

# Good practices for increasing the application of ecosystem-based adaptation and nature-based solutions for disaster risk reduction

## Volume II

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# Foreword by Brazil

Nature-based solutions emerge as a strategic pathway to address contemporary environmental and social challenges. In a context of accelerated climate change, where extreme events such as floods, droughts, and landslides are increasingly frequent, it is imperative to seek alternatives that integrate ecological resilience with social justice, preserving lives and ensuring socio-spatial equality. Urban and rural communities, particularly those in vulnerable situations, face serious risks arising from environmental degradation. Pollution, water insecurity, and food vulnerabilities not only compromise quality of life but also perpetuate historical inequalities.

However, by implementing solutions that respect and enhance nature, we envision a valuable opportunity to transform these challenges into new forms of development, strengthening the capacity for disaster prevention and response. Recognizing nature as an ally in this process is a strategic step toward developing more resilient infrastructures and sustainable cities through nature-based solutions.

This compendium brings together innovative and inspiring practices from G20 countries and partners, highlighting initiatives that operate in synergy with local ecosystems. By promoting community leadership and intersectoral collaboration, the G20 Disaster Risk Reduction Working Group aims create more resilient, inclusive, and sustainable cities and communities.

G20 Brazilian Presidency of Disaster Risk Reduction Working Group

**Jader Barbalho Filho**  
Ministry of Cities

**Waldez Goes**  
Ministry of Regional Development and Integration

# Foreword by UNESCO

Today, we are confronted with the escalating and devastating impacts of natural hazards which have placed unprecedented pressure on us to find solutions – both conventional and non-conventional. As the frequency and intensity of disasters rise, it is the vulnerable communities on the frontlines who bear the greatest burden. By embracing greening approaches, such as Nature-based Solutions, we can draw on the wisdom of indigenous communities and traditional practices to build resilience and foster a more harmonious relationship with the environment.

I thank the Government of Brazil for putting Disaster Risk Reduction on the agenda and continue the discussion on the Nature-based solutions since the Indian Presidency.

With its competencies in a variety of sectors including natural and human sciences, education, culture as well as communication and information, UNESCO plays a vital role in disaster risk reduction. As natural hazards wreak havoc globally, we need to work on a multitude of solutions to build a more resilient world. Through our scientific networks including Intergovernmental Hydrological Programme (IHP), the Intergovernmental Oceanographic Commission (IOC), Man and Biosphere Programme (MAB), International Geoscience and Geoparks Programme (IGGP), and UNESCO Designated Sites namely UNESCO Global Geoparks, Man and Biosphere Reserves, and World Heritage Sites, UNESCO has an added advantage to showcase Nature-based Solutions in vital places.

UNESCO is grateful to all 16 case study submissions from Member States, UN agencies and the European Commission to showcase best practices used in different countries and regions. These practices highlight the power of Nature-based Solutions, where the nature's own infrastructure becomes our greatest ally in building resilience, whether through trees that stabilize soil, rivers and wetlands that mitigate flooding, or mangroves that protect coastal communities and act as a buffer against rising seas.

UNESCO hopes this compendium presents a broad narrative of preservation, innovation, and profound respect for our shared planet, providing lessons that extend beyond borders and inspire us to strive for a greener, more sustainable, and resilient future.

**Lidia Brito**

Assistant Director-General for Natural Sciences, UNESCO

# Acronyms and abbreviations

**DRR**

Disaster Risk Reduction

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**Eco-DRR**

Ecosystem-based Disaster Risk Reduction

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**UNESCO**

United Nations Educational, Scientific and Cultural Organization

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**UNDP**

United Nations Development Programme

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**G20**

Group of 20

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**NbS**

Nature-based Solutions

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# I. Introduction

The second volume of the “Good Practices for Increasing the Application of Ecosystem-based Adaptation and Nature-based Solutions for Disaster Risk Reduction” builds on the foundational work established by the Group of 20 (G20) Working Group on Disaster Risk Reduction. As the world faces escalating challenges such as climate change, biodiversity loss, and the increasing frequency of natural hazards, the integration of nature-based solutions (NbS) into disaster risk reduction (DRR) and climate change adaptation has emerged as a vital strategy for building resilience. This compendium provides updated insights, case studies, and best practices that demonstrate the critical role of NbS in addressing these interconnected global crises.

The first volume emphasized the potential of NbS to offer cost-effective, scalable, and sustainable solutions for reducing disaster risks while fostering ecosystem health and community resilience. This second volume advances that narrative by incorporating the outcomes of the G20 Working Group on Disaster Risk Reduction, which has played a pivotal role in promoting the uptake of NbS among G20 countries. Recognizing NbS as a key priority, the Working Group has helped catalyze actions to scale up nature-based solutions and ecosystem-based approaches for DRR, supporting both developed and developing nations in enhancing resilience to natural hazards and climate change.

This compendium underscores the need for collective action to address climate risks, disaster vulnerabilities, and environmental degradation. The document reflects these shared priorities by showcasing successful NbS implementations across G20 countries and beyond, highlighting innovative financing mechanisms, legal and policy frameworks, as well as capacity-building initiatives. It aims to inspire more governments and organizations to adopt and adapt NbS in their DRR strategies.

Structured around key themes—including creating enabling legal environments, enhancing risk knowledge, implementing NbS for DRR, mobilizing public and private investments and reducing poverty and inequalities—this edition also draws upon lessons learned from a diverse range of case studies. Each section provides actionable insights into how NbS can help protect ecosystems, reduce disaster risks, adapt to climate change, and promote sustainable development, while also addressing socio-economic vulnerabilities.

Co-authored by UNESCO, this compendium seeks to be a valuable resource for policymakers, practitioners, and communities. It aims to foster knowledge sharing and collaboration to harness the full potential of NbS in reducing disaster risks and enhancing climate resilience globally.



# II. Good practice cases

**During the review of the cases, five overarching themes emerged that illustrate useful dimensions and perspectives in relation to NbS and their role in prevention, mitigation and preparedness for disaster risks.**

## 1. Creating an enabling legal and policy environment

The cases included under this theme underscore the pivotal role of legal and policy frameworks in facilitating the successful implementation of NbS. They demonstrate that NbS interventions are more likely to thrive where comprehensive disaster risk governance lays the foundation for their implementation. By fostering cross-sectoral collaboration, ensuring regulatory clarity and emphasizing ecosystem protection, Governments can create an environment conducive to working with nature towards socioeconomic resilience and prosperity.

## 2. Increasing risk knowledge, data and capacity

Robust knowledge, data and capacity-building efforts are prerequisites for effective implementation of NbS. Cases included under this theme emphasize the importance of interdisciplinary research, long-term monitoring and data-sharing. Furthermore, they illustrate the role played by capacity-building initiatives to equip policymakers, practitioners and local communities with the knowledge, expertise and skills to design, implement and evaluate NbS projects. Collaborative knowledge platforms and partnerships can bridge gaps in understanding and enhance the overall effectiveness of NbS interventions.

## 3. Implementing nature-based solutions for disaster risk reduction

Effective implementation of NbS is critical to ensure that they produce the expected environmental, social and economic benefits, increase resilience, and adequately address the disaster risk in question. The cases included under this theme emphasize the need for ensuring collaborative efforts that involve local governments and communities, leveraging traditional knowledge, employing robust monitoring and evaluation mechanisms, and focusing on long-term sustainability. By embracing these perspectives, NbS can emerge as a formidable tool in addressing environmental challenges and advancing climate resilience.

## 4. Enhancing public and private investments

NbS require substantial financial support. The cases included under this theme demonstrate the pivotal role of both public and private investments. Governments can leverage public funds through innovative financing mechanisms to attract private sector participation. The cases also showcase successful public-private partnerships that blend philanthropic, concessional and market-based funding. These partnerships can unlock substantial resources for NbS interventions when designed with clear accountability and risk-sharing frameworks.

On the whole, the cases presented in this compendium underscore the transformative potential of NbS and offer a number of entry points that can be tailored to specific national contexts, as well as lessons learned. Each of the four overarching themes is preceded by key takeaway messages to facilitate learning and understanding. By leveraging the perspectives offered in this document, governments, organizations and communities can harness the power of nature to address pressing environmental and socioeconomic challenges, building resilience and paving the way for a more sustainable and resilient future.

