of land and property, flooding, saltwater intrusion, shifts in the distribution and abundance of valuable marine habitats, species and biodiversity, and the accelerated spread of exotic and invasive species.

It may mean more frequent coral bleaching and increased mortality, loss of coastal wetland ecosystems and fishing grounds, and growth in the spread of marine dead zones.

The ocean is also becoming more acidic (decreased seawater pH) as it absorbs atmospheric carbon dioxide (CO_2). Ocean acidification has potential widespread effects on marine ecosystems. It may inhibit calcification, which will threaten the survival of coral-reef ecosystems. It will inhibit the growth of calcareous algae at the base of the food web and of shell-forming marine organisms (such as scallops), and it will stunt the growth of calcified skeletons in many other marine organisms, including commercial fish species. These species changes then affect local fisheries livelihoods and food supplies for coastal communities.

The ability of ecosystems and habitats to adapt to climate impacts can be increased by reducing other stressors such as overfishing and land-based pollution. Reducing these current stresses will increase the resilience or ability of the environment to adapt to future impacts, thus reducing threats to human welfare.

Coastal areas most vulnerable to climate change are low-lying islands, coastal areas and deltas; countries subjected to hurricanes and typhoons; and less developed countries

Relative to other coastal areas, low-lying islands, including many Small Island Developing States (SIDS), are more vulnerable to the impacts of climate change because they have relatively scarce natural resources (e.g., water resources, construction materials and physical space) and they have limited and high cost transportation options. Low-lying SIDS have little scope for adaptation and are particularly vulnerable to sea level rise and storm surge.

Less developed countries are vulnerable to climate change because of rapid population growth, much of it concentrated in coastal areas; high dependency on climate-sensitive industries such as fisheries, coastal agriculture and tourism; a degraded natural resource base; weak administration and governance systems; and poor transportation and communication infrastructure.

Low lying coastal areas and deltas are highly vulnerable to sea level rise, extreme weather events and storm surge. Globally, at least 150 million people live within 1 meter of high tide level, and 250 million live within 5 meters of high tide. At greatest risk are the densely populated Asian mega-deltas of rivers including the Yangtze (China), Ganges-Brahmaputra (Bangladesh), Mekong (Cambodia), and Irrawaddy (Myanmar). Other major mega-deltas at risk are the Nile (Egypt), Niger (Africa), and Mississippi (USA).

Climate change combines with and amplifies non-climate stressors on coastal ecosystems.

Coastal ecosystems are already seriously stressed in many areas of the world. Reasons include intense coastal development and overpopulation, poverty, internal conflict, fragmentation and loss of habitat, over-fishing, pollution, and spread of invasive species. These non-climate stressors will impair the resilience of ecosystems, i.e., the ability of the ecosystem to maintain its integrity and to continue to provide critical goods and services to coastal communities.

Uncontrolled development along the coast results in conflicts over access, increased demands on infrastructure, degraded water quality and increased risks to natural hazards. Sinaloa, Mexico

Mangroves, coral reefs, estuaries, seagrass beds, dune communities and other systems on or near shorelines serve critical ecological functions that are important to human society. Such functions include fisheries, storm protection, flood mitigation, erosion control, water storage, groundwater recharge, pollution abatement, and retention and cycling of nutrients and sediments. Healthy habitats function as self-

repairing "natural infrastructure," in contrast to human-built infrastructure, thus minimizing maintenance costs. When these critical resources are compromised, coastal ecosystems are weakened—and weakened, unhealthy coastal ecosystems are less resilient to climate change and variability.

Adaptive capacity refers to the ability of society to plan for and respond to change in a way that makes it better equipped to manage its exposure and sensitivity to climate change.

Adaptive capacity depends on economic well-being, ecological well-being, the extent of dependency on natural resources, infrastructure (human-built or natural), effectiveness of institutions and governance systems, insurance, secure land tenure and mediation measures, and information and communication systems. A community with the capacity to adapt is likely to be more resistant to impacts or able to recover from stressful events and conditions.

STEP 2: SELECT COURSE OF ACTION

Planned adaptation is strategic and aims to address the full range of coastal climate change hazards in ways that meet social objectives.

In general, there are two types of adaptation—'reactive' and 'planned'. Reactive adaptations are the changes in policy and behavior that people and organizations adopt after they have observed changes in climate and coastal risks. This Guidebook focuses on planned adaptation—that which is strategic, intentional, proactive, and occurs at the societal level.

