Policy Brief

WAVES
Policy Brief
Philippines
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Summary

Coastal habitats can protect people and property from storms, floods, and erosion, reducing coastal risk. Natural capital accounting can ensure that these ecosystem services are valued and accounted for in policy and management decisions. In the Philippines, significant expanses of mangroves have been lost in the last century, increasing coastal risk[2]. A recent report demonstrates that mangroves significantly reduce risks from flooding in the Philippines. Using high-resolution flooding models, the report compares flooding for scenarios with and without mangroves under different storm conditions, and estimates the annual expected benefits of mangroves for protecting people and property in social and economic terms to help inform decision making.

Background

This brief is part of a collaboration between The World Bank WAVES Program, The Nature Conservancy (Michael Beck, Siddharth Narayan, Dania Trespalacios), and The Environmental Hydraulics Institute of Cantabria (Iñigo J. Losada, Pelayo Menéndez Fernandez, Pedro Diaz Simal, Antonio Espejo Hermosa). Additional support provided by the German International Climate Initiative.

Valuing the Protection Services of Mangroves in the Philippines

Mangroves and other coastal ecosystems act as natural defenses to reduce the risks from flooding, erosion and natural disasters. Yet the value of these habitats is often not fully accounted for in policy and management decisions, and thus they continue to be lost at alarming rates. Using natural capital accounting, we can measure and value the services provided by these coastal ecosystems, and thus inform policies for sustainable development, disaster risk reduction, and environmental conservation. A new Report measures and values the coastal protection benefits of mangroves in the Philippines[1].

Key Points:

- If the current mangroves (data from 2010) in the Philippines were lost, **24% more people** would be flooded annually, i.e., an additional **613,000** more people, many of whom live in poverty.
- Damages to residential and industrial property would increase by 28% to more than **US $1 billion** annually; and **766 km of roads** would be flooded.
- One hectare of mangroves in the Philippines provides on average more than **US $3200/year** of direct flood reduction benefits.
- Based on the Philippines's current population, the mangroves lost between 1950 and 2010 have resulted in increases in flooding to more than 267,000 people every year. Restoring these mangroves would bring more than **US $450 million/year** in flood protection benefits.
- Mangroves provide the most protection for frequent lower intensity storms (for example, 1-in-10 year storm events). For more catastrophic events, such as the 1-in-25 year storm, they provide more than **US $1.6 billion** in averted damages throughout the Philippines. When combined with built infrastructure, mangroves provide an effective defense against storms and coastal flooding.

The aerial roots of mangroves retain sediments and prevent erosion, while the roots, trunks and canopy reduce the force of oncoming wind and waves and reduce flooding. Credit: Ian Shive.

To halt the loss of our natural capital and ensure the provision of ecosystem services, these services must be accounted for in policy and management decisions.

The Coastal Protection Services of Mangroves

Mangroves protect coastlines by decreasing the risk of flooding and erosion. The aerial roots of mangroves retain sediments and prevent erosion, while the roots, trunks and canopy reduce the force of oncoming wind and waves and reduce flooding. A 500-meter wide mangrove forest can reduce wave heights by 50-100%[3-5]. In low lying areas, even relatively small reductions in water levels can reduce flooding and prevent property damage. In the long term, mangroves increase sedimentation, decrease erosion, and maintain tidal creeks and channels. Mangroves can also support livelihoods and reduce social vulnerability by providing resources such as fish and other resources.

But mangroves are being lost at an alarming rate- 19% of the world's mangroves were lost between 1980-2005[6]-in part because we have not adequately valued these natural defenses. In the Philippines, mangrove loss has occurred primarily due to conversion of land to other uses, including aquaculture and human settlements[7]. If mangroves are degraded or destroyed, the coast line becomes more exposed and vulnerable to the destructive impacts of waves and storm surge, and is at higher risk of coastal flooding and erosion. As mangroves are degraded and lost, more people and property are directly at risk from the impacts of storms, floods, and sea level rise.