## 5. Poverty and Inequality

NbS can effectively address poverty and inequality by enhancing the resilience of marginalized communities, which are often the most vulnerable to climate change and disaster risks. By improving access to ecosystem services, creating sustainable livelihoods, and fostering inclusive decision-making, NbS can reduce socio-economic vulnerabilities while simultaneously mitigating disaster risks. The cases generate local jobs in disaster risk management, empowering communities by prioritizing the involvement of local people and businesses in implementing NbS. Investments are focused on vulnerable populations exposed to climate risks, with public policies promoting green infrastructure and community participation. These comprehensive approaches reduce vulnerability to disaster risk and simultaneously offers a path toward sustainable development that addresses both environmental challenges and socio-economic disparities.

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# A. Creating an enabling legal and policy environment



## Key takeaway messages

Legal frameworks and policies that prioritize ecosystem protection, disaster risk reduction (DRR), and climate resilience are critical to enabling the successful implementation of NbS. These frameworks facilitate cross-sectoral collaboration, ensuring that all stakeholders, from local communities to national governments, work together with clarity on regulations and guidelines.

Governments play a pivotal role in fostering an environment conducive to NbS by integrating disaster risk governance with environmental protection. This integration not only ensures that ecosystems are preserved but also supports socio-economic resilience by reducing vulnerabilities to climate-related disasters, thus protecting both natural and human systems.

The development, enforcement, and continuous updating of clear legal and regulatory guidelines ensure that NbS interventions are sustainable, scalable, and replicable. This is especially important for ensuring that other regions and countries can adapt and implement similar solutions based on proven success models.

# Case 1

## Case 1: Ebro Resilience Strategy



**Location:** Spain - Ebro River Basin District / La Rioja, Navarre, Aragon



**Level:** National



**Hazard:** Floods



**Solution/intervention type:** Nature-based solutions for flood risk reduction, social capacity building for flood risk adaptation, increase of risk awareness.



**Issue(s) addressed:** Flood risk management (prevention, protection, preparedness and recovery), climate change adaptation, improvement of the status of the waterbodies and habitats associated.

The central section of the Ebro River suffers frequent flooding that causes significant damage to the economic systems close to the river. This part of the Ebro River also holds significant environmental values, with areas included in the Natura 2000 Network and protected species. During the second half of the 20th century, important interventions were carried out to promote the expansion of intensive agriculture and flow regulation, which caused hydromorphological alterations and the loss of 50% of the river space, now occupied by vulnerable elements.

After the severe floods of 2015, the Ministry for the Ecological Transition and the Demographic Challenge launched the Ebro Resilience Strategy, in which the Autonomous Regions of La Rioja, Navarre, and Aragon participate under the coordination of the Ebro River

Basin Authority. It is a specific sub-programme of the Flood Risk Management Plan (FRMP) of the Ebro River Basin District (Ebro RBD) and constitutes the framework for cooperation between the different administrations and other actors to work in a coordinated way on flood risk management in this territory.

The Ebro Resilience Strategy aims to ensure that populations and economic activities within the Ebro River basin are compatible with the conservation of the river, while mitigating the risk of significant flood damage. The strategy establishes a new fluvial model focused on adapting to flooding and preserving river ecosystems.

Part of the strategy's actions will be developed through the Ebro Resilience P1, with a budget of 13 million euros from 2021 to 2027. The LIFE project aims to restore the river through nature-based solutions that induce flood risk reductions along the entire reach, and a novel intervention consisting of riparian buffers to minimize damage to farms and infrastructure.

Some key elements of the Strategy's success are the social action carried out, the participation of the local population from the beginning and throughout the process, and the framework of cooperation between all the administrations involved. The Ebro Resilience Strategy has launched communication, participation and training actions for the population in the affected areas, which include co-creation and working groups with the engagement of technical representatives of the project and the local population. Another strong point of the Strategy is the possibility of replicating the solutions proposed for similar cases in other areas of the Ebro river basin and other Spanish and European basins.

### Resources and further information:

- LIFE Ebro Resilience P1 VIDEO: [https://youtu.be/9PrIZg\\_BclM](https://youtu.be/9PrIZg_BclM)
- How Riparian Buffer Zones Work VIDEO: <https://www.youtube.com/watch?v=GGH6U9rFIdg>
- Website of the Ebro Resilience Strategy: <https://www.ebroresilience.com/en/>



**Morphological adaptation of the meander of "La Roza", Alfaro, La Rioja. It has led to the recovery of 22 hectares of fluvial space, and it is a protected area of the Natura 2000 Network "Sotos y Riberas del Ebro".**

Source: from the case study submission of Spain



**Technical visit of the co-creation group to determine the actions in "Soto of Alfaro".**

Source: from the case study submission of Spain

# Case 2

## Case 2: Ordinance for the sustainable treatment of sewage effluents.



**Location:** Argentina / Latinoamérica



**Level:** National



**Hazard:** Floods



**Solution/intervention type:** Legislation for the sustainable treatment of effluents



**Issue(s) addressed:** Climate risk, risk of surface and groundwater contamination.

The household effluent treatment system (sewer network) does not cover the entire city of Colón. For homes or establishments that cannot access this service, a Municipal Ordinance has approved the incorporation of an alternative treatment system inspired by biodegradation processes and the reuse of organic waste. These solutions prevent the direct discharge of effluents into watercourses or their infiltration into groundwater, along with the associated environmental risks, which are exacerbated during floods.

Ordinance 131/22 regulates the treatment of effluents generated by private homes, subdivisions, and tourist developments within the municipal jurisdiction, outside the reach of the sewer network, promoting the use of constructed wetlands and the reuse of treated effluents.

Through the ACC Río Uruguay Project, a technical proposal for alternative effluent treatment was

developed and presented to the Municipality of Colón, which approved it. A space for dialogue and exchange was then created with key actors and sectors of the city to build consensus. As a result, the proposal was submitted as a regulatory project to the local legislative body (HCD), which approved and enacted it as a Municipal Ordinance. Following this, dissemination and training activities were implemented by ACC Río Uruguay, promoting the adoption of these solutions.

Based on a technical proposal, an ordinance project was developed through a joint effort between the ACC Río Uruguay and the technical areas of the municipal executive. The initiative served as the foundation for a dissemination process, exchanges, and consensus-building to enhance the project. Once approved, technical training sessions were organized to enable users to implement sustainable effluent treatment in their own homes and businesses.

The population of intermediate cities is constantly growing, and their effluent treatment systems often do not cover all buildings. The solution proposed in the Ordinance suggests the gradual replacement of traditional 'cesspools,' promoting the emulation of natural processes, the creation of artificial wetlands, and the reuse of treated effluents, while simultaneously reducing the local water footprint. The initiative is replicable as a sustainable solution and also as a legal precedent, as the regulation can serve as inspiration for other localities to adopt this type of solution as an alternative.

### Resources and further information:

- Ordenanzas SbN: <https://www.youtube.com/watch?v=v4lNkZM5xuQ>
- Video: <https://youtu.be/zeOSshNezlg?si=pnzVE7Gg41uQbTTh>
- Manual: <https://accriouruguay.com/descargas/743>



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| Source: from the case study submission of UNDP



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| Source: from the case study submission of UNDP

## B. Increasing risk knowledge, data and capacity



### Key takeaway messages

Comprehensive and robust risk knowledge, underpinned by interdisciplinary research and long-term data collection, is essential for designing effective NbS interventions. Understanding the complexities of disaster risks and climate change impacts allows for informed decision-making and enhances the effectiveness of NbS in mitigating these risks.

Capacity-building initiatives are vital for equipping local communities, practitioners, and policymakers with the necessary skills and knowledge to design, implement, and evaluate NbS projects. These initiatives empower stakeholders at all levels to take ownership of NbS efforts, ensuring that interventions are context-specific and effectively address local needs.

Collaborative platforms for knowledge sharing, involving local and international organizations, enhance understanding and the overall effectiveness of NbS interventions. These partnerships help bridge knowledge gaps, facilitate the exchange of best practices, and foster innovation in the application of NbS across diverse geographic and socio-economic contexts.

# Case 3

## Case 3: Field Monitoring Hydro-Mechanical Effects of Vegetation Cover to Assess Triggering Mechanisms of Landslides



**Location:** Norway



**Level:** National



**Hazard:** Landslides



**Solution/intervention type:** Monitoring hydro-mechanical effects of vegetation cover including root strength



**Issue(s) addressed:** Increasing risk knowledge, data, and capacity

Rainfall-induced shallow landslides pose a serious threat to people, their dwellings, transportation infrastructure and the agroforestry production particularly in mountain areas. Vegetation can significantly contribute to slope stability; however, no studies on these effects has been conducted for Nordic conditions.

