The Nature Navigator

A handbook for disaster risk management practitioners

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Restore ecosystems. **Reduce** disaster risk. **Raise** resilience.

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The Nature Navigator.
A handbook for disaster risk management practitioners.

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Ethiopia, Amhara region. Community members maintain stone bunds on hillsides to reduce rainwater run-off, conserve soil, concentrate nutrients and enhance water infiltration and retention.
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Send us your feedback! This draft public version of the Nature Navigator has been carefully designed to assist you in working with nature. Before creating a final version in 2023, we would love hearing your ideas and suggestions on how the Nature Navigator can be further improved. Once you have read and/or used the Nature Navigator, click here to get started, and your name will feature on this page in the final version (if you like).

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Foreword

Climate and environmental crises are humanitarian crises and will increasingly be so in the future. Climate-related natural hazards are already displacing more than 20 million people every year, while we are seeing increasing food and water insecurity. Degraded ecosystems are amplifying disaster risks, destroying livelihoods and increasing health threats. Poor and vulnerable people and communities are affected the most. We need to act, and we need to act now.

The Red Cross Red Crescent Movement is there before, during and after disasters strike. We have a critical role in reducing exposure and vulnerability of the most vulnerable.

And we have solutions, including nature-based solutions (NbS) – protecting, managing and restoring ecosystems – that provide a holistic approach to community resilience.

NbS are relevant actions that can reduce vulnerability, exposure and hazards; and provide multiple social, economic and environmental benefits to local communities. Nature-based solutions are an institutional priority for us at IFRC – recognised in our Plan and Budget 2021-2025 and the Climate and Environment Charter for Humanitarian Organisations.

This guide is aimed at those working on disaster risk management throughout the RCRC network – from National Society branches to headquarters, from Secretary Generals to volunteers.

Working with nature may be new to many of us. The Nature Navigator is here to take you on the journey towards action – from smaller, starter options focused on raising awareness and catalysing action on nature, to larger nature-based solutions to reducing disaster risk and increasing resilience. It is aligned with the Roadmap to Community Resilience and achieving all eleven dimensions of resilience.

I wish you good luck on the journey - let's navigate this new approach and work with nature together!

Xavier Castellanos Mosquera
Under Secretary General, IFRC

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Photo: Alex Wynter, IFRC

Chapter 1

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Photo: Minva Helenius, Finnish Red Cross

Chapter 4

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Photo: Stacey Winston, IFRC

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Acronyms

BCR	Benefit-cost ratio
CBA	Cost-benefit analysis
CCA	Climate change adaptation
CCM	Climate change mitigation
CEA	Community engagement and accountability
CHS	Core Humanitarian Standards
CO_2	Carbon dioxide
CSA	Climate-smart agriculture
CSO	Civil society organisation
CTP	Cash transfer programming
DRM	Disaster risk management
DRR	Disaster risk reduction
EbA	Ecosystem-based Adaptation
EEC	Environmental Emergencies Centre
EFA	Environmental field advisor
EIS	Environmental impact study
EMS	Environmental management system
EPoA	Environmental plan of action
EVCA	Enhanced vulnerability and capacity assessment
FAO	Food and Agricultural Organization
FLR	Forest and land scape restoration
FMNR	Farmer-managed natural regeneration
GDP	Gross domestic product
GHG	Greenhouse gas
GRWG	Green Response Working Group
ICRC	International Committee of the Red Cross
IDP	Internally displaced person
IFM	Integrated flood management
IFRC	International Federation of Red Cross and Red Crescent Societies
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for the Conservation of Nature
IWRM	Integrated water resources management
JEU	Joint Environmental Unit (UN OCHA, UNEP)
LDN	Land degradation neutrality
MCA	Multi-criteria analysis
MPA	Marine protected area
NAP	National adaptation plans
NbS	Nature-based Solutions
NDC	Nationally determined contributions
NDRT	National Disaster Response Team
NGO	Non-governmental organisation
NRM	Natural resource management
NTFP	Non-timber forest products
OCHA	Office for the Coordination of Humanitarian Affairs (UN)
PER	Preparedness for effective response
RC/RC	Red Cross/Red Crescent
R2R	Road Map to Community Resilience
SDG	Sustainable Development Goals
SFDRR	Sendai Framework for Disaster Risk Reduction
SFM	Sustainable forest management
SLM	Sustainable land management
TNC	The Nature Conservancy
UN	United Nations
UNEP	United Nations Environment Programme
USAID	United States Agency for International Development
USD	United States Dollar
VNRC	Viet Nam Red Cross
WASH	Water sanitation & hygiene
WBCSD	World Business Council on Sustainable Development
WRI	World Resource Institute
WUI	Wildland-urban interface
WWF	World Wildlife Fund

Photo: Thuy Ha Bich via pixabay.com

Look after the land and it will look after you. Destroy the land, and it will destroy you.

Aboriginal proverb

Introduction

In 1994, the local Thai Binh chapter of Viet Nam Red Cross (VNRC) made an observation that emerged as the root of large-scale action. It noted that damages to coastal communities from typhoons had dramatically increased over preceding years.

Locals made the case that these disastrous trends were caused by the loss of mangroves. Whereas mangroves had hitherto absorbed some of the storm surges and offered a natural line of defence, they were being replaced by shrimp farms and structural developments.

The Red Cross proposed replanting mangroves — an idea that grew to a large-scale reforestation programme and that saw almost 9,000 hectares of mangrove forest restored.

An impact study found that for every US Dollar invested, mangrove reforestation created economic benefits of 19 to 69 US Dollars to communities (IFRC 2011). The benefits included direct livelihood benefits and reduced storm damages, among others.

Nature, lives, and livelihoods are inextricably linked. Where nature is degraded, our survival and our livelihoods are put at increased risk. Conversely, we experience numerous benefits if nature is protected and restored, such as reduced disaster risk and enhanced food and water security.

Over recent decades, disaster risk reduction (DRR) has achieved much progress. People are now less likely to die from a natural hazard than they were just 20 years ago, despite the numbers of disasters increasing (IFRC 2020). However, losses to livelihoods have dramatically increased over this timeframe (CRED 2020).

Climate change puts more lives and livelihoods at risk. Without further action to reduce emissions and to adapt to climate change, we may see a resurgence in disaster deaths as well as further acceleration of an already growing toll in terms of economic damages and losses (UNDRR 2019).

At the same time, we are experiencing unprecedented environmental crises — biodiversity loss, ecosystem degradation and pollution — that further undermine livelihoods and put people at risk.

Can we save lives, livelihoods, and ecosystems? Yes, we can. However, we must be bold in upscaling and transforming our efforts to stem the tide. As a report by the International Federation of Red Cross and Red Crescent Societies (IFRC) argued, the top priority must be the reduction of long-term vulnerability and exposure (see IFRC 2019).

In its Strategy 2030, the IFRC stresses the need for the entire Red Cross and Red Crescent Movement to address global climate and environmental crises (IFRC 2018). If we work together, we can reduce risk and help communities grow more resilient to the challenges that lie ahead. The Nature Navigator helps you to work with nature, offering multiple pathways that can be readily aligned with your context.

Who the Nature Navigator is for

You are probably reading this guide because you are working in disaster risk management (DRM). Because you're curious, concerned, committed? Good. The Nature Navigator is for you.

It aims to inspire, to guide, to trigger, enhance and enable action and to work with nature. It has been designed for all volunteers and staff of the Red Cross and Red Crescent Movement: whether

you are the Secretary-General of a National Society or a volunteer at a local branch, this guide is for you. The guide is also useful to community members and partners at government agencies and non-government organisations (NGOs) working on disaster risk reduction and in humanitarian contexts. Prior knowledge of DRM is helpful but not essential. The most important terms and concepts are explained in the next chapter on foundations.

Remember: this is just a guideline — it is nothing without you. It is you who can bring it to life. It is you who can make a difference, and help avert humanity's biggest threats: disasters, and in particular the climate crisis and environmental degradation.

Reading the Nature Navigator will help you work with nature to reduce disaster risk. The Nature Navigator is your assistant in this process of making communities more resilient. It gives you background and technical context, case studies and examples, steps to take (from small to large), an application toolbox with tools to work with, and a facilitation toolbox to train others.

How to use the Nature Navigator

Using the Nature Navigator is easy. It provides the essential information for all users and invites you to delve deeper by learning from case studies and further resources.

We encourage you to read it from start to finish. However, the guide is also designed to be your companion as you progress through integrating nature into the actual planning and implementation of your humanitarian and DRM efforts.

Therefore, the Navigator includes interactive features to jump to the relevant section as you go along. These are:

- The **navigation bar** at the top of each page, which lets you quickly switch between sections. Click on the page number to access the table of contents.
- Two types of **links**, which are coloured in purple (for external resources) or green (for resources within the Nature Navigator).
- The **glossary** explains all key terms. Access it via the navigation bar at the top of each page.
- The **icons** on the right are used to help you navigate the guide.

As its name suggests, the Nature Navigator helps you **navigate the process** of integrating nature in your actions. Essentially, navigation is about three aspects:

(a) Your **starting point** (where you are now),
(b) Your **destination** (where you want to go), and
(c) Your **journey** (how you get from (a) to (b).

The journey will be different for every user. In fact, the Navigator does not prescribe which journey you should take (you are flexible in determining the best way). The Navigator recognises the different contexts and capacities of each user. Some may be new to disaster risk management and want to focus on small-scale environmental actions, while others may be more experienced DRM professionals with available resources, who would like to see more systematic changes in reducing risk by working with nature.

How the Navigator is structured

Recognising these differences, the Nature Navigator offers multiple options. We will start off with general basics that you need to know for all options (chapter 1). We then proceed with 'starter options' — simple options that you can pursue without significant external resources and expertise (chapter 2). Note that such starter options are **not** nature-based solutions (NbS), which

Icons in the Nature Navigator


Tool


Checklist


Case study

are generally larger in scale and seek to create net benefits to ecosystems. Starter options are nevertheless important as **entry points** for working with nature, creating processes that may lead to advanced options.

In chapters 3 and 4, we focus on these advanced options that allow you to build on existing community-based disaster risk reduction experience and projects. These are aligned with the Road Map to Community Resilience (R2R) and range from means to enhance natural resource management (NRM) within existing disaster risk reduction (DRR) projects to the development of nature-based solutions (NbS) as an integral part of resilience programming.

The final chapter highlights opportunities for integrating natural resource management, and eventually nature-based solutions, in greener operations when supporting disaster response and recovery in disaster-affected communities.

Chapter 1 | Foundations

You may know a lot already about nature and ecosystems. Yet, before delving into action and exploring ways to reduce risk with nature, let's make sure that we are on the same page regarding some critical issues: why is nature useful for risk reduction and how does it protect us? How can we reduce our own negative impact on nature? How can we embed nature in our efforts to reduce risk and raise resilience? In addition to exploring these questions, the chapter gives an overview of key concepts and terms you must know.

Chapter 2 | Starter options

Let's assume you work with a local branch of the Red Cross Red Crescent and want to take immediate, local and (often) small-scale environmental action with community members and volunteers in your area, whilst promoting greater environmental awareness and local action in your area. You might want to do this through:

- **managing natural resources more sustainably**, for example through market gardens or planting trees; or
- **reducing your footprint on the environment**, for instance by promoting beach clean-ups, recycling, and cycle paths.

In this guide, we will focus on the first option — natural resource management — whilst pointing you to other resources on reducing your environmental footprint. Importantly, the options in this chapter are **starting points** that may do little on their own to reduce risk. However, they can be strategic by raising awareness, promoting wider action, and by planting the seeds for bigger and more advanced options for resilience such as those described in chapter 3.

Chapters 3 & 4 | Advanced options

As a DRM practitioner, you know that it takes time and hard work to reduce risk and raise community resilience. Chapter 3 provides the background of advanced options, while chapter 4 takes you through the process of integrating natural resource management and nature-based solutions into your project efforts. Whether you would like to tweak and retrofit an ongoing project or develop new projects, these chapters are for you. Taking the Road Map to Community Resilience as the basis, we will explore the steps and means to reduce risk with nature in chapter 4.

In ongoing or short projects, this may include actions such as adding a component of sustainable agriculture, small-scale tree planting, or improved regulations on the use of natural resources.

In new and longer-term projects, this should include actions to protect, restore or manage ecosystems that help reduce disaster risk and increase adaptive capacity, while also providing benefits to livelihoods, health, food, or water security. This is part of a

more comprehensive approach to resilience programming, which is discussed in chapter 4.

Learn how to integrate ecosystem expertise, ecosystem scale and time needed for ecosystem restoration from the outset in order to pursue effective NbS. They offer numerous benefits. For instance, restoration of upper watersheds can reduce the risk of landslides, mudflows and floods (DRR) and also help with management of droughts in the face of a changing climate (climate change adaptation, CCA). Other benefits include conserving biodiversity, food and employment for local communities, as well as the storing of carbon (climate change mitigation co-benefit).

Chapter 5 | Greening response & recovery

When responding to disasters, we seek to alleviate suffering and to support the recovery of those affected. At the same time, we may inadvertently generate negative impacts on the environment while overlooking opportunities for ecosystem-sensitive recovery. Therefore, this chapter highlights the pitfalls and potentials that all humanitarian practitioners should think of.

Learn how to integrate environmental considerations into disaster response and recovery. This can include

- **reducing the negative** environmental impact of operations (for example, reducing or better managing waste) or what is known as greening response and recovery.
- **strengthening the positive** aspects of natural resource management in recovery operations. For instance, you may move from **avoiding deforestation** as part of a shelter programme to **embedding reforestation** to reduce future risk and render communities more resilient.

In this guide, we will focus on the first option — natural resource management — whilst pointing you to other resources on reducing your environmental footprint.

Great if you decide to take actions from all chapters — start with those that are most relevant to you. No matter which one you select first, make sure you understand the foundations (next chapter). As you progress through this guide and learn new insights, you can use the **checklists** to recap key content. The Nature Navigator is kept in a succinct format and comes with two rich toolboxes for further exploration:

- The **application toolbox** includes numerous practical resources for stakeholder mapping, assessments, the identification of the most suitable measures, and for planning and monitoring.
- The **facilitation toolbox** includes all materials that facilitators of training courses will need, including presentations, a facilitation guide, homework, and teamwork tasks, as well as tools for participant administration.

How the Navigator aligns with other manuals

The Nature Navigator is aligned with the Roadmap to Community Resilience in its newest version (IFRC 2021) that now embeds the Enhanced Vulnerability & Capacity Assessment (EVCA). The proposed steps of the Nature Navigator are relevant even if you are following alternative guidance for disaster management and resilience programming.

The Navigator is furthermore linked to four other guides:

- **TNC (2021).** The Blue Guide to Coastal Resilience. Protecting coastal communities through nature-based solutions.
- **WWF (2016).** Natural and nature-based flood management. A Green Guide.
- **WWF (2016).** Green Recovery & Reconstruction Training Toolkit for Humanitarian Aid
- **UNDRR (2021).** Words into action. Nature-based solutions to disaster risk reduction.

1. Foundations

How nature protects us from disasters

Naryn valley, Kyrgyzstan

Photo: Patrick Bolte

Before turning to action, let us develop a foundation on key aspects related to risk reduction through nature. To do so, this chapter explores five questions:

1. **Why** should humanitarians and development practitioners care about nature?
2. **Why** are nature-based solutions useful?
3. **How** can we reduce our negative impact on nature?
4. **Who** should get engaged?
5. **How** can we reduce risk with nature?

Question 1: Why should humanitarians care about nature?

Climate and environmental crises — biodiversity loss and ecosystem degradation, pollution, and climate change — can lead to humanitarian crises and affect humanitarian operations.

Humanitarian actions can contribute to environmental problems. For instance, shelter construction that unsustainably sources timber may lead to deforestation. Therefore, we need to green our humanitarian operations, including response and recovery.

Disasters, including those related to climate and environment, disproportionally affect vulnerable communities and their livelihoods, which are also often most dependent on natural resources (Hallegate et al. 2017).

Therefore, we need to focus on DRR and NbS: preparing communities, reducing risks, increasing resilience, and managing ecosystems that livelihoods depend on. This is our main focus in this guide.

Nature is the natural world – air, water, soil, plants, animals. Nature includes ecosystems, which are "functional units consisting of living organisms, their non-living environment, and the interactions within and between them (IPCC 2018:548). Nature includes the plants, animals, and the environment around us, and understanding how they are structured, how they function, and how they interact as a whole.

Ecosystems interact with each other, and we interact with them too. Just think of the breath you take while reading this sentence.

Question 2: Why are nature-based solutions useful?

Nature-based solutions (NbS) are actions to **protect**, **sustainably manage** and **restore** natural or modified **ecosystems** that address societal challenges effectively and adaptively, simultaneously **providing human well-being and biodiversity benefits** (IUCN, 2016:xii).

There are three key reasons why NbS are useful for disaster risk reduction and increasing resilience: ***firstly***, they help to reduce risk, ***secondly***, they sustain ecosystems and the services they provide now and in the future, and ***thirdly***, they bring multiple direct benefits to communities and make them more resilient. Let us look at these three reasons in greater detail.

Reason 1: Lives depend on healthy ecosystems and their services

Healthy ecosystems provide goods that people depend on – such as water, food, medicines and energy. They can offer numerous benefits to lives and livelihoods (income, health and social

Fig. 1.1 **Key planetary crises**

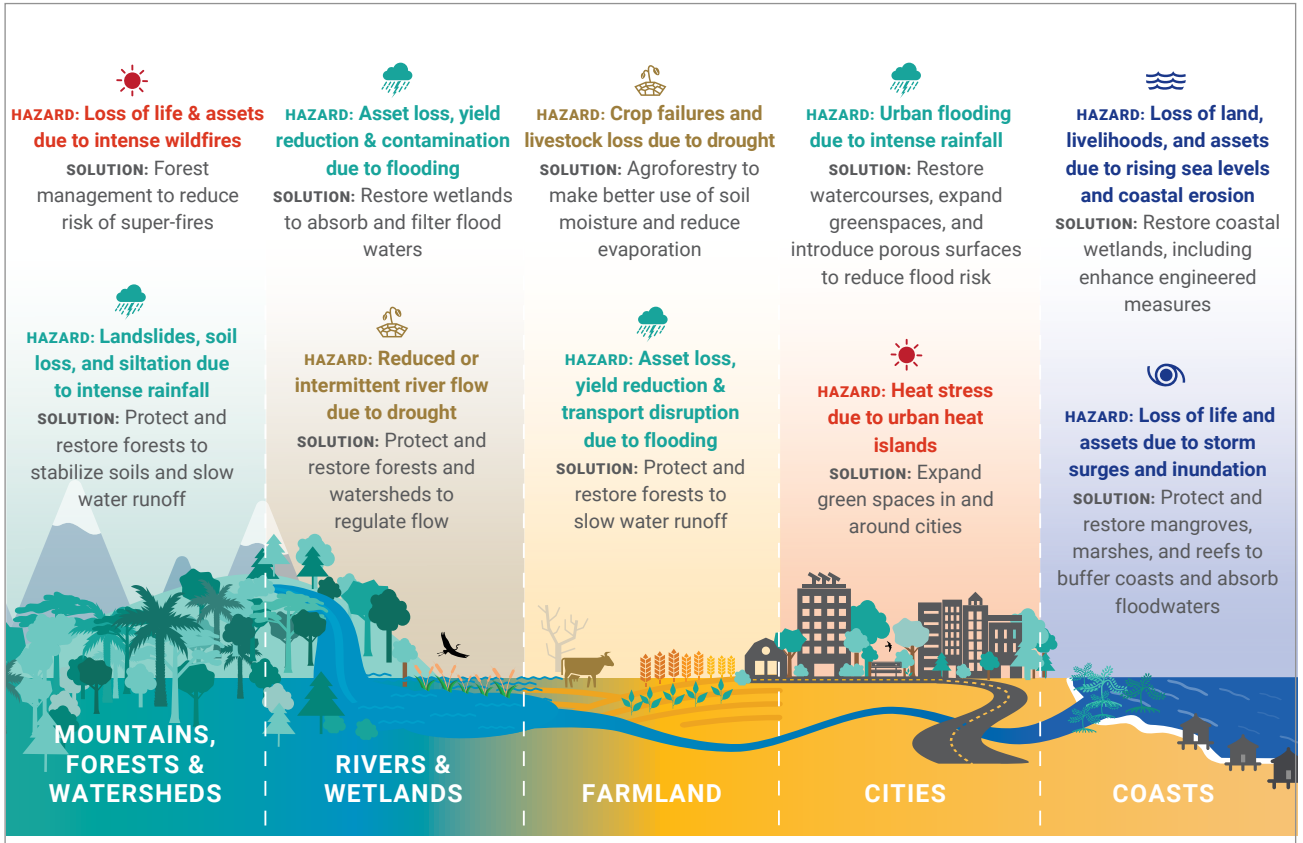
These self-inflicted planetary crises are closely interconnected and put the well-being of current and future generations at unacceptable risk. The global economy has grown nearly fivefold over the last 50 years, due largely to a tripling in extraction of natural resources and energy that has fuelled growth in production and consumption.

The world population has increased by a factor of two, to 7.8 billion people, and though on average prosperity has also doubled, about 1.3 billion people remain poor and some 700 million are hungry. This increasingly unequal and resource-intensive model of development drives environmental decline through climate change, biodiversity loss, pollution and resource degradation.

- **Biodiversity loss** The reduction of any aspect of biological diversity (i.e. diversity at the genetic, species and ecosystem levels) is lost in a particular area through death (including extinction), destruction or manual removal. (IPBES glossary)
- **Climate change**: a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods. (UNFCCC, Art. 1)
- **Ecosystem degradation** A long-term reduction in an ecosystem's structure, functionality, or capacity to provide benefits to people.
- **Pollution** Any substance that causes harm when released into the atmosphere. The presence of minerals, chemicals or physical properties at levels that exceed the values deemed to define a boundary between good or acceptable and poor or unacceptable quality, which is a function of the specific pollutant

Source: UNEP, 2021. Making Peace with Nature.

Fig. 1.2 **Examples of nature-based solutions in different contexts**



Source: Global Commission on Adaptation 2019

benefits), whilst protecting communities through regulatory functions such as filtering water, preventing soil erosion or acting as a global carbon sink.

Ecologists speak of **ecosystem services** and commonly divide them into four types (see figure 1.3). We often take these services as a given because they have always existed. Yet, these services are elemental to life on Earth. Just imagine if there was no water to drink, or no bees pollinating plants.

Ecosystems form soil and nutrients, filter water, prevent soil erosion, and sustain or rehabilitate local biodiversity habitats for flora and fauna. They play a crucial role as a carbon sink and for biodiversity. The world's forests alone absorb a net 7.6 billion metric tonnes of CO_2 per year (that's a 7.6 km high tower with a base of 1 x 1 km) (see WRI 2021).

Ecosystems are immensely powerful but also fragile to human impact and other stressors. If one element stops functioning, it affects other parts of the system. Imagine what happens if you remove a cog from an engine: it may stop working as well as it did or stop working altogether. Biodiversity loss and ecosystem degradation can directly undermine not only ecosystems themselves, but also the services they provide.

Therefore, protecting, restoring, and sustainably managing ecosystems for the benefits they provide to biodiversity and ecosystem function is an important underlying principle of all nature-based solutions. Only then can nature protect lives, now and in the future.

Reason 2: Nature-based solutions reduce disaster risk

Healthy ecosystems can help protect communities by reducing the impact of hazards such as droughts, floods, and storms (see fig. 1.2). Therefore, we should avoid practices that harm ecosystems, while also making sure ecosystem functions are preserved through protecting, sustainably managing, and restoring them.

How do intact ecosystems provide protection? Let's explore three common functions as speed brakes, sponges, and stabilisers.

Ecosystems as speed brakes

In many cases, ecosystems act as 'speed brakes': they stand in the way of an incoming force. Let's assume for instance that a tropical

Fig. 1.3 **Types of ecosystem services**

Provisioning	Regulating
The products obtained from ecosystems. These include: Food, fibres, clean water, oxygen, seeds, forage	The benefits obtained from the regulation of ecosystem processes. These include flood prevention, temperature control, wind control, pest control, pollination
Cultural	**Supporting**
The non-material benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, tourism, beauty, physical and mental health, cultural identity.	Services that are necessary for the production of all other ecosystem services. These include biomass production, soil formation and retention, nutrient cycling, water cycling, and provisioning of habitat.