The selection of a course of action to address climate vulnerability involves the identification of adaptation goals, and assessment of individual adaptation measures or measures bundled into a strategy.

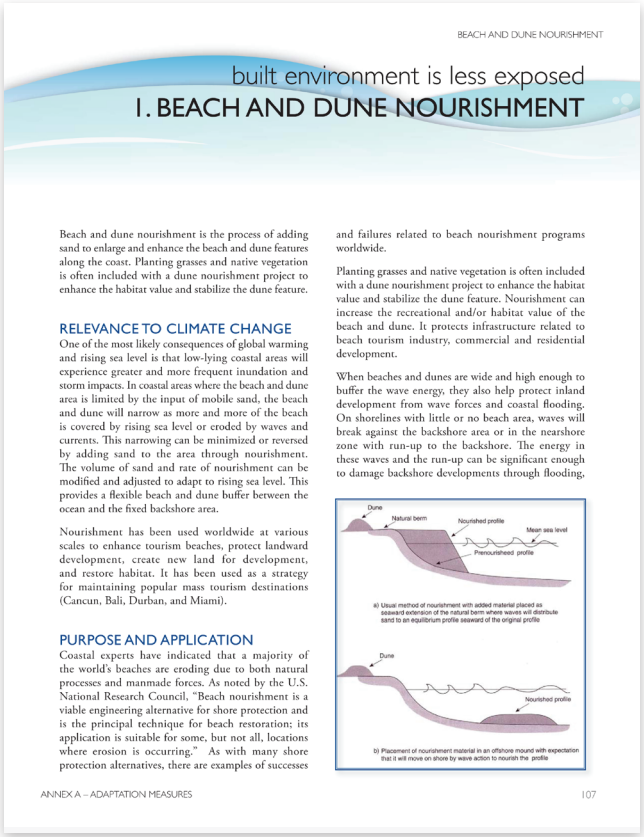
Coastal areas may be subject to a variety of climate impacts. Therefore, it is useful to prioritize your climate vulnerabilities. This will help in selecting your adaptation options and course of action. It is important to coordinate this with the decision-making procedures that govern the program, plan, or project for which climate is a concern. We urge policymakers to engage major stakeholders in setting adaptation goals, selecting criteria for and assessing adaptation options, and providing input into the final selection process. Major categories of management goals common to adaptation programs in coastal areas include:

1) Maintain functioning and healthy coastal ecosystems
2) Reduce exposure and vulnerability of the built environment
3) Strengthen governance frameworks for coastal adaptation
4) Maintain livelihood opportunities and diversify options
5) Reduce risks to human health and safety

A gallery of coastal adaptation measures has been developed for the Guidebook. Many of these will be familiar to coastal management professionals—the climate lens is new, but in most cases the tools are not.

The Guidebook includes practitioner briefs on 17 coastal adaptation measures and strategies. Each brief describes the measure's relevance, purpose and application to climate change, information and data requirements, design considerations, suggestions for improving likelihood of success, and list of resources. The 17 briefs were chosen by coastal practitioners from an initial list of 50 adaptation measures.

Traditionally, practitioners would view many of these adaptation measures in terms of their potential benefits in promoting coastal management goals. Applying a climate lens means that adaptation measures are viewed in terms of how they reduce impacts and/or improve the resilience of communities and ecosystems in the face of climate change and variability while promoting coastal management goals. In other words, it means planning with a longer time scale and a wider range of possible variability in mind.



BEACH AND DUNE NOURISHMENT

built environment is less exposed

1. BEACH AND DUNE NOURISHMENT

Beach and dune nourishment is the process of adding sand to enlarge and enhance the beach and dune features along the coast. Planting grasses and native vegetation is often included with a dune nourishment project to enhance the habitat value and stabilize the dune feature.

RELEVANCE TO CLIMATE CHANGE

One of the most likely consequences of global warming and rising sea level is that low-lying coastal areas will experience greater and more frequent inundation and storm impacts. In coastal areas where the beach and dune area is limited by the input of mobile sand, the beach and dune will narrow as more and more of the beach is covered by rising sea level or eroded by waves and currents. This narrowing can be minimized or reversed by adding sand to the area through nourishment. The volume of sand and rate of nourishment can be modified and adjusted to adapt to rising sea level. This provides a flexible beach and dune buffer between the ocean and the fixed backshore area.