A field monitoring site has been established in a natural slope in the Flåm valley in western Norway. The study aims to increase the evidence base to understand the effects of vegetation on slope stability and subsequently improve risk assessments of shallow landslides.

This project is funded by the Norwegian Research Council and this field monitoring work is carried out by

the Norwegian Geotechnical Institute with contributions from Bern University of Applied Sciences. The case study site, the Ryo farm, is situated on the hillsides of the Flåm valley on the west coast of Norway. The area is recognized by UNESCO as a world heritage site, and the cultural landscape is maintained by the local inhabitants through traditional farming methods. The selected monitoring site is situated on a slope above the farm residence, with the slope partially used for grazing and partially covered by deciduous forest.

In May 2023, monitoring equipment was installed, including two tensiometers, four volumetric water content (VWC) sensors, and temperature sensors at predetermined soil depths. The sensors are connected to data loggers that record the measured parameters every 15 minutes, and the data are wirelessly uploaded to the cloud through the cellular network. Additionally, a weather station registers climatological parameters. Field investigations were conducted in September 2023 to map the root distribution of birch and alder trees in soil profiles and to collect soil and root samples. More recently, in July 2024, fieldwork included in-situ root pullout resistance tests.

Monitoring continues, and the data gathered in this study will be analyzed and used as input data for slope stability modeling. The aim of this modeling is to assess the effectiveness of the existing forest as a shallow landslide mitigation measure at the Ryo case study site.

The primary co-benefits for local farmers include the continued use of the site as a cultural landscape and the preservation of traditional farming methods. On a broader scale, the next phase of the project will assess the co-benefits of mixed vegetation in mountain areas for climate mitigation, providing critical information for both scientists and decision-makers.





**Monitoring station to continuously register volumetric water content, temperature and soil surface tension at different depths below the surface.**

Source: from the case study submission of Norway



**In-situ root pullout resistance tests to quantify the mechanical effects of tree roots on slope stability.**

Source: from the case study submission of Norway

# Case 4

## Case 4: Adapting to Rising River Flood Risk in Europe using Nature-based Solutions



**Location:** European Union



**Level:** Regional



**Hazard:** River Flooding



**Solution/intervention type:**  
Natural Flood Detention Areas



**Issue(s) addressed:** Assessment of economic costs and benefits of adaptation measures to reduce future river flood risk in Europe

The problem of rising climate impacts in Europe is gaining more and more attention among policy makers and the public. Effective adaptation strategies are needed to face the increased intensity and probability of climate hazards due to global warming, as well as to reduce impacts driven by economic development in hazard prone areas. To address this challenge and support the EU Adaptation Strategy, the Joint Research Centre (JRC) of the European Commission has performed the PESETA IV study that aims to better understand the impacts of climate change in Europe and how these could be avoided with climate mitigation and adaptation policies.

As part of this research project, the JRC has developed a pan-European modelling framework to explore the costs and benefits of river flood adaptation measures for a range of future global warming scenarios. The

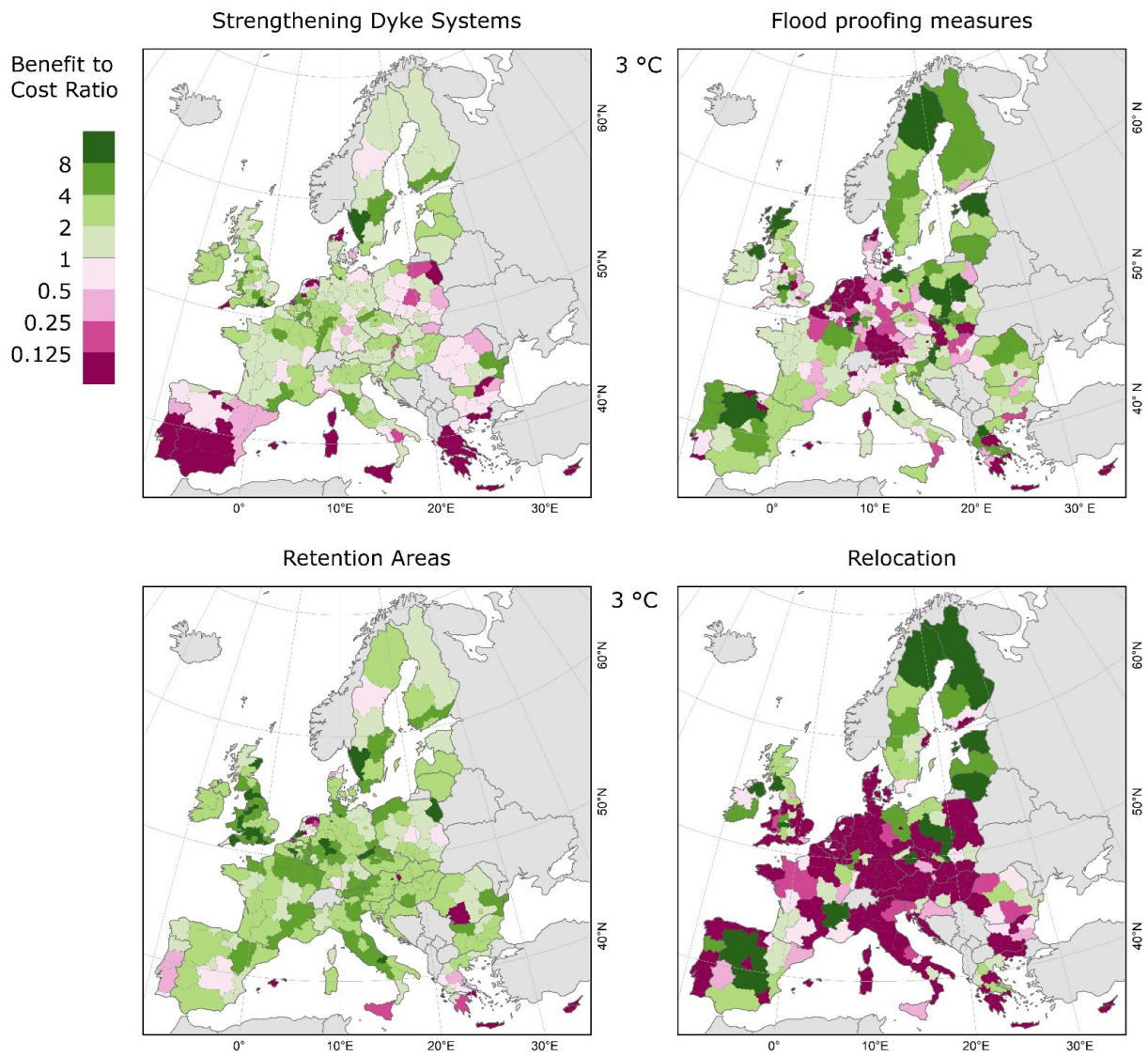
adaptation measures considered include “grey” measures, such as raising the height of river dikes, and nature-based solutions, such as the use of floodplains as natural detention areas to store excess floodwater and reduce peak flows.

The study found that the use of flood detention areas is the most effective measure in most of Europe, both in terms of risk reduction and cost-benefit ratio. The optimal implementation of this measure would need less than 2% of the overall cropland area in Europe, and could limit flood impacts to present-day levels, even with high levels of global warming. Moreover, each euro invested for the construction and maintenance of detention areas might save up to 4 euros of economic damages. This happens because all communities located downstream of detention areas receive protection from flood peaks, thus increasing overall resilience. In addition, reconnecting river with floodplains and restoring wetlands around the river course contribute to the protection and restoration of biodiversity and provide recreational opportunities.

The findings of this study are available for all river basins in the European Union and can be replicated at national or local scale for a more accurate assessment of the most effective risk reduction measures. The adoption of adaptation measures should be coordinated with adequate land use planning in flood-prone areas and with measures to mitigate climate warning.