Types as defined in the Millennium Ecosystem Assessment (2005).

storm (or hurricane, cyclone, typhoon) is about to hit two fishing communities called **Vulneraton** and **Resiliton**. They are almost identical in terms of demographics, wealth, livelihood profiles and geophysical setting, and the storm is approaching with the same destructive speed.

The only difference is that Vulneraton's coastline has nothing but a bare beach left after ecosystems were degraded, while Resiliton has healthy coral reefs, seagrass meadows, a wide mangrove belt and coastal forests along the coastline.

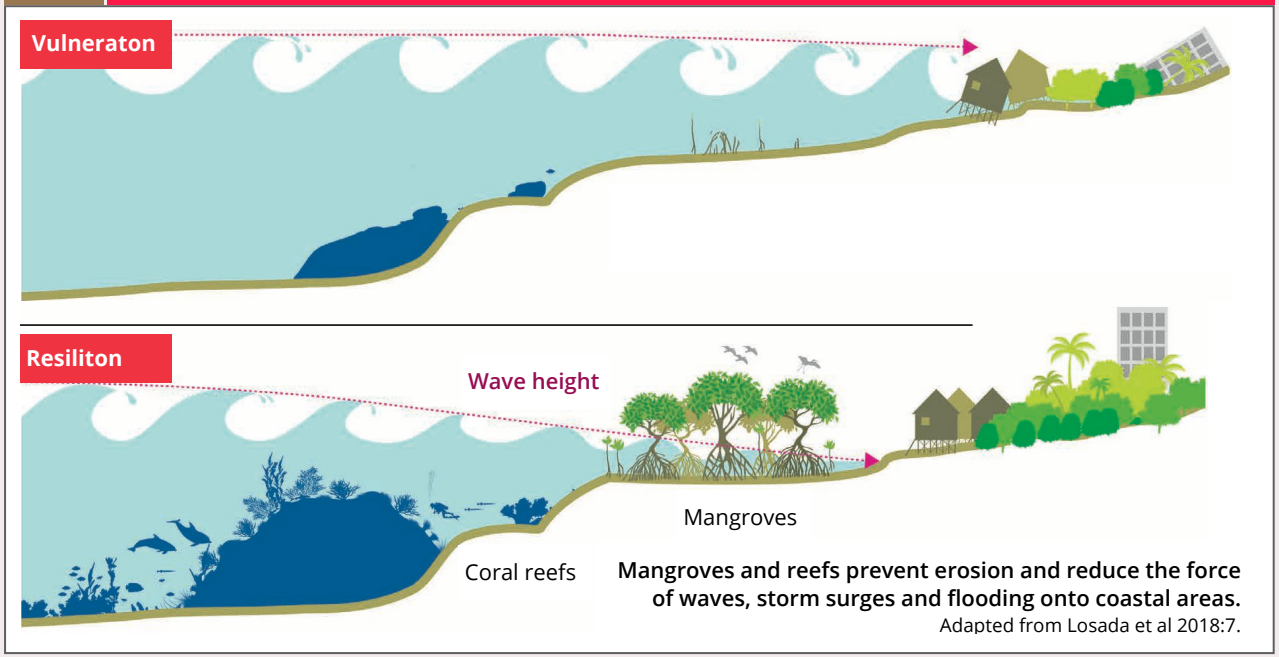
Which one will be affected more by the storm?

Consider some facts:

- **Coral reefs** dissipate 97% of the wave energy that would otherwise impact shorelines (Ferrario et al. 2014).
- **Seagrass meadows** help retain sediments and reduce coastal erosion.
- **Mangrove belts** reduce wave heights. Relatively narrow belts can reduce the height of wind and swell waves. Wider mangrove belts can also reduce storm surges by absorbing wave energy (see fig. 1.4 below).
- **Coastal forests** act as wind breaks: Windspeed (and thus the load on roofs of houses during storms) is reduced over an extensive area landward - up to 30 times the height of the highest trees (Wright/Stuhr 2002).

With its intact ecosystems, Resiliton is likely to suffer less damages and losses from the approaching storm than Vulneraton. If you want to reduce disaster risk in Vulneraton, it would thus make sense to include the restoration of coastal ecosystems into your package of disaster risk reduction activities. If working in Resiliton meanwhile, it is useful to highlight the protective aspect of the ecosystems — and protect and manage them.

Fig. 1.4 **How mangroves and corals protect communities**



Mangroves and reefs prevent erosion and reduce the force of waves, storm surges and flooding onto coastal areas.
Adapted from Losada et al 2018:7.

Forests act like sponges - they retain water in canopy and undergrowth, and help water infiltration into the ground. Thus, they help reduce the risk of floods as well as droughts. Photo: 15079075 via pixabay.com.

Ecosystems as sponges

Aside from acting as speed brakes, healthy ecosystems can perform like a sponge. If a sponge gets wet, it first absorbs the water and then slowly releases the water over time. In light of more erratic and at times extreme fall of rain (and snow) that comes with climate change, this sponge function is extremely useful.

Forests and wetlands absorb the rain through roots and foliage, stabilising soil and releasing it slowly or help the water to permeate into groundwater streams.

This sponge function has two protective benefits: it prevents rapid water runoff and thus ***flooding*** (including ***flash floods***). It also replenishes groundwater basins, making it easier to cope with ***droughts*** (see figure 1.5 opposite).

As much of the ground in ***urban areas*** has been sealed off with roads and buildings, water has no way to enter the sponge. Unless a city has good flood canals, drainage systems and green spaces, it thus gets flooded quickly after a downpour.

Ecosystems as stabilisers

Some ecosystems can act as a stabiliser: a forest on a steep slope not only helps retain water, the tree roots also stabilise the soil and reduce the risk of ***landslides***. Furthermore, they act as barriers to ***rockfalls***, ***avalanches***, and ***mudflows***. There are numerous other protective benefits of intact ecosystems, including some protection from ***heatwaves*** (shade of trees, cooler microclimates).

We often hear the term 'natural disasters', which is a misnomer. Natural hazards may lead to disasters if they overwhelm local capacity to prevent or reduce its impact, to respond and recover.

Disasters are always human-made and based on individual and political decisions — not only as to whether response teams are sufficiently trained and equipped, but also whether a forest is cut down or protected, for example as part of building shelter during humanitarian operations.

Hazards turn into disasters if they strike areas of vulnerability, which in turn is determined by communities' capacities to reduce these. Only through this interaction can a hazard turn into a disaster. Both vulnerability and capacity are social constructs, hence a disaster occurs because of humans.

Protecting and restoring the functions of ecosystems as speed brakes, sponges and stabilisers is a critical aspect of reducing disaster risk with nature.

Reason 3: NbS bring benefits to livelihoods and resilience

There is a third powerful aspect supporting the use of NbS: they bring many other benefits to communities that are ongoing and tangible. Whereas protective benefits can only become real when avoiding a hazard or when a hazard strikes (the extent to which damages and losses are avoided), ongoing and tangible direct benefits are real no matter whether and when a hazard strikes.

Compare, for instance, urban greening (for instance, urban wetlands and parks) with reinforced flood canals. Let's assume that they both have the same protective effect to reduce flood risk. An urban community nearby will only benefit from the flood canal in the case of a heavy rainfall.

By contrast, urban greening can bring numerous other benefits — including cooler micro-climates against heatwaves, better air quality and health benefits, green spaces for recreation, and in some cases livelihoods (e.g., urban agriculture). Green cities are more liveable.

Efforts based on conserving and protecting ecosystems have been shown to offer multiple direct benefits, for instance:

- **Economic opportunities:** These can include a range of sources of increased income, such as fishing, higher agricultural productivity, ecotourism, and unlocked development potential (see figure 1.6 overleaf).

- **Food and nutrition security**: Ecosystems can be important sources of food and also offer benefits for nutrition and health. These are often main sources of livelihoods and food, especially for poor and marginalised communities (including agriculture, fishing or the collection of non-timber food products (NTFP). In addition, ecosystems can be vital to cope with stressors.

Fig. 1.5 **Don't let the slope slip, slow the flow: forests functions on slopes**

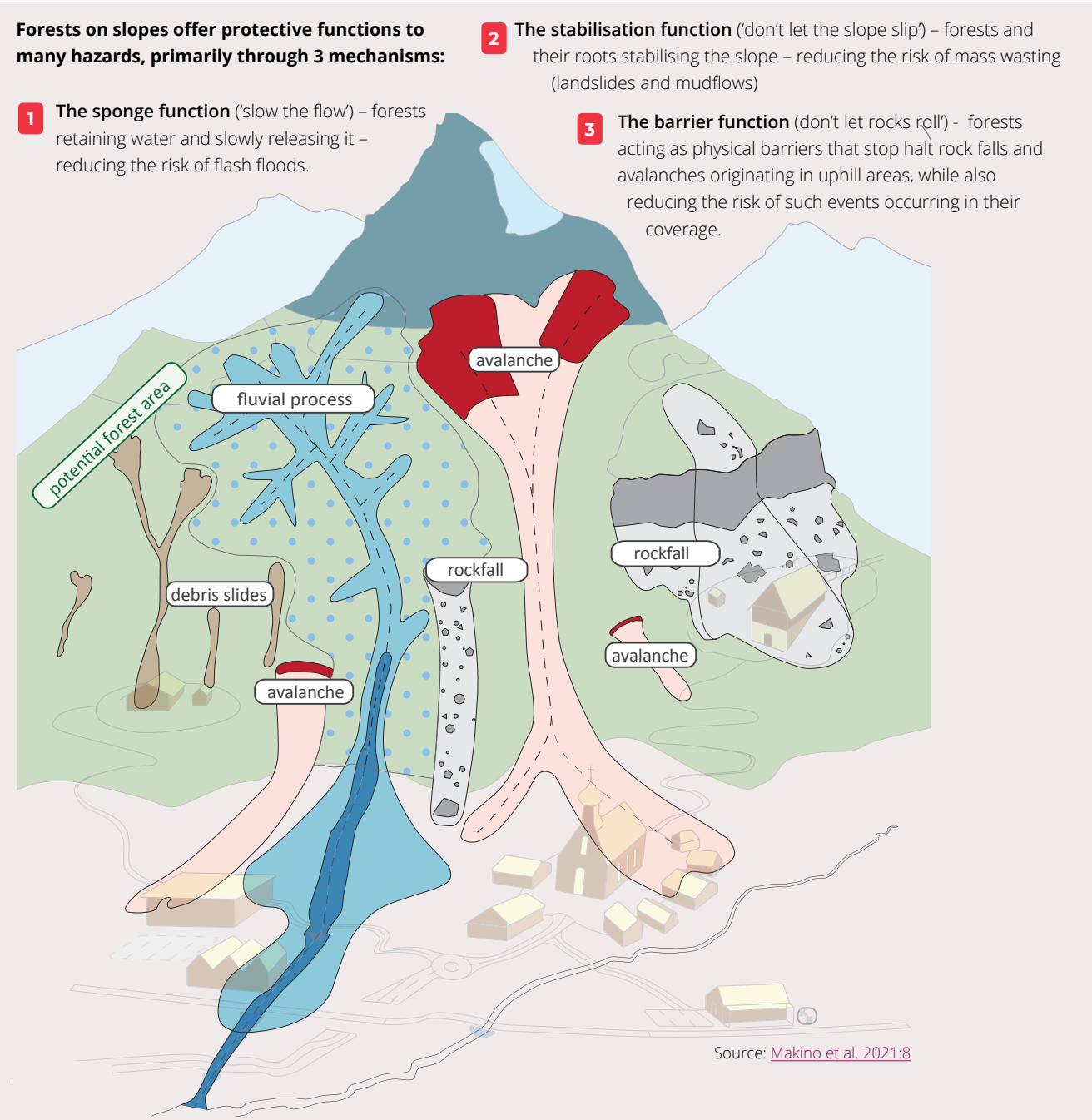


Fig. 1.6 **The triple dividend**

Many cost-benefit analyses of DRR focus on the protective benefits — avoided losses and lives saved. A 2015 paper argues that this practice underestimates the benefits.

Aside from the protective benefits (the **first dividend**) that only materialise when hazards hit, the paper makes the case that investments have two further dividends that materialise in an ongoing manner (Thanner et al. 2015).

The **second dividend** is about unlocking economic potential: whereas few would invest in a hazard-prone area, economic potential is unlocked if the same area is better protected. For instance, one may not build a hotel if there is substantial flood risk, but may do so if the risk is significantly reduced.

The **third dividend** concerns numerous other benefits — organisational, social, environmental and economic. These tend to be very high in the case of NbS — for instance, intact reefs may mean more fish stock and great tourism potential.

- **Water (and sanitation):** Ecosystems provide water. For example, the retention and slow release of water (the 'sponge' function) helps sustain water throughout droughts – both for household consumption and agriculture.

- **Health**: Healthy ecosystems are good for human health – this includes benefits such as clean air and water, reduced threat to lives through protective ecosystem functions, and reduced disease risk through less human-animal interaction.

- **Social cohesion**: More than grey solutions , nature-based solutions require collective engagement and action of the wider community. Several studies (e.g., IFRC 2011) have shown the sense of pride and satisfaction when an ecosystem has been restored as a result of strong community stewardship.

Cost effectiveness

'Hang on', you may say: one could do many other things to reduce risk. We could build a dam instead of restoring riverbanks or creating living weirs. We could build a concrete wave breaker instead of protecting the nearby coral reef. Indeed, you can.

In some cases, such 'grey measure' may be the only option you have (see fig. 1.7). In other cases, it makes sense to prioritise green measures or to combine grey measures with green ones in so-called hybrid solutions. However, NbS tend to be more cost-effective than grey solutions (Browder et al. 2019).

Grey structural measures usually require higher initial investments. A study focussing on the Caribbean concluded that coral reef and mangrove restoration projects in the region are 10 to 100 times cheaper than artificial coastal defences (Narrayan et al. 2019).

Assessing specific conditions is critical to finding the most cost-effective and sustainable solution in a given context.

If we ask 'what will it cost to reduce hazard-related losses by a defined level?' and then compare the options to achieve that level of reduction, in most cases NbS will be part of the most cost-effective option. In particular, if we weigh long-term benefits against costs, NbS often come out on top. Having such direct benefits is powerful in two ways.

First, they render NbS even more cost-effective than the mere analysis of protective benefits suggest. If we count all the benefits (protective and direct) and divide them by the costs, the case for green measures becomes even stronger.

Fig. 1.7 **Green, blue, grey, hybrid infrastructure**

As **green infrastructure** we understand a subset of nature-based solutions that "intentionally and strategically preserves, enhances, or restores elements of a natural system, such as forests and agricultural land". (World Bank, 2019).	**Examples**: Conservation, sustainable management and restoration of forests, parks, trees, plants, sand dunes etc. (UNDRR, 2021)
As **blue infrastructure** we understand a subset of nature-based solutions that highlights the water-based elements in the landscape. (UNDRR, 2021).	**Examples**: Conservation, sustainable management and restoration of coastal areas, rivers, marshes, lakes, floodplains etc. (UNDRR, 2021)
As **grey infrastructure** we understand infrastructure that "is built structures and mechanical equipment" (World Bank, 2019).	**Examples**: Reservoirs, embankments, pipes, pumps, water treatment plants, canals etc. (World Bank, 2019)
Hybrid green/blue Infrastructure is natural blue and/or green infrastructure combined with built grey infrastructure or ecologically engineered infrastructure.	**Examples**: Green roofs, green facades, sustainable drainage systems, urban wetlands, permeable pavements etc. (UNDRR, 2021)

The ***second*** aspect to this concerns sustainability: if a community benefits in an ongoing and tangible manner (not just in the event of a future hazard), it is more likely to engage in efforts to sustain the measures behind the benefits.

Question 3: How can we reduce our negative impact on nature?

We are experiencing unprecedented climate and environmental crises — notably the loss of biodiversity, pollution, and climate change – which threaten nature and the natural resources on which human well-being depends (UNEP 2020, see fig.1.1).

Climate change is having major humanitarian consequences, especially on the poorest and most vulnerable, including through increased extreme events (see fig. 1.8). Environmental degradation such as biodiversity loss and pollution can both exacerbate climate impacts and cause humanitarian consequences directly — for instance through the contamination of water sources by chemical pollution or drought caused by unsustainable management of land and loss of biodiversity.

These crises are therefore interlinked. Human actions, such as those related to land use and agriculture, energy consumption patterns and unplanned urbanisation, act as degradation drivers that directly cause biodiversity loss, pollution, and climate change. While we are part of the problem, we should be part of the solution.

Reducing our negative impact on nature is often called environmental sustainability. Sustainability is the ability of something (an object, skill or practice) to be sustained. Taking the world as that 'something', sustainability commonly refers to the continued capacity for Earth's biosphere and human civilisation to co-exist.

Fig. 1.8 **Climate-smart programming**

The Red Cross Red Crescent Climate Centre proposes three levels of integration of climate change into projects:

- **Climate-smart:** Programmes and operations have made use of available climate and weather information (both short-term weather and seasonal forecasts and long-term climate projections) in designing and/or adjusting activities to ensure that they contribute to reducing long-term risks and vulnerabilities, including likely unprecedented extreme events.

  In doing so, programmes and operations ensure that, at a minimum, they do not place people at increased risk in the future considering likely new cli-mate-related extreme weather events and growing vulnerabilities, and if possible/appropriate, empower communities to anticipate, absorb and adapt to climate shocks and long-term changes.

- **Climate-aware:** Programmes and operations have used past and current climate and weather information in the design of activities (based on past extremes and forecasts) but not longer-term climate projections.

- **Climate not considered:** Programmes and initiatives that have not considered changing climate risks or made use of climate and weather information. This may be deliberate because climate may not be affecting the particular activity, or it may be due to a lack of capacity or resources.

Tajikistan: members of a local disaster management committee discuss lessons from a disaster. For the first time in 70 years, the village of Zaravshar had been impacted by a sudden mudflow.
Photo: Patrick Bolte, Banyaneer

Sustainability is defined through environmental, economic, and social domains that are interdependent to each other. This notion also stands at the backbone of the UN's 17 Sustainable Development Goals (SDG) that were launched in 2015 as a global development framework. Unless we have environmental sustainability, we are unlikely to achieve development goals on hunger and poverty reduction or increased access to water and energy.

Environmental sustainability can be most easily defined by three principles (Daly 1990:1):

- the rate of harvest or use should not exceed the rate of regeneration (sustainable yield);
- the rates of waste generation should not exceed the assimilative capacity of the environment; and
- the depletion of a resource should require comparable development of renewable substitutes for that resource.

An environmentally sustainable future will require significant shifts in economic, financial, and productive systems (UNEP 2020a).

This task is large. It involves everyone — and the Red Cross Red Crescent Movement has its role to play. This includes better managing our waste and reducing our pollution, whether as part of our humanitarian operations or within our offices. It includes reducing our greenhouse gas emissions and carbon footprint — for instance by looking at our supply chains or promoting renewable energy in our operations and offices. Some of these options are showcased in figure 1.9 and discussed in Chapter 5.

Environmental sustainability also includes how we work with nature to actively manage it – the trees, the soil, the water – through **natural resource management**, as part of our disaster risk reduction, response, and recovery work. In this guide, we focus on this element and go even further to look at how we can **protect, sustainably manage, and restore natural resources for human benefit (nature-based solutions)**.

Notably, natural resource management features as one of the eleven resilience dimensions in the IFRC Road Map to Community Resilience ("A resilient community sustainably manages its natural resources").

Finally, and in response to the climate crisis, we should adopt climate-smart programming throughout all our work, which "equates to 'good and sustainable programming' supporting development and enabling people to anticipate, absorb and adapt to climate shocks." (Climate Centre 2020:4).

This means that planning of projects is not only based on past and current risks but also prepares for future changes and vulnerability. This is a relevant approach for all the types of actions – whether they are humanitarian operations, disaster risk reduction programmes or actions around environmental sustainability, including nature-based solutions.

Fig. 1.9 **Reducing our footprint**

There are steps we can take as organisations, ranging from **basic** (specific actions such as investing in energy efficiency or promo-ting greener behaviours among staff and volunteers) to **advanced** measures (systematic efforts to reduce emissions or even becoming climate-neutral).

For example, in 2018, ICRC launched a project to develop a carbon accounting tool to enable the annual monitoring of ICRC's GHG emissions.

The project found that almost three-quarters of ICRC emissions are related to humanitarian programmes, in particular the purchase of food and relief items. Based on its carbon footprint analysis, ICRC decided in 2020 to reduce its greenhouse gas emissions (direct and indirect) by at least 50% by 2030.

Options to reduce its emissions include optimisation of relief items, reducing procurement of commodities with high sustainability risks, and reduction of fuel consumption.

See chapter 5 for examples of environmental sustainability in the context of disaster relief and recovery operations. Also see guidance and examples for organisations here:

- Greening the Blue
- Climate Neutral Now

How does this all relate to disaster risk? Local exposure to hazards and stressors (and thus, disaster risk) is often exacerbated by environmental factors such as climate change, pollution, and unsustainable management of natural resources.

Think for instance of a **village located in a steep valley**: more erratic and extreme rainfall (a manifestation of climate change) may make the soil along the slopes unstable.

If the natural environment along the slopes has been degraded — let's say a forest was cut down, this increases the village's exposure to hazards. Depending on the location, these may be flash floods, landslides, rockfalls, mudslides, or avalanches. By working with communities and stakeholders, we can ensure that the forests, mangroves, reefs, and dunes are protected and restored if degraded – thereby reducing disaster risk.

We can reduce our impact on the environment and promote better waste management so that waste doesn't block waterways and increase flood risk. The list of what we can do is endless. Some local actions, such as reforestation, can also help contribute to reducing greenhouse gas emissions and climate change – an additional benefit.

Question 4:
Who should get engaged?

Still, you may wonder: why should a Red Cross or Red Crescent Society get involved in green issues and environmental conservation? Isn't that the job of others? With a health crisis and pandemics (such as the Covid-19) and increasingly frequent disasters, don't we already have enough on our plate?

Fig. 1.10 **A new charter**

In May 2021, IFRC and ICRC adopted the Climate and Environment Charter for Humanitarian Organisations. It is a landmark commitment of the humanitarian sector to climate and environmental action.

The Charter has already been signed by many humanitarian organisations and National Societies and features the following high-level commitments:

1. **Step up** our response to growing humanitarian needs and help people adapt to the impacts of the climate and environmental crises.
2. **Maximise** the environmental sustainability of our work and rapidly reduce our greenhouse gas emissions.
3. **Embrace** the leadership of local actors and communities.
4. **Increase** our capacity to understand climate and environmental risks and develop evidence-based solutions.
5. **Work collaboratively** across the humanitarian sector and beyond to strengthen climate and environmental action.
6. **Use** our influence to mobilise urgent and more ambitious climate action and environmental protection.
7. **Develop** targets and measure our progress as we implement our commitments.

Alleviating human suffering is at the heart of the Red Cross and Red Crescent and other humanitarian organisations. However, our current approaches focused on health and social services may not be enough. The 2019 report 'The Cost of Doing Nothing' warned that by 2050, the number of people affected by disasters may double, with expected losses steeply rising (IFRC 2019:23).

In the past ten years, 83% of all disasters triggered by natural hazards were caused by extreme weather- and climate-related events, such as floods, storms, and heatwaves (IFRC 2020:2). The first priority, the 'Cost of Doing Nothing' report concludes, is to reduce long-term vulnerability and exposure.

In other words, we must get better at preventing hazards turning into disasters. We must reach out to communities and help them become more resilient. Addressing the climate and environmental crises was identified as the number one priority in IFRC's Strategy 2030 and IFRC Secretariat Plan 2021-2025.

The scale of change: The Sahel zone in Africa is one of the world's climate change hotspots. Desertification, land degradation and droughts pose severe challenges to communities and ecosystems alike.

Numerous projects are underway that use NbS — ranging from the 'Great Green Wall' initiative (large picture) to smaller projects using the half-moon technique (small picture, see case study K).

Photo: Mari Aftret Mørtvedt, Norwegian Red Cross

Photo: UN Convention to Combat Desertification (UNCCD)

In recognition of the need to scale up action, the International Red Cross and Red Crescent Movement developed "Movement Ambitions to Address the Climate Crisis" in 2020. The recognition to promote greater action across the humanitarian system was also one of the reasons IFRC and ICRC co-led the development of the Climate and Environment Charter (see fig. 1.10).

With their multiple benefits outlined earlier, nature-based solutions make for an excellent ally in this context. This is what chapters 3 and 4 are all about.