Nourishment has been used worldwide at various scales to enhance tourism beaches, protect landward development, create new land for development, and restore habitat. It has been used as a strategy for maintaining popular mass tourism destinations (Cancun, Bali, Durban, and Miami).

PURPOSE AND APPLICATION

Coastal experts have indicated that a majority of the world's beaches are eroding due to both natural processes and manmade forces. As noted by the U.S. National Research Council, "Beach nourishment is a viable engineering alternative for shore protection and is the principal technique for beach restoration; its application is suitable for some, but not all, locations where erosion is occurring." As with many shore protection alternatives, there are examples of successes and failures related to beach nourishment programs worldwide.

Planting grasses and native vegetation is often included with a dune nourishment project to enhance the habitat value and stabilize the dune feature. Nourishment can increase the recreational and/or habitat value of the beach and dune. It protects infrastructure related to beach tourism industry, commercial and residential development.

When beaches and dunes are wide and high enough to buffer the wave energy, they also help protect inland development from wave forces and coastal flooding. On shorelines with little or no beach area, waves will break against the backshore area or in the nearshore zone with run-up to the backshore. The energy in these waves and the run-up can be significant enough to damage backshore developments through flooding,

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Adaptation measures are summarized as practitioner briefs in Annex A.

Criteria for evaluating adaptation measures consider technical effectiveness, costs, expected benefits, and implementation characteristics.

Countries or coastal areas may share the same climate change issues. Yet, each has different circumstances (climate, natural resources, infrastructure, technological state, economy, governance, etc.) so the responses to those climate change issues may vary. Coastal adaptations must be "tailored" to the local context through an inclusive process that matches development goals with the climate change issues and the technical capabilities and the capacity of the institutions and community stakeholders of the place. Following are key criteria for deciding the best adaptation option given the local context:

- ***Technical effectiveness:*** will the adaptation option be effective in solving problems arising from climate change while also meeting current development or management goals?
- ***Costs:*** what is the cost to implement the adaptation measure?
- ***Benefits:*** what types (and magnitudes) of benefits will be generated by the adaptation measure and who will benefit?
- ***Implementation considerations:*** how easy is it to design and implement the option in terms of the level of skill required, information needed, and scale of implementation?

It is useful to distinguish between climate benefits and non-climate benefits. Climate benefits include such things as avoiding damages and their associated costs and reducing greenhouse gas emissions. Non-climate benefits are those that result under current climate conditions. An example is enforcing prohibitions on mining coral reefs, an activity that exacerbates coastal erosion and reduces coastal protection. Adaptations that yield non-climate benefits greater than the costs of implementation are referred to as "no regrets"

options. This term implies society will have no regrets in implementing these measures—even if climate change is less significant than projected.

In general, except in intensely developed areas, adaptation options that favor ecosystem and living shoreline approaches are recommended over hard structures to stabilize the shoreline.

Living shoreline approaches address erosion and flooding by providing for long-term protection, restoration or enhancement of vegetated shoreline habitats. Such "no regrets" approaches—i.e., approaches that are beneficial even in the absence of climate change—should be a priority. The use of natural living infrastructure provides multiple benefits while minimizing repair costs. Functional coastal ecosystems are more resilient to climate change and variability. They also provide goods and services that are important to human society in the face of climate change (fisheries, livelihoods, food security, storm protection, flood mitigation, shoreline natural defenses, erosion control, water storage, groundwater recharge, retention of nutrients and sediments, and filtering of pollutants). Maintaining ecosystem biodiversity is critical to ensuring healthy ecosystems and thus natural-resource dependent livelihoods, such as wild fisheries.

Adaptation responses will often include "bundles" of adaptation measures and require additional considerations in evaluating multiple measures.

In evaluating and selecting the best combination of adaptation measures, policymakers and practitioners might consider the following:

- ***Complements vs. substitutes:*** Ideally, bundles should include adaptation measures that are complementary to each other. This capitalizes on synergies and ensures that each measure adds benefits. If measures are substitutes for each other, select and include in the bundle the measure that is least costly and/or provides the greatest net benefits.
- ***Budget constraints:*** Often, there are limited financial resources available to cover the costs of implementation. In these situations, no-cost and low-cost measures may be more attractive than expensive measures such as human-built infrastructure. Adaptation is a continuous process, so we recommend a phased approach when priority measures are not affordable.

