SUSTAINABLE INFRASTRUCTURE PARTNERSHIP

LANDSCAPE OF KIRITSUGO WETLAND, NEMURO PENINSULA, HOKKAIDO, JAPAN ©RITSU MIYAMOTO/Shutterstock.com

JAPAN

ECOSYSTEM-BASED DISASTER RISK REDUCTION AS "NATURAL INFRASTRUCTURE" IN JAPAN

2022

The International Good Practice Principles for Sustainable Infrastructure

set out ten guiding principles that policymakers can follow to help integrate sustainability into infrastructure planning and delivery. They are focused on integrated approaches and systems-level interventions that governments can make to create an enabling environment for sustainable infrastructure. This case study illustrates specific aspects of one principle in a country context, showing good practices and challenges, and considering potential for advancement or replicability.

GUIDING PRINCIPLE 4: AVOIDING ENVIRONMENTAL IMPACTS AND INVESTING IN NATURE

Adverse environmental impacts from infrastructure should be minimized, and natural capital enhanced to the greatest degree possible. Construction should be avoided in areas important for the persistence of biodiversity or having high ecosystem service value. The development of physical infrastructure should seek to complement or strengthen, rather than replace, nature's ability to provide services such as water supply and purification, flood control and carbon sequestration. Nature-based solutions should be prioritized.

BACKGROUND

Japan is particularly vulnerable to natural hazards such as typhoons, heavy rains, landslides, floods, earthquakes, tsunamis and volcanic eruptions. Disaster risk reduction is therefore a priority for national and local governments. After Typhoon Vera killed 5,000 people in 1959, the government established the Central Disaster Management Council and the Basic Disaster Management Plan, and invested in dams and sea walls for flood control (Japan International Cooperation Agency 2016).

However, Japan is now confronted with the need to replace this ageing infrastructure, including infrastructure used to safeguard the well-being of more vulnerable communities. Overall, the operation and maintenance of built infrastructure places a significant burden on the national budget and has had negative impacts on ecosystems, weakening their ability to act as buffers against natural hazards and to provide ecosystem services in non-disaster times (Kato and Huang 2021). Climate change is set to further alter – and in many cases increase – the frequency, intensity, spatial extent and duration of extreme weather events, leading to increased stress on human and natural systems (Lavell *et al.* 2012). In response, Japan is adopting Ecosystem-based Disaster Risk Reduction (Eco-DRR), a framework which minimizes impacts from infrastructure on ecosystems and enhances ecosystem resilience by combining long-term spatial planning with a return to traditional – and more sustainable – methods of disaster risk reduction.

Japanese people have historically used "natural infrastructure"[1] to limit damage from erosion, floods and natural hazards while conserving ecosystems. Farmers have cultivated forests to prevent soil erosion and planted bamboo alongside riverbanks to reduce flooding. In addition, Japanese people have traditionally integrated built infrastructure solutions with natural infrastructure. For example, farmers have used discontinuous embankments called *kasumi-tei* to store floodwater in rice paddies and riverbank forests since the sixteenth century. Eco-DRR integrates such traditional methods into planning and action frameworks, to reduce exposure to natural hazards and support communities during non-disaster times.

1 Natural infrastructure, also sometimes called "green infrastructure", refers to "elements of nature that are managed so that they provide infrastructure services" – see the International Good Practice Principles for Sustainable Infrastructure (United Nations Environment Programme (UNEP) 2022) for more information on the terminology of natural infrastructure, green infrastructure and sustainable infrastructure.

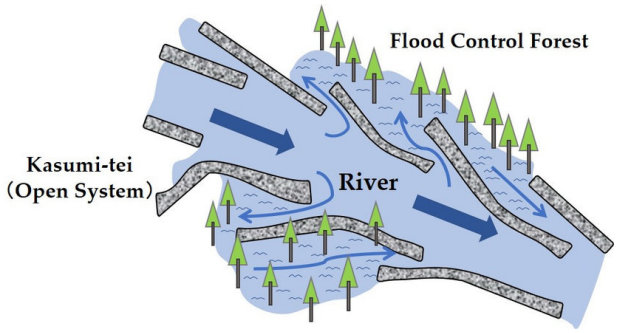


FIGURE 1: KASUMI-TEI

Source: Suzuki 2020.
Note: Kasumi-tei are discontinuous embankments which allow excess water to flow into temporary reservoirs such as rice paddies or riverbank forests during floods. After the flood, rice paddy and forest ecosystems slowly release water back into the river.