With their multiple benefits, NbS are ideally suited to reinforce **community resilience**, which has been a key objective of the Red Cross Red Crescent Movement for many years (IFRC 2014).

The multi-dimensional concept of community resilience in general as well as the environmental aspects in particular (one of the eleven resilience dimensions is about 'natural resource management') in particular necessitate capacities that may be beyond the core capacities of National Societies. To compensate gaps, Societies should seek top develop **strategic partnerships** and always seek to work with experts when implementing NbS.

Working with nature is something that the IFRC, all National Societies as well as their chapters and branches can and should do. As you will see in a moment, there are lots of things you can do as part of your work — ranging from small steps to big leaps.

This can range from institutional-level shifts within IFRC and National Societies in the way we do resilience programming and reduce and manage disasters that comprehensively integrates nature (ch. 3 & 4), implementing projects around NbS at local level (National Societies), to small scale awareness raising campaigns (chapters and branches).

Question 5:
How can we reduce risk with nature?

Working with nature is not rocket science. However, some of the options are not exactly easy either and require specific expertise. In particular, most nature-based solutions require longer timeframes, scales and the assessment of ecosystems by experts.

Take mangroves, for instance. Although it may be tempting to simply plant seedlings on bare mudflats in an effort to demonstrate a result by the end of a two-year project, such a course of action may result in little more than frustration or failure.

If a mangrove belt has been degraded, one needs to first understand the factors that led to the degradation. In many cases, addressing these factors is what is needed for the recovery of the mangroves, and the restoration of its protective effect to the nearby communities. Restoring the water flows may do the trick - the forest can recover without any replanting. But ecosystem assessments and exploration take time, as well as the support of experts.

The Nature Navigator is here to help you make your work with nature a success, and to prevent you from getting 'stuck.' Where would you like to start your work with nature? Consider your capacities, contexts, and initial priorities.

Before you move on, make sure that you understand the key terms (fig. 1.11) and approaches (fig. 1.12) on the following pages. Remember that you can look up all terms in the glossary. Finally, consider using the 'questions for reflection' on the right to gather initial thoughts.

Questions for reflection

See also appendix F.1a

1. **Why** should we care about nature (in our National Society, our chapter/branch)?
2. **How** can we reduce our negative impact on nature, within our community and/or National Society?
3. **What** are nature-based solutions? Are they relevant for us, and if so why and how?
4. **How** does this tie to our other work?
5. **Can** we reduce risk with nature?
6. **Who** should we engage within our team or community in initial discussions?

Fig. 1.11 **Key terms you need to know**

Biodiversity Source: IPCC 2018:543	Biological diversity means the variability among living organisms from all sources, including, inter alia, terrestrial, marine, and other aquatic *ecosystems* and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.
Climate change Source: IPCC 2018: 544	Climate change refers to a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer.
Ecosystem Source: IPCC 2018:548	An ecosystem is a functional unit consisting of living organisms, their non-living environment, and the interactions within and between them.
Ecosystem services Source: IPCC 2018:548	Ecological processes or functions having monetary or non-monetary value to individuals or society at large. These are frequently classified as (1) supporting services such as productivity or biodiversity maintenance, (2) provisioning services such as food or fibre, (3) regulating services such as climate regulation or carbon sequestration, and (4) cultural services such as tourism or spiritual and aesthetic appreciation.
Ecosystem-based adaptation (EbA) Source: CBD 2009	Ecosystem-based adaptation is the use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people to adapt to the adverse effects of climate change.
Ecosystem-based disaster risk reduction (Eco-DRR) Source: PEDRR	Ecosystem-based disaster risk reduction (Eco-DRR) is the sustainable management, conservation and restoration of ecosystems to provide services that reduce disaster risk by mitigating hazards and by increasing livelihood resilience.
Exposure Source: IPCC 2018:549	The presence of people, livelihoods, species or ecosystems, environmental functions, services, and resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected.
Green response & recovery Source: IFRC 2020	Green response is all about improving the environmental sustainability of our work and avoiding, minimising, and managing the damage we cause to the environment and climate.
Hazard vs disaster Sources: IPCC 2018:551* IPCC 2018: 547**	A **hazard** is the potential occurrence of a natural or human-induced physical event or trend that may cause loss of life, injury or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems and environmental resources.* A **disaster**, by contrast, concerns severe alterations in the normal functioning of a community or a society due to hazardous physical events interacting with vulnerable social conditions, leading to widespread adverse human, material, economic or environmental effects that require immediate emergency response to satisfy critical human needs and that may require external support for recovery.** When a hazard event overwhelms the capacity of a system to cope with its effects, it leads to a disaster.
Nature-based solutions Source: IUCN 2016	Actions to protect, sustainably manage and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits. Common societal challenges are climate change, food security, disaster risks, water security, social and economic development as well as human health.
Resilience Sources: Walker/Salt 2005:1 IFRC 2014:6	Resilience is the ability of a system to cope with adverse impact and return to a state that allows it to resume its original functions. **Community resilience** is the ability of communities to anticipate, prepare for, reduce the impact of, cope with and recover from the effects of shocks and stresses without compromising their long-term prospects.
Risk Source: IPCC 2018:557	The potential for adverse consequences where something of value is at stake and where the occurrence and degree of an outcome is uncertain. Risk results from the interaction of vulnerability (of the affected system), its exposure over time (to the hazard), as well as the (climate-related) hazard and the likelihood of its occurrence.
Vulnerability Sources: IPCC 2018:560 CARE 2019: 7	The propensity or predisposition to be adversely affected. Vulnerability to the same risks may differ based on gender, wealth, mobility and other factors. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.

Fig. 1.12 **Overview of climate and environmental approaches**

Approach	Objective	Reduce/ resilience[1]	Entry point[2]	Information needed[3]	Time scale[4]	Type of actions (examples)
Green response and recovery Saving lives and reducing suffering without risking damage to the environment or the livelihoods, assets, health and survival of affected people (IFRC Secretariat Environmental Policy, 2019)	Humanitarian response and recovery operations use an environmental sustainability lens and reduce their impact on the environment	• Reduce	• Environment • Climate change	Climate and environment information (analysis of local environmental resources and impact of operations on the environment)	• Short	Sustainable management of solid waste, sustainable supply chain management, use of renewable energy in projects
Institutional greening	An organisation as a whole (incl. all its activities and staff), reduces its environmental footprint (incl. carbon footprint)	• Reduce	• Environment • Climate change	Climate and environment information – in particular on greenhouse gas (GHG) emissions and environmental impact	• Short • Medium • Long	Reduce greenhouse gas emissions, better waste management & more recycling
Climate change mitigation A human intervention to reduce GHG emissions or enhance the sinks of greenhouse gases (IPCC, 2018)	Institutions, programmes and operations aim to reduce their greenhouse gas emissions. Within RCRC, mitigation is part of both green response and institutional greening (see above).	• Reduce	• Climate change	Climate information on GHG emissions	• Short • Medium • Long	Low-emissions fleet, solar panels for shelter
Disaster risk reduction Preventing new and reducing existing disaster risk and managing residual risk, all of which contribute to strengthening resilience (UNDRR, 2021)	Programmes (and where possible, operations) prevent new and reduce existing disaster risk and manage residual risk	• Resilience	• Disasters, incl. climate related	Disaster and hazard information (including climate information)	• Medium • Long	Early warning early action (incl. Forecast-based Financing), nature-based solutions (see below), earthquake resistant shelter
Climate-smart Programmes and operations consider and make use of available climate and weather information in designing and/or adjusting activities to ensure that they reduce risks and vulnerabilities.	Programmes and operations ensure that they do not place communities at increased risk in the future considering likely new extreme climate-related weather events. If possible, empower communities to anticipate, absorb and adapt to climate shocks and long-term changes. Related to climate change adaptation (see below).	• Resilience	• Climate change	Climate and weather information (both short-term weather and seasonal forecasts and long-term climate projections)	• Short • Medium • Long	Building shelters in non-flood prone areas, based on climate information that predicts increased flooding in area
Climate change adaptation In human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities (IPCC, 2018).	Programmes plan for actual or expected climate variability and change and its effects, and aim to moderate harm and, where possible, exploit beneficial opportunities	• Resilience	• Climate change	Climate and weather information	• Medium • Long	Drought-resistant seed varieties in agriculture, planned relocation
Nature-based Solutions Actions to protect, sustainably manage and restore [...] ecosystems, that address societal challenges [...] providing human well-being and biodiversity benefits (IUCN, 2016).	Programmes that aim to increase community resilience to climate change and/or disasters; to reduce greenhouse gas emissions (a climate change mitigation option – see above); and/or to provide e.g. food and/or water security	• Reduce • Resilience	• Disasters • Climate change • Environment	Climate, ecosystem and disaster/ hazard information	• Medium • Long	Restoring mangroves for protection against tsunamis and coastal erosion (co-benefit to CCM)

1. Approaches are categorised based on whether the primary objective is to **reduce** greenhouse gas emissions and/or environmental impact; or to increase **resilience** of communities to hazards and shocks.
2. Approaches are categorised based on whether the approach is primarily applied to address **disasters**, **climate change** or **environmental** issues.
3. Information needed to design and implement the approach.
4. **Short**-term is defined as up to 1 year; **medium**-term as up to 5 years; and **long**-term more than 5 years (often 10 years or more).

2. Starter options

Easy actions to raise awareness and build momentum

Solomon Islands, Kolombranga Island
To adapt to the increasing issues linked to climate change, the community has introduced new methods of gardening, such as basket gardens. These avoid vegetables coming into contact with sea water.

Photo: Benoit Matsha-Carpentier, IFRC

Imagine you work with a local Red Cross or Red Crescent branch and would like to promote environmental action to reduce disaster risk. Where do you start? How can you reach a broad audience and spur people into action?

Of course, you could invest in 'awareness raising' and hope that people will act as a result. Awareness raising is important, but on its own is unlikely to lead to action. In addition to reaching out and raising awareness, try turning things around.

Engage people in basic actions first that are easy to implement. **Excite people, learn with them, and build further together.**

Starter options may include recycling or market gardening, rainwater harvesting or tree-planting, and many more. Such basic options have in common that they

- are relatively cheap and easy to implement,
- require no or minimal external expertise, and
- can be carried out by small groups over short timeframes.

While these basic options benefit those pursuing them, their role in reducing risk for broader communities tends to be limited.

Beyond their immediate benefits (e.g., raised income or more liveable neighbourhoods), basic options have however a **strategic role**: you can utilise the engagements to learn together and sow the seeds for larger-scale actions such as the nature-based solutions (NbS) presented in chapter 4.

Basic options are powerful to create champions for green action. After all, people are much more likely to listen to their neighbours than to the messages in a leaflet.

In this chapter, learn how to go about and get started. Be inspired by examples from Red Cross Red Crescent branches and others, and see how from small things, big things grow.

The case studies in this chapter (A-C, see overleaf) are from different continents and very different contexts. Yet, they have things in common: they were relatively cheap and easy to implement and carried out by community groups, requiring little external expertise.

Actions like those in Nairobi, Jakarta and elsewhere bring immediate or short-term environmental benefits and strengthen social cohesion. Such collective action can be a fertile ground for further action and awareness raising.

Start with small actions. As a local Red Cross/Red Crescent branch or as a community group, you too can spearhead local action: explore both global trends of risks and local issues, and then think of easy actions you can instigate in your community.

To get some inspiration, have a look at the following resources:

- The **Urban Action Kit** (IFRC 2021) is a useful resource that features simple, low-cost, do-it-yourself activities for urban resilience. It is available in 12 languages and comes with sets of cards for facilitation. It is visual, easy to follow, and offers short and inspiring case studies. While focussing on the urban context, many of the activities can also be implemented in rural settings.
- **ActNow** is the United Nations campaign for individual action on climate change and sustainability. It proposes ten actions one can take every day and comes with a mobile app to guide users through action and the progress they make.
- **The Lazy Person's Guide to Saving the World** is a two-page overview of easy everyday actions one can do from home, in the neighbourhood and at work.

There are many things you can do with the community, ranging from rainwater harvesting, creating green roofs and vegetable

gardens, to recycling and composting. When proposing actions, consider that they should create a direct benefit to those involved: being rewarded for your efforts (by having more food variety, more shade, or cleaner streets) is a powerful motivator.

Don't stop with small action. The beauty of small community-driven initiatives is that they can get off the ground quickly. They can help us raise awareness on the environment, get motivated and start thinking bigger.

Having that said, we will need upscaled and more systematic action that increases resilience and reduces disaster risk from increasing floods, storms, drought or heat.

Learn together. While implementing the action, use the opportunity to explore larger patterns. For instance, you may seek to link your action with prevailing risk factors (see the 'Global Links' sections in the Urban Action Kit):

- Why are we planting trees?
- Does it make sense in the context of more frequent heatwaves or soil erosion, for example?
- How do green roofs relate to flood risk and heat waves?
- How can sack gardens help improve food security during crises?

By addressing questions like the ones above, you can foster collaborative learning and heighten the sense of risk awareness

Case study A | **Sack gardens in slums**

Location: Nairobi, Kenya
Partners: Solidarités International, Kenya Red Cross, IFRC

In the informal settlement of Kibera, Nairobi – where food insecurity is prevalent, and space is limited – residents have found a resourceful way to do urban farming: vertical sack gardens using recycled sacks or biodegradable cement bags. Over 1,000 farmers, mostly women , are using this technique to grow vegetables such as kale, spinach, onions and tomatoes to feed their families and enhance their incomes.

The project provides the residents of Kibera with a source of nutritious food without having to buy from the market and maximises the use of roofs and other underused spaces to serve as small-scale farms.

The project was initiated by French NGO Solidarités International, which provided the farmers with seedlings and training. The IFRC also supported this initiative by supplying vegetable seeds to use in the farms.

Vertical basket gardening was already a wide-spread local practice — but by combining it with new techniques and technologies, it was made more sustainable – e.g., using recycled sacks or biodegradable cement bags; adding a central column of stones before filling the sack/bag with soil (to allow plants to grow on the top and from the sides); making compost from kitchen waste and other organic materials; and intercropping seasonal vegetables with leguminous crops. Water is sourced from hand-dug wells or domestic wastewater.

The project has helped to strengthen social bonds within the community, especially among young people, women, and the elderly – the main participants. These farmers share skills and produce as well as the opportunity to support their families and enhance their incomes.
See the full story here.

much more than you can with any leaflet or poster on its own. It can also help you identify how you would need to expand current actions and what expertise you would need to work with nature to reduce disaster risk (see chapter 4).

Spread the word. Engagement is at the heart of the best calls to action. You may want people to adopt less polluting, more climate-friendly, and risk-adjusted behaviours. With small actions and collaborative learning, you now have created natural ambassadors who can spread the word and lead to wider adoption within your community. See appendix F for a general backgrounder on effective calls to action.

Build further. Ideally, such learning and action should lead to larger actions that put nature at the centre of community-based risk reduction. Consider the short Climate-Ready Communities manual as guidance for such processes, or move on to a more comprehensive process as described in the next chapter.

Remember: from small things big things grow. Just think of the mangrove afforestation project in Vietnam that started with an idea at the local level.

Reflect with your team on what you can do in terms of starter options — consider using the list of questions on page 24.

Case study B | **Vertical household gardens**

Location: Jakarta, Indonesia
Partners: Indonesian Red Cross

In Jakarta, Indonesia, the Indonesian Red Cross Society (Palang Merah Indonesia or PMI) worked with the local government, United States Agency for International Development/Office of US Foreign Disaster Assistance and the American Red Cross on a multifaceted project.

The initiative set up vertical and organic house-hold gardens, thereby increasing residents' access to nutritious food as well as enhancing their incomes by selling surplus garden produce and compost at new markets.

For the duration of the project, the local agriculture office was on hand to provide technical assistance in setting up the vertical and organic household gardens.

It also collaborated with public parks and private sector businesses to find new opportunities to sell the compost and surplus fruit and vegetables. At the household level, the project included the promotion of vertical gardens for food production.

The multi-faceted initiative focused on addressing recurring flooding in the city by cleaning blocked rivers, canals and drains. It also introduced recycling and composting facilities, reducing waste.

Case studies C | **More actions from around the world**

Location: Ethiopia
Partners: Ethiopian Red Cross, Netherlands Red Cross

Pupils planting trees in Ethiopia. This project in northern Ethiopia focused both on tree roots and rooting environmental values in youngsters' minds.

Worgadja school's environment club in Northern Ethiopia combined both goals since 2012. As described by the club's 13 year-old president: "Every pupil plants and is responsible for five tree seedlings. In total, we have 2,000. We have to weed and water them every week. There is not much rain in our area."

According to another pupil, children did not at first understand why they should plant trees. "But now we see that it gives us shade, and looks nicer than bare school surroundings. It is important for the environment and for us."

The young gardeners tell their parents about tree planting, and about the Ethiopian Red Cross nursery site where they can obtain seedlings. In cooperation with the Netherlands and Ethiopian Red Cross, teachers assist pupils to plant seedlings and teach them about the role trees play in helping to mitigate and adapt to climate change, and the general need for cleaner surroundings.

The school installed waste baskets and dug a well. When the children are on holiday, a simple plastic bottle drip-irrigation system takes over. Next step: planting vegetables and fruit trees.

Source: *IFRC (2016) Small and simple actions to address climate change*

Location: Lam Dong, Viet Nam
Partners: Viet Nam Red Cross

Community clean-up campaigns in Viet Nam. In order to ensure a clean environment and to prevent diseases from spreading in urban areas, Viet Nam Red Cross (VNRC) regularly conducts community clean-up campaigns. In Lam Dong province, the VNRC chapter launched a cleanup initiative in the capital Da Lat. "We were only expecting maybe 40 people, but more than 100 gathered here to help clean up", a delighted branch representative said.

The cleanup drive attracted Red Cross volunteers, community members, and government officials eager to do something for the environment.

Around the world, many branches and chapters run similar clean-up actions in cities or at beaches — often linked with schools. Such events can be coupled with education and awareness-raising on pollution and other environmental crises, and used to think bigger: what more can schools, communities and individuals do to better protect their local environments?

Source: *IFRC Audiovisual library, 2016*

Location: Numerous countries around the world
Partners: Red Cross Red Crescent Climate Centre

Games to learn and act. Games are a fun but serious way to learn and plan. The Red Cross Red Crescent Climate Centre and its partners have designed at least 45 new games on humanitarian issues (including disaster preparedness, gender, food security, climate information, health, road safety, and the management of urban waste).

Across five continents, in at least 40 countries, farmers, schoolchildren, Red Cross Red Crescent volunteers, meteorologists, students, government officials, climate policy negotiators, city-dwellers, staff of development banks, and donors, have explored the power of game-based learning.

For example, numerous communities have played the game Upstream/Downstream to learn how ecosystem management, climate change adaptation and disaster risk reduction are linked.

Others played Ready! to help communities develop or update preparedness plans before the rainy season. Against the clock, community members brainstorm together, listing and prioritising the actions they would take if they received warnings of a disaster.

Games generate ideas and collate people's inputs in a realistic, participatory and agreed local action plan that is truly owned by the households who contributed. For an overview of such games and experiences, see this report.

Source: *Red Cross/Red Crescent Climate Centre: Using games to experience climate risk*

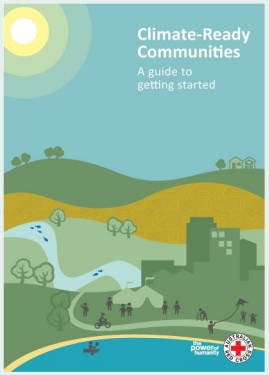
Resources for starter options

Urban Action Kit (IFRC 2021)
The Urban Action Kit is a compendium of do-it-yourself activities you can spearhead. It is available in 12 languages and comes with sets of cards for facilitation.

It is visual, easy to follow, and offers short and inspiring case studies. While focussing on the urban context, many of the activities can also be implemented in rural settings.

Small and simple actions to address climate change (IFRC 2016)
This small and simple actions guide features many case studies related to 1. heat wave preparedness (case study from France), 2. tree-planting (Ethiopia), 3. solid waste management and recycling (Sri Lanka), 4. fuel-efficient cook stoves (Nicaragua and Guatemala), and 5. the promotion of climate-smart family preparedness plans through games.

Each topic comes with checklists that you may wish to consider when using these small and basic actions.



Climate-Ready Communities (Australian Red Cross, 2019)
An example of locally contextualised guidance for basic action among community groups is this short Climate-Ready Communities manual from Australian Red Cross. It proposes these four stages: a) **Understand** what climate change means for your community; b) **Get ready** to engage your community; c) **Have** a climate-ready conversation; and d) **Identify** your next steps.

This guide includes worksheets to document the process of engagement as well as four checklists for 1. individuals and households, 2. community groups/organisations, 3. service providers, and 4. local government councils.

Reflections: what could be your starter options?

Have a conversation among your National Society: what initial environmental actions could you take with existing resources? See the questions below and use appendix F.1a in the application toolbox to start and document your exploration of starter options.

1. What are some of the **key environmental issues** affecting your community? Consider waste (solid, chemical etc.), pollution (air, water, sea), degraded land (soil erosion, deforestation).
2. How does **climate change** affect your community? Consider changes in temperature, rainfall patterns, extreme events.
3. What are some of the **causes of these problems**? Consider lack of waste treatment, lack of renewable energy, need for firewood, the use of pesticides and fertilisers.
4. What **natural resources do you use and what state** are they in? Consider use of land, trees, water and agriculture, now and in the past.
5. What **actions** can you take as a community to address environmental issues?
6. What is the **objective of your action**? How does your action help you achieve it? Consider, for instance:
   - planting trees to reduce our negative impact on the environment;
   - recycling to better manage waste;
   - tree planting to create community awareness;
   - tree planting to engage schools in environmental education;
   - urban gardens to create aesthetically pleasant green spaces;
   - fruit trees and market gardens to provide some more local food.
7. What **resources** do you need (time, human, money)?
8. How can this tap into **other on-going work**?
9. Are there some local **experts** on these issues you can partner with?
10. How can we take **bigger action** to increase our resilience through working with nature? What would be our ideal situation? What would it take? Who would we need to work with?

3. Towards resilience with nature

Harness nature's power to protect communities from disasters

Nissan island, Papua New Guinea
Photo: Patrick Bolte

Having explored starter options, let us now move on to more advanced options and learn how to reduce risk with nature. While the starter options are useful to raise awareness and build momentum with the community, the advanced options in this chapter make a difference to communities' risk and resilience.

And while their benefits are far greater, we must also be mindful of the fact that these options require more time, resources, and expertise.

Typically, they are part of local level planning and implemented in the context of a community-based or larger scale project (at the eco-system or landscape level). Many donors are supportive of NbS projects (see part 3.2.5).

Often, NbS are promoted by national governments in their plans and policies (e.g., in National Adaptation Plans, see fig. 3.7) or part of local planning initiatives. We will reflect here on different entry points for natural resource management (NRM) and NbS – from national to local levels.

Before we proceed and delve into the details, ask yourself: which of the four scenarios in figure 3.1 applies to you? Make your selection, then use the guidance in chapters 3 & 4, as listed in fig. 3.1.

This process of planning and implementing NRM and NbS is outlined in the following chapter 4 and generally aligns with the Road Map to Community Resilience. We will start our journey in a moment.

But first, let's gain a deeper understanding of nature, its interaction with risk, and its potential for risk reduction and resilience. We will also use this as an opportunity to reflect on the broader entry points for nature and nature-based solutions in your country and for your National Society in general.

Fig. 3.1 **How to use the Nature Navigator for your context**

Project status	Description	How to use chapters 3 & 4
Ongoing project	You have been implementing a community-based disaster risk reduction (CBDRR) project and would like to see whether you can retrofit options to better harness nature's potential over the remainder of the project phase.	Consider tweaking your project to tackle NRM issues (fig. 3.4), to include starter options, or to use your project as a foundation for a future phase with NbS.
Planned short-term (<2 years)	You plan to implement a typical CBDRR project that has a duration of no more than two years and wish to include a component around working with nature.	Follow the general guidance in this chapter
Planned long-term (>2 years)	You want to design a nature-based solutions project or explore ways to integrate nature-based solutions as a core component into a longer-term DRR project — one that exceeds the duration of two years.	Follow the general guidance in this chapter as well as the specific guidance on NbS (NbS steps in chapter 4)
No planned projects	You want to explore, as a National Society, how working with nature might be relevant for you, without clear plans for a specific project.	Follow the general guidance in this chapter, consider awareness-raising (ch. 2), advocacy for funding.