### Resources and further information:

- Peseta IV project website, [https://joint-research-centre.ec.europa.eu/scientific-activities-z/peseta-climate-change-projects/jrc-peseta-iv\\_en](https://joint-research-centre.ec.europa.eu/scientific-activities-z/peseta-climate-change-projects/jrc-peseta-iv_en)
- Dottori et al., 2023, <https://doi.org/10.1038/s41558-022-01540-0>
- Nature-based solutions - European Commission ([europa.eu](https://europa.eu))



**Average Benefit-to-Cost ratio at local administrative level in EU+UK for different adaptation strategies for the 3 °C warming scenario.**

Source: from the case study submission of the EU

# Case 5



## Case 5: Analysis and mapping of threats, vulnerabilities, and capacities in protected areas



**Location:** Uruguay and Argentina / Latin America



**Level:** Regional



**Hazard:** Floods



**Solution/intervention type:**  
Mapping of risk factors and ecosystem benefits



**Issue(s) addressed:** Climate Risks

Climate change is altering ecosystems and the distribution of species, which must be considered in the management plans of protected areas and in biodiversity conservation. For this reason, the ACC Río Uruguay project provided funding to identify and map ecosystem services, including the condition of the coastal edge in the Esteros de Farrapos and Islas del Río Uruguay National Park (PNEFIRU), as well as the distribution of invasive woody exotic species especies exóticas invasoras leñosas (EEIL) that threaten biodiversity in El Palmar National Park (PNEP), to contribute to the planning and management of two protected areas along the Uruguay River.

The identification and mapping of ecosystem services and the distribution of EEIL, along with their incorporation into the planning and management of protected areas, will contribute to reducing the vulnerabilities of the Uruguay River's coastal ecosystems in the face of climate change

The ACC Río Uruguay project funded a consultancy carried out by specialists from the University of the Republic (Udelar) for PNEFIRU, whose final report is published on the project's website. Another consultancy is underway at PNEP, with its work plan publicly presented in the park. Central management bodies for protected areas in both countries (the National System of Protected Areas in Uruguay and the National Parks Administration in Argentina) are part of the initiative. The Río Negro Departmental Government and the Government of Entre Ríos are cooperating in generating these essential inputs.

Ecosystem services were mapped in PNEFIRU (including carbon sequestration through vegetation, nutrient retention, and riparian buffering capacity); erosion risk was also mapped, and the vulnerability of the coastal edge was characterized to guide possible conservation and restoration actions (PNEFIRU). Meanwhile, in PNEP, progress is being made in the identification and mapping of EEIL, including a survey protocol allowing interested individuals to collaborate with this enormous task, even without specific training or experience in the subject. The consultancy covers 4,500 survey points across the park's 8,250 hectares.

The deepening and updating of available knowledge and information, along with the distribution of these analytical elements in protected areas, contribute to optimizing management plans, conserving coastal ecosystems and their biodiversity, and supporting climate change adaptation. This benefits the population, infrastructure, and vulnerable activities on both sides of the river.

### Resources and further information:

- Informe de avance de consultoría (Consultancy Progress Report)  
<https://accriouruguay.com/materiales/717-2/>

# Case 6

## Case 6: Operandum Project



**Location:** European Union



**Level:** Global



**Hazard:** Hydro-meteorological risks



**Solution/intervention type:**

Creating platform serves as a hub for the NbS community; Developing NbS Policy Catalogue and analysing NbS policy



**Issue(s) addressed:** Promoting public awareness, knowledge, and uptake of Nature-based Solutions for Disaster Risk Reduction.

The OPERANDUM Project, funded by the European Union and supported by UNESCO, focuses on promoting NbS for mitigating hydro-meteorological risks such as flooding, landslides, and coastal erosion.

While the concept of NbS holds promise for addressing climate resilience and disaster risk reduction, the challenges related to policy integration, regulatory complexity, and national governance differences must be addressed to advance the effective and widespread use of NbS across Europe and beyond.

A key component of the project is the Geospatial Information Knowledge Platform (GeoIKP), designed to enhance public awareness, co-creation, and uptake of NbS in both urban and rural contexts. The platform serves as a central hub where the growing NbS community can share information, visualize data, use advanced mapping tools, and access case studies, policies, and other resources.

GeoIKP builds on the experiences of 7 Open-Air Laboratories across Europe, which have tested local NbS solutions. A significant contribution by UNESCO was leading the development of the NbS Policy Catalogue, an extensive collection of over 2,000 policy documents related to NbS from more than 100 countries. This policy database provides valuable insights into the environmental legislation and regulation at various governance levels, from local to international, helping to guide future NbS implementation globally.

In addition to its work on the NbS Policy Catalogue, UNESCO collaborated with project partners to analyse the connections between European and national legislation on NbS. This analysis, which is summarized in a published paper, emphasizes the importance of understanding these linkages to promote the mainstreaming of NbS across different governance levels. The findings help align the NbS agenda at both the EU and global levels while addressing the challenges posed by national-scale governance systems. The paper highlights the critical role of decision-makers and local stakeholders in mainstreaming NbS and stresses that simplifying regulatory processes could enhance NbS uptake. Further alignment of national and EU policies, especially in areas such as climate adaptation and mitigation, will strengthen NbS implementation. The findings underscore both the gaps and opportunities in current policies and offer the NbS policy catalogue as a resource to support policy coherence and the operationalization of NbS in Europe and beyond.

### Resources and further information:

- GeoIKP: <https://geoikp.operandum-project.eu/>
- NbS Policy Catalogue: <https://geoikp.operandum-project.eu/policy/catalogue>
- OPERANDUM Project: <https://www.operandum-project.eu/>

# Case 7

## Case 7: Effectiveness and Cost-Effectiveness of Ecosystem-Based Disaster Risk Reduction (ECO-DRR) Interventions in Low- and Middle-Income Countries



**Location:** Low- and Middle-Income Countries



**Level:** Global



**Hazard:** Hydrological, Meteorological, and Climatological disasters



**Solution/intervention type:** Rapid systematic review



**Issue(s) addressed:** The evidence on the effects and cost-effectiveness of ecosystem disaster risk reduction (Eco-DRR) interventions on the prevention and mitigation of hazards and natural disasters, and consequences for natural capital and human development outcomes.

Nearly 90% of disaster-related deaths occurring between 2000 and 2018 were in low- and middle-income countries (L&MICs). Climate change has intensified the frequency and impact of hydrological, meteorological, and climatological disasters. Traditional disaster risk reduction measures are often costly and are not sustained, necessitating alternative approaches like Eco-DRR.

Therefore, a rapid evidence assessment (REA) has been done to examine the evidence of the effects of such interventions among 58 existing studies. This REA finds that Eco-DRR measures, particularly green

and blue infrastructure (wetland restoration, mangrove replantation and river management), effectively mitigate natural hazards and offer high economic returns. Green infrastructure (forest restoration, tree planting, and urban green spaces), particularly protected areas, has a substantial impact in augmenting natural capital stocks and curtailing the occurrence of hazards such as forest fires. Economic evaluations support the cost-effectiveness of Eco-DRR, especially in reducing flooding, with high benefit-cost ratios for interventions like early warning systems and mangrove restoration. More comprehensive economic evaluations that consider direct and indirect costs and benefits, distributional effects, and monetize a fuller range of non-monetized benefits are needed.

This REA also points out that the evidence base on Eco-DRR is compartmentalized, with a lack of studies on environmental geological and geophysical hazards, indicating a research gap in L&MICs. The research on the social welfare impacts of Eco-DRR is also limited, especially on vulnerable populations which calls for a need for more equity-focused studies.

To this light, this research brings out recommendations which include increased investment in Eco-DRR, enhanced research, incorporation of economic evaluations, strengthening community participation and integration of Eco-DRR into policy frameworks. Assessment of the scale and cost-effectiveness of interventions to reduce hazard risks are essential. The findings are less useful without a clear cost analysis and a defined intervention scale. Additionally, evaluating impacts on natural capital and human development is crucial to identifying potential trade-offs in disaster mitigation, which may require complementary policies. Future economic evaluations should be more comprehensive, considering both direct and indirect costs and benefits. They should include sensitivity analyses to help decision-makers better understand the uncertainties associated with the findings.

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## C. Implementing nature-based solutions for disaster risk reduction



### Key takeaway messages

The successful implementation of NbS depends on inclusive and participatory approaches that actively involve local governments, communities, and traditional knowledge holders. Collaboration from the outset ensures that NbS are culturally appropriate, socially accepted, and tailored to the specific environmental challenges faced by the community.