Valuing our Natural Capital

Conventional approaches to measuring wealth and economic development focus only on built capital and fail to account for the value all the goods and services provided by natural capital. Currently, only a subset of the extractive benefits provided by ecosystems, such as fish and timber harvests, are valued. Many critical services, such as flood protection and climate mitigation, that rely on keeping ecosystems intact are rarely valued[8]. This lack of consideration encourages short-term over-exploitation and degradation, reducing the quantity and quality of the goods and services provided. To halt the loss of our natural capital and ensure the provision of ecosystem services, these services must be accounted for in policy and management decisions. Better valuations of the protection services of coastal habitats can inform decision-makers as they strive to meet risk reduction and environmental management objectives. National economic accounts provide an important pathway for the consideration of these ecosystem services[9].

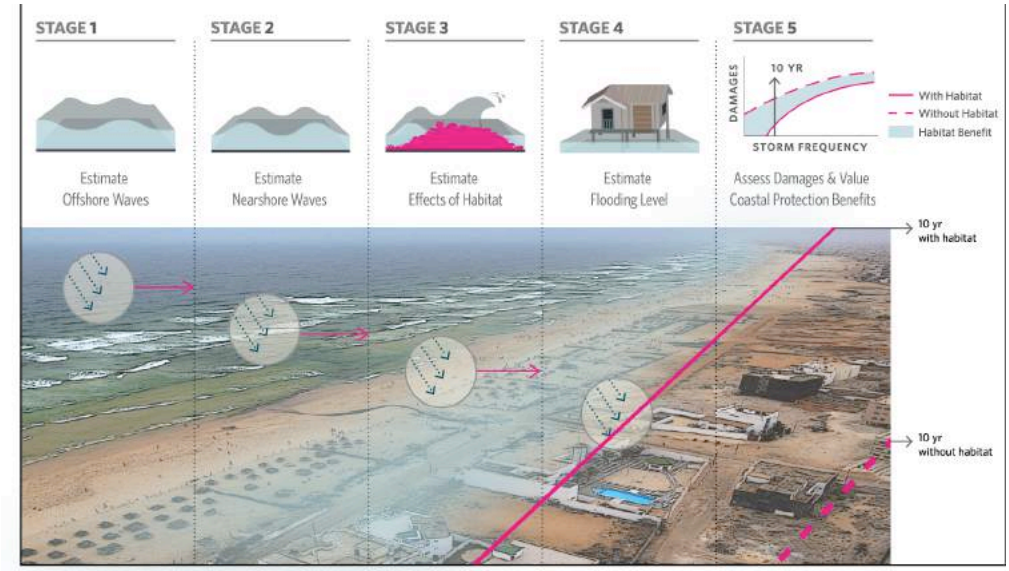
The Philippines at Risk

The Philippines is at particularly high risk from coastal hazards. Between 2005 to 2015, 56% of property damage from natural hazards was due to typhoons and storms, and another 29% due to floods[2]. Further, the Philippines has lost hundreds of thousands of hectares of mangroves in the last century, increasing coastal risk.

Due to a recognition of these increasing risks, and of the potential role of natural defenses to reduce these risks, the Philippines WAVES program on natural capital accounting is helping the Philippines create mangrove accounts, with the dual goals of 1) including the value of mangroves in the national accounts and 2) providing critical information to decision-makers that may harness natural defenses for disaster risk management, coastal zone management, and climate change adaptation. The mangrove accounts will account for multiple services, and will include area, volume, carbon sequestration, ecotourism, and coastal protection services.