STEP 3: MAINSTREAM COASTAL ADAPTATION

Climate change adaptation on the coast must be understood as a fundamental challenge for managing coastal resource uses and must be 'mainstreamed' into coastal policy at all levels.

Mainstreaming means that climate concerns and adaptation responses are integrated into relevant development policies, plans, programs, and projects at the national, sub-national, and local scales. National climate change adaptation strategies are more effective when guidance on adaptation is mainstreamed into development and sectoral plans and strategies and is "owned" by those authorities responsible for preparing and implementing them.

There are many entry points for mainstreaming coastal adaptation. This Guidebook highlights three of these: 1) national or regional level public policy, 2) sectoral investments and projects, and 3) sub-national, place-based initiatives. Each entry point offers challenges, creates new roles for citizens, the private sector

and government, and can create new opportunities. Government must play a pivotal role in creating enabling policy, financial and legal frameworks, capturing and sharing experience, and raising public awareness.

Engaging a broad group of stakeholdersthroughout the process is key to successful adaptation.

Guidelines and policies for mainstreaming climate concerns and adaptation responses into capital investment plans and project cycles are recommended in the face of climate change.

Development banks, such as the African Development Bank and the World Bank, are increasingly concerned that a substantial share of investments are at risk from direct impacts from climate change, thereby increasing vulnerabilities or reducing the intended development benefits. Estimates of Development Banks' portfolio at risk range from 25-40%. For example, infrastructure that cannot be adapted to withstand the impacts of climate change may expose more people and assets to risk. Mainstreaming climate concerns into capital investment plans and project cycle management entails integrating climate issues and adaptation priorities into country strategies. Greater consideration must also be given to vulnerability and adaptation in project designs, screening, selection and evaluation.

A two-track approach combining local level, community-based adaptation with national level enabling policy, finance and legal frameworks is an effective approach to adaptation implementation.

Successful mainstreaming requires reinforcing linkages between local and national level adaptation entry points. Government, together with non-government partners, must play a pivotal role in fostering the connections across national, sectoral, and place entry points.

There may be resistance to mainstreaming climate adaptation. Coastal managers can draw upon their repertoire of experience to formulate strategies to overcome such barriers.

There is often inherent resistance to the introduction of any new policy idea. Because climate change impacts are cumulative and occur over the long-term, there may be little sense of urgency to act. Individuals and organizations may resist because of the uncertainties that surround climate change and because they have different tolerance levels for the risks associated with taking action under such uncertainties. The Guidebook lists good practices for successful and sustained coastal adaptation that have proven effective in coastal management worldwide and that can help in overcoming resistance to mainstreaming coastal adaptation.

STEP 4: IMPLEMENT ADAPTATION

Implementation of adaptation measures brings new challenges and potential conflicts. Practitioners and coastal professionals need to be aware of these and address them proactively.

Implementation challenges include: inadequate administrative, institutional, and staff capabilities; lack of sustainable financing or cost recovery; weak legal frameworks and enforcement; information gaps on the costs of acting vs. not acting (doing nothing); maintaining scientific data and monitoring to sustain the measures; unengaged political leadership and stakeholders; and poor technical effectiveness of the measures. The Guidebook identifies specific responses to each implementation challenge. Many of these challenges can be anticipated and addressed prior to implementation—i.e., during the assessment, design, and mainstreaming steps of coastal adaptation.

Coastal practitioners and professionals must be alert to implementation challenges and address them proactively as they become evident. Recommended actions include periodic program reviews at the national or local levels to ensure agencies and communities are aware of successes and failures. Another action is to educate and encourage the public and property owners to be active in the stakeholder process. Also, take action to keep coastal adaptation on the public agenda, and conduct monitoring and scientific studies to reduce uncertainty about the effectiveness of the measures being implemented.

STEP 5: EVALUATE FOR ADAPTIVE MANAGEMENT

Coastal adaptation is an on-going and iterative process that will benefit from periodic evaluation of performance coupled with an adaptive management process to fine-tune implementation.

Once coastal adaptation measures are implemented, there will likely be considerable interest in how they perform. Policymakers will be keen to demonstrate that the measures are beneficial to the citizenry. They will also want to assuage stakeholders who have borne some of the costs of the measures. Evaluation is the process of reviewing and analyzing all relevant data and information required to determine if the set of adaptation options are meeting expectations. If measures do not perform according to expectations, they must be adjusted. The process of reflecting on and adjusting the course of action based on evaluation results, new information, and changing conditions is referred to as adaptive management.