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An Ecosystem Approach to Disaster Risk Reduction: The Challenges of Multilevel Governance

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Introduction

In response to the increasing frequency of extreme disaster events across the world, scholars of disaster risk reduction (DRR) are showing interest in the opportunities presented by ecosystem-based approaches (Renaud et al., 2013; Uy and Shaw, 2012; Sudmeier-Rieux et al., 2006; Sudmeier-Rieux et al., 2009). Recent research has highlighted the effectiveness of ecosystem functions and services for reducing disaster risks, including coastal and urban flooding, tsunami, and storm surges (Kathiresan and Rajendran, 2005; Spalding, 2014; Nel et al., 2014). However, in addition to the importance of physical ecosystem functions for providing risk reduction benefits, we must also understand how an ecosystem-based approach can be better implemented and governed across different spaces and scales to yield more effective disaster risk reduction policies and actions.

The Strengths

Ecosystems offer many types of services, including different supporting, provisioning, regulating, and cultural services (MEA, 2005). Based on the outcome of the Rio Earth Summit in 1992, an "ecosystem approach" is defined as a strategy for the integrated management of land, water, and living resources to promote their conservation and sustainable use in an equitable way. This language was later adopted by the Convention on Biological Diversity (CBD) in 2000 (Adams et al., 2004).

Current DRR research shows that the provisioning and regulating services of ecosystems are the most prominent functions for reducing disaster risk. An example is the use of mangroves as natural barriers to protect settlements from tsunami or coastal flooding, which yields hazard reduction benefits while simultaneously offering livelihoods support and vulnerability reduction opportunities for communities. Other best practices include the planting of riparian tree as buffers to flooding in river catchment areas or incorporating the participation of local communities to raise awareness and ensure the sustainability of different risk reduction programmes (Daigneault et al., 2016). Also, research conducted on the opportunities of ecosystem-based coastal defence in the UK showed that reclaiming marshland will yield more economic benefits compared to building dike infrastructures after a period of only 25 years (Turner et al., 2007).

Research has also shown that such "soft" forms of disaster mitigation – as compared to concrete "hard" infrastructures such as sea walls and breakwater – result in fewer incidences of environmental degradation as well as fewer direct threats to local livelihoods. For example, the use of mangroves as natural barrier against destructive waves and storm surges has proven to simultaneously conserve marine biodiversity (such as fishes and crabs) while also protecting the productivity of local fishermen (Renaud et al., 2013; Sudmeier-Rieux et al., 2006; Sudmeier-Rieux et al., 2009; World Bank, 2016). However this is not always the case. For example, in India, the construction of a breakwater to combat storm surges in Tamil Nadu closed off coastal spaces for local fisherman to dock their traditional fishing crafts, land and dry daily fish catches, and mend fishing nets and other gear (Lakhsmi et al., 2012). In Kerala, the existence of breakwaters produced worsening levels of coastal erosion in adjacent areas (see Rodriguez et al., 2008).

The examples above show three distinct strengths of ecosystem-based approaches: they are (1) environmentally sustainable, (2) cost effective, and (3) socially and economically responsible.

The Limitations

Despites the various strength, some have argued that ecosystem-based approaches are not a panacea for all types of disaster risk reduction. Some note that ecosystem-based strategies must be pursued according to a case-by-case basis in order to tackle local disaster risks and impacts effectively. Furthermore, in some cases, a hybrid approach that combines the functions of both hard and soft infrastructures can be more effective in addressing disaster risks (see for example the Demak projects in Indonesia as described in de Vriend et al., 2015).

In general, several conditions should be considered when incorporating ecosystem-based disaster risk reduction. First, the non-linearity of disaster events means that not all types and magnitudes of disaster risks can be reduced solely by ecosystem-based approaches. Natural variability and the presence of previous interventions must also be taken into account (Koch et al., 2009). For example, in the case of tsunami, there are debates on whether mangroves can actually protect the coastal zones (see Kathiresan and Rajendran in 2005; as debated by Kathiresan and Rajendran, 2006; Kerr et al., 2006). In this case, hard engineering structure is needed to provide effective and immediate protection.