WAVES

The Expected Damage Function Approach



Data Needs	Wind Global Waves Astronomical Tide Storm Surge Tropical cyclones Sea Level Rise	Nearshore Waves Astronomical Tide Storm Surge Tropical Cyclones Sea Level Rise Bathymetry	Coral reefs (distribution, height, condition) Mangroves (distribution, density) Sea grasses	Erosion Flooding	Land Use Poverty Wealth GDP Built capital
Sample Models & Tools	Tide Forecasting Wave, Surge Hindcasting SLR Projections	Wave set-up Delft 3D Snell's Law	Delft 3D SWAN GIS	Delft 3D X-Beach	Damage & Loss Function
Key Philippine Agency	PAGASA[10] NAMRIA	PAGASA NAMRIA	NAMRIA DENR	PAGASA NEDA	PSA, PAGASA, NEDA

Figure 1 The figure identifies the key steps and critical data needed for the Expected Damage Function Approach, and some of the key agencies in the Philippines that may have critical roles and responsibilities in the development of data, models and results for each step.[3]

The Technical Report: Methods

The Philippines WAVES program commissioned a Technical Report to assist the Government of the Philippines in the development of their mangrove accounts. The goal of the Report is to value the coastal protection provided by mangroves in the Philippines and to identify where these natural coastal defenses provide the greatest protection benefits.

To measure and value the coastal protection benefits provided by mangroves, the Report follows the Expected Damage Function approach, commonly used in engineering and insurance sectors and recommended for the assessment of coastal protection services from habitats[3] (see Figure 1). The benefits provided by mangroves are assessed as the flood damages avoided by keeping mangroves in place.

The Report compares the people and property flooded under 3 different scenarios: mangrove cover existing in 1950, mangrove cover existing in 2010, and finally no mangrove cover (that is, the Report assumes all mangroves are lost). It also takes into account the wave reduction effect from adjacent coral reefs. The Report considers the flooding that occurs under regular storm conditions, including storm surge, by analyzing more than 30 years of wave and water level data, and it also considers flooding under the most extreme events, by analyzing the historical data and spatial distribution of 548 cyclones that made landfall in the Philippines.

The Report values the benefits provided by mangroves nationally across the Philippines, and locally in the municipalities of Pagbilao and Busuanga. The analyses for the municipalities involved very high resolution bathymetric data and hydrodynamic flooding models (see Figure 4). The results from the high resolution local analyses are compared to the results from the national-level analyses.

Key Findings from the Technical Report

The protection services of mangroves can be quantitatively valued.

- Without mangroves, flooding and damages to people, property, and infrastructure would increase annually by approximately 25% (Figure 2).
- Nationally, Philippine mangroves reduce flooding to 613,000 people annually, of whom more than 23% live below poverty.
- Mangroves annually avert more than US $1 billion in damages to residential and industrial stock (Figure 2).
- Mangroves are expected to avert more than US $1.7 billion in damages from 1-in-50 year events (Figure 3).
- Mangroves provide significant benefits for more frequent, lower intensity events (see Figure 3).
- If mangroves were restored to their 1950 distribution, there would be additional benefits to 267,000 people annually, including 61,000 people below poverty, and US $450 million in annual averted damages.
- The results from the general, national-scale models were compared with the results from higher resolution, local models. These comparisons reveal that the national scale models are robust and conservative, i.e., the national models err towards predicting less flooding and less benefits from mangroves.
- Maps of the distribution of risks reduction benefits provided by mangroves can inform protection & restoration priorities (see Figure 5).

Key Data and Capacity Needs

- The national models could be most improved with better topographic and bathymetric data and secondarily with better data on the density of mangroves.
- The valuation of mangrove flood reduction benefits requires inputs from multiple Philippine agencies, including PAGASA, DENR, PSA and others[10]. To any one agency, the data and models will seem complex, however these agencies are already using the core flooding models and accompanying data on mangrove distribution.
- Potential next steps in the Philippines could be: adjusting or augmenting the existing models; supporting data integration efforts between these three Philippines agencies; and targeted capacity building in key Philippine agencies.

