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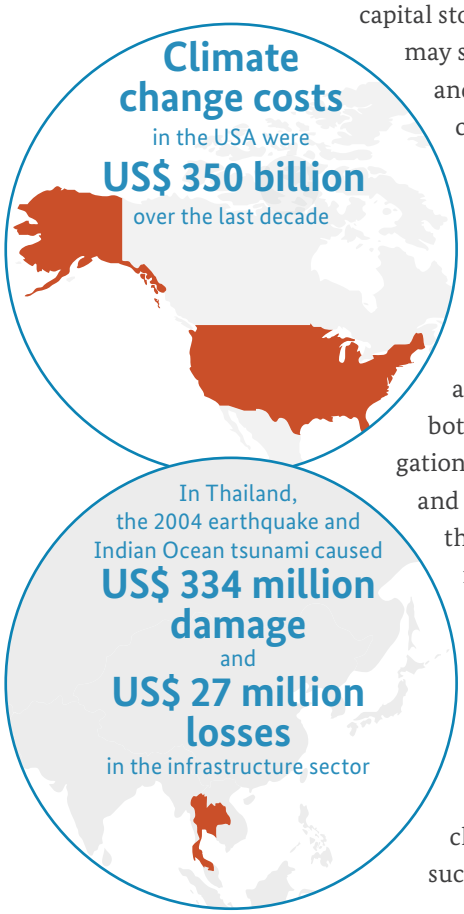
Opportunities in

the infrastructure sector [1]

for integrating ecosystem-based approaches to climate change and disaster risk reduction

How physical and natural infrastructure is affected by climate change and disaster risks

Industrialization, the use of fossil fuels, and poor consideration for the environment have contributed to climate change, intensifying the frequency and strengths of natural disasters around the world. Extreme weather patterns are causing intensified storms and flooding and at the same time in other regions, droughts and desertification are becoming the norm. Natural disasters destroy jobs, oblige people to move and slow down economic activity through the destruction of capital stock, delivery and transport systems and other infrastructure. Although rebuilding capital stock following a disaster may stimulate GDP, the short- and long-term economic consequences of disasters are negative, particularly for developing and smaller economies (Felbermayr and Gröschl, 2013). Infrastructure is a key area that can help meet both climate change mitigation in reducing emissions and adaptation objectives through building disaster resilience.



Physical and natural infrastructure can be negatively damaged or even destroyed by natural hazards and climate change impacts such as extreme weather events in the short term. As the global population and economy grow thus more physical infrastructure is to be constructed, there will be more risks for the infrastructures around the world. A 2017 report by the U.S. Government Accounting Office found that climate change had cost U.S. taxpayers some US$ 350 billion over the previous decade (GAO, 2017); in Thailand, the 2004 earthquake and Indian Ocean tsunami caused US$ 334 million damage and US$ 27 million losses in the infrastructure sector (ADPC, 2014). Although natural hazards and climate change impact natural infrastructure, it can be regarded as a disturbance that is a part of a long-term natural process and it can recover and adapt to the changing conditions.

Physical infrastructure and natural infrastructure such as sea walls, riverbanks, dams, coastal forests are also built and maintained to mitigate disaster risks. They also need to be adapted to the long-term climate change impacts such as sea level rise and changing weather patterns such as intensifying and increasing storms or droughts. UNFCCC estimate of additional annual investment need and financial flow needed by 2030 in the infrastructure sector to cover costs of adaptation to climate change is 8 to US$ 130 billion (UNFCCC 2007).

Why ecosystem-based approaches for infrastructure should be strengthened

Many scientists recently started to argue ecosystem-based approaches can provide more cost-effective and low-regrets solutions especially in the face of uncertain climate change scenarios

[1] The development and authorship of the sectoral brief "Opportunities in the infrastructure sector for integrating ecosystem-based approaches to climate change and disaster risk reduction " was led by the International Labour Organization with contributions from the International Union for Conservation of Nature.

(Cheong et.al. 2013, Timmerman et.al. 2013 and 2015, Martin and Watson 2015). Scientists also compare the strengths and weaknesses of built infrastructure, natural ecosystems, and point out the innovative opportunities to combine the two into hybrid approaches (Sutton-Grier et.al. 2015).

