



Managing Coasts with Natural Solutions

Groundbreaking World Bank Guidelines for better measuring and valuing the coastal protection services of mangroves and coral reefs

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Our Costly Coastal Risk Problem

Flooding, erosion, inundation and extreme weather events affect hundreds of millions of vulnerable people, important infrastructure, tourism and trade — causing significant human suffering and losses to national economies.

In 2011, insured losses from natural disasters reached an all-time high. The amount of the world's

gross domestic product (GDP) annually exposed to tropical cyclones has increased by more than US\$1.5 trillion in just the past 30 years. Insurers alone have paid out more than US\$300 billion for coastal damages from storms in the past 10 years, which often goes toward rebuilding similar coastal infrastructure that is still vulnerable to coastal storms and flooding.

KEY POINTS

- Mangroves and coral reefs provide significant coastal protection benefits.
- Planners and decision makers can rigorously value the Annual Expected Benefits of natural coastal protection.
- Many countries are already using these natural coastal protection benefits in policy and practice.
- These Guidelines recommend using the Expected Damage Function (EDF) approach to estimate and account for the coastal protection benefits of mangroves and reefs.

A Powerful and Underused Solution

Global spending on expensive and inflexible gray infrastructure has largely failed to see one powerful truth: nature reduces risk.

Governments all over the world are dedicating billions of dollars to reduce risks from disasters and climate change. The Total Fast Start Finance commitments under the United Nations Framework Convention on Climate Change (UNFCCC) through 2012 include roughly US\$3 billion for climate adaptation assistance. In the United States, the Federal Emergency Management Agency (FEMA) spends US\$500 million per year to reduce flooding hazards. Middle-income countries, such as Brazil, China and Colombia, are making multibillion-dollar investments to address the risks of flooding and other disasters exacerbated by climate change. However, most of these funds are destined for the creation and maintenance of “gray infrastructure,” such as seawalls and breakwaters.

“By showing how important mangroves and reefs are as a first line of defense, we can inspire more action not just from conservationists, but also from disaster risk managers, development planners and ministries of finance and development.”

—Glenn-Marie Lange, Sr. Environmental Economist at The World Bank



▲ Mangroves growing in the Jardines de la Reina, a national park on the coast of Cuba. © Ian Shive for The Nature Conservancy

There is an important and cost-effective way to help deal with this risk. When integrated into the mix of coastal infrastructure solutions, coastal and marine habitats — particularly coral reefs and mangroves — can substantially reduce exposure and vulnerability, providing people and

infrastructure with cheaper, more flexible and enhanced protection from risk.

Mangroves can reduce wave height from 13 to 66 percent over a 100-meter-wide belt, and 50 to a full 100 percent over a 500-meter-wide mangrove belt. If mangrove forests are sufficiently large, they can reduce storm surge peak water levels between 4 and 48 cm per kilometer of mangrove. In low-lying areas, even relatively small reductions in peak water levels can reduce flooding and prevent property damage.

Coral reefs protect coasts from erosion and flooding by reducing wave energy and supplying and trapping sediment found on adjacent beaches. Coral reefs reduce wave energy by up to 97 percent. Healthy reefs can protect coasts even during cyclones with strong wave conditions. Healthy coral reefs are expected to keep pace with sea level rise, and require little direct maintenance costs.

A Game-Changing Approach to Measuring and Valuing Nature-Based Solutions

One crucial aspect holding back the integration of natural solutions has been the lack of rigorous approaches for measuring their risk reduction benefits. However, standard engineering and insurance industry tools can value natural protection benefits right alongside gray infrastructure.

Through the World Bank’s Wealth Accounting and Valuation of Ecosystem Services (WAVES)

global partnership, the World Bank and a team of economists, ecologists and engineers led by The Nature Conservancy have created the new report, “[Managing Coasts with Natural Solutions: Guidelines for Measuring and Valuing the Coastal Protection Services of Mangroves and Coral Reefs.](#)”

The Guidelines draw on spatially explicit, risk industry-based approaches to demonstrate a more precise path to measuring the protective services of mangroves and coral reefs.



▲ A restored reef near Borneo thrives with life. © Curt Storlazzi

The Guidelines present ways to measure and value nature-based solutions in a manner consistent with national economic accounts, and to include these services in other decision-making processes to support planning for development, disaster risk and coastal zone management.