Monitoring, evaluation, and learning (MEL) frameworks are critical for assessing the effectiveness of NbS in delivering long-term benefits, such as increased resilience, biodiversity conservation, and enhanced ecosystem services. Establishing robust mechanisms for tracking outcomes enables continuous improvement and ensures that NbS interventions are adaptive to changing environmental and social conditions.

Implementing NbS with a focus on sustainability ensures that they not only address immediate disaster risks but also contribute to long-term ecological health and social well-being. These interventions provide co-benefits, such as improved water quality, carbon sequestration, and enhanced livelihoods, which make them valuable tools for holistic development and climate adaptation.

# Case 8

## Case 8: Management and Protection of Mangrove Ecosystem



**Location:** Indonesia



**Level:** National



**Hazard:** Tsunamis, floods, storms, erosion



**Solution/intervention type:** Socio-ecological approach



**Issue(s) addressed:** Planning, Investment, Implementation, Capacity building.

Mangroves play a crucial role in maintaining biodiversity, contributing to climate change mitigation and adaptation by sequestering large amounts of carbon, and are vital for disaster risk reduction, shielding coastlines from erosion, storms, and tsunamis with their robust root systems. Most importantly, they support economic prosperity for coastal communities by providing livelihoods through fisheries and nature-based tourism. Despite the recognized significance of mangroves, these vital ecosystems continue to face numerous challenges that lead to degradation, deforestation, and eventually, socio-economic loss. Natural phenomena such as sea waves, rising sea levels, tides, and pests, along with human activities like land conversion for agriculture, pollution, urban development, and aquaculture, are major drivers of mangrove loss. Data from 1980 to 2005 indicates that Indonesia lost 31% of its mangrove ecosystem, decreasing from 4.2 million hectares to 2.9 million hectares. The lack of community awareness and institutional capacity to develop sustainable strategies that balance mangrove conservation with socio-economic needs also contributes to this degradation.

To address the complex and intertwined causes and impacts of mangrove degradation and deforestation, the Government of Indonesia has developed a

comprehensive ecosystem-based approach. This approach integrates ecological principles, community involvement, and sustainable management practices to create long-term benefits for both the environment and the people who depend on it.

The approach is implemented by creating an enabling environment and taking direct action. This includes establishing the Mangrove and Peat Restoration Agency, building national and local capacity, empowering communities, and updating relevant data and information. Direct actions include ongoing efforts in mangrove conservation, reforestation, and law enforcement for mangrove ecosystem protection. To scale up these actions and share knowledge and expertise, Indonesia continues to strengthen collaboration with regional and global partners. This includes leading the ASEAN Mangrove Network (AMNET), partnering with the World Bank in the Coastal Resilience Programme, and developing a Sustainable Mangrove Rehabilitation model to enhance community resilience with KOICA-Korea. The Mangrove Resolution, initiated by Indonesia and adopted during the Fourth United Nations Environment Assembly (UNEA4) in 2019, further highlights global recognition of Indonesia's leadership in this area.

A prominent initiative is the establishment of the World Mangrove Center (WMN), located in the Ngurah Rai Mangrove Forest Park in Bali. Initiated by the Ministry of Environment and Forestry and the Coordinating Ministry for Maritime and Investment Affairs, with support from the governments of Germany, the United Arab Emirates, Japan, and the Republic of Korea, the WMN serves as a center of excellence and an information hub on mangrove ecosystem-based management. The center's facilities include the Mangrove Information Center, Mangrove Research Center, and other units providing information on various aspects such as biology, conservation and restoration, socio-economic benefits, carbon, climate, and resilience. The WMN also operates observatory fields in several areas across Indonesia. Indonesia hopes the WMN will support the advancement of sustainable mangrove ecosystem management worldwide.

### Resources and further information:

- Secretariat of the Indonesian G20 ECSWG, Indonesian Ministry of Environment and Forestry.



# Case 9

## Case 9: Landslide Remediation based on Tree-Planting in Sugarloaf Mountain



**Location:** Sierra Leone



**Level:** National



**Hazard:** Landslide



**Solution/intervention type:** Landslide remediation work (stabilizing unstable ground)



**Issue(s) addressed:** Landslide Risk Mitigation and Response.

Sugarloaf Mountain, located on the outskirts of Sierra Leone's capital of Freetown, collapsed after days of torrential rain. On 14 August 2017, a tidal wave of mud, floodwater, boulders and trees buried and destroyed homes and businesses in the Freetown neighborhood of Regent. When Sugarloaf Mountain collapsed, a tidal wave of mud, floodwater, boulders and trees buried and destroyed homes and businesses in Freetown - More than 1,100 people were reported killed or missing. The landslide also destroyed schools, bridges, healthcare facilities and other essential infrastructure causing an enormous amount of economic loss. A World Bank report estimated that the total economic value of the disaster amounted to approximately USD 31.65 million.

Lower-income informal communities—often built in hazardous areas along the slopes of mountains and in low-lying and flood-prone areas—were particularly hard hit by the landslide and the subsequent flooding. Experts partly attributed the landslide to deforestation caused by the rapid expansion of Freetown's urban areas into landslide zones, as people settled in the city after the end of the civil war in 2002.

UNOPS has undertaken landslide remediation work (stabilizing unstable ground) with funding from the World Bank and the government of Sierra Leone to make the area safer as survivors return.

To better understand the nature of the landslide area and to gather the information needed to determine how to stabilize the area, engineers and geologists used drones and 3D imagery. Further activities included debris management, human remains removal, contractor management, and stakeholder coordination and engagement. In addition, 5 watercourses were rebuilt and 10,000 trees were replanted to help stabilize the soil and provide a source of food and income. Trees will be revegetated to promote the sustainability of the slope. Local communities will manage the trees providing food and medicine, including fruits, nuts, seeds, kernels and leaves. It will also allow the local communities to promote the growth of species listed on the International Union for Conservation of Nature's (IUCN) Red List of Threatened Species. The local community provided much of the labor for the project and received training in forestry and tree husbandry.

# Case 10

## Case 10: Ecohydrology Demonstration Site - Radom City, Poland



**Location:** Radom City, Poland



**Level:** Regional



**Hazard:** Extreme storm water flow



**Solution/intervention type:** Implementation of ecohydrological “blue-green infrastructure”



**Issue(s) addressed:** Management of extreme flows.

The city of Radom, like many others worldwide, is grappling with the serious effects of climate change, including increasingly frequent heavy rainfall and resulting floods. To mitigate the risks posed by extreme rainwater flows, the city has implemented integrated, demonstrative solutions in the form of ‘blue-green infrastructure’ within its urban spaces.

An ecohydrology approach was applied at the river catchment level, aiming to simultaneously mitigate extreme water flows entering the city and enhance stormwater retention. This was achieved through the restoration and creation of multi-use retention areas, which also serve as habitats for biodiversity. Various ecohydrological nature-based solutions have been implemented, including a Sequential Sedimentation Biofiltration System, hybrid systems, and ecohydrological river restoration to restore its natural retention capacity.

In the inner-city level, the Radom demonstration site showcases new blue-green solutions and practices that

mitigate excess runoff on sealed surfaces, minimizing localized flooding, reducing excess flows into the drainage system, and protecting natural habitats in the city’s rivers. One of the primary goals of the project is to integrate and enhance biodiversity in all activities. The demonstration site includes efforts to restore habitats in urban water bodies and create microhabitats within the city’s climate adaptation infrastructure. Additionally, the city’s blue-green infrastructure is designed to raise awareness and build community capacity for climate adaptation. Awareness-raising activities are being implemented to increase understanding of the impacts of climate change on the city’s economy, health, social and environment functioning, and the importance of cost-effective adaptation strategies.

The Radom demonstration site also holds significant potential for transferability and replication. By showcasing a comprehensive, multi-level approach to stormwater management, utilizing Geographic Information System (GIS) tools, and demonstrating effective blue-green infrastructure, the project offers valuable insights for other cities and stakeholders facing similar challenges. This multi-faceted project not only addresses immediate flood risks but also contributes to long-term ecological and social resilience in Radom City.

