Issues Brief

Considering Green Infrastructure and Ecosystems in the Sendai Framework Monitor

[Contribution to Working Session on 'The role of green, blue and gray infrastructure in reducing disaster risk']

By

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RATIONALE

A majority of current and planned infrastructure investments in disaster risk reduction (DRR) still target grey solutions such as dykes, sea-walls, groins, and reservoirs, which have protected many people globally and still have an important role to play in DRR. Nevertheless, grey approaches also have their limitations and have failed as a single solution on numerous occasions, or sometimes have increased the impacts of natural hazards, for instance by providing a false sense of security for communities settling behind them.

One disadvantage of the grey infrastructure is that it cannot self-adjust to the consequences of climate change, and it does not provide further benefits than offering protections against a certain magnitude hazard. Grey infrastructure neither address the underlying causes of disaster risk, nor prevent the emergence of new risks.

The global DRR community is encouraging investments in resilient infrastructure. Respective solutions might be called green or blue infrastructure (GI), ecosystem-based DRR (Eco-DRR), building with nature or nature-based solutions (NbS) for DRR in different fields of research and practice, and have gained increasing attention in the last ten years as measures that can work in a complementary way with grey approaches either as stand-alone solution or in combination with grey measures (known as 'hybrid solutions').

The implementation of green or hybrid solutions means that GI and ecosystems need to be maintained, well managed, and monitored as they become critical infrastructures in the context of DRR.

To achieve better management, monitoring and uptake of GI and Eco-DRR, it is key to understand 1) how these reduce disaster risk and provide critical infrastructure services, 2) how GI and ecosystems losses can be monitored to report the progress made towards the SFDRR and 3) how the uptake of GI and Eco-DRR can be enhanced by providing guidance on combining green and grey infrastructure in overall DRR planning.

STATE OF PLAY AND OPPORTUNITIES

GI and ecosystems reduce disaster risk and provide critical infrastructure services

Ecosystem-based solutions are relevant to various dimensions of DRR: they can attenuate the hazard itself and, as an important difference to grey infrastructure, they can help to reduce social vulnerability through provisioning services such as food and water supply. For example, restored and maintained wetlands, such as floodplains, marshes, peatlands and lakes help to increase rain infiltration and thus reduce peak river discharge but also buffer low-flow situations and thus water scarcity. At the same time, the biodiversity of these systems allows for food to be collected and they can become important features in water supply networks. When ecosystems are protected or restored along e.g. coastlines or riverbanks, they can act as a natural buffer to hazard events and as such possibly reduce exposure to hazards. **With a**

growing number of GI and Eco-DRR implementation world-wide, there is increasing evidence for the effectiveness of these ecosystem-based approaches for DRR. For example, coral, and oyster reefs, seagrasses, sand beaches, dunes, and barrier islands, mangroves, salt marshes, and other wetlands have been shown to contribute to shoreline stabilization, erosion control and/or wave energy attenuation. Ecosystem-based solutions can also protect grey infrastructure, thus reducing maintenance costs, supporting lifespans and enhancing the sustainability of grey infrastructure. **Ecosystem-based solutions are now increasingly mainstreamed**, one example being the World Bank's Nature-based Solutions Program, which sets out to facilitate uptake of nature-based solutions in DRR projects (Ozment et al. 2019).

Monitoring green infrastructure as part of Sendai Target C and D

In the Technical Guidance for Monitoring and Reporting on Progress in Achieving the Global Targets of the Sendai Framework for Disaster Risk Reduction (TGN) published by the United Nations Office for Disaster Risk Reduction, GI is referred to as a category of possibly damaged or destroyed infrastructure. According to the TGN "Green infrastructure is a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services such as water purification, air quality, space for recreation and climate mitigation and adaptation, and management of wet weather impacts that provides many community benefits".