3.1 Background: Natural resource management and nature-based solutions

In chapter 1, you have already learned about the challenges posed by climate and environmental crises to humanitarians and communities, about the benefits of healthy ecosystems in terms of risk reduction (speed brakes, sponges, stabilisers), livelihood and other benefits, and about the need to reduce negative impacts of our work. Now, let's have a closer look at what we can actually do to harness nature's multiple benefits. We begin with general considerations of natural resource management, then move deeper to nature-based solutions, and conclude with remarks on nature and resilience.

We experience increasingly frequent disasters, many of which relate to climate and environmental crises (IFRC 2020: 52).

Fig. 3.2 **Natural resource management (NRM) and nature-based solutions (NbS)**

	Natural resource management	Nature-based solutions
Objective	▸ Usually to provide food, water, fuel and fodder ▸ Ideally sustainable. Short-term benefits to humans may override long-term benefits to humans and ecosystems.	▸ To address a societal challenge, such as climate change, disaster risk, food or water scarcity ▸ Needs to consider sustainability, ecosystem integrity, and biodiversity benefits; the focus is on providing longer-term benefits and support resilience
Scale	Any scale - from small to large	Ecosystem or landscape
Approaches	Any - from local and traditional to mechanised or commercial	Ecosystem-based approaches

For example, in 2019, Bangladesh's flood-prone north-west was flooded five times in the span of four months. The current approach — a mixture of some regular services (e.g., First Aid and blood services), preparedness for response, and some direct support to community-based projects — may no longer be enough in this new multi-hazard reality. Unless we can reduce the level of exposure and long-term vulnerability to climate and environmental crises — identified by the IFRC as the global top priority for action — humanitarian needs will exceed our collective capacity to respond. The scale of resilience programming must be drastically expanded.

Critically, this needs to include protecting, restoring, and sustainably managing the ecosystems, in particular those on which livelihoods depend. We must learn to harness nature for disaster risk reduction and climate change adaptation.

The significance of ecosystems and natural resources is often overlooked. Ecosystems commonly have numerous benefits for resilience — both in terms of protecting communities and offering direct and tangible gains for livelihoods. Where ecosystems are degraded (often as the combined result of unsustainable practices and increasing climate change impact), their benefits — or so-called "ecosystem services" for communities diminish (as we already saw in chapter 1).

Promoting the conservation of ecosystems and more sustainable natural resource management therefore should always be part of efforts to raise resilience.

At the community level, it is advisable to consider **natural resource management (NRM)** as a key component of broader resilience and DRR projects, and to design and implement ecosystem-scale **nature-based solutions (NbS)** where time and resources allow. See figure 3.2 on how NRM and NbS compare.

Raising resilience on a broad scale is a daunting but rewarding mission. It requires a change in the way we work. It requires training, partnerships, and leadership. This change is a necessity if we want to stem the tide and better prepare for increasingly devastating disasters and climate change.

3.1.1 Natural resource management

One of the eleven IFRC dimensions of resilience reads: "A resilient community has access to, manages and uses its natural assets in a sustainable manner." (IFRC 2021:28, see fig. 3.3 opposite). As such, it focuses on land, water, soil, plants, and animals, and incorporates the aspect of environmental sustainability.

When working with a community, think of these questions:

- What natural resources do we depend on (in our community or region)?
- How do we manage the resources and to what extent is this management effective?
- Who has access to the resources? (e.g., do different groups have different access, what is the potential for conflict?)
- What is the availability of natural resources? What are the trends? For instance, have resources become less available or degraded?

- What are the main drivers of natural resource degradation in our community?
- Given our current use of natural resources, will the level be sustained over coming years and for future generations?
- How can we make our natural resource management more sustainable? What actions can we take with existing resources? What additional resources may be needed?
- How does our natural resource management relate to other dimensions of resilience (e.g., health, water and sanitation, shelter, food, economic opportunities)?
- How can we take further action to increase our resilience to disasters through working with nature? What would be our ideal situation? What would it take? Who would we need to work with?

Natural resource management is to a large part about the **governance** that lays out the framework for sustainable practices. This should take emerging and future factors such as those related to climate change into account. Note that there may be multiple stipulations to regulate the use of natural resources, issued by actors from various levels. For instance, there may be national policies and laws, regional plans, and local plans — as well as local frameworks arranged at the community level (such as regulations on the use of water for irrigation or on the harvesting of forest products).

If the governance is insufficient to prevent environmental degradation, explore ways to strengthen the governance and improve regulations that promote sustainable use. This may include a combination of local actions (e.g., the formation of water user groups, NRM committees, the inclusion of environmental oversight as one of the tasks of existing village committees), and advocacy for updated plans/policies at higher levels.

In addition to the governance aspect, we subsume basic actions under the NRM umbrella that render **usage** more sustainable.

Fig. 3.3 **Resilience dimensions and their relation to NRM and NbS**

A resilient community...
As described in the Road Map to Community Resilience, there are 11 resilience dimensions.

These **dimensions** are about functional characteristics that a community needs to have in order to 'anticipate, prepare for, reduce the impact of, cope with, and recover from the effects of shocks and stresses'. They are useful when assessing and monitoring the level of resilience in a given community, for instance by using the resilience star.

One of these 11 dimensions is called '**natural resource management**' (NRM) — this can be used to assess the state of NRM as part of the community's overall resilience.

DIMENSIONS

ACTIONS

There are many actions a community can take to raise its resilience. When working with nature, this includes actions subsumed under natural resource management (e.g., improved governance on the use of natural resources).

Certain actions are called nature-based solutions (NbS) — these are also based on principles of sustainable natural resource management but, in addition, feature further qualifying aspects. NbS usually take more time and resources than basic NRM applications.

Both NRM and NbS can help to reinforce the resilience of a community, across many or all dimensions.

Both NRM and NbS can help to strengthen many or all resilience dimensions, not just the one called natural resource management (dimension 8).

Investing in NRM and NbS and sustaining or strengthening ecosystem services can, for instance, enhance risk management, food security, health and economic opportunities (see ch 1).

Natural resource management (NRM)

- Actions to improve the governance and use of natural resources in a sustainable manner

Nature-based solutions (NbS)

- Address societal challenges
- Are informed by scale
- Lead to ecosystem net gains
- Consider economic viability
- Based on inclusive governance
- Managed adaptively
- Balance trade-offs
- Are sustainable and mainstreamed

Fig. 3.4 **Examples of poor NRM — and what you can do**

Practice	Risk implication	What you can do
Farmers use large amounts of pesticides and fertilisers on their fields	Possible impacts on water and food safety, on biodiversity, on other ecosystems (e.g., on downstream/ coastal areas), and on food security long-term	Regulate use of pesticides and fertilisers, offer more sustainable alternatives
People cut down mangroves and trees for firewood	Removal of trees greater than the natural re-growth leads to deforestation and removes the ecosystem services (e.g., the speed brake, sponge, and stabiliser functions).	Regulate logging/tree removal, provide heating alternatives and/or increase efficiency (eco-friendly cookstoves, insulation).
Farmers use water excessively to irrigate crops	If too much water is drawn from wells, the groundwater sinks and necessitates deeper drilling at high cost. This can impact entire ecosystems (trees drawing water through their roots), have health impacts (in many places, deeper water is associated with arsenic contamination), and lead to land subsidence that increases flood risk.	Regulate water extraction, adjust agriculture to less water-dependent crops and/or seed types or use intercropping, add rainwater harvesting for household use and gardening.
People overfishing and/or destroying natural fish nurseries (e.g., seagrass meadows or reefs).	Unsustainable fishing practices endanger food security and mid- to long term incomes of fisher folk. They also threaten biodiversity and the health of ecosystems that the wider community depends upon.	Regulate fishing through quotas and ban harmful practices. Declare no-take zones in critical biodiversity areas.
Businesses extracting sand from riverbeds for construction	Dredging riverbeds increases water flows and leads to increased flood risk and riverbank erosion	Regulate and limit dredging and seek alternative sources from less vulnerable locations.

Natural resource management actions that can be incorporated into typical DRR project timeframes include:

- **Reforesting along rivers** (riverbank stabilisation) and throughout the community (providing shade and reducing storm loads on buildings — but make sure that trees cannot fall on buildings),
- **Rainwater harvesting** as well as other simple means to retain water (such as sand dams and half-moons), and
- Some basic forms of **sustainable agricultural adjustments** (such as the planting of more drought-tolerant crops and seeds, as well as some types of agroforestry).

To understand why NRM is so important for resilience, let's imagine a community with poor and unsustainable practices, and what this means for risk. Figure 3.4 provides an overview. Do you notice any patterns in the examples? We'd like to highlight three aspects.

First, those pursuing the unsustainable practices benefit from it in the short term while externalising the costs to the wider community (diminished prospects and increased risk).

Second, many of the actions to rectify these issues tend to be relatively simple and can be implemented over short terms, usually during a typical CBDRR project. However, there may be cultural or political resistance to implement NRM.

Third, by improving NRM, the whole community benefits and grows more resilient. Over the long term, that tends to include even the perpetrators of unsustainable practices and can help shift cultural and political resistance.

In a nutshell, mainstreaming NRM into your DRR project can help avoid emerging risks through improved governance, awareness-raising, the promotion of alternative practices, and the integration of immediate actions to reduce risk. Therefore, you should always strive to embed the promotion of better NRM into your DRR project.

Furthermore, you should think bigger. Even if your time and resources are too limited to integrate larger-scale nature-based solutions (NbS), you may already lay the foundation for these natural risk reducers further down the track — especially if you plan to extend your project with a new phase.

For instance, by bringing environmental issues and risks on the community agenda, you can nurture the sense of **environmental stewardship** that will be pivotal for nature-based solutions.

You can work towards protecting ecosystems, start developing partnerships with ecosystem experts, and liaise with government agencies on possible opportunities. If time and resources allow, you can already arrange for ecosystem assessments.

3.1.2 Nature-based solutions: the standards

Nature-based solutions are resilience superstars. NbS can help improve resilience on several resilience dimensions (see fig 3.3), not only on the dimension of 'natural resource management'.

Protecting, sustainably managing, and restoring ecosystems reduces disaster and environmental risk and helps communities adapt to climate change, whilst providing livelihoods safety nets. In a world that will get harsher and less forgiving, this will be the essence of community resilience.

Aside from improved economic opportunities (such as tourism, increased yield, and unlocked development potential), perhaps the greatest value of 'nature-based resilience' lies in the potential to strengthen the connections between the natural environment and livelihood resilience (e.g., food and water security or health).

The enormous potential of NbS has been recognised by many governments, with NbS highlighted in national plans and policies such as National Adaptation Plans (NAPs) (see fig. 3.7). NbS have also been recognised by donors, and numerous specific **funding** streams exist for NbS projects (see fig. 3.8).

These give prospect to much-needed DRR programmes that are larger in scale and longer in duration. However, such funding will only be available to proposals that adequately meet the certain criteria (we will come to these shortly). Proposing to plant a row of trees will not be enough for this purpose.

Implications of implementing NbS

In fact, you should be aware of three key programming implications of pursuing NbS: you will need time, scale, and experts. Let's have a quick look. Furthermore, explore the IUCN Global Standard in fig. 3.5 that sets out what is and what is not a NbS.

T I M E Be realistic about timelines and make masterplans.

NbS typically feature the protection, sustainable management, and/or restoration of ecosystems. In many cases, the process of restoring ecosystems can require several years — longer than the typical timeframes of DRR projects. For instance, the rehabilitation of wetlands or mangroves may require the restoration of natural hydrology, addressing the factors that led to degradation in the first place, the monitoring of natural recovery, and if natural recovery fails, replanting (or 'assisted recovery').

In addition, policy or legislation to protect ecosystems may be required, and will take time (see case study G).

The mismatch of common timeframes of ecosystem restoration and DRR projects poses a practitioners' dilemma.

While it may be tempting to seek shortcuts, these should be avoided. For example, immediately deciding to plant mangroves without having assessed the factors that led to the degradation in the first place may bring a short-lived success concealing a long-term failure.

With luck, one may see young mangroves by the end of a three-year project. But without proper analysis and consultation, the mangroves may quickly succumb to the adverse factors that caused the initial degradation. The net effect for risk reduction may thus be zero. In addition, it is critical to consider where to plant mangroves, to maximise risk reduction benefits, and to identify species that are

best adapted to the local ecosystem, to climate change and/or for livelihood purposes. Thus, **avoid shortcuts**!

Other nature-based solutions may be faster to implement, for example those related to sustainable agriculture. In some cases, protecting existing resources at local scale may be feasible in a shorter time span, for instance through changes in local natural resource management plans.

It is important to be realistic about the time required to protect, sustainably manage, or restore ecosystems. Develop a longer-term **masterplan** that spans several project cycles, if needed, or aim for an adequately long project. Aim to build on existing **national or local plans** that already prioritise NbS, or integrate NbS into community and local/municipal level plans to ensure government buy-in and sustainability (see chapter 4 – Stage 1 of the Road Map to Community Resilience). This can help maintain activities beyond the life-cycle of projects.

EXPERTISE Have ecosystem experts on board to help assess and advise.

Integrate technical expertise with local knowledge of ecosystems. Communities often have a lot of knowledge regarding access, management and use of natural resources for their livelihoods. This should be the starting point.

However, technical expertise is critical to NbS. Because ecosystems are complex, dynamic, and interdependent with other ecosystems and socio-economic factors, nature-based solutions should only ever be implemented if suitable experts can accompany the assessment, planning, implementation, and monitoring process. NbS design and implementation must avoid undermining the integrity of the ecosystem and seek to enhance its functionality and connectivity — experts are needed to ensure this is the case. This usually entails carrying out an ecosystem assessment at the outset of project implementation (see case study D).

Consider reaching out to nearby universities and research centres for support or partnering with environmental NGOs and/or local and national environmental authorities to be part of the joint design process of NbS from the onset, thereby combining local knowledge with technical expertise.

Partnerships with such experts are likely the easiest and most common path for National Societies working on NbS. In the long run, National Societies might look into having environmental expertise in-house.

SCALE Identify the right scale to maximise effectiveness.

Finally, consider the right scale. In most cases, ecosystems are not aligned with administrative borders but straddle numerous communities. Furthermore, there are interdependencies between ecosystems, as well as with broader social, economic, and other systems. For example, the management of watersheds upstream will have a direct impact on water availability downstream. Therefore, it is important to identify an appropriate scale of NbS to yield effective outcomes.

Certain scales are also required to reach the intended effects. In the watershed example, restoration of upland forests will need to have a certain scale to have a flood-reducing effect downstream (remember the sponge function?). Similarly, urban greening will need to be applied at scale to reduce flood risk — sponge cities are good examples of applications at scale (see this video on sponge cities in China). An ecosystem assessment can also help identify the appropriate scale.

Case study D | **Resilient Islands (Jamaica)**

Location: Jamaica
Partners: Jamaica Red Cross, IFRC, TNC

The Resilient Islands Project in Jamaica is part of a regional initiative in Jamaica, Grenada and the Dominican Republic, being implemented in partnership between the three Red Cross Societies, IFRC and The Nature Conservancy (TNC) with funding from the German Government (IKI). The objective of the Resilient Islands project is for the government and communities in Jamaica to integrate community- and ecosystem-based adaptation into their local, national and regional decisions in order to reduce community vulnerability and boost adaptive capacity. Thereby, it focuses on **addressing the societal challenges** of reducing risk and adapting to climate change.

The project includes: selecting sites, identifying vulnerabilities and implementing Ecosystem-based Adaptation (EbA) measures in target communities; developing and deploying assessment tools; enhancing the role of NbS in legal and policy frame-works; and resource mobilisation. The project has had a strong focus on working at community level on resilience, whilst bridging this with the required expertise, ecosystem scale considerations and planning entry points at national level. In Jamaica, the focus community is Old Harbour Bay, the country's largest fishing community, which is exposed to flooding, storm surge and coastal erosion, exacerbated by climate change.

The project has worked on a strong **evidence base** and included both local and national level **expertise** in the planning and implementation of EbA measures. The project is a partnership between the Red Cross and TNC, an environment organisation, enabling the combination of DRR and environmental expertise. In terms of the government, close partnerships are built with thematic experts in the Office of Disaster Preparedness and Emergency Management (ODPEM) and National Environment and Planning Agency (NEPA). The University of the West Indies provided guidance on implementation of EbA measures, while local level knowledge has been sought from local government and community-based organisations.

In terms of **scale**, the ecosystem-based adaptation activities are focused on one community, Old Harbour Bay. However, the Rapid Ecological Assessment took an ecosystem focus in assessing threats, pressures and drivers on ecosystem services the community depends. This was combined with community-level assessments (including EVCAs and knowledge, attitude and practice (KAP) surveys) , to ground-proof findings with local knowledge (see case study J for further information).

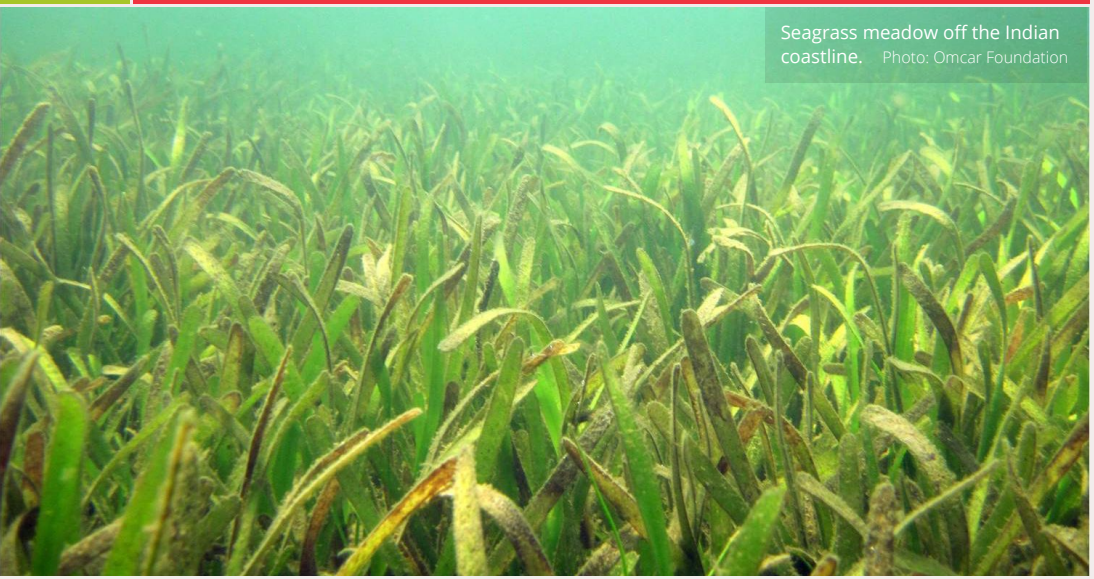
Coral reefs, seagrass meadows and mangroves protect a Caribbean coastline and nearby communities. Photo: Marjo Aho

In its second phase, under the Greening DRR project funded by USAID, work in Jamaica will be considering a ridge-to-reef ecosystem-scale approach, between an upstream and a downstream community. Ensuring **ecosystem integrity** has been critical in designing EbA measures.

The project sought to **integrate** its activities within the national and local **planning and policy** context. The proposed actions in the Rapid Ecological Assessment were developed as to align with Jamaica's Vision 2030: National Development Plan. The project site was chosen based on a *Vulnerability Ranking Index*, developed by the Office of Disaster Preparedness and Emergency Management (ODPEM). The original three major categories/criteria for assessment of communities by the tool were physical, social and economic vulnerability. The Resilient Islands project partnered with OPDEM to improve the tool and to add the criterion of environmental vulnerability to the Index. The data is used for planning and prioritisation of government resilience and vulnerability reduction projects.

Furthermore, the project carried out *An Integrated Analysis of Climate Change Adaptation and Disaster Risk Reduction in Jamaica's Legislation and Policies.* While the analysis found that there is comprehensive disaster management legislation and climate change policy, challenges have included the lack of effective enforcement mechanisms to ensure comprehensive implementation. Some of these issues have been addressed in community level programming. Finally, the project has worked on **economic viability**. It has mobilised resources beyond its initial stage – both by securing an additional second phase, supported by USAID through the *Saving Lives by Working with Nature* project, as well as by integrating priority EbA measures into local planning.

Fig. 3.5 **The IUCN Global Standard**



Seagrass meadow off the Indian coastline. Photo: Omcar Foundation

Time, expertise, and scale are critical when implementing NbS. The question as to what is a NbS (and what is not) was addressed by the eight criteria of IUCN's Global Standard (IUCN, 2020). These criteria are listed below.

If you would like to devise projects centred on NbS (for example, applying to specific funding for such efforts), make sure that your project idea will meet these criteria.

1. NbS effectively address societal challenges.

NbS are designed as a response to societal challenges that have been identified as priorities by those who are or will be directly affected by the challenges, such as disaster risk, food and water insecurity, or the lack of economic opportunities.

In the context of community-based projects, this benchmark is easily met, provided that the community assessment is conducted in an inclusive manner.

2. The design of NbS is informed by scale.

Identifying the 'right' scale is based on a good understanding of how the systems in your target area interact with each other and with the wider environment. For solutions to be sustainable, NbS require a 'systems' framing that acknowledges and addresses these types of interactions and builds them into the decision-making process, assessing how people, the economy and the ecosystem interact, both within the landscape and beyond.

For instance, consider a community located mid-stream along a river. If we only looked at that single community, we may decide that the best way to reduce risk from flash floods would be the reinforcements of embankments and canalisation. There may be economic interests for investing in such structures.

That may indeed reduce the risk of that community, but what about the neighbouring communities downstream? Not only may they not benefit from the canals. They may even be exposed to greater risk of flooding (diminishing the overall net protective effect).

By contrast, if we worked with all communities along the river and all stakeholders to address flooding — for example, by reforesting along riverbanks upstream and establishing joint water use and management plans with downstream communities, building on traditional water management practices, all communities along the river may benefit. Within the watershed, we must also adopt an ecosystem perspective and consider how soil, water and forests interact – how reforesting impacts soil fertility and water availability, both upstream and downstream.

Taking account of the economic, social, and environmental systems that communities are embedded in is important. This includes the recognition of the multiple levels of government as well as the fact that ecosystems commonly straddle the boundaries of several communities.

This will help identify risks and design durable NbS that duly assess how they either positively or negatively impact, or are impacted by, stakeholders, interests, and ecosystems outside the immediate intervention area.

3. NbS result in a net gain to biodiversity and ecosystem integrity.

While our efforts at the Red Cross/Red Crescent are geared to reduce disaster risk and bring other benefits to local communities, they must also bring net benefits to the environment.

NbS design and implementation must avoid undermining the integrity of the ecosystem and instead, proactively seek to enhance the functionality and connectivity of the ecosystem, as to ensure the long-term resilience and durability of the NbS.

This includes ensuring that ecosystem services that the community benefits from are maintained long-term.

In practice, this means that we need to assess the status and health of ecosystems (and identify degradation drivers), and then implement measures that improve the status of the ecosystems. This is usually done through ecosystem assessments. This also needs to include the monitoring of outcomes not just in terms of community benefits but also those to the environment.

4. NbS are economically viable.

NbS are based on long-term investments, as we mentioned earlier when highlighting the timing implication for programming. The economic case for a selected solution must be made and communicated to all stakeholders — they must be on board.

Therefore, it is important that you

- **analyse** the costs and benefits (direct and indirect);
- **justify** the selected measure against possible alternatives (incl. non-NbS measures), and
- **explore** a funding mechanism that ensures the financial long-term viability.

It is also important to show the benefits in the medium- to long-term, as in some cases NbS may take initially longer to implement but provide longer term benefits.

5. NbS are based on inclusive, transparent, and empowering governance processes.

As a practitioner of community-based projects, you probably have a good sense of the importance of inclusive management. For NbS, such management is crucial: communities and other key stakeholders, especially the government, must pull on one string. Inadequate stakeholder inclusion has been identified as a key fault where NbS have failed.

Due consideration needs to be given to vulnerable groups and stakeholders that might have a particular role in the protection and management of ecosystems, such as women and Indigenous Peoples.

The stakeholder management tool (appendix F.4) will help you to navigate this complex process.

6. NbS equitably balance trade-offs between achievement of their primary goal and the continued provision of multiple benefits.

Related to stakeholder management, this criterion is more critical than you may think. After all, some stakeholders or community members may be negatively affected by a proposed NbS measure (from fisher folk affected by no-take zones to timber businesses affected by rainforest protection). Trade-offs (weighing the positives and negatives from any measure) cannot be avoided but must be carefully negotiated and managed.