### Resources and further information:

- Promotional video: <https://youtu.be/xD8NxvRbNXQ>
- Publications: <https://www.life.radom.pl/pl/o-projekcie/publikacje-naukowe-prasowe>
- UNESCO Radom City Demosite: <https://www.ahaunescochair.org/unesco-radom-city-demosite>
- Jarosiewicz, P., Jurczak, T., & Zalewski, M. (2021). [Ecohydrology for sustainable urban water management. Pre-conference for the second international conference on water, megacities and global change.](#)



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**Ecohydrological reclamation of the Mleczna River in Radom to slow down water runoff, increase landscape retention and support biodiversity**

Source: @ S. Szklarek



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**Construction of a flood polder in the Cerekwianka river valley in Radom to collect rainwater during heavy rainfall and prevent flooding of lower-lying parts of the city**

Source: @ S. Szklarek



# Case 11

## Case 11: MangRes: Mangrove restoration as a nature-based solution in La Encrucijada Biosphere Reserve, Mexico



**Location:** Mexico



**Level:** Regional



**Hazard:** Climate change, habitat fragmentation, invasive species



**Solution/intervention type:**  
Holistic mangrove restoration as a nature-based solution



**Issue(s) addressed:** Restoring and conserving mangroves to protect its important ecosystem services.

La Encrucijada Biosphere Reserve, located in Chiapas, Mexico, faces threats to its rich mangrove ecosystems due to climate change and human activities. The invasion of African oil palm for example, exacerbates these challenges, threatening mangrove health and the well-being of local communities. Yet it is important to protect this ecosystem, as these mangroves form the largest formation in the North American Pacific, are the tallest in Mexico, and are vital for biodiversity, local livelihoods, and ecosystem services like carbon sequestration and coastal protection.

The MangRes project, initiated by UNESCO's Man and the Biosphere Program (MAB) in 2022, focuses on addressing the core issues that threaten the local mangrove ecosystems. It operates in La Encrucijada

and six other biosphere reserves across Latin America and the Caribbean. The project targets both ecological restoration and community engagement, aiming for sustainable conservation practices.

MangRes is implemented through collaborative efforts involving local communities, scientific institutions, and international funding bodies. In La Encrucijada Biosphere Reserve, for example, communitarian brigades have been established to physically remove African oil palms, as well as a young teacher network to raise awareness on the importance of mangroves. The project partners with local research institutions such as ECOSUR, UNAM, and CINVESTAV, alongside Flemish institutions like VUB and VLIZ. It receives financial support from the Government of Flanders, Belgium, and Spain's National Parks Autonomous Agency (OAPN).

The project has successfully removed vast amounts of invasive African oil palms, engaged more than 200 people in educational activities, and gathered crucial biophysical and social data for better mangrove management. Workshops involving local communities, such as the Afromexican community, have helped to map the threats to mangroves, while academic partnerships have produced valuable cartographic and scientific data to support resource management.

This initiative contributes significantly to the mangrove's ecosystem resilience and enhances the local well-being by integrating sustainable livelihoods and raising awareness. The project's comprehensive approach offers potential for scaling to other regions and ensuring long-term sustainability through local and scientific collaboration.

### Resources and further information:

- MangRes: <https://www.unesco.org/en/mab/mangres>



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**Local fishermen in the mangroves of the La Encrucijada Biosphere Reserve.**  
Source: @Jorge Silva



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**Mangroves in the La Encrucijada Biosphere Reserve.**  
Source: @La Encrucijada Biosphere Reserve

# Case 12



## Case 12: Sustainable hydrological management in La Esmeralda stream and its estuary.



**Location:** Uruguay / Latin America



**Level:** National



**Hazard:** Floods



**Solution/intervention type:**  
Intervention in La Esmeralda stream and conservation of its wetland



**Issue(s) addressed:** Climate risk.

The urban area of the La Esmeralda River Basin (Fray Bentos, Uruguay) has been progressively expanding, with insufficient rainwater drainage, so that heavy and/or abundant rainfall can cause flooding, affecting housing, infrastructure and equipment. For this reason, an integrated project has been implemented to solve the hydrological and hydraulic aspects (under the responsibility of the Departmental Municipality of Río Negro, Uruguay), complemented by the conservation of the wetlands associated with the stream, within a floodable park (financed by Adaptación al cambio climático (ACC) Río Uruguay).

The initiative aimed to improve the environmental conditions, rainwater absorption and run-off, expand buffer zones and create new public green spaces for use and enjoyment by all.

As part of the integral intervention of La Esmeralda river, ACC Río Uruguay financed the creation of a floodable park, which proposes a re-signification of this space to avoid its occupation with housing; it incorporates a new space for the enjoyment of all people and preserves the wetland associated with the stream. It is a joint work between the IDRN and the ACC Río Uruguay (with its implementing agencies and the Uruguayan Ministry of the Environment), with the collaboration of local organizations and institutions in Fray Bentos city.

The IDRN carried out the first hydrological interventions in the river basin (a stormwater retention basin for rainwater collection and slow down its flow, and the reconnection and adaptation of drainage channels). The flood park implementation project was then adapted with a climate change perspective and a gender, intergenerational and human rights approach, and the La Esmeralda Park was finally created and inaugurated in August 2023.

Environmentally sustainable hydrological interventions and the creation of the park, preserving the wetland, have been key to improving rainwater runoff and absorption, reducing flood-related risks. Additionally, efforts have begun to restore sites that were environmentally degraded, creating spaces for social gathering and the enjoyment of nature.

### Resources and further information:

- Parque La Esmeralda - Proyecto Binacional ACC <https://www.youtube.com/watch?v=fZA0olxst94>
- Presentación de la intervención integral (Presentation of the comprehensive intervention) <https://www.rionegro.gub.uy/wp-content/uploads/2022/05/Presentacion-Taller-del-proyecto-en-Colon.pdf>



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| Source: from the case study submission of UNDP

## D. Enhancing public and private investments



### Key takeaway messages

Significant financial investments from both the public and private sectors are crucial for scaling up NbS initiatives. These projects often require upfront capital to establish infrastructure and long-term maintenance, making it essential for governments and private investors to collaborate and pool resources for maximum impact.

Innovative financing mechanisms, such as public-private partnerships and blended finance models, are instrumental in unlocking resources for NbS. Governments can leverage public funds to attract private sector investments, ensuring that funding is available for both large-scale projects and localized NbS interventions that benefit communities directly.

By combining different sources of funding—philanthropic, concessional, and market-based—NbS projects can thrive and deliver sustained benefits. Clear accountability and risk-sharing frameworks are essential to ensure that investments are used efficiently, with measurable outcomes that enhance both environmental sustainability and economic resilience.



# Case 13



## Case 13: Revitalizing a Traditional Stone Masonry Dam for Flood Protection in Gudbrandsdalen Norway



**Location:** Norway



**Level:** National



**Hazard:** Flooding



**Solution/intervention type:** Modification of traditional stone masonry dam and selective clearing of vegetation along tributary river



**Issue(s) addressed:** Implementing nature-based solutions for disaster risk reduction (hybrid NbS showcasing traditional building techniques)

The Skurdalsåa River is one of many steep tributaries to the main river Gudbrandsdalslågen, which flows through Gudbrandsdalen Valley in eastern Norway. Like most small and steep catchments in Gudbrandsdalen, also Skurdalsåa responds rapidly to precipitation and snowmelt. In recent years, transportation and residential infrastructure have experienced repeated flood damage.

The principles of nature-based solutions inspired the revitalization of a traditional stone masonry dam from the late 1800s. The intervention was co-funded by the European Horizon 2020 PHUSICOS project, coordinated by the Norwegian Geotechnical Institute, with Innlandet County and Sør-Fron Municipality as collaborative

partners. Ownership of the lake and the dam, along with its irrigation rights, is shared between six local farmers. They have formed a dam cooperative and registered as a business entity in the Norwegian business registry. As such, the dam cooperative could be contracted to carry out parts of the project using their own machinery.

The physical work on the Lake Svintjønna dam and spillway began in the autumn of 2022, after the irrigation of farmland was no longer necessary. The modifications to the dam included a modest increase in the dam height by 0.5 meters, the establishment of a new discharge gate and threshold, and the installation of automatic lake level monitoring. The spillway was also improved and extended. With these implementations, hydrological analyses estimate that the peak flood of a 200-year flood event can be retained for up to two days, provided that the lake is initially tapped to its lower level. In early summer 2023, local farmers carried out selective clearing of vegetation along the tributary river. Forest was cleared to remove trees that were either in the river channel or in danger of falling over during a flood, which could cause problems such as sealing bridges and culverts during high flows.