The indicators under Target C5 focus on direct economic loss resulting from damaged or destroyed critical infrastructure attributed to disasters and Target D4 on the number of other destroyed or damaged critical infrastructure units and facilities attributed to disasters. For these two indicators, GI can be considered as one type of critical infrastructure. Blue (water-related) infrastructure, which are part of ecosystem-based approaches, can and should also be considered integral part of the Sendai target indicators. Despite this reporting option, countries are not yet taking advantage of it and have not yet considered GI in their reporting efforts to date. Improving the situation involves the development of guidance on how to monitor GI as part of Sendai Target C and D.

Uptake of GI and Eco-DRR, integration of grey and green solutions

Overall, although there is recognition of the role of ecosystem-based approaches and although the necessary tools for applying green and blue infrastructure in DRR are increasingly available, scaling-up implementation of these solutions has proven challenging so far. This is in part due to the fact that a majority of investments (current and planned) in infrastructure are grey. In addition, they are rarely risk informed from a DRR and ecosystem/community resilience perspective and there is a **lack of guidance to design and evaluate GI on the same footing as grey infrastructure** (Browder et al. 2019).

WAY FORWARD

1) Monitor green infrastructure as part of Sendai Target C and D

The GI related indicators in D-4 and C-5 in the Sendai Framework Monitor (SFM) are specifically mentioned in the footnote, which allows for the monitoring of green infrastructure as one type of critical infrastructure. This footnote on green infrastructure represents an opportunity for monitoring losses related to GI and ecosystems. For assessing the disaster impact on GI and ecosystems as critical infrastructure **clarity is needed to determine which GIs and ecosystems are to be considered as critical infrastructure**.

The critical infrastructure function might be defined by the GI´s contribution to DRR e.g. via specific GI functions and/or services, notable GI **protection function** (e.g. wetland and coral reefs in context of storms) **or the provision of basic services** (e.g. wetlands or sand dunes contributing to water purification and with that to water supply) (Sebesvari et al. forthcoming). After an **identification and localization of these GIs** by means of e.g. social-ecological risk assessments, ecosystem service assessments, watershed/water supply assessments, **a baseline assessment** needs to be produced based on e.g. available publications, earth observation data or field data on ecosystems, ecosystem services, natural capital, strategic environmental impact assessments, and economic assessments of ecosystem goods and services.

Additionally, a country which identifies wetlands, for example, as an important element of its DRR strategy, could **also identify wetland restoration and protection as one of its custom targets in the SFM**, and could define respective custom indicators. This would allow Member States to report, not only on losses but on progress made in protecting, and thus managing of GI and ecosystems for DRR more sustainably (Sebesvari et al. forthcoming).

2) Uptake of GI and Eco-DRR, integration of grey and green solutions

As countries start replacing ageing infrastructure while investing in new ones**, new ways are needed to highlight how we can better integrate green and blue infrastructure into current and future planning processes**. Integration means that a hydraulic engineer, for instance, increasingly seeks collaboration with other disciplines, such as ecology, economics, social and administrative sciences for innovative and acceptable solutions. In other words, **design approaches are moving from being reactive, minimizing and mitigating the impacts of a set design, to being pro-active by optimizing all functions and ecosystem services**. Private investors and other stakeholders working alongside governments, will and can play a profound and positive role in the delivery of GI as means to prevent future risks while taking into account the current risk landscape. **Progress has been made in moving away from discussing and assessing GI solutions in isolation, towards demonstrating how the combination of green and grey infrastructure reduces disaster risk and offers multiple benefits.** Further guidance on how grey and green infrastructure can be combined to enable the adoption of more effective green-grey project strategies is provided by for instance by a

recent report on ´Integrating Green and Gray: Creating Next Generation Infrastructure´ (Browder et al. 2019).

The DRR community can also **learn from early adopters in the field of implementation**. Examples include USACE´s recently released ´Engineering with Nature´, an atlas presenting the diversity of applications and benefits (Bridges et al. 2018) and EcoShape´s Building with Nature Guideline, helping users to choose appropriate solutions (https://publicwiki.deltares.nl/display/BTG/Guideline and De Vriend and Koningsveld, 2012).

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