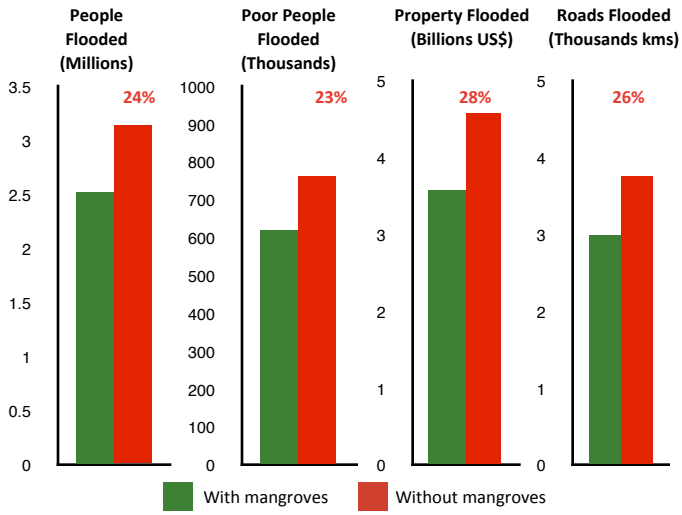
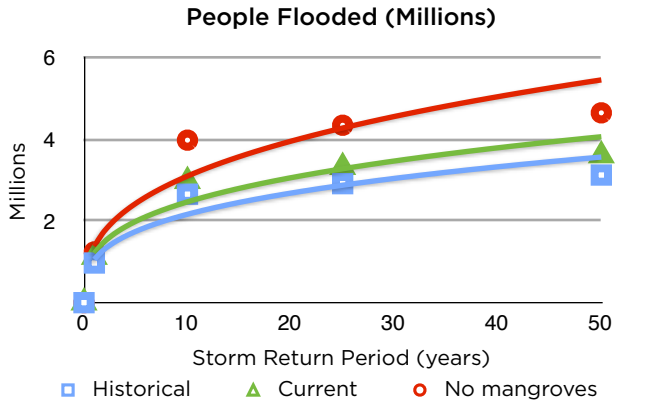


Figure 2 The bars shows the Annual Expected Damages from flooding in the Philippines under current (2010) mangrove cover (in green) and under no mangrove cover (in red), including the annual percent increase in damages to people and property if mangroves were lost.



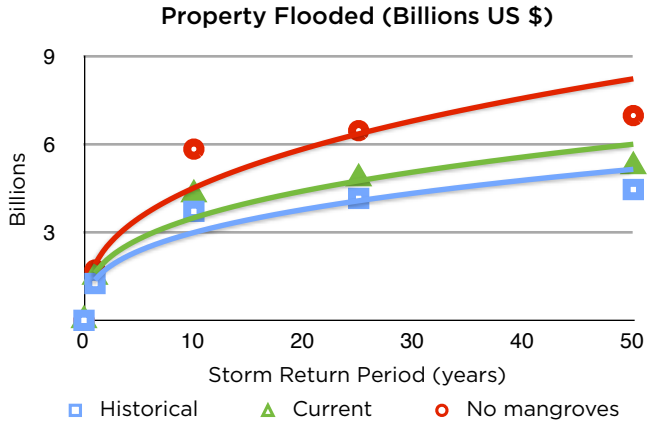


Figure 3 The curves represent the expected damages from flooding to people and property under historical (1950), current (2010), and no mangrove scenarios. The difference between the curves represents the avoided damages, or benefits, provided by mangroves.