This involves the credible assessment, full disclosure, and agreement among the most affected stakeholders on how the trade-offs should be addressed. Fair and transparent negotiation and compensation among potentially affected parties for any damages or trade-offs to local opportunities and livelihoods provides the basis for successful long-term NbS outcomes.

7. NbS are managed adaptively, based on evidence.

One of the most important success factors of any project is agility: the ability to quickly identify changing circumstances allows us to address challenges before they become problems, and to seize opportunities before others do. This is all the more so in the context of a changing climate.

NbS are based on ecosystems — complex and dynamic entities with living components. Only if we monitor the ecosystems as well as other components of our projects, can we adjust and steer our project to the most effective results.

Aside from good monitoring, this requires a certain level of flexibility. For instance, we may first attempt to use 'light touch' mode of assisted natural recovery for a degraded forest but can only decide later on whether additional measures will be needed. Remember these words: Monitor. Learn. Adjust. Repeat.

8. NbS are sustainable and mainstreamed within an appropriate jurisdictional context.

The final criterion is about aligning your efforts with policies and laws of the location you work in. Make sure you review existing frameworks and inform them through advocacy and the sharing of your experiences. NbS are often already prioritised in national plans and policies, whilst local plans offer an ideal ground for integrating NbS.

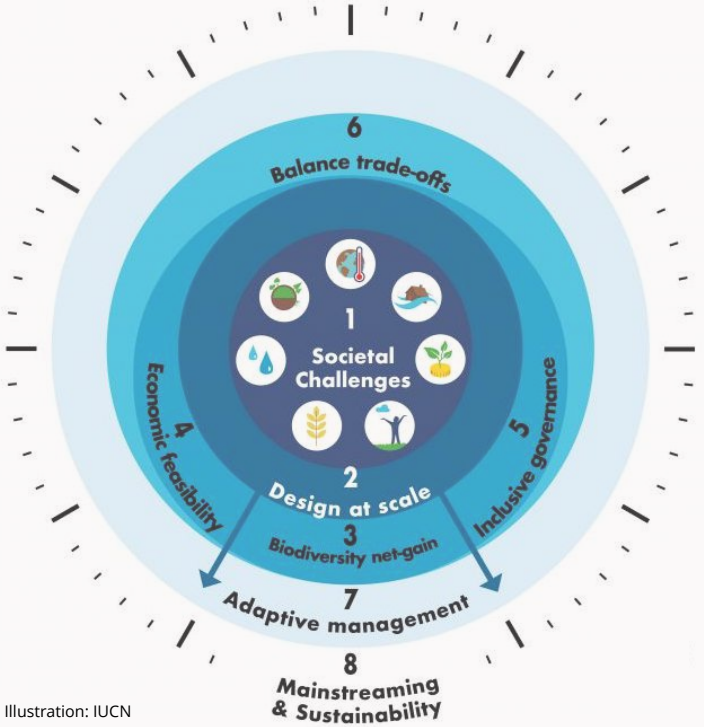


Illustration: IUCN

Indonesia: a farmer in West Kalimantan collecting peppers. Supported by project focussed on community-led conservation, communities were trained in sustainable agriculture and agroforestry — in an effort to reduce deforestation and biodiversity loss. See the full case study on Panorama. Photo: Yayasan Planet Indonesia

In addition to time, expertise and scale, other issues should be considered when applying nature-based solutions:

Stewardship & cohesion

Trust is an essential prerequisite if you want to nurture a strong sense of community stewardship of ecosystems. For NbS, this is even more important than for many structural measures. Ecosystems, after all, are dynamic by nature (pardon the pun).
If adjacent communities do not sufficiently care and protect them — or continue practices that led to ecosystems being harmed in the first place — then prospects for success are low. Therefore, continue deep engagement. Visit often. See what people think and do. Run surveys and focus group discussions, convince community leaders, and innovate to reach the wider community in an ongoing fashion.

See whether you can work with existing groups in the community to become NbS champions, or help form new groups. Train and equip groups, so that they can be strong stewards. Develop ways to render these groups sustainable and resilient themselves.

For instance, provide training on technical skills, fundraising, financial and volunteer management. Help them establish routines. Make sure that their drive does not solely come from just one person.

Ensure high technical quality

Let's take reforesting a hilly slope as an example. It may sound simple, but it is not. Selecting the wrong seedlings, planting at the wrong time of the year, or not sufficiently protecting the young plants from grazing livestock may lead to low plant survival rates.

Although you need to brace for occasional setbacks, ensure that you reduce the risk by operating with high technical standards. Following the detailed advice in external resources (see appendix B for solution factsheets and appendix D for main resources) and investing in the right skills will help you in the process.

Be aware of trade-offs

It is important to recognise that there may be **trade-offs** related to land and natural resource management when promoting nature-based solutions, as mentioned in Criterion 6 of the Global Standard (see fig 3.5). This means that protecting or restoring an ecosystem for community resilience may have short-term negative social or economic impacts. The *hilsa* fish conservation programme in Bangladesh provides an example of this (Reid & Ali 2018).

Eleven percent of Bangladesh's population depends on fisheries, with *hilsa* one of the country's main food sources. Overfishing and habitat degradation were leading to severe stock decline. The Hilsa Fisheries Management Action Plan in 2003 was established to address the problem, including through the creation of sanctuary sites where fishing is banned at certain times of the year. Partners and community members have evidenced, over a decade, that the conservation programme improved community resilience and adaptive capacity, since overall fish production has increased, thereby increasing food availability and income.

However, benefits have not been felt equally by all stakeholders, with fishing restrictions affecting hardest poor fishers who lacked alternative livelihoods. Furthermore, people in downstream programme areas experienced improvements more than upstream areas where catch/production increases were lower. Incentive programmes, such as micro-finance and compensation to fishermen were put in place to address this.

While trade-offs in land and natural resource management cannot always be avoided, they can be effectively and equitably managed. Support fair and transparent negotiation of trade-offs and compensation among potentially affected parties, for example through meetings, dialogue and joint assessments. This is the basis for successful long-term NbS outcomes.

Land access, management and use

Another critical issue is land use and land access: there may often be competing demands on land on the one hand. On the other hand, communities wishing to implement NbS may not have access to the land needed to implement NbS measures, especially at scale.

A wide range of drivers can impact land use and land use change (such as deforestation): small- and large-scale agricultural expansion, population growth, transportation infrastructure, technology change and international trade (FAO 2020). Whether for industrial or local-level use, such practices can lead to the loss of ecosystems and ecosystem services. There can be competition between exploitative land use and land use for nature-based solutions, such as agroforestry.

Integrated approaches are needed that consider the multiple needs and uses of land. The BioCaribe Connectivity Initiative, for instance, promoted large-scale ecosystem connectivity-corridors to link isolated protected areas (see FAO 2019 case study). The corridors were informed by sustainable production systems that included silvo-pastoral systems, agroforestry, mixed orchards, water-source and shore restoration, mangrove restoration and wetland recovery with aquatic agriculture. The aim was to combine approaches that support both biodiversity conservation and food production. It also required territorial planning and active community engagement in visioning, planning and management.

For land-use pattern to change, policy and regulatory shifts are required. For example, sustainable forest policies may be in conflict with fiscal policies that provide agricultural subsidies, with agriculture being the biggest driver of deforestation.

Finally, communities need access to land as to be able to implement NbS. Close collaboration and agreement is needed with authorities regarding government-owned land. There are no easy solutions, although regular and close dialogue, as well as joint planning with authorities from the design phase of NbS onwards can help address such issues.

Beware of maladaptation

Planning adaptation is always an exercise in uncertainty: we don't know for sure the level of increased flood risk and thus, what exactly

Fig. 3.6 **The range of NbS: an overview with examples**

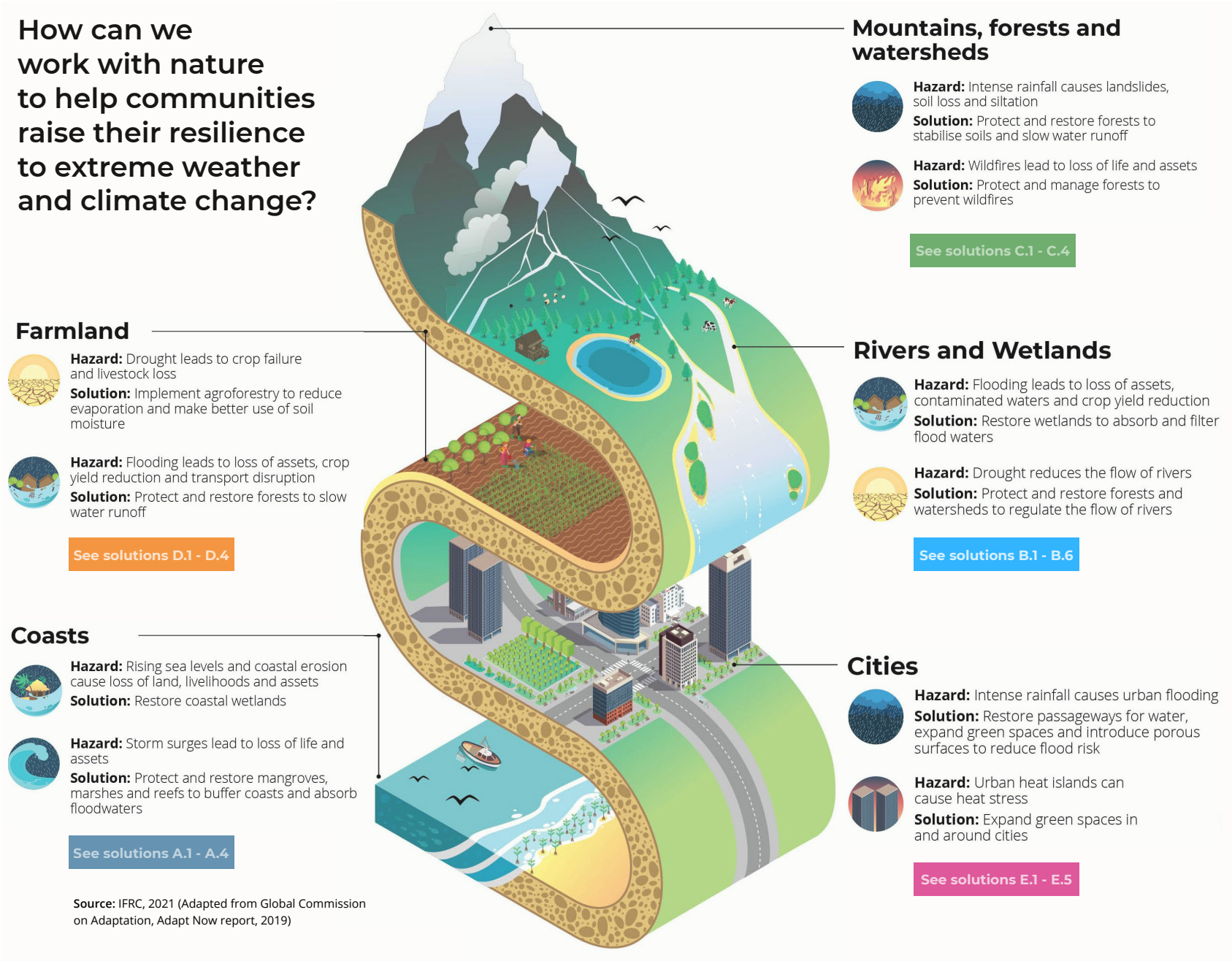
This overview lists **examples** of solutions and presents them along the lines of hazard and ecosystem contexts. It shows the interconnectedness and scale of ecosystems.

How you manage your mountains and watersheds will influence your rivers and wetlands, cities and farmlands, all the way to the coast. Ideally, you can choose options at scale to have the best chance of achieving your objectives to reduce risk. Even if you implement small-scale, community-based actions, it is important to understand how the broader ecosystem impacts your community and actions.

This figure gives you an idea as to what you could do. Protecting and restoring forests can be a solution to landslides in mountain areas. Restoring wetlands can absorb and filter flood waters. Agroforestry can enhance soil moisture and reduce the impacts of drought. See the solution factsheets in appendix B for more information.

Note that not every solution suits every context. For each ecosystem, for each hazard, there are a range of solutions you can take. In forests, you could look at conservation, reforestation or agroforestry. And as part of agroforestry, there are a range of measures, such as intercropping, crop diversification, and soil and water management.

In fact, identifying feasible and suitable solutions to your context, and then selecting the most promising combination of measures is an art that we will explore in the chapter 4, as we go through the Road Map to Community Resilience.



we need to adapt to and when. Neither do we know exactly how specific ecosystems will be affected by climate change, and thus, how their services will perform in future.

Built inevitably on imperfect information, some adaptation and risk reduction strategies fail — either providing no net benefit or leaving communities more vulnerable than they were in the first place. The latter case is known as maladaptation.

Examples include flood control measures that had severe negative impact on livelihoods in Bangladesh and seawalls in Fiji that prevented stormwater drainage —increasing net flood risk (Schipper 2020).

While there is no silver bullet to prevent maladaptation, common causes are:

- not being aware of what drives vulnerability in the first place;
- putting emphasis on the wrong actors;
- not understanding the wider development context; and
- investing in infrastructure or other semi-permanent changes that can lead to lock-in effects (ibid.).

Robust initial analysis of trends and dynamics (among ecosystems, communities, and the wider development context) as well as monitoring the performance of the measures that were put in place (whether they are NbS or not) can help reduce the risk of maladaptation. Communication is also crucial: you'll need to be clear on what a measure can and cannot do to avoid creating a false sense of security.

3.1.3 Nature-based solutions: the range

So far, we have been looking at the benefits of NbS, implementation principles and the criteria of the IUCN global standard. You may wonder: what are these actual solutions?

Fig. 3.7 **Examples of policies, plans and laws relevant for NbS**

Level	Examples	Relevance
National	▸ National Disaster Management Plan or Disaster Law ▸ National Climate Change Plans, Policies and Laws (incl. National Adaptation Plans (NAP), Nationally Determined Contributions (NDC)) ▸ Sectoral policies and regulations (incl. forest, agriculture, land-use, water, infrastructure etc.) ▸ National Development Plan ▸ National Environment, Biodiversity, Conservation Strategies or Policies	Policies and plans at this level may identify national priorities around NbS, incl. in terms of geographical areas for NbS; and national and sectoral budget priorities for NbS. Such policies can also ensure government buy-in for NbS projects at all levels. On the other hand, there may be some plans, policies and regulations around land use or infrastructure that override ecosystem restoration and can undermine NbS measures.
Sub-national (province, state, district)	▸ Local Disaster Management Plans ▸ Watershed Management Plans ▸ Local Development Plans ▸ Protected Area Management Plans ▸ Forest management plans	Often most relevant scale for implementing NbS (ecosystem, watershed etc.). Enables planning and budgeting for NbS, government buy-in and commitment beyond project cycles.
Community	▸ Community Disaster Management Plan ▸ Community Resilience Plan ▸ Water management plans ▸ Rangeland management plans	Direct entry points for integrating NbS actions at community level, ownership, buy-in

Figure 3.6 provides an overview, listing some solutions along the lines of hazard and eco-system contexts. The figure shows the interconnectedness and scale of ecosystems.

It is not exhaustive but gives you an idea as to what you could do. Protecting and restoring forests can be a solution to landslides in mountain areas. Restoring wetlands can absorb and filter flood waters. Agroforestry can enhance soil moisture and reduce the impacts of drought.

Note that each NbS comes with a solution factsheet (appendix B). For each ecosystem, for each hazard, there is a range of solutions you can take. Identifying feasible and suitable solutions to your

context, and then selecting the most promising combination of measures is an art that we will explore in the next chapter.

3.2 NRM and NbS: Entry points at the national level

This section is meant for National Societies who are looking to engage more deeply in working with nature and nature-based solutions in particular. It provides steps that are useful for National Societies to carry out and reflect on, *before* going into community level work and projects (which will be discussed in chapter 4).

This is especially the case for nature-based solutions which, as has been discussed above, tend to operate at a different scale – ecosystem scale and involve numerous communities.

3.2.1 Climate, disaster and ecosystem data and knowledge

What are the key ecosystems in our country? How are they being degraded? How are they being impacted by climate change and other disasters? How is ecosystem degradation creating environmental crises? If we want to start working on nature-based solutions, where should we start working?

As a starting point, it can be useful to gather existing information to better understand how ecosystems work in your country and how they are being impacted by climate change and disasters (see also questions at the end of chapter 1). Some useful sources of information might include:

- Reports by meteorological departments, disaster management authorities, agriculture authorities, research institutes, and water or forest authorities;
- National climate change reports, such as the National Communications to the UNFCCC (see here);
- National biodiversity reports, such as National Biodiversity Strategies and Action Plans (see here);
- Maps of natural hazard risk, including the Opportunity Mapping tool that maps areas that are both at high disaster risk and high levels of ecosystem degradation (see here) as well as land cover change maps; and
- Reports on climate change, natural resource use, drivers of degradation, and risk maps by NGOs and other organisations.

Such an initial desk review can help to identify: (a) vulnerable or priority ecosystems and regions in the country that you may wish to focus on, including areas vulnerable to natural hazards; (b) priority areas of work for NbS (e.g., wetland restoration over agroforestry); and (c) background information, which is critical for project proposals (see below). You can map this information against disaster and risk data you regularly use.

3.2.2 Policy and planning for NbS

When aiming for NbS, we should think of the appropriate scale and of systems. This means that there are potentially various policy and planning entry points, from national to the local level. Ideally, at the outset, you can spend some time compiling relevant national level plans, policies, laws and regulations that are directly relevant for NbS – national disaster plans, climate change plans and policies, sectoral policies, development and environment policies, climate change laws (see fig. 3.7). You may carry out these types of policy reviews as part of other activities you might have on disaster law or climate policy within your National Society.

Policies and plans at this level may identify national priorities around NbS, including in terms of geographical areas as well as national and sectoral priorities. For example, climate change plans such as

Case study E | **Restoring mangroves in Viet Nam**

Location: Eight provinces in northern Viet Nam
Partners: Viet Nam Red Cross, Danish Red Cross, IFRC, Vietnam Government

Photo: Thorkell Thorkelsson, Icelandic Red Cross

Viet Nam Red Cross (VNRC) has been involved in the Mangrove Plantation and Disaster Risk Reduction (MP-DRR Project) for almost three decades, since 1994. The first phase was supported by Danish Red Cross and the Government of Viet Nam, with later support from the Japanese Red Cross and British Petroleum Group. The province of Thai Binh in North-Eastern Viet Nam was chosen as a site to reduce typhoon impacts. It is one of the areas of Viet Nam to have experienced significant loss of mangroves, largely due to war, natural causes, aquaculture and urban development. Massive conversions exposed coastal infrastructure (incl. sea dykes) and livelihoods to typhoons and storm surges.

In the first phase, the intervention focused on planting mangroves in one pilot province to protect sea dykes and livelihoods. VNRC worked with targeted communities and local government to select appropriate planting areas, map the area, reach common agreements and mobilise community participation and experts in mangrove planting and protection. After initial success, VNRC scaled up its interventions to 8 coastal provinces of Ha Tinh, Hai Phong, Nam Dinh, Nghe An, Ninh Binh, Quang Ninh, Thai Binh, and Thanh Hoa. VNRC added a capacity building component to strengthen community disaster risk reduction including vulnerability and capacity assessment, planning, small infrastructure DRR works, training provincial and Commune disaster response teams, and awareness raising with children and teachers at school.

VNRC engaged and contracted the Mangrove Ecosystem Research Centre (MERC) under Hanoi University to provide technical support, including advising on type of mangrove species and land conditions. MERC worked with the Department of Agricultural and Rural Development to advise on the most suitable solutions.

This intervention has continued for over 20 years. Mangroves restored by VNRC and communities are currently covering approximately 9,000 hectares in nearly 100 coastal communities. The project has provided protection to local communities against typhoons and storm surges, whilst also bringing direct economic and livelihood benefits through aquaculture and non-timber forest products. The project brings benefits to an estimated 190,455 direct beneficiaries and many more indirect beneficiaries. In areas with mangroves, yields from collecting marine species increased by up to 57.2%. The household survey results done in 2015 showed an average income of VND 179,000 (USD 6.50) per person/day or VND 3,580,000 per person/month (US$ 159) (IFRC, project evaluation, 2015).

The carbon sequestered by the planted mangroves was estimated to be 1,204 tCO2/ha in 2013. Using The World Bank's (2014) price of 37 USD/tCO2, it was estimated that from 8,313 ha of mangrove under the VNRC MP-DRR programme, the annual estimated value of CO2 emissions absorbed was about USD 370 million.

Lessons learned included:

- Long-term commitments of communities, local governments, and donors are required..
- Good documentation, planning and mapping are success factors for effective mangrove restoration.
- Clear forest ownership by forest guardians protects against future conflicts, while co-management mechanisms for forest management and protection ensure sustainability.

Protection of mangroves has been challenging, due to trade-offs and community interest in aquaculture. VNRC facilitated and coordinated meetings, dialogues and negotiations with local authorities, communities, and the central government to minimise the loss of mangroves for aqua-cultural development, facing both successes and losses.

VNRC was also involved in advocacy with the Government for legislation to preserve and protect the mangroves. The Government of Vietnam approved decree #199/2016 'Decree to provide for policies on sustainable management, protection and development of coastal forests to respond to climate change'.

This defines roles and responsibilities for the protection of coastal forests, assigns budgets and sets provision for technical guidance.

Fig. 3.8 **Key donors for NbS**

A recent report by UNEP, *State of Finance for Nature* (2021), found that USD 133 billion currently flow into nature-based solutions annually, 86% of which represent public funds. This is investment by governments, through domestic budgets, in protection of biodiversity and landscapes, agriculture, forests and fisheries, or water resource conservation. National governments, with their plans and budgets, are therefore key allies for implementing NbS.

The report further finds that investments in NbS will need to at least triple by 2030 if the world is to meet its climate change, biodiversity and land degradation targets. This requires unlocking private finance, which currently accounts for 14% of total flows to nature-based solutions. Private sector investments include e.g. biodiversity offsets, philanthropy and payment for ecosystem services.

Nature-based solutions are currently prioritised by several bilateral and multi-lateral donors. Some examples include:

- The Green Climate Fund priority adaptation result area on ecosystems and ecosystem services
- The German Climate Initiative BMUB/IKI adaptation priority on ecosystem-based adaptation
- GEF Climate Funds for adaptation (LDCF and SCCF) that mainstream climate change adaptation and resilience for systemic impact for ecosystems and livelihoods
- EU GCCA+ funds for priority actions that strengthen the resilience and adaptive capacity of human and natural systems to climate-related natural hazards and disasters (including EbA and eco-DRR).

National Adaptation Plans (NAPs) and Nationally Determined Contributions (NDCs) might identify nature-based solutions as a thematic adaptation or mitigation priority, whilst also prioritising actions in the agriculture sector specifically (e.g., around agroforestry for adaptation) or prioritising specific ecosystems and geographical areas for adaptation (e.g., highland pastures or coastal wetlands).

Note that provincial/state and district governments and agencies may also have policies and plans that should be reviewed.

Knowing these priorities can help identify the types of NbS and areas that have been prioritised by government, usually based on data analysis (see point 3.2.1) and consultations. This can help ensure government buy-in for NbS projects at all levels, make collaboration easier, and also open more opportunities for funding. You can work on combining this with disaster management data and hazard maps.

It is also important to assess what sub-national or local plans around DRR, natural resource management, conservation or development are in place. For example, there may be Watershed Management Plans or Protected Area Plans already in place, to which you can link community-level disaster management activities. This can provide planning support, ensure an ecosystem angle, and government buy-in and commitment beyond project cycles.

It is also useful to consider whether national or local policies and plans might be restrictive to nature-based solutions. Are there land use or development plans in the area that may negatively impact planned NbS measures?

You would not want to spend a lot of time, money, and effort into restoring an important ecosystem only to find out later that a new industrial estate had long been planned at that site. The need for assessing community level natural resource management plans will be discussed in chapter 4.

Another crucial aspect that should be explored early on concerns land ownership and access: who owns the land areas, and what are the title holders' plans for their areas? It is important to note that without the endorsement of land owners, NbS cannot proceed.

3.2.3 Site selection

Based on the previous steps, you should now have some idea of potential national priorities in terms of geographical areas and ecosystems, as well as types of nature-based solutions.