Second, since disaster risks are often framed as a "wicked" problem, ecosystem-based approaches entail different implications for governance and policy implementation. In particular, there continues to be a gap between the science and its usage in evidence-based policy-making, which leads to unclear and sometimes contradictory information on the role of ecosystems for DRR, such as the quantification of ecosystem value and services to reduce hazards and/or vulnerability (Renaud et al., 2013). Furthermore, efforts to harness ecosystem services to reduce risks require strong involvement and commitment of governance actors across all levels. This facilitates joint and integrated actions for realising the benefits of ecosystem-based approaches.

The Challenges on Multilevel Governance

The aim of this section is to unpack the challenges associated with effectively implementing and mainstreaming ecosystem-based disaster risk reduction approaches across different levels of governance.

The Global Level

At the global level, there are three recent global frameworks that seek to mainstream ecosystem-based approaches. These include the Sendai Framework on Disaster Risk Reduction, the Sustainable Development Goals (SDGs), and the COP21 Paris Agreement.

The Sendai Framework for Disaster Risk Reduction mentions ecosystems as being both prone and vulnerable to natural and human activity-induced hazard impacts, therefore they need to be adequately protected over the next 15 years. Furthermore, these global frameworks argue for their sustainable use and management to reduce disaster risks (UNISDR, 2015). However under the SDGs, ecosystem-based approaches as "tools" for reducing disaster risk have not been specifically mentioned. Instead the SDGs mainly focus on conserving ecosystem health with relation to water and marine ecosystems (see Goals 6 and 14) (UN, 2015). Lastly, similar to the SDGs, the COP21 Paris Agreement is addressing climate change impacts and disaster risks on people, livelihoods, and ecosystems (UNFCC, 2015). Despite these global policies and protocols, all share crosscutting constraints in their vague articulation of priorities related to ecosystems and ecosystem-based approaches, as well as the non-standardisation of monitoring and evaluation mechanisms.

The National Level

At the national level, the existence of policies and incentives for mainstreaming disaster risk reduction into national development agendas is the critical factor. However, there remain questions about whether ecosystem-based approaches prioritise actions against particular types of disasters, which often depends on how a country defines *disasters*. For example, in Indonesia, where disaster management has been skewed towards sudden and quick onset disasters such as earthquakes and tsunamis, *response* mechanisms are typically prioritized over *preparedness* actions (Ardiansyah, 2016). This highlights the need to build confidence in particular interventions and to balance long-term ecosystem rehabilitation against short-term protective benefits.

The Local Level

As global frameworks tend to be very general and not tailored to each case, the implementation of global norms at the local and community level is challenging due to the diverse characteristics of each region. Since a majority of case studies from the local level include different participatory mechanism, this will lead to double standards in measuring programmatic impacts as well as difficulties in evaluating the success of ecosystem-based disaster risk reduction efforts. As a result, there is a need to envision and facilitate ecosystem-based approaches that are *at scale*, and target local political, economic, and environmental conditions.

Policy Recommendations

A multilevel perspective is critical to understanding the opportunities and

constraints of ecosystem-based approached to disaster risk reduction. To encourage policy development, future approaches must consider the following:

- Indicators should be developed to account for appropriate and effective ecosystem-based disaster risk management tools, technologies, and policy solutions. These indicators should be accompanied by a robust decision-support mechanism to help governments evaluate, prioritise, and monitor specific interventions. This system should then be institutionalised in the form of a comprehensive repository of best practices that catalogue on-the-ground, empirical examples.

- Evaluative tools for ecosystem-based approaches should be developed and harmonised across multilevel governance and policy-making contexts. Future policies must account for multilevel decision-making pathways, sources of financial and capacity support, pathways of data and knowledge transmission, and mechanisms for civil society participation.

- There is a need for clear identification of synergies between ecosystem-based approaches and other disaster risk reduction strategies, as well as with corresponding tools for climate change adaptation. Without an understanding of these cross-sectoral synergies, the full benefits of ecosystem-based approaches will not be realized.

In summary, despite the presence of different global frameworks for DRR, there will likely be gaps between global rhetoric and national and local implementation. To further the effectiveness of ecosystem-based actions, national and local actors should develop a repository of knowledge that is applicable to different contexts.

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