A HANDBOOK FOR PRACTITIONERS TO IMPLEMENT ECO-DRR

In 2011, a tsunami resulting from the Great East Japan Earthquake destroyed what was then Japan's most robust sea wall in the Taro district of the Iwate Prefecture (Japan, Miyako City 2015). Since this tsunami, the Japanese government has adopted a "multiple protection" disaster risk reduction framework, which includes Eco-DRR and safe evacuation procedures. National and local government institutions have gradually developed Eco-DRR projects for coastal system restoration, flood management and reforestation in the six prefectures impacted by the Great East Japan Earthquake (Japan, Ministry of the Environment 2016). In 2016, the Ministry of the Environment compiled the basic information on practical aspects of Eco-DRR in a handbook for practitioners to promote natural infrastructure for Eco-DRR in Japan (*Ecosystem-based Disaster Risk Reduction in Japan. A handbook for practitioners* [Japan, Ministry of the Environment 2016]).

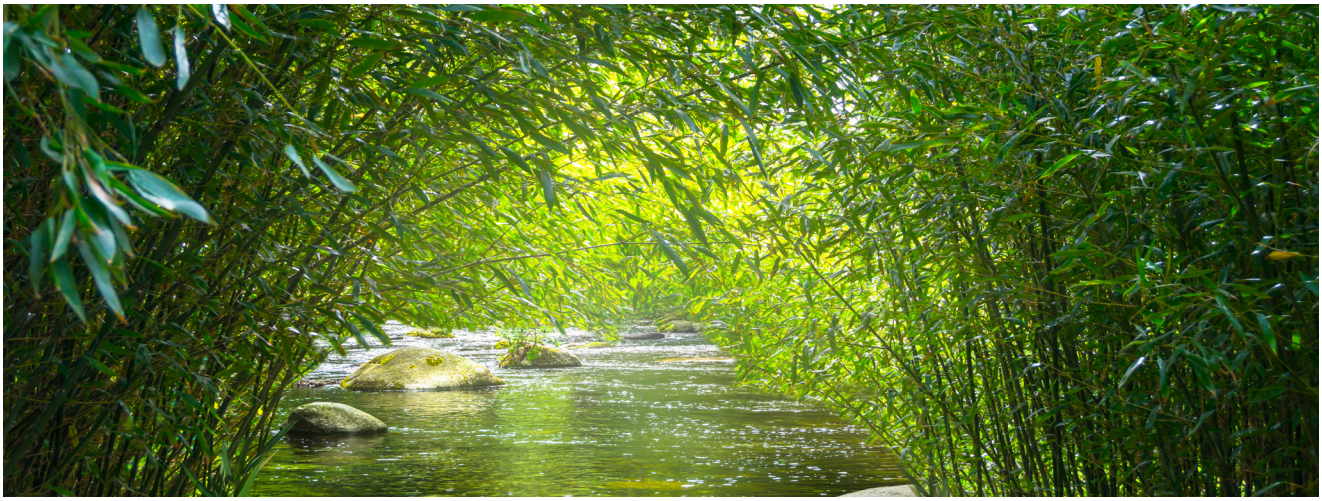
PRESERVING ECOSYSTEMS TO REDUCE DISASTER RISK

Sustainable natural infrastructure management lies at the core of the handbook's approach to Eco-DRR. The handbook advises practitioners to "minimize environmental impacts" and promote infrastructure that "utilizes the diverse functions of natural environments" to provide habitats for fauna and flora, control temperature rise and reduce exposure to hazards. In Japan, restoring coastal and river ecosystems is a critical component of disaster risk reduction and is articulated in the handbook as a priority. Degraded ecosystems can worsen the impact of extreme weather events (Estrella and Saalismaa 2013). For example, riverbank and coastal deforestation strips protection afforded by forests and leaves local communities more exposed to floods, tsunamis, erosion and storm surges. Long-term river management may include both forest conservation and the integration of ecosystems with agricultural infrastructure – for example, protection of upstream forests using rice paddies to limit downstream flooding (Kato and Huang 2021). Healthy forest ecosystems store and slowly release water, limiting flooding in lowlands, while paddy fields capture excess floodwater from forests and prevent damage in urban areas further downstream. Combining natural infrastructure with agricultural infrastructure like paddies or artificial structures such as concrete embankments affords multiple layers of community protection.

Regardless of the occurrence of natural hazards, Eco-DRR interventions provide multiple benefits for human well-being. The handbook advises local governments and other practitioners to capitalize on ecosystem benefits to public health and services such as food, scenic beauty and opportunities for education and tourism during non-disaster times. For example, paddy fields provide rice, serve as habitat for insects, amphibians and fish, and act as sinks to recharge groundwater and regulate water temperature (Natuhara 2013). River, coastal and mountainous ecosystems may support local economic development with opportunities for eco-tourism and recreational activities. The handbook encourages local governments to use Eco-DRR projects to enhance the target area's long-term productivity and safety, and bolster the socio-economic resilience of society at large. Furthermore, it emphasizes that quantitative and economic assessments of ecosystem functions will provide rational criteria for making decisions to build a consensus.