If you have chosen a region you wish to focus on, and you have project funding already available, you may even be able to carry out an ecosystem assessment at this stage.

This can help you narrow down the ecosystem to focus on, and communities you wish to work with within that ecosystem. The ecosystem assessment (and how it can be carried out in parallel with community vulnerability assessments), is explained in chapter 4, stage 2. It is critical to combine ecosystem data with hazard maps and disaster data. Questions to consider may include which part of a slope to reforest in as to avoid landslides, or which type of soil/part of land to implement agroforestry in as to reduce drought impacts.

3.2.4 Stakeholders and projects for NbS

An initial mapping of key national level environmental stakeholders can help identify partners for designing and implementing nature-based solutions. Such stakeholders can even help identify entry points, provide technical guidance from the outset, and help shape joint project proposals.

It is also useful to start looking at projects that may already exist in your country, specifically around nature-based solutions.

Is there a government project working on wetland restoration to reduce coastal erosion and flooding? Is there an international or national organisation working on NbS as part of post-disaster operations and recovery? What activities are you already carrying out as a National Society that are relevant for NbS?

Knowing what projects are 'out there' can give ideas for your own NbS activities, provide potential visits for learning, and help find partners.

Fig. 3.9 **Do small-scale NbS exist?**

With scale being one of the IUCN criteria as to what constitutes a nature-based solution (see fig. 3.5), one may feel intimidated: as a National Society, will we be able to pull off such a large-scale project? Frankly, it's a valid concern.

In fact, the section 3.2 was designed to highlight that we need to explore and utilise the national entry points: without a good analysis of the NbS entry points (data, partners, funding etc.) and a strategic discussion within National Societies, it will be hard to plan, implement and fund ecosystem or landscape-scale project. Consider this exploration as a precursor to the process based in communities (as it is described in the Road map to Community Resilience).

Still, are there smaller-scale NbS that can be pursued as part of typical DRR projects? Yes, there are. Some forms of climate-smart agriculture, bio-engineering and agroforestry can be seen as NbS (see case study H). In case study collections such as Panorama (see an overview of such collections in appendix B), there are numerous other examples of small-scale solutions.

Nevertheless, it must be understood that the smaller scale of an intervention usually comes with a smaller effect on risk reduction. And in some cases, scale is required to ensure a protective effect (see 3.1.2). In others, scale is needed to know how the broader ecosystem interacts with our smaller-scale NbS intervention (e.g. upstream deforestation can cause flooding and undermine a downstream agroforestry project). With the substantial climate- and degradation-driven increase in risk, we need to think bold: therefore, aim high — and seek to reduce risk at scale.

3.2.5 Funding for NbS

The steps described above may already have helped identify potential sources of funding for NbS — be they national, sectoral or local government budgets or co-financing from government.

Several international finance sources, including bilateral and multilateral funding for climate and environment, prioritise ecosystems and NbS as a funding theme. There is also increasing private sector interest in NbS. See fig. 3.8 for some examples (noting that financial priorities do shift and change). It is important to note that funding proposals for NbS require considering the criteria described under point 3.1.2 and often benefit from carrying out some of the initial steps mentioned in this chapter as background research.

3.2.6 Conclusion

In this chapter, we have learned about NRM and NbS and the underlying principles. We have also explored some of the entry points for NbS — emphasising that **getting a good overview** of existing data and knowledge, of policies and plans, of possible priority areas, of stakeholders and funding opportunities is critical to the implementation of nature-based solutions.

Considering the time, scale and expertise typically needed for NbS, such a good initial analysis will make your concrete work in communities a whole lot easier: you already know the wider context (and can synthesise national data with information obtained in community and ecosystem assessments). You can align with plans. And you may already have the partners that you can collaborate with in community-based efforts. Now, let's proceed to the process of raising community resilience with nature.

Ready? Turn the page.

Checklist: Towards resilience

		Yes	No
1.	Have you reviewed some **key national reports on climate change, disasters and ecosystems**? What are some of the main climate impacts? What are the key ecosystems and drivers of degradation? How do these compare to areas highly vulnerable to natural hazards? Are certain ecosystems or geographical areas prioritised at national level? Are certain groups or communities?	☐	☐
2.	Have you reviewed national climate, development, environment and disaster **plans and policies**, to see how they might integrate NbS? Are certain priority ecosystems or NbS activities proposed?	☐	☐
3.	Have you considered any of the above information as part of your **site selection** process?	☐	☐
4.	Have you mapped out some **key national level stakeholders for NbS**? Do you have an initial mapping of NbS projects in your country?	☐	☐
5.	Have you explored **funding options for NbS**? Which ones are you (or your partners) eligible for?	☐	☐

4. The process: Raising resilience with nature

Valencia, Spain
In the hot and dry summer weather, devastating forest fires are a constant risk in Spain. Spanish Red Cross volunteers are patrolling the Devesa Albufera National Park in Valencia to spot fires and protect this unique habitat.

Photo: Spanish Red Cross

4.1 Overview of the Road Map to Community Resilience (R2R)

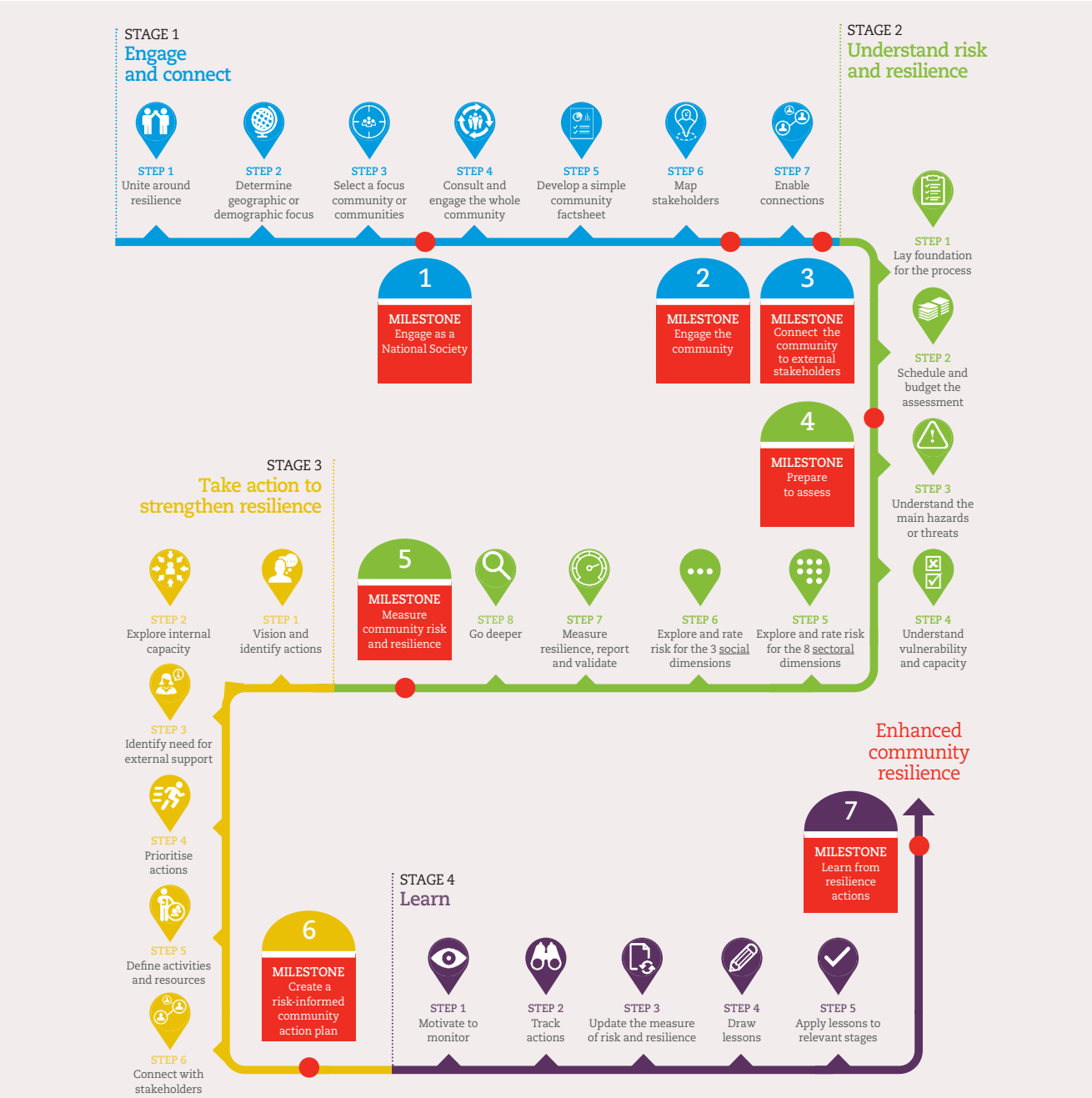
Many in the Red Cross Red Crescent are familiar with the Road Map to Community Resilience (R2R). The Road Map and the Enhanced Vulnerability and Capacity Assessment (EVCA) are used by Red Cross and Red Crescent Societies and offer a good entry point for integrating natural resource management and nature-based solutions into broader DRR and resilience programming. Let's explore how to integrate nature into the Road Map to Community Resilience and the EVCA process.

The Road Map to Community Resilience was first created in 2016 as a process manual to guide National Societies and their branches in efforts of raising community resilience. In 2021, IFRC published an updated version (v2) that integrated the EVCA. The Road Map comes with a rich set of reference sheets and links to a dashboard for the measurement of community resilience.

The Roadmap has **four stages** and **seven milestones** that allow you to track your progress (see fig. 4.1), as well as **five landmarks** that can be understood as qualities to be applied throughout the entire process. The landmarks are:

1. **Risk-informed:** Looking at all risk components at communities, rather than just at individual threats in isolation;
2. **Holistic (systems-oriented)**: Recognising the wider systems that communities are part of;
3. **Demand-driven:** Ensuring that the demand to reduce risk is articulated by the community, and then addressed through the Roadmap process;
4. **People-centred and inclusive:** Ensuring that we listen to concerns from all groups within a community, rather than imposing our ideas; and

Fig. 4.1 **Stages and steps of the Road Map to Community Resilience**



5. **Climate-smart and environmentally sustainable:** This fifth landmark aligns directly with the Nature Navigator: the reduction of impacts from climate and environmental crises.

All landmarks are relevant for natural resource management and NbS, in particular landmarks 2 and 5. As mentioned above, the Road Map to Community Resilience features **eleven dimensions** of community resilience, one of which is natural resource management (see figure 3.3).

Fig. 4.2 **Strategic engagement within National Societies**

'Unite around resilience' is the first step of the Road Map — and while this sounds easy, one should note that ideally, this should entail a strategic process among the leadership and departments of National Societies.

In order to prevent resurgent trends in disaster deaths, ballooning damages and losses, and overwhelmed response capacities of National Societies and disaster management agencies, we must support communities around the world to adapt and grow more resilient. Despite the common commitment to 'build resilience', such efforts thus far make up for a minor share of the of the Red Cross and Red Crescent Movement. More importantly, the communities supported by the Red Cross and Red Crescent represent only a small share of those that are at increasingly high risk.

To deliver on the gargantuan task of raising resilience on a much broader scale, we need to strengthen the capacity of branches and chapters so that they can 'accompany, connect and enable' communities. That entails a sober analysis of the capacity at all levels of National Societies ('where are we now?'), the formulation of targets ('where do we want to be?'), and the development of a resilience strategy ('how do we best get from here to there?').

This process should explore the potential of strategic partnerships — after all, resilience is a multi-dimensional concept, and few if any National Societies are likely to have strong expertise across all of the eleven resilience dimensions.

For instance, the dimension on natural resource management (see also fig. 3.3) and in particular the implementation of NbS will require technical expertise — that National Societies can incorporate by partnering with environmental NGOs and technical agencies (see fig. 4.7).

The strategic process within National Societies should furthermore explore the use of NbS as part of their DRR and resilience portfolios. After all, their numerous benefits on many or all of the resilience dimensions make NbS a formidable set of tools to render communities more resilient. As discussed in ch. 3, exploring national-level entry points should be part of the strategic process.

Consider the formation of partnerships as part of your overall resilience strategy. A national-level partnership with the Ministry for the Environment, for instance, may make it a lot easier for RC chapters or branches to form respective partnerships at the district or province/state level.

4.2 Applying Road Map & Nature Navigator as a twin pack

Let's start our journey and learn how to integrate NRM and NbS in the process towards raised resilience. Moving through the stages and steps of the Road Map, we point out aspects to consider when seeking to integrate NRM and NbS. For a full overview of the Road Map to Community Resilience, please visit https://www.ifrcr2r.org/overview.

The role of the RCRC, throughout the process, is to accompany, enable and connect, while ensuring that communities take the lead in the NbS and resilience journey.

Overall, the R2R approach is relevant and well-aligned with processes for designing nature-based solutions for resilience and disaster risk reduction. However, it is worth noting that while the Road Map to Community Resilience is primarily focused on the community level, nature-based solutions may require a landscape or ecosystem scale.

This requires a different approach and key additional steps, for example, around ecosystem assessments and planning implications beyond the community level. These points are highlighted throughout the following sections. An overview of NbS steps is furthermore provided in fig. 4.3 opposite.

Throughout assessments, planning and implementation of projects aiming to raise resilience, make sure that your approach is **gender-responsive** and **inclusive** (see landmark 4 of the Road Map). Ensure that the data you collect are appropriately disaggregated, and that all voices and interests are heard and reflected when designing solutions.

Fig. 4.3 **Summary of NbS steps** to be considered when appyling the Road Map to Community Resilience

The role of Red Cross and Red Crescent Societies and their branches is to **accompany**, **connect** and **enable** communities along a path towards raised resilience through nature.

Stage 1. Engage and connect

NbS Step 1A. Include ecosystem data when deciding on focus area and communities.

Data on ecosystems, future risk as well as on context and capacity should be considered.

NbS Step 1B. Make sure to include environmental information in the community factsheet.

Consider the role of the environment in all eleven resilience dimensions of the community factsheet.

NbS Step 1C. Map and engage stakeholders at an ecosystem scale.

Stakeholder mapping should be based on an ecosystem scale (beyond individual communities), and be followed up with strategic engagement.

NbS Step 1D. Foster or create a steering group/team.

NbS efforts need governance, which may include existing groups and/or additional committees that represent stakeholders and target communities.

Stage 2. Understand risk and resilience

NbS Step 2A. Conduct an ecosystem assessment with technical experts and local knowledge.

Both technical expertise and local knowledge are crucial for effective ecosystem assessments.

NbS Step 2B. Conduct an analysis of local plans.

A robust analysis of existing plans and policies (at multiple levels) must underpin further exploration to enable well-aligned solutions.

NbS Step 2C. Collate information, define objectives and entry points.

When working at multiple levels (e.g., several communities, ecosystem, district), collating information is crucial to define overarching objectives.

Stage 3. Take action to strengthen resilience

NbS Step 3A. Explore NbS actions.

NbS actions should be explored first: what ecosystem-based measures can be taken to reduce risk and raise resilience? These will be based on the findings of ecosystem assessments (NbS step 2A).

NbS Step 3B. Add non-NbS actions and develop options.

Now add further actions that may be needed to reach your objectives. Then, create different options (packages of actions) to enable a comparison.

NbS Step 3C. Compare and prioritise options.

Set criteria for comparison and conduct a multi-criteria analysis (MCA) to prioritise those options that best meet your objectives and context.

NbS Step 3D. Decide on your DRR solution.

Share the results of your analysis through an inclusive process and then decide on the best option (which is your DRR solution).

NbS Step 3E. Turn your DRR solution into a plan.

Operationalise your DRR solution by creating a logframe, work plan and budget that describes how the solution will be implemented over time.

Stage 4. Implement and learn

NbS Step 4A. Implement & monitor.

One of the keys for NbS is adaptive management, which requires strong ongoing monitoring. Seven implementation principles should be kept in mind when implementing NbS.

NbS Step 4B. Analyse & learn.

Beyond ongoing monitoring, efforts centred around NbS should run systematic analyses and reviews to better understand and improve the protective performance of applied measures.

Step 4B.a Systematically analyse outcomes.
Step 4B.b Conduct hazard event reviews.
Step 4B.c Learn & adjust to maximise impact.

NbS Step 4C. Share & expand.

Sharing of lessons and insights is critical to support a wider application of NbS in the context of disaster risk reduction.

Step 4C.a Document your experiences well.
Step 4C.b Share openly and widely
Step 4C.c Advocate for and support replication.

Fig. 4.4 **Stage 1**

Not using the Road Map?
If you are following a different DRR or resilience programming approach, the proposed NbS steps are likely to remain relevant.

Stage 1. Engage and connect

What this stage is about. This stage is about setting the scene: as a National Society, you unite around resilience, develop a shared understanding amongst different units, and make a commitment to resilience programming that is underpinned by a team and resources (step 1.1).

You then decide on the broad geographic or demographic priority focus (step 1.2) and select focus communities to work in (step 1.3).

You then visit these communities and engage broadly (1.4) and develop a simple community factsheet for each community (1.5). You conclude this stage by mapping stakeholders (1.6) and enabling connections between communities and stakeholders (1.7).

At the end of stage 1, you have agreed on resilience programming, selected communities, and gained initial insights and connections around these communities.

Nature perspective. At the very **first step (unite around resilience)**, you should include discussions on the role of nature in resilience. See the questions in chapters 2 and 3 for ideas on how to integrate this dimension of resilience in initial conversations.

You should also consider and strengthen your internal capacity. Think of horizontal and vertical aspects.

In terms of **horizontal aspects**, explore your organisation's expertise in terms of the eleven resilience dimensions. To what extent do you have the skills and knowledge to guide branches and communities on assessing the various resilience dimensions – especially dimension 8 on natural resource management? This dimension may require expertise in agriculture, forestry, water, conservation, and ecosystem management, among others.

Regarding the **vertical aspects**, ask yourself to what extent a) local branches have this capacity and b) your headquarters can strengthen local branch capacity for resilience programming. Remember that all implementation is local: it is your branches who will assume the role of accompanying, connecting, and enabling communities.

To some extent, you may be able to address gaps (e.g., on natural resource management) through internal capacity-strengthening. Better still, form or strengthen national partnerships with key partners who can add expertise in fields where you have limitations. Such alliances are beneficial not only to supplement expertise. They also help you to better understand the efforts of others and align your planning with government agencies, research institutes, and NGOs. Do not plan in isolation but take the existing context as a starting point.

NbS-specific guidance. If you seek to implement nature-based solutions, you must in fact develop local or national partnerships with actors who have expertise in relevant ecosystems (e.g., coasts,

forests, drylands, mountains), their conservation, sustainable management, and restoration. This is important for considering the appropriate scale (compare IUCN criteria 2 and 8) and site selection.

In practical terms, you will also need experts who can provide ecosystem assessments at stage 2 and guide the design and implementation of nature-based solutions.

NbS Step 1A. Include ecosystem data when deciding on focus area and communities.

When it comes to **deciding on the geographic or demographic focus (step 1.2)**, the Roadmap proposes to identify the areas or population groups at the highest risk by reviewing existing data (such as those available at Inform Index, the 510 initiative, IFRC GO, as well as national and regional websites; see case study F).

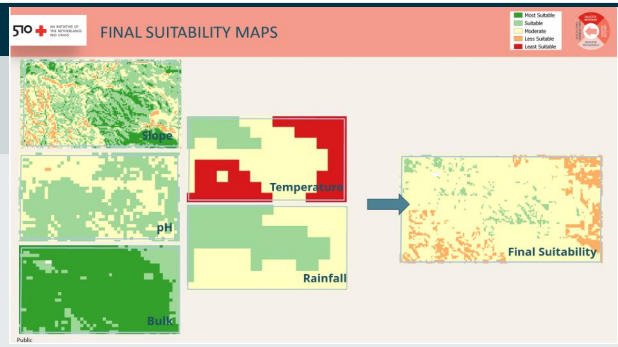
We suggest adding considerations of future risk (including those related to climate change), relevant environmental data (on forest cover, water maps etc.) and local capacities when deciding on the geographic and demographic focus.

First, try to obtain data on future risk (see also part 3.2.1). Given the evolving impact of climate change, historical data on hazard events alone may be an imperfect guide on future risk hotspots. Climate change information can be gathered from official sources (such as weather and meteorological reports, and national climate change communications) as well as through participatory processes on local observations (see fig. 4.9). It may require analysing climate information and getting guidance from experts, such as government agencies (e.g., weather agencies) and research institutes working on climate change. See also the new Red Cross Climate Course.

Second, ecosystem data can be relevant for all types of resilience programming. It is useful to look at broader landscapes in which

Case study F | 510 Data for site selection in Haiti

Location: Haiti
Partners: Haiti Red Cross, Netherlands Red Cross,



Haiti Red Cross and Netherlands Red Cross carried out a site suitability analysis in 2020-2021 as part of the Green Pearls project. The goal of the Green Pearls project is to restore ecosystems for disaster risk reduction. The initiative features three operational pillars: healthy landscapes, resilient communities and economically empowered people. Multiple 'green peals' or landscapes will be assigned for this project, with La Vallée de Jacmel being the first one.

Part of the project is a local reforestation programme. A search for suitable reforestation locations was performed to find the optimal conditions for sustainable reforestation. This was done as an exercise involving technical knowledge from the Netherlands Red Cross 510 Data team and local knowledge from Haiti Red Cross, including an agronomist.

The process included applying: site suitability analysis, the Opportunity Mapping tool, multi-criteria analysis and composite mapping. Initially, global data sources such as Earth Engine Data, World Soil Information and WorldClim were used to identify reforestation data and indicators for Haiti including on: elevation (slope); soil (pH, texture, density); and climate (temperature, rainfall, solar radiation). The methodology and data sources were checked and ground-proofed based on field knowledge and field visits of local experts. The combined data was used to develop site suitability maps (see image).

Based on the suitability analysis and maps, communities, the National Society and partners (such as local government) selected sites for reforestation. Selection was done based on local knowledge – for example, how easily accessible those sites were. However, the most important criteria for the final site selection was land ownership. In order to reforest an area, a permission from the owner and/or the government is necessary. If the land ownership data were available digitally, it could have been directly included into the analysis. Often however, this data is either not digitalised or in some cases it is not available due to privacy reasons.

Lessons learned include that involving local experts and the community is as important as having the data. Their insights and knowledge of the region and the context helped significantly to shape the methodology and site selection.

Another lesson learned is that even if the most suitable sites for reforestation were identified, they were not always chosen. The reason for this is that there are plenty of factors that make those sites not suitable, which were impossible to include in the model. One such example is accessibility. Some of the most suitable sites were located in such remote areas that there was simply no way of accessing them.

However, another interesting insight from local experts was that the absence of roads can also be considered a positive factor. Illegal deforestation unfortunately happens regularly in Haiti and if there is no way to easily reach the reforestation site, trees will be left to grow instead of being illegally cut. Once more, involving the community turned out to be very insightful and a prerequisite for a successful reforestation campaign.

Source: Site Suitability Analysis for Reforestation. Angelina Savchuk and Djamilja Oud, Netherlands Red Cross. Presentation 21.07.2021.

Fig. 4.5 Data sources

When gathering ecosystem-relevant data, consider the following data sources:

- **Meteorological department**: climate and meteorological data
- **Agriculture authorities and research institutes**: data on soil fertility, crops, agroforestry, vegetation cover etc.
- **Water authorities**: data on watersheds, water levels, water quality, irrigation etc.
- **Forest authorities and research institutes**: forest cover, land use etc.
- **NGO reports**: on local level climate change data, natural resource use, drivers of degradation etc.
- **Online tools** relevant for ecosystems such as the PEDRR Opportunity Mapping tool and 510 data, and satellite data for land cover.

Fig. 4.6 Local committees or teams

Depending on the local context, consider

- working through (and strengthening) existing community teams;
- forming local resilience/DRR teams if needed; or
- establishing a project steering committee in the case of larger projects.

Irrespective of the option, you should ensure effective engagement with all key partners. Given the specific relevance of the ecosystem scale for NbS, it is also important for communities to consider the linkages with other communities in the same ecosystem. Arrangements may already be in place, such as Watershed Management Plans, that can be tapped into. If that is not the case, your National Society may help foster dialogue between different communities within the same ecosystem. This is very important, as there may be different uses and even conflicts over natural resource use."

communities are located. For example, data on water and land resources or maps on rates of forest cover can help identify areas of risk relevant for all types of resilience programmes. If there is mass deforestation upstream, it might increase vulnerability and affect the viability of community resilience projects downstream. This may again require partnering with experts. See case study F for an example on how 510 data on natural capital was used for site selections in Haiti and Philippines.