Some of the key benefits of Ecosystem-based approaches are summarized as follows:

- **Multiple benefits:** Besides risk reduction, ecosystem-based adaptation and disaster risk resilience provide a multitude of benefits to society and economy at low cost, including provision of natural resources (food, fibres, medicine), water regulation, climate change mitigation by carbon sequestration, recreation and provision of habitats for species.

- **Cost-effectiveness:** As natural buffers, ecosystems are often less expensive to maintain and could be more effective than physical engineering structures. Depending on local conditions and climate projections, hybrid green-grey infrastructure solutions that combine ecological infrastructure (e.g. forests, wetlands) with built infrastructure (e.g. dams, water retention ponds) may work best in terms of public health, social cohesion, urban biodiversity and mitigation, creating win-win solutions for the environment, society and the economy (NWP, 2017).

- **Contribution to the local economy and decent jobs:** Investing in infrastructure provides opportunities for employment creation, income generation and inclusive economic growth. The construction and maintenance of infrastructure create direct, indirect and induced impacts through employment while the assets subsequently built up will improve access to services, income, and sustained employment and trade opportunities. The optimal use of local labour and materials will have further backward and forward linkages, stimulating the local economy and contributing to poverty reduction as well as ensuring sustainable construction practices.

- **Adaptive management:** Due to the fixed design and purpose of built physical "grey" infrastructure measures, they often cannot be modified afterwards; ecosystem-based or hybrid approaches, combining grey and green infrastructure can be adapted and managed more easily to fulfil their functions for society.

- **Using local knowledge:** Ecosystem-based approaches are often built on local, traditional or indigenous knowledge. They acknowledge and utilize this knowledge in combination with scientific knowledge in the context of using land-based and marine resources.

Practical examples of ecosystem-approaches are also increasing in the face of climate change. For example, Room for the River programme in the Netherlands aims to bring back the natural river flood plains and wetlands to act as buffer capacities in case of increased river water levels. Green Infrastructure Plan of New York City is building rain gardens and other types of green infrastructure to manage storm water and improve water quality in local waterways. ABC (Active, Beautiful, Clean) waters policy tries to build attractive green space, parks, water courses and green buildings to capture and retain rain waters as well as to create an attractive urban environment. Mangrove for the Future (MFF) project restores mangrove forests along the coastline in more than 10 countries in Asia to protect coastlines as well as contribute to the local livelihood.

Photos, from top to bottom:
❶ Eco-engineering by using broom grass for road stabilisation thus reducing landslides risks, Nepal. © Sanjaya Devkota
❷ Mangrove restoration with hydrological plans carried out by the Mangrove Action Project (MAP) to reduce flood risks, Thailand. © MAP

Typical ecosystem-based approaches & technologies include the following:

Approach / technology examples	Environmental benefit	Risk reduction benefit	Socio-economic benefit
Use forests for disaster mitigation – identify areas where forests can mitigate natural hazards and plant and / or protect forests in those areas e.g. protection forests in Japan and Switzerland.	Providing habitats for species, climate change mitigation by absorbing carbon, conserving landscape beauty	Water retention, prevention of landslides, mitigating damage from wind, airborne sand, high-tides, tsunamis, snow, fog, avalanches, rock falls, flood damage mitigation etc.	Firewood, fodder, timber, other non-timber forest products
Maintain and restore mangroves for coastal protection – protect or / and plant mangrove trees by evaluating the environment and selecting appropriate species e.g. mangrove reforestation in Bangladesh.	Providing habitats for species, climate change mitigation by absorbing carbon, conserving landscape beauty	Mitigating damage from wind, airborne sand, high-tides, tsunamis, preventing land erosion, coping sea level rise	Increase of fish catch and other aquatic resources, eco-tourism opportunity, firewood, fodder, timber
Use coral reefs and seagrasses for coastal protection – protect coral reefs and sea grasses by designating marine protected areas.	Providing habitats for species, creating recreational opportunity	Mitigating wave energy, cooping sea level rise, coastal protection	Increase of fish catch and other aquatic resources, eco-tourism opportunity
Use wetlands for flood control – use wetlands or farmlands for flood control.	Providing habitats for species, creating recreational space	Mitigating flood risk	Increase of fish catch and other aquatic resources, eco-tourism opportunity, recreational space
Use protected areas for disaster risk reduction and reconstruction – setting aside hazardous area as protected areas.	Providing habitats for species, creating recreational space	Mitigating various disaster risks	Eco-tourism opportunity, recreational space
Apply ecological engineering and combine grey and green infrastructure – e.g. quasi-natural river engineering.	Providing habitats for species, conserving landscape and seascape beauty	Mitigating various disaster risks	Increase of fish catch and other aquatic resources, eco-tourism opportunity, recreational space