The efforts were tested during the extreme weather event Hans that hit Norway in August 2023. Early forecasts made it possible to tap the dam before the storm struck, allowing water to be released in a controlled manner and thus reducing water flow in the river compared to previous cases. No damage had been reported after the extreme weather event Hans.

### Resources and further information:

- PHUSICOS EU Horizon 2020 [Project Site](#)
- PHUSICOS According to Nature, [Deliverable Work Package Report, 2023](#)



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**The old stone masonry dam from 1870 at Lake Svintjønnå before revitalization.**

Source: from the case study submission of Norway



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**The old stone masonry dam after modifications completed, the measures increased the dam height by 0.5 meter and established a new gate and threshold, with automatic monitoring of the lake level.**

Source: from the case study submission of Norway

# Case 14

## Case 14: Restoration Insurance Service Company (RISCO)



**Location:** The Philippines



**Level:** National



**Hazard:** Storms, Typhoons, and Flooding



**Solution/intervention type:** Mangrove Restoration



**Issue(s) addressed:** Financing, Implementation

Extreme flooding and storms are increasing in severity and frequency due to climate change, exacerbated by biodiversity loss, resulting in large-scale damage to coastal assets and communities. Coastal areas, particularly those rich in mangrove forests, provide an important solution to reducing wave height and intensity, and therefore reducing coastal exposure to flood damage. Mangroves also provide huge potential for climate change mitigation, as they are capable of storing 10 times more carbon than some terrestrial forests. However, despite their benefits, mangroves have suffered extensive deforestation, with around 50% of the world's mangroves lost over the past 50 years.

The Restoration Insurance Service Company (RISCO) is a social enterprise that incentivizes the conservation and restoration of mangroves in coastal areas by analyzing their risk-reduction benefits for coastal assets exposed to storms, typhoons and flooding and incorporating this information into insurance pricing, thereby monetizing risk-reduction benefits. The Philippines were selected as the piloting location due to its significant experience in large-scale mangrove restoration and its high vulnerability to storms and

flooding. RISCO works closely with local insurance companies and coastal asset owners to develop insurance products that reflect the protective benefits of mangroves. The business model is designed to generate annual revenues from service fees which are paid by insurance companies for quantifying these benefits as well as from the sale of blue carbon credits derived from restored and conserved mangrove ecosystems. RISCO aims to apply its methodology to indemnity-based insurance in the form of property insurance for assets, including airports, hotels, ports, industrial estates, and residential properties. By integrating the benefits of mangroves in the pricing of insurance schemes, lower premiums can be achieved, therefore, conservation or even restoration of mangroves is incentivized through insurance schemes. Through the company's integrated approach, the effects of the measures contribute to a comprehensive risk management, connecting disaster risk reduction with climate change adaptation and further risk transfer measures in collaboration with the private sector.

RISCO has the potential to significantly enhance human well-being by protecting coastal communities from disasters, reducing economic losses. Mangrove restoration in this case not only provides critical ecosystem services like coastal protection and carbon sequestration but also contributes to biodiversity conservation by preserving vital habitats. The model has laid the groundwork for future expansion and replication in other countries, such as India and Thailand.

### Resources and further information:

- Catalysing Finance and Insurance for Nature-based Solutions: [GIZ](#) | [Adaptation Community](#)



## E. Poverty and Inequality



### Key takeaway messages

NbS have the potential to reduce poverty and inequality by generating green jobs, enhancing livelihoods, and improving access to natural resources for marginalized communities. By incorporating NbS into broader development strategies, governments can ensure that vulnerable populations benefit from ecosystem services and disaster risk reduction.

Integrating NbS into national development programs, such as employment guarantee schemes and rural development initiatives, allows governments to address both climate risks and socio-economic disparities. This approach not only improves the resilience of vulnerable communities but also promotes inclusive economic growth, particularly in regions prone to disasters.

Focusing NbS on vulnerable populations, particularly in informal urban settlements or rural areas, helps governments address inequalities while promoting human rights and social justice. By empowering these communities to participate in the design and implementation of NbS, governments can ensure that solutions are equitable and accessible, contributing to long-term resilience and sustainable development.

# Case 15

## Case 15: ECO-DRR leveraging in MGNREGS Development Programme



**Location:** India



**Level:** National



**Hazard:** Climate disasters



**Solution/intervention type:** Local job creation related to natural resources management (integrating DRR within the MGNREGS)



**Issue(s) addressed:** Coastal erosion, drought, flooding, forest fires, landscape degradation, and landslides.

Between 2019 and 2023, the United Nations Environment Programme (UNEP) collaborated with the Kerala Institute for Local Administration (KILA) to showcase how Eco-DRR can be an effective approach for achieving greater resilience to climate disasters through the Mahatma Gandhi National Rural Employment Guarantee Scheme in India (MGNREGS), one of the largest cash-for-work programmes in the world. Nearly 70% of its activities are related to natural resource management and are often planned without considering their contributions to Disaster Risk Reduction (DRR).

The project provides a model to showcase how ecosystem protection and restoration can effectively mitigate disaster risks while benefiting local livelihoods. Over 1200 technical experts, work supervisors at the grassroots level, MGNREGS engineers, and nationally elected officials in the Indian states of Kerala, Odisha, and Karnataka received extensive training to include Eco-DRR in their work and future programming.

Over 100,000 women and men benefitted from the implementation of Eco-DRR related work by MGNREGS engineers trained by KILA. Additionally, a training package and handbooks on Eco-DRR were developed for local government officials, engineers, and the local supervisors of MGNREGS works.

The new investments in Eco-DRR-related workstreams in 2022 amounted to USD 70 million in the State of Kerala, a considerable increase from 2019. This funding boost was allocated to projects focused on the conservation of ponds, restoration of streams, coasts, slopes, and quarries. This surge in investment resulted in the institutionalization of a new state policy on Eco-DRR, largely attributable to the project's activities and with one third of State of Kerala local government incorporating Eco-DRR in their Disaster Management Plans, covering a population of close to 10 million women and men.

Lastly, the adoption of NbS for infrastructure has yielded positive externalities beyond their primary purpose, contributing to climate disaster resilience and the creation of green jobs, thereby reinforcing the environmental and economic sustainability of the regions involved.

### Resources and further information:

- The national MGNREGS budget is approximated at USD 1 billion annually, with year-on-year fluctuations and variable state allocations. The European Union (EU) contributed to this UNEP Eco-DRR capacity-building project with a budget of 1,361,150 USD, in the framework of a wider EU funded project, the "Up-Scaling Community Resilience through Ecosystem-based Disaster Risk Reduction (Eco-DRR) Priority Areas 1, 2 and 3" that ended in December 2023.
- Ecosystem-based Disaster Risk Reduction (Eco-DRR): <https://www.unep.org/topics/disasters-and-conflicts/country-presence/india>



**Figure 1. Kerala State MGNREGS Mission work**

Source: Kerala State MGNREGS Mission

# Case 16

## Case 16: NbS Action in the Peripheries (Ação de SBN nas Periferias)



**Location:** Brazil



**Level:** National



**Hazard:** Floods and Landslides



**Solution/intervention type:** Public Policy



### **Issue(s) addressed:**

Design of a national public policy for inclusive climate adaptation through improving urban-environmental quality and social participation in informal urban settlements.

In Brazil, favelas and urban communities embody the tragic and perverse process of urbanization, characterized by urban spoliation, socio-spatial segregation, climate injustice and environmental racism. They concentrate social, urban and environmental precariousness and are more vulnerable to the impacts of climate change.

In 2023, the Federal Government, under the leadership of President Luiz Inácio Lula da Silva, recreated the Ministry of Cities to resume urban policy in the country and established the National Secretariat for Peripheries, an institutional innovation due to its territorial focus on urban peripheries. Among its responsibilities is the formulation and implementation of actions related to the management and reduction of risks associated with climate extremes, prioritizing vulnerable populations and nature-based solutions (NbS).

The new public policy on a national scale is configured as a budgetary action “Support for the implementation of Nature-based Solutions (NbS) for inclusive adaptation of urban peripheries to climate change”. It was designed with the participation of several representatives from governments, universities, social movements, and international organizations, resulting in the design of 6 strategic axes, 2 of which are structuring, for direct results of risk reduction and climate adaptation, and 4 complementary, with indirect results of NbS interventions.

