Building Coastal Resilience in South & Southeast Asia Through Mangrove Restoration for Risk Reduction

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Refined Problem Statement

The world's coastal zones are changing rapidly from climate change, population growth and coastal development. The combination of these factors is significantly increasing the incidence of and exposure to a range of hazards including erosion, inundation and extreme weather events that affect livelihoods of hundreds of millions of vulnerable people, critical infrastructure and national economies. For example, the proportion of the world's Gross Domestic Product (GDP) annually exposed to tropical cyclones increased from 3.6 percent in the 1970s to 4.3 percent in the first decade of the 2000s (UNISDR 2011). Catastrophic damages are significantly exacerbated by the loss of mangrove forests and other coastal habitats because of the role they play in natural coastal protection. Their decline as a result of mounting human pressures will severely impact the resilience of coastal populations.

Mangrove forests are critical for building coastal resilience due to their capacities to shape and regulate the physical environment and deliver ecosystem services in many ways, including:

- ***Mangroves decrease exposure by reducing wave energy at the shoreline and helping to reduce coastal erosion and flooding*** (McIvor et al. 2012a, b, McIvor et al. 2013, Beck and Lange, in review). They can reduce storm surge levels and considerably reduce flood extents. Decades of data show that mangroves can reduce wave energy by up to 73 percent (Narayan et al. 2015) and the width and density of the forest band are key factors that contribute most to wave and surge reduction. Mangroves also build land by trapping sediment and accruing organic matter and may keep pace with sea level rise (McIvor et al. 2013).

- ***Mangroves reduce social vulnerability to disasters by reducing susceptibility and increasing coping and adaptive capacity.*** The benefits provided by mangroves enable people to better withstand shocks, prepare for extremes and anticipate future change. Further, mangroves can help communities cope after disasters by providing food and fuel and by supporting livelihoods. This is particularly important for women, children and the elderly, who are the most negatively affected by the physical impacts of hazards and also tend to suffer more following a disaster as they are less readily able to move elsewhere and access financial or other emergency support (Mutter, 2005; Habtezion 2013). Mangroves enhance lives and livelihoods through the provision of fisheries, timber, charcoal and other products such as honey and beverages (Tri et al. 1998, Burke et al. 2008, Barbier et al. 2008, Walters et al., 2008; Baba et al., 2013, Beck 2014). Coastal livelihoods supported by mangroves include subsistence, commercial and recreational fisheries (Hutchison et al. 2014; Rönnbäck, 1999) and mangrove eco-tourism (Salem and Mercer, 2012).

- ***Mangroves mitigate climate extremes due to their capacity to store huge amounts of carbon.*** Mangroves account for only 0.7 percent of tropical forest area, but their degradation contributes to 10 percent of global emissions from deforestation (Donato et al. 2011). Hence the conservation and rehabilitation of mangroves is critical for mitigating global climate change.

Though they contribute greatly to building resilience, **mangroves are at great risk**. Mangroves are estimated to be disappearing at a rate faster or equal to that of coral reefs and tropical forests (FAO, 2003, Duke et al. 2007, Polidoro et al. 2010) suggesting we may lose these valuable ecosystems completely within the next century (Alongi, 2002, Duke 2007, Donato 2011). Losses are highest throughout South and Southeast Asia, a region that harbours most of the world's remaining mangroves (Strong and Minnemeyer, 2015), and that is at particularly high risk with respect to coastal hazards (Beck 2014). Major causes of mangrove loss in the region include: (i) conversion to other land use such as oil palm plantations, mining, shrimp farms, infrastructure, and human settlements; (ii) over-harvesting; (iii) pollution; (iv) decline in freshwater availability; (vi) reduction of silt deposition; (vii) coastal erosion due to subsidence and sea level rise; and (viii) disturbances due to cyclones and hurricanes (Giri et al. 2015).

Despite losses and risks, **mangroves can be conserved and restored at scale** and there are many successful demonstration projects. For example, in the Indus Delta, Goa and the Sundarbans 80,461 hectares were restored between 2000-2012 (Giri et al. 2015). In Vietnam, hundreds of thousands of hectares of mangrove have been restored with support from humanitarian and relief organizations such as the Red Cross. National policies have also been implemented or enhanced to support large scale mangrove restoration. In the Philippines, policies have been in place to help protect mangroves since the 1970s and, more recently, there have been multimillion-peso national programs for mangrove rehabilitation on top of externally funded projects. There has been more restoration of mangrove forests than any other coastal habitat and, thus, substantial experience and practice.

Given the importance of mangroves in building resilience and the successes of past mangrove restoration demonstration projects, **why are we still losing mangroves, and why have mangrove conservation and restoration not been greatly expanded**? There are a number of critical impediments to large scale conservation and rehabilitation of mangroves.