Moving towards nature-based solutions, such analysis can provide a systems perspective and enable you to consider watersheds or forests that link multiple communities as your geographic focus area. Finally, ecosystem assessments (if they already exist) can add further targeted guidance on site selection.

Third, consider the local capacity in possible areas, including in DRR and the environment. If you have no reach in a high-risk area, or a branch that is not willing or able to support resilience programming focused on nature, then it may be difficult at best and unsuccessful at worst to roll out resilience programming in that area.

When **selecting specific communities (step 1.3)**, keep the systems perspective in mind. If you seek to engage in ecosystem protection, management, or restoration, select communities that are linked to that ecosystem. Nature-based solutions such as restoring wetlands may require engaging several communities, across an ecosystem, to be effective.

Once you have selected the communities, you should **consult and engage these communities (step 1.4)**. Map all natural resource user groups at community level – for example water use committees or forest user groups. Within communities, different groups may have different roles in natural resource management – such as women's forest user groups. For nature-based solutions, this may entail engaging communities from different parts of the ecosystem – such as a watershed or coastal area. There may already be relevant community, local or ecosystem scale groups in place (such as community forest user groups, local disaster management groups or ecosystem-scale watershed management groups).

If such groups do not exist, a Community-level Resilience Team (or DRR Team) may be formed, which can also become the local NbS or ecoDRR team. See case study G as an example of such teams.

NbS Step 1B. Make sure to include environmental information in the community factsheet.

Develop a simple community factsheet (step 1.5) for each community. Make sure that you explore environmental aspects in these early discussions and clarify to the Community Resilience Teams (CRT) the role of nature in resilience and risk reduction. See an example of a community factsheet as well as a checklist in appendix F. These issues can be explored in further depth as part of ecological assessments in Stage 2.

NbS Step 1C. Map and engage stakeholders at an ecosystem scale.

The Road Map's steps 1.6 and 1.7 are about **mapping and engaging stakeholders.** These steps are critical and deserve some specification when you seek to integrate NbS.

Regarding stakeholder mapping, ensure that environmental actors are mapped. We already discussed the national level stakeholder mapping in chapters 2 and 3. Community-based stakeholder mapping will reveal the stakeholders that the community is familiar with. But when working in multiple communities and around ecosystems, stakeholder mapping can become more complex.

Complete initial mapping exercises in each community, then collate the information from all communities. Probe for and explore any agencies and actors that have stakes in, or are in charge of, ecosystems. This may include national or regional agencies that communities may not immediately identify as stakeholders. Local authorities have a particularly relevant role to play in NRM and NbS. Bring interrelated communities and related government and non-government actors together.

Use the stakeholder management tool (appendix F.4) for this process. As it will be difficult to fully engage with all stakeholders at the same level, consider grouping them by priority.

- **Level 1 stakeholders:** those with the strongest interest and potential influence and impact over planned efforts, including those most affected by them. Engage with these closely and frequently.
- **Level 2 stakeholders:** those with medium influence or impact. Engage with these regularly.
- **Level 3 stakeholders:** those with limited interest, influence, or impact. Inform and invite to main meetings.

Once identified and thus grouped, approach stakeholders by priority and invite them to participate in the process of assessment, planning and implementation of nature-based solutions.

Establish links with organisations who can offer ecosystem expertise. As previously highlighted, most NbS require specific technical expertise and scientific input. Therefore, make sure to identify local sources of support early on. Consider local or nearby universities, research centres, NGOs, and of course environmental government agencies. See figure 4.7 for a list of possible partners. Importantly, you will also need to have climate expertise on board to gain insights on regional impact projections of climate change, in particular its impact on ecosystems.

Case study G | **Enabling connections for NbS**

Location: Jamaica, Honduras, Kenya


Photo: Jamaica Red Cross

As discussed under NbS Step 1D (see p. 51), connections between communities and stakeholders are essential for NbS, including with experts, and can take various forms such as regular meetings, consultations and dialogues.

To design, implement and monitor NbS, you will also need teams on the ground. Depending on your specific context and existing institutional arrangements, this can entail strengthening existing teams or creating new ones. For larger projects, a project steering committee might be created.

In the case of the **Resilient Islands Project** in Jamaica (see p. 30 and 49), multi-stakeholder approaches have been a key element of the project. Stakeholder engagement was initiated through community sensitisation meetings, with community members and its leaders, to build awareness and cement support.

Engagement included participating in community events and festivals with project booths. Regular meetings were also held with government agencies and other institutional partners. A project NbS Committee was created, with representatives from different national and international organisations with the aim to provide technical guidance in the identification and planning of NbS measures for Old Harbour Bay.

The ***Resiliencia* project in Honduras** (see p. 47) worked directly with existing Local Emergency Committees (CODELs). CODELs are part of the National System for Risk Management of Honduras. These are linked with higher level, the Municipal Emergency Committee (CODEMs).

CODELs were directly involved in implementing bioengineering techniques to protect community infrastructure (incl. schools, health centres, water infrastructure, evacuation routes), as well as providing some support to household level bioengineering works. CODEL also coordinated with the community members themselves, as well as other existing key local groups, in particular health committees and water management committees.

The multiple stakeholder approach and working together through alliances facilitated working with different community organisations. The project approach also enhanced links between CODEL committees, municipalities and Municipal Emergency Committees (CODEM).

For the **green belts in Dadaab refugee camp in Kenya** (see p. 70), the project was implemented by and with communities – both in the camp and the host community.

Environmental groups were formed to undertake environmental rehabilitation activities. Government agencies, especially of the Ministry of Agriculture and the Ministry of Forests, were closely involved at both local and national levels to provide technical advice, and also to ensure the initiatives was supportive of government plans and programmes. This included technical guidance for agricultural officers within the camp and at sub-county level. Kenya Red Cross provided further technical support. UNHCR was a key partner throughout the work, given their active role in the camp.

Fig. 4.7 **Possible partners**

Sources	Examples of experts	Types of partnership
Government	▸ Ministries of Environment (Climate Change Department, Ecosystem Management Department, Water Department, Research Department and/or institutes, local/municipal/regional branches of Ministry etc.) ▸ Ministries of Agriculture, Forestry, and Disaster Management (Environment Department, Climate Change Department, Research Department, local/ municipal/regional branches) ▸ Protected Areas Agency (and local branches) ▸ Local/municipal/city/regional Department of planning	▸ Align NbS measures with policy and planning priorities ▸ Integrate NbS into national/local plans and budgets; advocacy ▸ Support for research and e.g. ecosystem assessments ▸ Ensure scale of NbS measures ▸ Consultations ▸ Co-financing for NbS from government/donor/private sector sources ▸ Joint implementation of NbS
Research	▸ Research institutes (e.g. on environment, climate change, forestry) ▸ Universities ▸ Think tanks	▸ Ecosystem assessments ▸ Monitoring and evaluation ▸ Consultations
NGOs	▸ National environmental NGOs ▸ International environmental NGOs with local branches (e.g., WWF, The Nature Conservancy)	▸ Ecosystem assessments ▸ Joint implementation of NbS ▸ Monitoring, evaluation and learning ▸ Consultations
Communities	▸ Water user groups, forest user groups, Rangelands/grazing management groups ▸ CSOs working on the environment	▸ Design and implementation of NbS ▸ Consultations
Private sector	▸ Small- and medium- sized enterprises working in e.g. agriculture, forestry, water management or tourism ▸ Larger companies with corporate social responsibility (CSR) projects in NbS	▸ Consultations ▸ Co-financing of NbS ▸ Implementation of NbS

Ideally, you should strive for ongoing partnerships with climate and environmental experts in government. If you can, try to create links between the environment, climate change and DRR within government structures. Long term, your work should lead to growing in-house expertise of your National Society.

Discuss the idea of implementing NbS in and around your selected communities and invite these potential partners to support the process.

NbS Step 1D. Foster or create a steering group/team.

The final step of the Stage 1 gives useful guidance on **enabling connections (step 1.7)** between communities and stakeholders. For larger-scale efforts such as those involving NbS and multiple communities, this can include a set of regular consultation meetings at all stages of NbS – from assessment and prioritisation; through to design; implementation; and learning (see following Stages 2-4). Certain external experts and stakeholders should not just be occasionally consulted but instead work with communities throughout assessment, implementation, and long-term follow-up.

Depending on your specific context and existing institutional arrangements, this engagement can take different forms. The most relevant entry point for a National Society is likely to be the community level. The Roadmap to Community Resilience advises on creating a Community Resilience Team as part of your resilience planning process.

As part of stakeholder mapping, it is useful to assess what relevant community, municipal and/or local level teams might already exist. In some cases, there may already be for example a Disaster Risk Reduction Team or Watershed Management Team, into which you can integrate a DRR and/or NbS perspective, without having to create a new team.

Maybe you are carrying out your activities in the context of a specific DRR or NbS project? This is an excellent opportunity to create a steering committee, with members ranging from local communities to national level external experts and government

representatives. Such committees can even become national level experts on NbS/ecoDRR, as was the case in Jamaica (see case study G).

Steering committees should **comprise** around 5-15 members — small enough to enable effective discussions and big enough to have all major stakeholders included; **offer** a range of perspectives and areas of expertise, and **steer** the overall process as you progress through the next stages.

So before proceeding to the next stage, make sure that all stakeholders can continue to be meaningfully engaged, based on their "levels" of required engagement. Furthermore, see the community engagement hub for a list of tools and resources to effectively engage communities.

Checklist: Stage 1

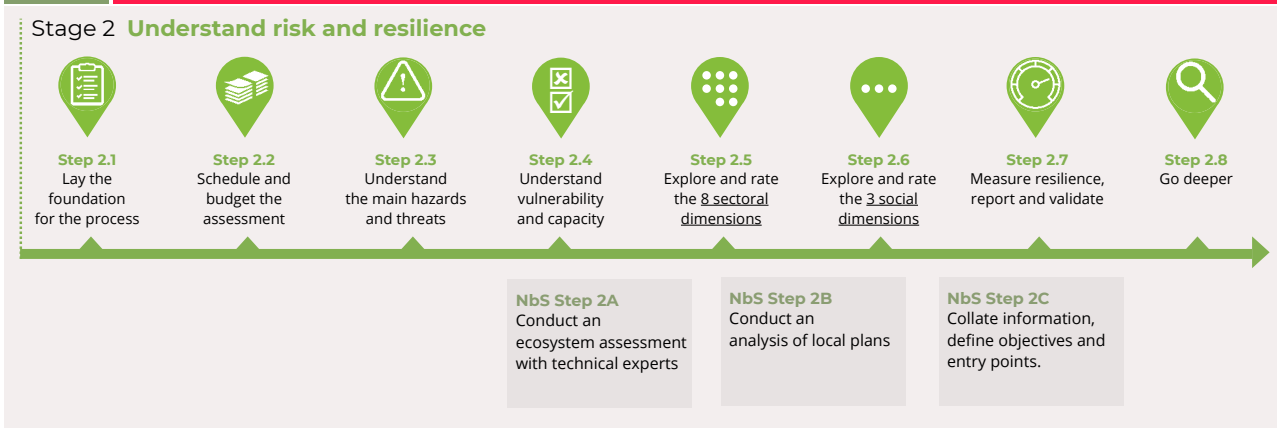
		Yes	No
1.	Have you engaged with environmental experts at national, local and community levels? If so, which ones (please list, by level 1-3) and how?	☐	☐
2.	Have you carried out a stakeholder mapping that includes environmental experts at national, local and community levels?	☐	☐
3.	Have you considered the linkages, in terms of joint ecosystem management/NbS, between different communities and levels?	☐	☐
4.	Do you plan to engage environmental experts throughout the assessment, planning and implementation stages of DRR and/or NbS measures?	☐	☐
5.	Have you considered climate and/or environmental data and capacity in choosing your geographic and community focus? If so, how?	☐	☐
6.	Have you included natural resource management as part of your community checklist for Roadmap to Community Resilience (if you used one)?	☐	☐

Stage 2. Understand risk and resilience

What this stage is about. This stage is about assessing risk and resilience in each selected community by using the EVCA toolbox. You first prepare your team and make arrangements, including budget and schedule (steps 2.1, 2.2), and then work with the community to understand main hazards and threats (2.3) as well as vulnerability and capacity (2.4). You then explore and rate the eight sectoral and three social dimensions of resilience (steps 2.5, 2.6) and use the findings to measure resilience and prepare a report (2.7). Where further information gaps exist, conduct specific assessments to fill these gaps (2.8).

At the end of stage 2, you have obtained a detailed overview on risk and resilience in each of the selected communities.

Fig. 4.8 **Stage 2**



Case study H | **Eco-DRR in Honduras**

Location: Olancho, Honduras
Partners: Honduran Red Cross, Swiss Red Cross

The *"Resiliencia"* project is implemented by Honduran Red Cross and Swiss Red Cross in the Department of Olancho, a rainforest mountain area located in the range area of Cordillera Central and Sierra de Agalta, at an average altitude of 1,500m. Most of Olancho is protected as a natural reserve or natural park. However, there are high levels of deforestation, primarily from livestock keeping and industrial forest management, but also from small-scale farmers. Some local practices result in forest fires, soil degradation and erosion. Furthermore, Olancho is regularly affected by tropical storms and hurricanes.

The project applied so-called bio-engineering* techniques based on the use of living vegetation to protect slopes and embankments from erosion and landslides. Stabilised slopes and embankments are also transformed into sustainable production areas, such as agro-ecological family orchards or medicinal gardens. The measures mitigate disaster hazards, enhance health and food security, and help strengthen community organisations.

The project carried out a step-wise approach. A comprehensive, participatory risk assessment was carried out by a multidisciplinary team to identify sites most vulnerable to landslides. The project prioritised the implementation of ecosystem-based disaster risk reduction (eco-DRR). Family Emergency Plans were then developed with participating households. Community workshops and home visits were used to raise awareness of existing hazards and to sensitise and build capacity on bio-engineering techniques, soil conservation and climate change. Field visits were used to get acquainted with the techniques and learn from others.

The techniques were then implemented, with follow-up and maintenance being carried out. The following techniques were promoted.

Fascine drains are used to remove excess water from slopes that affect lands or houses in lower areas. Fascine drains are implemented by digging lateral ditches in a fishbone formation connecting to a main central drain. The trenches are filled with 'fascine bundles' (bunches of grass), which are fixed in place with cuttings of trees. Soil is added and grass is sown (on top of the fascines to avoid production losses). These grasses can be cut three times a year and used as fodder. Before implementation of fascine drains, the speed of water flow damaged plots of land in the lower areas of the implementation sites. Once the fascine drains are set in place, water filters into the ground at a higher rate, thereby reducing its flow speed: the water flows towards the stream in a controlled way.

Slope stabilisation. Plants are established on the embankments to reinforce the soil with their roots and/ or foliage, thus facilitating drainage and creating barriers to retain sediment. Vegetation was combined with local materials (rocks, wood) to create living weirs.

Stabilised slopes and embankments were transformed into sustainable production areas, such as **agro-ecological family orchards or medicinal gardens**. Thus, beneficiaries can diversify their production and diet, and generate income by selling their production surplus. The agro-ecological approach promotes the combination of bio-engineering works with plants, fruit trees, vegetables and medicinal plants, using organic fertilisers.

Agroforestry has also been promoted, which enabled sustainable and diversified production. As a result of the project, collective action improved in the community, and the municipality has included bio-engineering and agro-ecological measures in their planning and budget.

The safety of the community has increased, whilst resilience has been enhanced also through health and livelihood benefits of the agro-ecological production.

The measures require little input and are easy to replicate with plant material found on the site, and are adapted to local climate conditions. However, the measures require some time to be able to see the protective effect of bio-engineering. Continuous maintenance is required. Using demonstration sites has helped make the case for the approaches.

* Bio-engineering is a discipline that applies engineering principles of design and analysis to biological systems and biomedical technologies. See further details here.
For further information on this case study, see p. 85-98 in Harari et al. (2017).

Nature perspective. If you aim for the integration of NRM into your resilience programming, follow the guidance of the Roadmap and make extensive use of the tools in the EVCA toolbox. Complete the screening checklist to assist you with the discussion of dimension 8 on natural resource management. To fully incorporate the natural resource management perspective, consider using some EVCA tools that are particularly relevant for NbS, or that have been tailored for NbS by other organisations. See figure 4.9 to the right. Always make sure to integrate the NRM component and consider the linkages with other resilience dimensions.

NbS-specific guidance. If you plan to incorporate nature-based solutions into your programming, you must schedule and budget for a more detailed assessment of relevant ecosystems and eco-system services in the target area. Often, the target area of assessment will span an ecosystem or multiple communities. Ideally, this ecosystem assessment is aligned, and done in parallel, with the community-based vulnerability assessments (as described above).

NbS Step 2A. Conduct an ecosystem assessment with technical experts and local knowledge.

The ecosystem assessment will require ecosystem expertise and data, so a partnership with experts is recommended. The Red Cross/Red Crescent team working on the EVCA can then work closely with the ecosystem experts on carrying out both the EVCA and the ecosystem assessment.

Ecosystem assessments usually assess ecosystem health, threats and drivers at an ecosystem scale, spanning multiple communities. This type of general assessment at this scale is useful, even if it identifies solutions that would be implemented at a smaller, community scale. This is because it helps identify drivers outside the community that may be undermining ecosystem health within the community.

For example, land degradation and deforestation in mountain communities may lead to landslides in valley communities.

When done at the same time, findings can be taken into account when exploring the sectoral (step 2.5) and social dimensions (step 2.6), and to measure resilience (step 2.7). If that is not possible, make sure that the ecosystem assessment is completed as part of the 'go deeper' analysis (step 2.8). In this case, ensure that the findings of the ecosystem assessment are shared and used to update the resilience measurement.

Fig. 4.9 **Tools relevant for ecosystems and nature-based solutions**

Tool	In EVCA	Other sources	Ecosystem relevance
Mapping	**Yes**	CARE CVCA Hazard map, Partners for Resilience (PfR) manual	Can allow to map key ecosystems and ecosystem services a community or set of communities use; also enables visualising the ecosystem scale and considering e.g. upstream/downstream linkages in natural resource use
Seasonal calendar	**Yes**	CARE CVCA Seasonal calendar, PfR	Can show how seasonal changes, e.g. climate variability, affects natural resources
Historical profile	**Yes**	CARE CVCA Historical timeline, PfR	Can show how natural resource use has changed over time. Also allows to see how hazards, incl. climatic ones, have affected natural resources in the past.
Transect walk	**Yes**	PfR	Enables assessing the ecosystem visually and in person – where are natural resources, how do they relate to one another, what are some of the pressures and drivers, which are the key ecosystem services and sources of livelihoods, what are some risk areas and how might ecosystem health constitute a hazard (e.g. soil erosion) etc.
Resilience star	**Yes**		Enables to gain an overview of all resilience dimensions and can be used to show linkages between nature and all 11 dimensions.
Vulnerability matrix		CARE CVCA, PfR	Assess natural resources as one of the 5 key dimensions of vulnerability and against different hazards (e.g. heavy rains, droughts, hurricanes etc.)
Flood resilience measurement for communities		Zurich Flood Resilience Alliance	Assess natural capital as one of 5 key capitals under which sources of resilience are graded, with a focus on flood hazards

Case study I | **Jamaica rapid ecological assessment**

Location: Jamaica
Partners: Jamaica Red Cross

The Resilient Islands Project (see p. 32) included a ***Rapid Ecological Assessment*** of Old Harbour Bay coastal and marine habitats to: i) identify, locate and map the major threats, vulnerabilities and pressures to the ecosystem and biodiversity by anthropogenic and natural phenomena (including climate change); ii) the causes, sources, effects and impacts, as well as the actors related (where applicable).

This work aimed to support decisions for sustainable and community-based approaches for ecosystem-based adaptation. The assessment was prepared by a consultant team of specialists in climate change adaptation, disaster risk management and natural resources management.

The data was collected through desk review, field work, and extensive stakeholder consultations. The desk review included reviews of historic and current data and local surveys. Challenges included the lack of data on habitat extent and condition, as well as lack of economic valuation studies.

Amongst others, the study found that the people and economies of Old Harbour Bay are highly dependent on the wetlands, seagrass, coral reefs and beaches. These ecosystems support jobs, provide income, and protect the coastal populations and property from floods and storm damage. Specific findings included that the areas with live coral were the most important fishing grounds, whilst the reefs also provide protection through wave attenuation.

Beaches provide an overall important source of livelihoods for the local community. Coral reefs have suffered severe damage from natural and anthropogenic impacts, including wave damage during storms and hurricanes, dynamiting, nutrient loading, and unsustainable fishing practices.

Detailed spatial action plans and maps were developed with recommendations and sites for protection, restoration and conservation actions to address impacts and climate change-related risks. The assessment recommended declaring special protection zones for habitats with high biodiversity value, establishing community-based ecotourism programmes; implementing living breakwaters; and replanting coral reef nurseries, seagrasses and mangroves.

A set of non-ecosystem-based actions were also proposed. The findings were presented at validation workshops where local experts and community members provided feedback on the results and explored the potential for ecotourism, livelihood activities and/or income generation from the natural environment. The assessment helped raise awareness and increase understanding on the value of ecosystems for local livelihoods. The information also enabled the development of knowledge products.

The results were complemented by an Enhanced Vulnerability and Capacity Assessment (EVCA). This used a range of methods, including focus group discussions, historical profiles, seasonal calendars, mapping and transect walks.

These enabled understanding, amongst others, of the hazards the community faced (now and in the past), where they affected them and how; and identifying vulnerabilities, root causes and impacts. Further, a knowledge, attitudes and practices survey (KAP) on disaster risk reduction was also carried out and found out that level of awareness on ecosystems, DRR and climate change was low and that there was a lack of livelihood diversity. These were further used to inform activities around awareness raising and the need for solutions that diversify livelihoods.

While initial discussions with stakeholders and insights from the community vulnerability assessment may give you a rough estimate of the use and status of local ecosystems, a more detailed scientific assessment should be added when considering NbS.

The health status and conditions (e.g., soil and water quality, nutrients, forest health) of an ecosystem (or often multiple and interrelated ecosystems) will inform what nature-based solutions are possible and suitable for desired objectives, including the reduction of disaster risk.

Engage experts in this process, such as agronomists, foresters or marine biologists experienced in assessments of your local ecosystems and their services. Such experts can be found through partners mentioned during Stage 1 and include environmental government agencies, research institutes or NGOs. For projects, the steering committee should facilitate this process and for some aspects (e.g., assessing use of ecosystems for livelihoods), the community should be involved.

In some cases, ecosystem assessments may be mandated or carried out by national government or local/municipal authorities.

The assessment process may differ for variable contexts and types of studies that are taken, but generally tends to follow the outline described below:

- **The setting.** Description of communities and ecosystems. Analysis of current plants and species as well as critical interactions between them
- **Hazards.** When done specifically for DRR purposes, a description of hazards and their interaction with ecosystems must be included. If the assessment is focused on climate change, this would focus on specific climate change impacts in the area of study, in particular the climate impacts on ecosystems and ecosystem services.

- **Current ecosystem health status**. This includes an assessment of current ecosystem health, including ability to regenerate and deal with threats.
- **Drivers and threats.** This part identifies the drivers of ecosystem degradation and threats that ecosystems are exposed to. This leads to the investigation of causes: are they due to environmental/global factors, to local practices by nearby communities (e.g., fertiliser run-off, coral mining), or a combination of both? The future health of ecosystems should be also assessed in view of current and projected climate change.
- **Actions**. Based on the findings, ecosystem assessments conclude with recommendations for action. Among others, the set of options depends on whether and how causes for degradation can be halted. They often specifically identify a set of recommended nature-based solutions, as well as other (non-nature-based) actions to address disaster risk reduction or climate change adaptation.

NbS Step 2B. Conduct an analysis of local plans.

Remember that when aiming for NbS, we should think of the appropriate scale and think of systems. Therefore, extend your existing knowledge of policies and plans that are relevant to your envisaged effort.

Unless you already did so as part of broader preparation described in part 3.2.2, spend some time compiling all relevant plans, policies and regulations that may have an effect (positive or negative) on your planned effort – at national, sub-national and local levels (see fig. 4.10).

Combine this with insights gathered through the EVCA and consultations with government agencies and stakeholders. **On the positive side**, are there local plans that specifically support NbS, such as water or forest management plans? **On the negative side**, are there land use or development plans in the area that may negatively impact planned NbS measures?