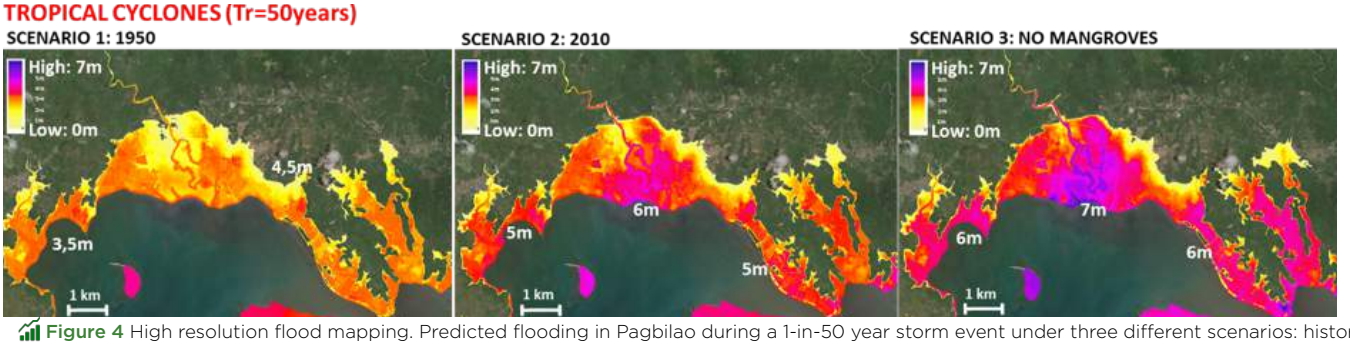


Figure 4 High resolution flood mapping. Predicted flooding in Pagbilao during a 1-in-50 year storm event under three different scenarios: historical mangrove cover (1950), current mangrove cover (2010) and no mangrove cover (assuming all mangroves are lost.) Results were produced with a high resolution flood model using data from historical cyclones.