Photos, from top to bottom:
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❶ Coastal forest, Vietnam. © ICPM
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In 2011, the ILO coined the term "Green Works" to refer to "infrastructure and related works that have direct environmental benefits or are in response to a specific environmental context including changes in climate and extreme weather events". Different techniques appropriate to labour based approaches can be used, for example on road construction, including cold techniques with bitumen emulsion, which avoid heating the aggregates and can reduce the environmental impacts and decrease occupational hazards (ILO, 2013). Green Infrastructure (GI) encourages infrastructure investments by relying on services produced by ecosystems, for example, using natural infrastructure for flood protection, water purification and storage, and by reducing runoffs. As such GI through labour-based approaches can contribute to decreasing ecological casualties while bringing significant benefits to biodiversity, environmental rehabilitation and increasing biodiversity.

Existing opportunities & required action

Entry points as opportunities for strengthening ecosystem-based approaches for climate change adaptation and disaster risk reduction for physical and natural infrastructure include the following:

- Mainstreaming into various policies, plans and strategies such as national development plans, employment plans, infrastructure development plans, environmental plans, adaptation plans (NAP) (e.g. European Commission introduced Green Infrastructure Strategy in 2013; Japan integrated Green Infrastructure into its 4th National Infrastructure Development Plan in 2015).

- Using strategic environmental assessment as an opportunity to consider natural or hybrid "green-grey" infrastructure as an option.

- Pilot testing innovative technologies and ideas and try to upscale them into technical standards (e.g. Building with Nature programme is pilot testing innovative technologies in private-public partnership) and employment intensive investment programmes.

- Use recovery and reconstruction process to introduce ecosystem-based approach (e.g. green works / infrastructure and approaches that were integrated into Hurricane Sandy Rebuilding Strategy and an international competition to select Sandy recovery plans was organized under these recommendations).

- Empowering affected communities – especially poor rural or urban ones, as well as indigenous and tribal peoples – to adapt to the changing climate is necessary to reduce future impacts on their livelihoods and living conditions.

- Recognizing that indigenous peoples' traditional knowledge often does not receive adequate focus as a means for building climate resilience at the local level.

Further action will be needed in the following areas:

- Promote scientific research and pilot testing to further accumulate evidence on ecosystem-based approaches and scaling-up this knowledge into technical standards and guidelines.
- Collect and revisit traditional knowledge and practices on ecosystem-approaches and integrate them into modern science.
- Encourage further collaboration among different scientific disciplines and government sectors such as civil engineering, disaster management, climate change, ecology and natural resource management.
- Device innovative comprehensive and inclusive planning process that should inform to stakeholders multiple benefits and risks of various options for infrastructure design ranging from physical to natural infrastructure in an unpredictable changing climate.
- Seek for more strategic, proactive, systems-level approaches to infrastructure planning that ensure nature-based solutions are carefully considered and integrated across different sectors, in close connection to the SDGs.
- Mainstreaming green infrastructure into National Adaptation Plans (NAP) and putting them into practice to meet both climate change mitigation and adaptation objectives by reducing infrastructure emissions and building resilience.
- However, inadequate resources and poor governance often result in the poor provision of public and community infrastructure, assets and services. Those services that would help to manage and cope by building climate resilience through water and soil conservations schemes, but also by supporting productive means of livelihoods through better irrigation and transportation systems, often receive limited attention in many of the countries of the region. At the same time, indigenous peoples' traditional knowledge often does not receive adequate focus as a means for building climate resilience at the local level.

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