What Is in The Guidelines?

The Guidelines:

- Summarize the role that mangroves and coral reefs play in coastal protection and risk reduction
- Review ecological, economic and engineering tools for estimating natural coastal protection benefits
- Examine how the valuations of these coastal protection services can ultimately be considered in the System of National Accounts (SNA)
- Provide 20 case studies from countries where natural coastal protection benefits from reefs and mangroves have been used in policy and practice

- Provide recommendations for advancing the assessment and the use of coastal protection benefits from coral reefs and mangroves in national and regional decisions

At the center of The Guidelines is a recommended approach for ecosystem service valuation – the Expected Damage Function (EDF) approach – which is adapted from engineering and insurance industry approaches. This approach works by examining current flooding levels and what they would be if these reefs or mangroves were lost. The difference in flooding levels, and the social and built capital that exists between those flooding levels, is the expected benefit from keeping those reefs and mangroves in place. The Guidelines note that the Replacement Cost valuation approach, which looks at the cost of replacing natural infrastructure with gray infrastructure, can be used as well.

The Guidelines also point to examples of nature-based solutions being effectively integrated into major policy decisions, including:

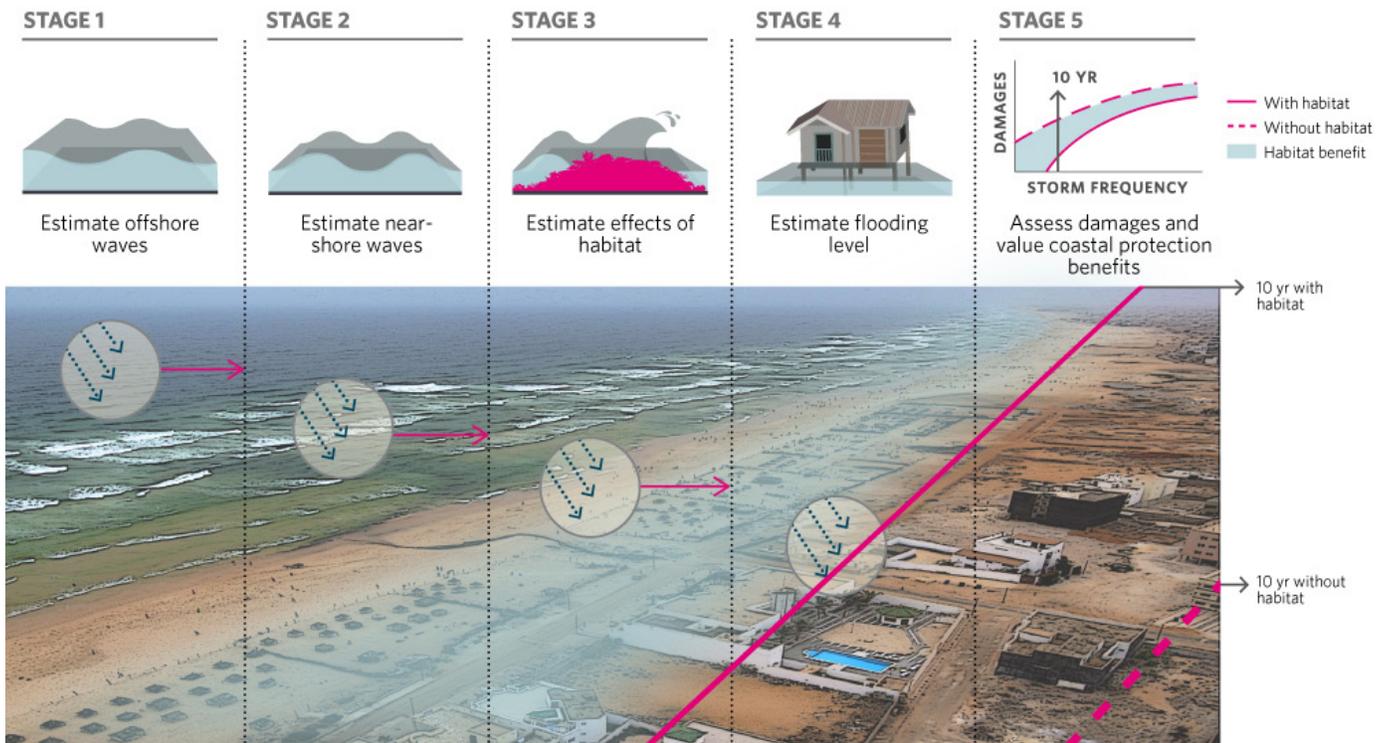
- In Vietnam, 9,000 hectares of reforested mangroves demonstrated cost-benefit ratios ranging from 3:1 in some communities to as high as 28:1 in other locations.