Structuring Axes:

Axis 1: Reduction of hydrological risks

Axis 2: Reduction of geological-geotechnical risks

Complementary Axes:

Axis 3: Reduction of high temperatures

Axis 4: Reduction of urban water pollution

Axis 5: Reduction of water insecurity

Axis 6: Reduction of food insecurity

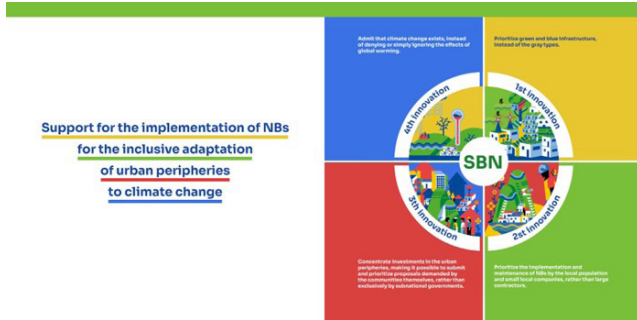
During the regulation of the new public policy, four major innovations proved to be urgent and evident, and are included in the official name of the budgetary action: 1st innovation - Prioritize green and blue infrastructure, instead of the gray types; 2th innovation - Prioritize the implementation and maintenance of NbS by the local population and small local companies, rather than large contractors; 3rd innovation - Concentrate investments in the urban peripheries, making it possible to submit and prioritize proposals demanded by the communities themselves, rather than exclusively by subnational governments, and 4th innovation - Admit that climate change exists, instead of denying or simply ignoring the effects of global warming (Figure 1).

To guide the planning and implementation processes of interventions supported by the Ministry of Cities, 6 cross-cutting principles and 4 successive activities were suggested: participation, communication and transparency, technical advice, tactical action,

governance, monitoring and evaluation, with four successive activities: 1 - Technical-community analysis of the reality and the definition of local priority demands, 2 - Co-creation, 3 - Co-construction and 4 - Use and maintenance (Figure 2)

Policy design is an essential part of funding, which was oriented into two modalities of NbS intervention

on informal settlements (Figure 3): Modality 1 - Action plan and implementation of prototype NbS, for cases of participatory planning processes and incipient technical elements; and Modality 2 - Implementation of action plan, which aims to support the implementation, in full or in stages, of a broad intervention.



Source: from the case study submission of Brazil

### Cross-cutting principles and successive activities



Source: from the case study submission of Brazil



Source: from the case study submission of Brazil



# III. Conclusions and way forward

**Key insights from this compendium underscore that effective implementation of NbS requires strong collaboration across sectors, clear legal frameworks, and the active engagement of local communities. By integrating traditional knowledge with modern practices, stakeholders can ensure that NbS are not only ecologically effective but also socially equitable and culturally relevant. This approach is crucial for building trust, ownership, and long-term commitment among those most affected by climate risks.**

The second volume of the Good Practices for Increasing the Application of Nature-based Solutions (NbS) for Disaster Risk Reduction (DRR) builds upon the foundational insights and best practices outlined in the first edition, emphasizing the ever-growing importance of NbS in addressing the intertwined challenges of climate change, biodiversity loss, and disaster risk. This volume reaffirms that, as the impacts of climate change become more severe and unpredictable, NbS represent a critical tool for enhancing resilience and adaptive capacity in communities around the world.

The way forward involves scaling up NbS through increased investment, both from public sources and through innovative financing mechanisms that engage the private sector. Governments and international partners must continue to prioritize the mainstreaming of NbS into policy frameworks, ensuring that these solutions are recognized as essential components of disaster risk reduction and climate adaptation strategies. The collaboration of entities such as UNESCO and the G20 Working Group on DRR has been instrumental in fostering a global dialogue around NbS and should serve as a model for future partnerships.

Looking ahead, this compendium calls for a continued focus on monitoring and evaluation to measure the long-term effectiveness of NbS, alongside efforts to fill existing research gaps, especially in low- and middle-income countries. More comprehensive data and evidence will support the refinement of NbS approaches, ensuring that they remain adaptable to evolving climate conditions and community needs.

The second volume highlights that nature-based solutions are not only a response to environmental challenges but also a pathway to achieving broader socio-economic goals, such as poverty reduction, gender equity, and improved livelihoods. By leveraging these co-benefits, governments and organizations can pave the way for sustainable and inclusive development, creating a world where both people and nature thrive. The journey to mainstreaming NbS is ongoing, but with a commitment to collaboration, innovation, and shared learning, a more resilient and sustainable future is within reach.”

# References

1. Nature-based solutions for comprehensive disaster and climate risk management: Toolkit for integrated planning and implementation of disaster risk reduction and climate change adaptation. Available Online: <https://www.undrr.org/publication/nature-based-solutions-comprehensive-disaster-and-climate-risk-management-toolkit>
2. Nature-based solutions infrastructure: How natural infrastructure solutions can address sustainable development challenges and the triple planetary crisis. Available Online: <https://www.preventionweb.net/publication/nature-based-solutions-infrastructure-how-natural-infrastructure-solutions-can-address>
3. Scaling nature-based solutions for climate resilience and nature restoration. Available Online: <https://www.eea.europa.eu/publications/scaling-nature-based-solutions>
4. Working paper: Increasing the application of ecosystem-based approaches to DRR. Available Online: <https://www.undrr.org/publication/working-paper-increasing-application-ecosystem-based-approaches-drr>
5. Catalysing finance and insurance for nature-based solutions. Available Online: <https://www.preventionweb.net/publication/catalysing-finance-and-insurance-nature-based-solutions>
6. Nature-based green infrastructure: A review of African experience and potential. Available Online: <https://www.preventionweb.net/publication/nature-based-green-infrastructure-review-african-experience-and-potential>
7. Assessing the benefits and costs of nature-based solutions for climate resilience: A guideline for project developers. Available Online: <https://www.preventionweb.net/publication/assessing-benefits-and-costs-nature-based-solutions-climate-resilience-guideline>
8. Towards a typology of nature-based solutions for disaster risk reduction. Available Online: <https://www.preventionweb.net/publication/towards-typology-nature-based-solutions-disaster-risk-reduction>
9. Nature-based solutions for disaster risk management, The world Bank. Available Online: <https://www.preventionweb.net/publication/nature-based-solutions-disaster-risk-management>
10. World Bank, 2021. A Catalogue of Nature-based Solutions for Urban Resilience. Washington, DC. World Bank Group. Available online: [https://www.gfdr.org/sites/default/files/publication/211102%20NBS%20catalogue\\_FINAL\\_LR.pdf](https://www.gfdr.org/sites/default/files/publication/211102%20NBS%20catalogue_FINAL_LR.pdf)
11. Words into Action: Nature-based Solutions for Disaster Risk Reduction. Available Online: <https://www.undrr.org/words-action-nature-based-solutions-disaster-risk-reduction#:~:text=Nature%2Dbased%20solutions%20are&text=Defined%20as%20actions%20that%20protect,well%2Dbeing%20and%20biodiversity%20benefits.>
12. The Guidebook for Monitoring and Evaluating Ecosystem-based Adaptation Interventions Available Online: [https://www.adaptationcommunity.net/download/ME-Guidebook\\_EbA.pdf](https://www.adaptationcommunity.net/download/ME-Guidebook_EbA.pdf)
13. The Voluntary Guidelines for the Design and Effective Implementation of Ecosystem-based Approaches to Climate Change Adaptation and Disaster Risk Reduction adopted by CBD COP14 (CBD Technical Series 93) Available Online: <https://www.cbd.int/doc/publications/cbd-ts-93-en.pdf>
14. UN Environment-DHI, UN Environment and IUCN (2018). Nature-based Solutions for Water Management: A Primer. Available online: [https://www.unepdhi.org/wp-content/uploads/sites/2/2020/05/WEB\\_UNEP-DHI\\_NBS-PRIMER-2018-2.pdf](https://www.unepdhi.org/wp-content/uploads/sites/2/2020/05/WEB_UNEP-DHI_NBS-PRIMER-2018-2.pdf)
15. GIZ, EURAC & UNU-EHS (2018). Climate Risk Assessment for Ecosystem-based Adaptation – A Guidebook for Planners and Practitioners. Bonn: GIZ. Available Online: <https://www.adaptationcommunity.net/wp-content/uploads/2018/06/giz-eurac-unu-2018-en-guidebook-climate-risk-asesment-eba.pdf>