Beyond the handbook, Eco-DRR has been increasingly incorporated into the national policies of the Government of Japan. The 2013 Basic Act for National Resilience/Fundamental Plan for National Resilience asks the government to take advantage of "regional ecosystem-based functions to prevent and reduce disasters". The 2015 Priority Plan for Social Infrastructure Development requires Japan to keep pace with international discussions promoting natural infrastructure and Eco-DRR. In 2015, Japan was one of the 187 countries adopting the Sendai Framework for DRR during the third United Nations World Conference on Disaster Risk Reduction, which marked a significant shift from disaster management relying on built infrastructure to reducing risk exposure with ecosystem-based solutions. In 2020, Japan

used successive COVID-19 recovery packages as an opportunity to mainstream Eco-DRR into national climate mitigation and adaptation policies (Japan, Cabinet Office and Ministry of the Environment 2020). For instance, the Minister of the Environment and the Minister of State for Disaster Management are requesting government workers to ensure that future disaster recovery packages go beyond rebuilding in affected areas, and engage with adaptive land-use planning and community resilience to climate change.



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FUNDING NATURAL INFRASTRUCTURE

Eco-DRR, like many forms of natural infrastructure, may reduce initial, operating and maintenance costs by making use of existing ecosystems when possible. Whereas built infrastructure often generates environmental costs by degrading natural ecosystems, natural infrastructure accrues environmental benefits by safeguarding the landscape and supporting biodiversity before and after disasters. Healthy ecosystems provide local and global benefits like carbon sequestration, and help conserve biodiversity (Renaud *et al*. 2013). In Japan, partnerships between national institutions, prefectures and private corporations provide local governments with much-needed financial support.

The Ministry of Land, Infrastructure, Transport and Tourism provides Regional Renovation Infrastructures Reinforcement Subsidies and grants for regional rehabilitation projects, as well as community development funds designed to support local residents' involvement with infrastructure projects. The MLIT additionally provides funding and support for public-private partnerships through the Organization for Promoting Urban Development, and the Ministry adopted 20 public-private partnership projects for earthquake reconstruction in 2015. National institutions and private companies furthermore collaborate to send qualified personnel to small-sized local governments (Japan, Ministry of Land, Infrastructure, Transport and Tourism 2016).

A LOCAL GOVERNANCE PERSPECTIVE

Eco-DRR projects in Japan are multi-scale and people-centred. Local councils comprising residents (community association members), relevant organizations (including non-governmental organizations), chambers of commerce, fisheries cooperative associations, etc.), academics and empirical experts take land use patterns and regional development goals into account when devising Eco-DRR strategies. Reaching a consensus is particularly important in cases where Eco-DRR projects require continuous maintenance from diverse stakeholders, and where local residents are exposed to different degrees of risk. Overall, incorporating a variety of perspectives in the planning process helps councils formulate Eco-DRR plans to maintain local benefits and simultaneously build resilience on a regional scale.

For example, the local council in charge of a "Proposal for the Uda River Area Flood Control Plan" in Tottori Prefecture encouraged public participation with newsletters, briefing sessions for the local residents and public meetings. The flood control plan prioritized constructing embankments in residential districts and improving sections of the waterway most commonly used by local communities. In response to concerns from farmers, the proposal evolved to guarantee soil fertility in the rice paddies used as water storage sites. Monitoring soil quality ensures that the paddies in the Uda River Area will provide services both in

disaster and non-disaster times. This Eco-DRR strategy reflects local needs from the outset, in turn maintaining sustainability principles and inclusivity in response to natural hazards.

REPLICABILITY

Eco-DRR has expanded across Japan since 2011, with projects evolving to reflect local communities' needs and preferences. Japan's Minister of the Environment and Minister of State for Disaster Management encourage future infrastructure projects to utilize traditional disaster prevention knowledge and wisdom in considering the relationship between natural and built infrastructure. Eco-DRR is most likely to be successful – and sustainable – when building on existing land use patterns and establishing mechanisms for long-term management by local residents. For instance, in Uganda, community water user groups brought together upstream and downstream actors to co-lead a project to restore forest and riverbank ecosystems and reduce erosion and floods (Klein *et al.* 2019). There is no "one-size-fits-all" solution, but countries with very different economies, socio-political structures and ecosystems can successfully carry out natural infrastructure projects with commitment to principle.

KEY INSIGHTS

- Eco-DRR is a planning and action framework that uses healthy ecosystems as buffers to reduce exposure to natural hazards. This form of "natural infrastructure" helps preserve the capacity of ecosystems to provide services such as food, water, educational and tourism opportunities and scenic beauty in non-disaster times. The Government of Japan has been promoting good practices through a handbook for practitioners

- Quantitative and economic assessments of ecosystem functions will provide rational criteria for making decisions to build a consensus. Adapting an Eco-DRR approach may reduce initial costs, operating and maintenance costs.

- Eco-DRR is particularly efficient and sustainable when local communities are empowered to contribute to discussions around land use. The Uda River Area Flood Control Plan in Japan improved environmental and economic outcomes by preserving forest ecosystems and maintaining the viability of agricultural land.

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