- In the aftermath of Typhoon Haiyan of 2013, the Government of the Philippines pledged US\$8 million for a cash-for-work program to restore mangroves and beach forests along the hardest hit coastlines.
- The Caribbean Catastrophic Risk Insurance Facility (CCRIF) found that, in seven out of the eight countries examined, reef and mangrove restoration was one of the most cost-effective approaches to coastal risk reduction and adaptation.

Maximizing Coastal Protection Requires Urgent Action

Today, policy and management decisions too often leave out the value of mangroves and coral reefs as nature-based defenses. And, our coastal risks are only increasing as we continue to lose these systems due to poor infrastructure choices and a changing climate.

Already, 30 to 50 percent of wetlands have been lost, 19 percent of mangroves have been lost from 1980 to 2005, and 75 percent of the world’s coral reefs are now rated as threatened.



▲ Key steps for estimating the coastal protection benefits provided by mangroves and reefs, following the Expected Damage Function approach.

And risk increases as coastal ecosystems are lost. The Global Assessment Report on Disaster Risk Reduction highlights that economic loss risk resulting from tropical cyclones and floods is growing as exposure of economic assets increases and the status of ecosystem services degrades, and that societies are excessively discounting risk in development choices, particularly in coastal areas.

Mainstreaming the coastal protection value of mangroves and reefs in policy and management

TOP 10 RECOMMENDATIONS FOR COASTAL PROTECTION FROM THE GUIDELINES

1. **Harness the power** of coral reefs and mangrove forests in reducing flooding and erosion.
2. **Focus research** on coastal protection services near reef crests and on mangrove forest density and structure.
3. **Use the EDF approach** to value coastal protection benefits.
4. **Advance country pilot projects** that value natural protection benefits and include them in national accounting.
5. **Develop national risk maps** for all coastal countries and identify where habitat conservation and restoration provide significant risk reduction value.
6. **Reduce threats** and improve management of existing mangroves and coral reefs as one of the cost-effective solutions for coastal defense.
7. **Identify where natural protection services have been lost** and habitat restoration can significantly reduce risks. Do not create habitats that did not previously exist.
8. **Develop coral reef guidelines and improve mangrove guidelines** for habitat restoration for risk reduction.
9. **Develop large-scale commitments** to conserve and restore degraded mangroves and coral reefs.
10. **Include reefs and mangroves in national adaptation plans** (for developing nations) or adaptation and risk reduction support programs (for developed nations).

decisions is an essential near-term opportunity, as there are substantial opportunities and risks that will affect the ecosystems and the communities that rely on their services during the next 5 to 10 years.

The World Bank's WAVES Global Partnership and The Nature Conservancy

Wealth Accounting and Valuation of Ecosystem Services (www.WAVESpartnership.org) is a global partnership led by the World Bank that aims to promote sustainable development by mainstreaming natural capital in development planning and national economic accounting systems. Currently, eight developing countries — Botswana, Colombia, Costa Rica, Guatemala, Indonesia, Madagascar, the Philippines, and Rwanda — are partnering with WAVES to establish natural capital accounts that include the value of ecosystems and ecosystem services. The methods for measuring and valuating the ecosystem services of mangroves and reefs is well established. WAVES partnered with The Nature Conservancy, UCSC, RFF, UCD, UCSB and SNAPP to develop The Guidelines.

Learn more about The Nature Conservancy's global Oceans work at nature.org/global

"By bringing together ecologists, economists and engineers, we have advanced a rigorous approach for valuing the powerful benefits that reefs and mangroves provide for protecting people and property."

-Michael Beck, Lead Marine Scientist at The Nature Conservancy