Problem 1: Poor practices in mangrove rehabilitation. While there have been important successes in mangrove conservation and restoration, there have been substantial failures too. In the Philippines, a review of mangrove rehabilitation initiatives indicated a survival rate of only 10-20% (Primavera and Esteban 2008). Similar rates are reported from other countries. There are many reasons for these failures. While generic best practice guidance on mangrove restoration is available (Primavera et al, 2012; Lewis and Brown, 2014), practitioners may not sufficiently tap into resources due to lack of awareness, a lack of capacity, or due to a lack of more specific standards for good practice. In particular, there has been; (i) too much focus on high-cost active planting, instead of facilitating natural regrowth through ecological rehabilitation, (ii) too often the wrong species are planted in the wrong sites (e.g., *Rhizophora spp.* in the subtidal instead of *Avicennia marina* in the upper intertidal), (iii) too much focus on meeting quotas for acreage or number of trees planted rather than survival of mangroves or area of existing forest maintained, (iv) a disproportionate focus on monocultures instead of more naturally resilient and diverse forest. Consequently, there is an ongoing debate about how to implement mangrove restoration and sustainable management projects well (Lacambra et al. 2013) and a growing discordance between agencies, organizations, and scientists that use mangrove conservation and restoration projects to meet social or ecological goals instead of identifying where and how to best meet joint goals.

Problem 2: Lack of vision on where and how mangroves can optimally enhance resilience. In most places, there is a lack of understanding of where mangroves should be most cost effectively restored or conserved for risk reduction. Because of this information gap, no large scale vision of mangrove restoration for resilience exists. There is also little information about where losses of remaining mangroves may result in the greatest increases in risks to guide preservation of current forests.

We need to identify where investments in mangrove restoration and conservation can effectively buffer the impacts of coastal hazards and reduce social vulnerability, particularly of women and children. In the Philippines, offshore fishing is traditionally a male activity and gleaning of shellfish for domestic consumption is left to women and children. Where fisheries are depleted and fish catches low, such gleaning provides food security to the household. The importance of mangroves for providing income to women and supporting food security is critical and rarely accounted for in environment and development decisions. Thus, there is a need to build on and utilize existing social vulnerability indicators (e.g., Beck 2014) to better target areas that are of particular importance for women and other vulnerable groups.

Problem 3: Ineffective Governance Frameworks and Institutions. Mangrove rehabilitation and management is often implemented independently from other coastal zone management and disaster risk reduction measures and policies. In most countries there are policies on mangrove conservation, but these frameworks are often not put into practice and/or often fail to align with other environment and development policies (or even contradict them). Infrastructure development for risk reduction (i.e.

dikes or seawalls) is often considered a competing approach to mangrove restoration, whereas, in practice, both have a role to play in the wider landscape and can often be combined to deliver optimal benefits (Figure 1). A more holistic approach to coastal management and policy could support integration of such approaches. Furthermore, many mangrove forests exist as common pool resources and, in such cases, unclear tenure and property rights can inhibit the development and implementation of mangrove management and rehabilitation plans (e.g., Roy et al. 2013). In the Philippines, tens of thousands of hectares of aquaculture ponds have been abandoned and should be reverted back to mangroves, but this process is often delayed by contentious tenure issues (Primavera, 2005).

Figure 1. A breakwater was installed to protect and grow beachfront mangroves. Ajuy, Iloilo, Philippines.

Problem 4: Lack of Convincing Business Cases. Ideally, environment and development decision making would be guided by analyses of the full costs and benefits of projects. Some benefits provided by mangrove are difficult to assess, particularly many cultural values. Increasingly, research is demonstrating that many mangrove values can be accounted for in monetary terms such as coastal protection, fisheries and blue carbon (e.g., Barbier et al. 2008, Siikamaki 2014), but they are rarely used in comparisons of development options. In the absence of convincing coastal protection values of mangroves, risk managers will tend to utilize conventional solutions, such as hard-infrastructure designs. Further, the lack of analysis of the costs and benefits of integrated solutions makes it hard to identify trade-offs and devise incentives for conflicts to be resolved. A World Bank Guidance Note is being developed that provides approaches for including mangrove coastal protection values in National Wealth Accounts and other national decisions (Beck and Lange, in review). This kind of information on values, trade-offs and the distribution of ecosystem benefits is sorely needed as there are many instances where mangrove conversion and infrastructure development have provided windfall profits to some at the cost to those who are most at risk.

Problem 5: Few Measures and Effective Methods for Assessing Success. Measurements of success of mangrove conservation and restoration projects are uncommon. Often support for restoration projects end just after the last active intervention, e.g., the last seedling has been planted (NOAA SAB 2014, Ferrario et al. 2014), which is one reason why poorer practices are not improved. If we had easier methods of assessing current and past successes of mangrove projects it would enable more strategic investments by donors and create the transparency and pressure necessary to implement better practices that could lead to large-scale mangrove rehabilitation. Without such measures and effective, easy to use monitoring tools, there is no way to understand what is working and there is little accountability related to mangrove restoration and management effectiveness.