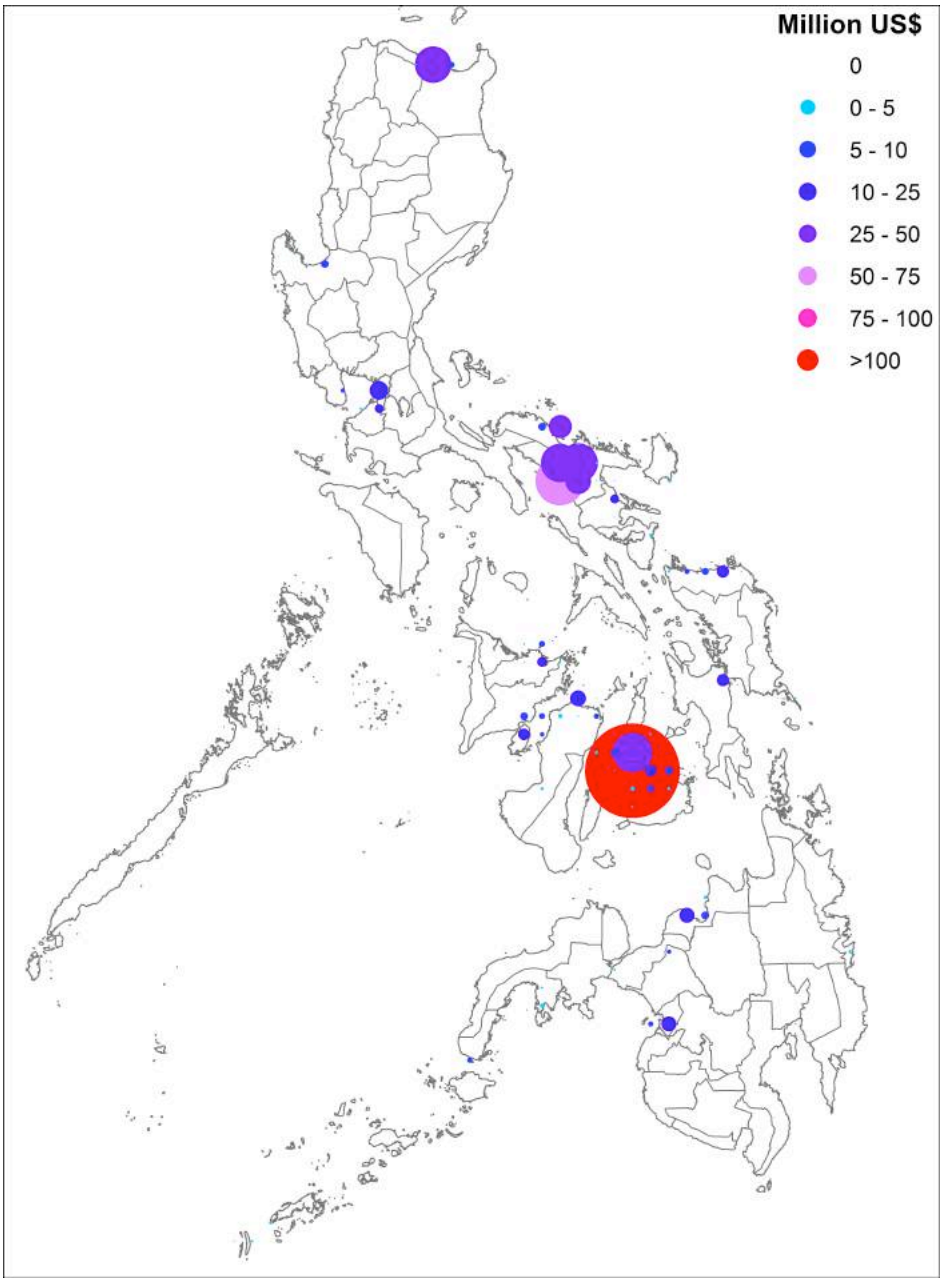


Figure 5 The map shows the spatial variation in flood protection benefits from mangroves in the Philippines. Circles represent the annual expected benefit from mangroves for flood protection ($US millions). The values are the difference in expected damages with current mangrove coverage (2010) and without mangroves.

The Way Forward: Opportunities for the Philippines (and Beyond)

Mangrove conservation and restoration can be an important part of the solution for reducing coastal risks in the Philippines, especially as those risks increase with climate change. This Report provides a social and economic valuation of mangroves that can inform the policy and practice of many Philippine agencies, businesses and organizations across development, aid, risk reduction and conservation sectors as they seek to identify sustainable and cost-effective approaches for risk reduction.

By showing the spatial variation of the flood reduction benefits provided by mangroves, these results can identify the places where mangrove management may yield the greatest returns. By valuing these coastal protection benefits in terms used by finance and development decision-makers (e.g., annual expected benefits), these results can be readily used alongside common metrics of national economic accounting, and can inform risk reduction, development and environmental conservation decisions in the Philippines.

In the Philippines, many opportunities exist for the application of these results:

- These results can help identify priority sites for mangrove conservation and restoration for coastal protection, either as 'stand-alone' solutions, or part of hybrid approaches that combine mangrove natural defenses with built infrastructure.
- Numerous programs can incorporate these results into their plans and analysis, including: the National Greening Program; Integrated Area Development, Risk Resilience and Sustainability Program; Green Climate Fund and People Survival Fund; and the Comprehensive Land Use Plans of local governments.
- PAGASA[10] and Local Government Units may use these results to inform and improve their risk assessment and flood risk mapping.
- These results can be considered in risk industry models, which may influence insurance premiums in the Philippines and the development of innovative finance mechanisms to support mangrove management. Catastrophic hazard bonds, resilience bonds, and blue bonds among others could use the risk reduction benefits of mangroves to support habitat conservation and restoration[11].

In the past nature-based measures for coastal protection, such as mangrove restoration, were not assessed for their cost effectiveness for risk reduction, because rigorous values of their coastal protection benefits were missing. These services can be rigorously valued to inform national accounting, cost-benefit analyses and comparisons of different coastal protection options, including natural, hybrid and built defenses.

Notes

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Wealth Accounting and the Valuation of Ecosystem Services (WAVES) is a global partnership led by the World Bank that aims to promote sustainable development by ensuring that natural resources are mainstreamed in development planning and national economic accounts