NbS Step 2C. Collate information, define objectives and entry points.

At the conclusion of stage 2, connect the dots: what does the information from the assessments of community risk, ecosystems, and external context tell you? You now have a lot of information and a good idea about risk, resilience, and underpinning factors around opportunities for working with nature to reduce disaster risk.

Review and discuss the results of the assessments — with your community group, Steering Committee and/or national group —

Fig. 4.10 **How to scan local plans for NbS-relevant information**

It is easy to get overwhelmed by the plethora of national and local plans, policies and frameworks. It therefore pays off to be strategic — follow the guidance below and see appendix F.3 in the application toolbox.

1. **Understand** the overall government structures — the different **administrative levels** (e.g., national, provincial, district) as well as the **functional departments** (e.g., environment, planning, economy, agriculture).

2. **Scope** broadly for existing plans and policies that may be relevant to your nature-based efforts. These may include broad frameworks on DRR, agriculture, fisheries, climate change, health, infrastructure and economic development, as well as specific management plans for ecosystems. Ask your stakeholders for initial advice and for referrals to experts with deeper knowledge of these frameworks. Explore whether they are relevant to your envisaged efforts.

3. **Scan** the list of frameworks you have thus gathered for specific stipulations. Mark these and take notes with specific references (e.g., page and/or article number). Consider using a keyword search for key terms.

4. **Map** the key references in a grid with three columns. In the first column, list favourable conditions and stipulations. In the second, list those that may pose challenges to your efforts. In the third, feature any other technical stipulations.

5. **Summarise** the findings and highlight follow-up action: what are the entry points?

Case study J | **NbS steps for action to strengthen resilience**

Location: Old Harbour Bay, Jamaica
Partners: Jamaica Red Cross, IFRC, TNC

The NbS steps in Stage 3 (pages 58-61) describe a process for identifying DRR solutions and turning them into plans.

The Resilient Islands project in Jamaica (see p. 32 and 55) identified a range of NbS options as well as non-NbS measures, based on an ecological assessment, an EVCA process, and a KAP survey that specifically addressed livelihoods, resilience and DRR more broadly.

Based on all of the above assessments, the proposed actions were discussed by an NbS Committee, with representatives from different organisations, with the aim to identify a suite of NbS for Old Harbour Bay. Several sessions were held to present, prioritise and shortlist options over a three-month period.

Criteria for assessment included identifying options that

- restore ecosystems;
- provide livelihood benefits;
- address the identified threats;
- are sustainable; and
- provide short-term benefits.

Project ideas were mapped to identify priority areas and synergies. This led to a portfolio of seven NbS project ideas for Old Harbour Bay that were based on science-based tools with recommendations from government, community, NGOs and private sector, with the goal of increasing investments in the protection of key ecosystems and overall community resilience.

Projects include: beach rehabilitation; bird-watching ecotourism initiative; and sustainable fisheries. The costs and benefits of each project were estimated assuming: a) directly or indirectly all community members are beneficiaries and b) sea level rise and storm surge during storm/hurricane events could lead to flooding of three metres or more.

Calculations were also carried out to estimate the overall benefits of the seven projects:

- Number of beneficiaries were estimated at 45,974 people in Old Harbour Bay
- Avoided damages to infrastructure to all homes within 3m of floodplain, estimated at USD 102,432,102
- Avoided impacts on 17 critical facilities within 3m floodplain

The solutions were then discussed and validated with community members and expert partners such as the Centre for Marine Sciences. The priority actions were integrated into a local level DRR/EbA plan.

and don't forget to share the results with a broader group (all communities and other stakeholders).

Note that unless you focus on a single community, you will be working at **two different levels**.

On the **first level**, you should collate information for the whole target area (multiple communities linked by one ecosystem). This includes the data from ecosystem and context assessments.

On the **second level**, you will have the specific information for each of the target communities.

You should now define your **high-level objective(s)**: what is it that you ultimately want to reach – both at the broader ecosystem level and in each of the communities.

- What is your objective beyond DRR - are you looking at a specific additional objectives such as adapting to climate change, mitigating climate change, enhancing food security, providing health benefits or economic benefits?
- Are you focusing on an individual DRR and/or NbS project?
- Are you trying to identify a set of relevant options (and potential projects) on disaster risk reduction or climate change adaptation with local government?
- What are the entry points in local, sub/national or national plans and policies to support your objective?

Having clarity about the general goals is an important precursor to the next stage: identifying the most suitable solutions to reach them.

Checklist for Stage 2

1. Do planned community vulnerability assessments include a strong component on natural resource management? Yes ☐ No ☐

2. Do you plan to carry out an ecological assessment? If so, what are the resources needed (human, financial, etc.)? Does it align with the EVCA and Roadmap to Community Resilience process? Yes ☐ No ☐

3. Have you analysed relevant local, sub-national regional and/or national policies, and plans and laws, for how they can support/hinder NbS implementation? If so, please list key policies, plans and laws Yes ☐ No ☐

4. Do you have clarity on the focus of your work? Yes ☐ No ☐
   - **Scale**: a community? An ecosystem (set of communities)? Planning entry points: at community level (e.g., local natural resource management plan)? At local/municipal level (e.g., local disaster risk reduction plan)? And/or at national level (e.g., NAP)?
   - **Focus**: a single project? Identifying a set of relevant NbS, DRR and/or CCA options?
   - **Objective**: e.g., reduced disaster risk to floods/droughts/heatwaves; increased food and/water security; climate change adaptation and/or mitigation etc.

Stage 3. Take action to strengthen resilience

What this stage is about. Having already identified the risk and resilience pattern, this stage is about identifying solutions to reduce risk and raise resilience. You first identify possible actions (step 3.1) , then explore the internal community capacity (3.2) and need for external support to pursue them (3.3). Next, you prioritise actions (3.4) and define activities (3.5), then share your draft with stakeholders and enable connections (3.6).

At the end of stage 3, you should have a risk-informed community action plan. This may have different names depending on the community, such as a community Disaster Risk Reduction Plan. It may also be integrated into existing community level development, natural resource management or disaster plans (see 2B above). As such, stage 3 is about planning (rather than 'taking') action.

Fig. 4.11 **Stage 3**

Nature perspective. The general path of the Roadmap should be followed if you work in a single community and would like to include NRM but not NbS. In this case, review the results of the natural resource management dimension and ensure that

- gaps in NRM governance within the community are being addressed,
- the planned activities have no or minimal negative environmental impact, or that negative impact is compensated for,
- the measures are climate-smart,
- there is a net benefit in terms of improved NRM for the community, and that
- the planned NRM activities are aligned with local NRM plans, where these exist (see NbS step 2B).

Furthermore, try to identify basic activities that promote more sustainable NRM practices. These may include:

- small-scale adoption of certain agroforestry practices,
- rainwater harvesting and vegetable production/home-gardening (food security), and
- the promotion of bio-fertilisers and drought/heat/flood-tolerant crops and seeds.

In all activities you plan to carry out, explore and explain multiple benefits (for instance, for risk reduction, food security and economic opportunities). Remember, the more you can link tangible, direct benefits with protective ones, the better.

NbS-specific guidance. If you want to integrate NbS into your risk-informed community action plan (or into a larger project plan), the identification of actions requires a more elaborate process – but do not worry, the Nature Navigator will guide you. To identify the nature-based solutions that are most effective to address the risk in your context, work with the Community Resilience Team and have all information at hand. If the EVCA and Roadmap to Community Resilience process are being carried out in the context of a project, engage the Steering Committee.

Given that NbS usually require a broader scale, remember that the visioning and identification of actions may be happening at a larger scale, with multiple communities — for example, as part of local/municipal planning (see NbS step 2B). Always keep your high-level objectives in mind.

Before getting started, make sure that you have

- completed the risk assessments in all selected communities,
- conducted ecosystem assessments (NbS step 2A),
- collated information on the governance context,
- identified planning and policy entry points (NbS step 2B),
- formed a Community Resilience Team (or similar) or a project Steering Committee (Stage 1, Steps 1.6. and 1.7.), and
- defined high-level objectives (NbS step 2C).

At this stage, as part of the R2R process, you will identify a set of potential actions for reducing disaster risk (step 3.1), which can then be developed into community action plans or community DRR plans that include NbS.

Let us clarify some key terms that we will use through the remainder of this chapter, which will entail the process of exploring options, prioritising actions (step 3.4) and defining activities and resources (step 3.5).

- **Actions** are the individual items geared to reduce risk. They should be centred on NbS actions and be complemented with other types (see fig. 4.12 opposite for examples of actions).
- **Options** are combinations of different actions in a package. These packages can include green and grey actions and should focus on NbS actions. For instance, an option centred on forest

restoration may include agroforestry and climate-smart agriculture, green infrastructure and the construction of drainages.

- **Solutions** are defined here as the eventual priority options you decide on to address the identified problems. You may have created several options (A, B, C); the one you select becomes your solution (see example). This should ideally be based on the performance in terms of sustainability and effectiveness.

There are **four NbS steps** towards identifying your solution (NbS steps 3A - 3D), plus another step to turn your solution into a plan (3E). These steps are summarised in fig 4.13 overleaf. Go through the process with your Community Resilience Team (CRT) – or, in the context of a project, with the Steering Committee – and do not rush. Where relevant, engage with broader local/municipal groups and stakeholders involved at the landscape or ecosystem scale in consultations. Allow for a series of sessions instead of aiming to complete the search for your solution in one go. Also note that at times, you may need to gather additional data.

NbS Step 3A. Explore NbS actions.

The first step of Stage 3 is to identify the actions that we may be able to integrate into our eventual solution. Begin by listing the ecosystems in your area. For each ecosystem, list possible NbS actions that were identified through the ecosystem assessment. Use the template in appendix F.5 to complete this list

NbS Step 3B. Add non-NbS actions and develop options.

Under this step, we combine different actions into packages (the options). To do so, we first expand our catalogue of actions and then create different combinations of these.

We already have the catalogue of NbS actions from NbS step 3A. Now, add further actions that may be needed to reach your objectives. These may include additional green actions (see fig. 4.12) as well as other actions typically deployed in DRR projects (non-NbS). Once you have completed the catalogue, create up to five different permutations of actions (our options). You may vary the composition and scale of selected actions between each option. For instance, option A could be a package that requires little external input, option C could be a large-scale package dependent on external funding, and option B could be a middle ground.

It also makes sense to compare options that are mainly green with others that are mainly grey: this can be useful to compare the different benefits (in practice, this can be used to make the case for NbS to stakeholders who prefer grey actions).

NbS Step 3C. Compare and prioritise options.

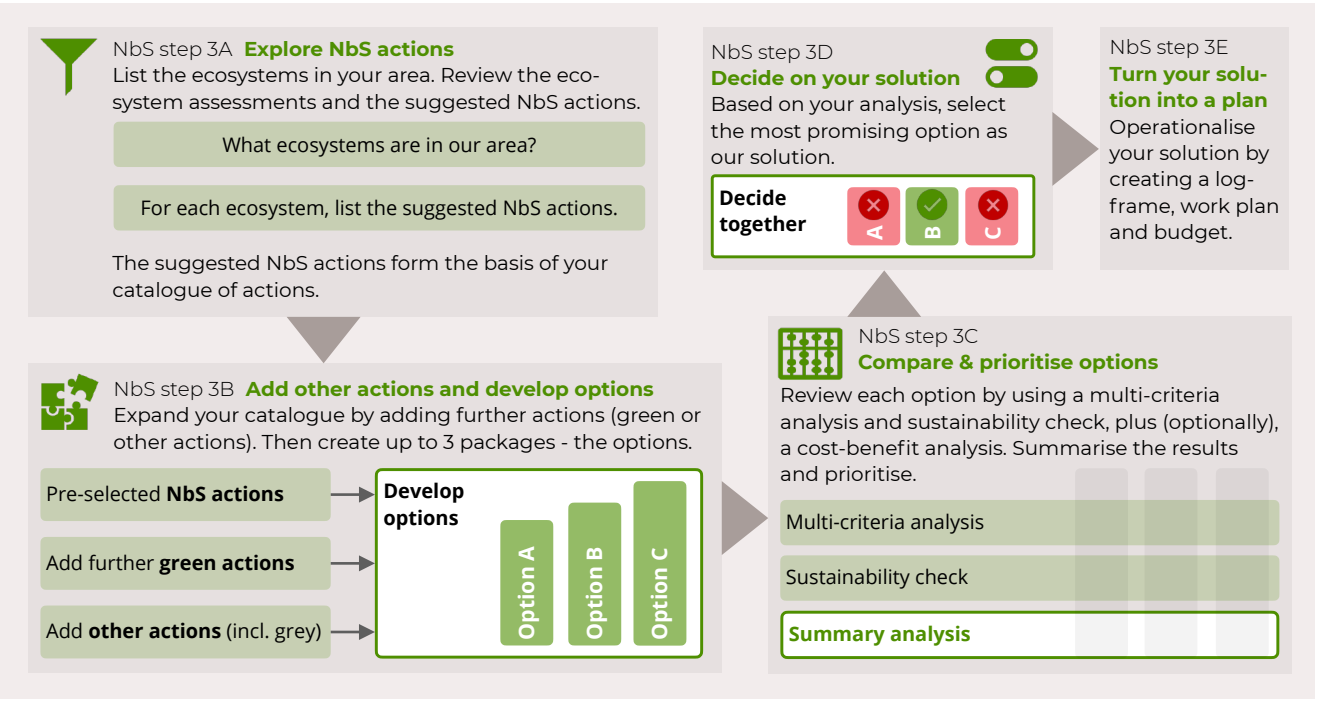
Having completed the various options, let us explore how each of them may perform in practice. Analyse the different options by

Fig. 4.12 **Types of DRR actions: reducing risk through nature (with examples)**

	Green actions (incl. NbS and NRM)	Other (incl. grey) actions
Governance-oriented Actions directed to enhance environmental and risk governance	▸ Protection arrangements for specific ecosystems ▸ Advocacy for broader legal and governance change in natural resource management ▸ Community-based governance of ecosystem and natural resources	▸ Risk management plans (incl. contingency plans, mitigation plans), building codes and risk-informed land use plans ▸ Advocacy for broader legal and governance change on risk management
Practice-oriented Actions that aim to change practices of communities to reduce risk	▸ Promoting collective action (environmental stewardship of ecosystems) ▸ Behaviour change towards sustainable management practices	▸ Efforts to strengthen early warning/early action ▸ Community preparedness and broader resilience ▸ Household-level preparedness
Structural* Actions that change the structural environment to mitigate hazard exposure.	▸ Management and restoration of ecosystems to strengthen their protective role and other ecosystem services (e.g., mangroves, protective forests)	▸ Construction of engineered defences, such as seawalls, drainages, or levees

* Note that in addition to green and grey structural actions, there are **hybrid forms** as well. These include living weirs sustainable drainage systems, and green roofs, for instance.

Fig. 4.13 **Overview of the solution finder**



completing a multi-criteria analysis (MCA). Establish criteria related to the objectives you want to achieve, and then rate the extent to which each of your options are likely to contribute to the objectives. Ensure that you have robust information to make your judgment. Use the template in appendix F.5 for this process. Consider using specific NbS criteria (you may wish to be inspired by the NbS Global Standard, presented in chapter 3). You may also add further aspects that you deem important.

As an additional decision-making tool, you may wish to conduct a basic cost-benefit analysis (CBA) . A CBA requires careful data entry of costs and benefits under different scenarios. While the calculation of benefit-cost ratios is automatic, you should note that this is an advanced feature that will take some time to complete. It is useful if you plan larger interventions and seek government funding (CBAs are commonly practiced by government agencies and many larger organisations).

Furthermore, screen each option in terms of their sustainability. The template in appendix F.5 covers eight aspects based on the willingness and capacity of local actors to pursue the option long-term as well as the enabling environment.

Conduct the analysis with your steering committee and CRTs and gather additional data if needed. Finalise the comparison of options with a summary statement.

NbS Step 3D. Decide on your DRR solution.
The exploration of components as well as the development and comparison of options usually takes several sessions — this process is most manageable if pursued by the inclusive group representing communities and stakeholders (your community DRR team or project steering committee).

The final decision however should be made with as broad a consensus as possible. Therefore, try to arrange community gatherings and broader stakeholder gatherings, or engage with existing local/municipal groups. This is especially the case when considering NbS at scale, spanning multiple communities.

Summarise the process thus far and present the results of the comparative analysis from NbS steps 3C and 3D. Then deliberate with the communities and finally decide on the solution to move forward.

NbS Step 3E. Turn your DRR solution into a plan.
By now, you have engaged the communities and stakeholders, completed the assessment of risks, ecosystems and governance,

and developed the solution to reach your objective. At this point, you will need to operationalise your solution. While your solution is a combination of building blocks, you now need to determine when each block will be laid and by whom. See appendix F.6a for detailed guidance on planning and consider using the planning tool in appendix F.6b.

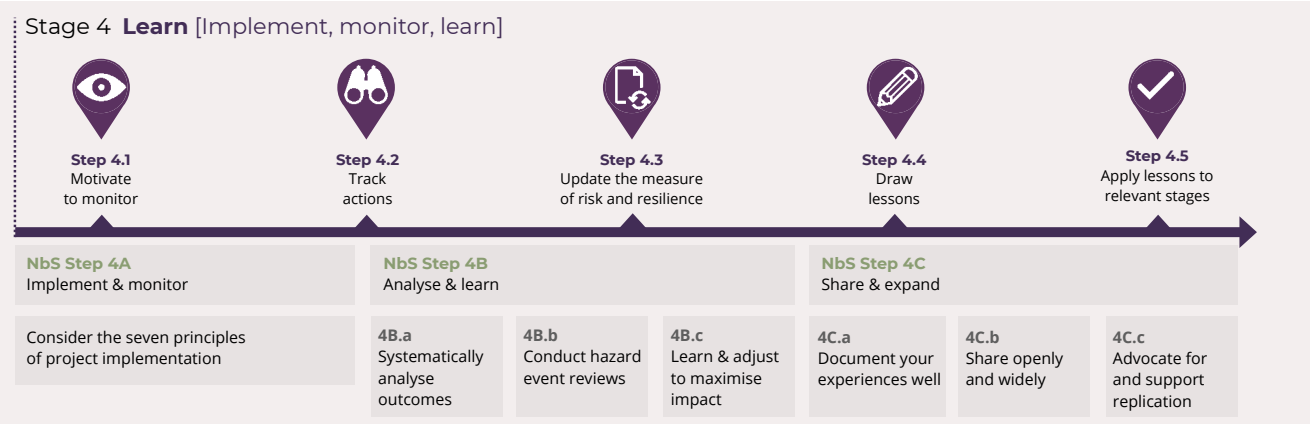
Principles and tips:

- Keep the steering committee and/or CRTs engaged in the process. For ecosystem-scale projects that span multiple communities, be mindful that both levels should be engaged.
- Be ambitious but realistic in setting objectives and timelines.
- Ensure that your logframe indicators are SMART, and that your logframe is logically coherent.
- Retain flexibility: your plan should resemble a framework that still allows communities to have variable pathways. You need to lay the foundation to manage adaptively.
- Be specific on responsibilities: who should do what and when?

Checklist for Stage 3

		Yes	No
1.	Have you identified a set of relevant DRR measures?	☐	☐
2.	Have you identified a set of NbS actions based on ecosystem assessments and consultations? If so, please list them in the solution finder (app. F.5).	☐	☐
3.	Have you developed the above actions into a set of DRR and NbS options?	☐	☐
4.	Have you used scenarios? Describe assumptions.	☐	☐
5.	Have you compared and prioritised options? Who was involved in the comparison and prioritisation (please list dates, names etc).	☐	☐
6.	Have you turned your solution into a plan (at project or community level?	☐	☐

Fig. 4.14 **Stage 4**



Stage 4. Implement and learn

What this stage is about. This stage is about implementing the community action plan and learning from the process along the way. The Road Map points out that you should create a monitoring system (step 4.1) and track actions (4.2). Over time, you should update the measure of risk and resilience (4.3), draw lessons (4.4), and apply them to improve implementation (4.5).

Nature perspective and NbS-specific guidance. Here, we aim to focus on implementation and learning, specifically around the NbS actions that were prioritised in Stage 3. The guidance on implementation and learning in the Road Map to Community Resilience is rather short. When working in multiple communities and in particular when implementing NbS, we must have a more comprehensive frame for implementation and learning in place.

At the end of stage 4, you should have contributed to the enhancement of community resilience — notably through NbS and the continuation of a community-led process.

Fig. 4.15 **Seven principles of project implementation**

Principle	Description
Principle 1 **Invest in your team.**	One of the most critical success factors of projects is the strength of the project team. Strong technical and communication skills are essential. Ensure that the size of your team is proportionate to the scale of the project and that your team has the right mix of skills. For typical community-based efforts, your team should have these skills: project management & leadership; stakeholder liaison & advocacy; community facilitation; technical expertise in risk management; protection, gender & inclusion; monitoring & data analysis; and financial management & administration.
Principle 2 **Monitor to manage.**	Timely identification of success factors allows you to strengthen the role of those success factors in programming. The flipside: the sooner you can identify problems and causes, the sooner you can rectify them. Good monitoring enables adaptive management. Identify challenges before they become problems. Have well-trained members on your team who understand both qualitative and quantitative modes of analysis, as well as at least some basic statistics.
Principle 3 **Use tangibles as mobilisers.**	Aim for benefits that are tangible. There is much more incentive to maintain an outcome if community members receive ongoing direct livelihood benefits from it, as well as eventual hazard protection later on.
Principle 4 **Build & maintain trust.**	A strong relationship of trust between your project team and the community is absolutely essential. It is good to visit frequently and maintain a constructive relationship with the wider community. Listen. Ask. Explain. Convince. Be humble. Be honest. Be respectful. Never promise what you may not be able to deliver. Avoid taking sides in local conflicts. Make sure you include all groups of the community. Good facilitation requires strong social skills and a sound understanding of culture and context. Ensure that your team has the right set of facilitators who have and maintain people's trust.
Principle 5 **Nurture stewardship & cohesion.**	Continue deep engagement to enable stewardship and cohesion. See whether you can work with existing groups in the community or help form new groups. Train and equip groups, so that they can be strong stewards. For instance, provide training on technical skills, fundraising, financial and volunteer management. Fostering social cohesion and collective action often emerges as a by-product of project efforts. By facilitating equitable engagement and promoting a common vision, you can play a direct role in helping communities become more cohesive and proactive.
Principle 6 **Ensure high technical quality.**	It almost goes without saying: any measure that is implemented should be of high technical quality to ensure that it can endure over time. Having the technical expertise on board is crucial. Following the detailed advice in external resources and investing in the right skills (see principle 1) will help you in the process.
Principle 7 **Adapt to remain agile.**	The final principle may be counterintuitive, but it is paramount: don't stick to your plan. A plan is a pathway to reach your objectives. With a robust monitoring system, new information emerges all the time on what works and what does not. With good stakeholder networking, you may get new insights on government plans or policies that affect your current plan. With an open mind to new opportunities, you may be able to explore different and possibly better pathways. Think. Explore. Test. Then adapt and change your pathway. Communicate and explain changes to all parties involved.

NbS Step 4A Implement and monitor.

You now have your plan, based on the solution you identified. This solution is now ready to be implemented on the ground.

If you have carried out the prior stages as part of a project, you will already have funding secured for implementation and a steering committee set up to oversee and guide implementation. If you are only starting to set up a project for implementation now, first secure funding (revisit fig. 3.8 on page 41 to assess different funding options) and set up a project steering committee, (see Stage 1, steps 1.6. and 1.7). Excellent! It is time to start implementing.

The Nature Navigator provides seven principles that you should keep in mind throughout implementation. These principles reflect success factors in community-based programming. These are summarised in fig. 4.15, with additional sections pertaining to NbS projects specifically described in detail below. You may also refer to the IFRC guidance on project management. Projects should include the development of a logframe, work plan, and budget. Appendix F.6a offers guidance for this process, and you may use the template in appendix F.6b .

Principle 1 – invest in your team

You should have expertise within your team on ecosystem management, in particular expertise specific to the ecosystems that are part of your solution. There may be lots of technical questions for which adequate guidance is needed. Having the right expertise on your team will thus be immensely useful.

For example, projects around forest and land restoration may require agronomists or foresters, while mangrove and coral reef restoration projects may require marine biologists. If that is not possible, ensure that you have strong arrangements with relevant

partners you can frequently draw on. The mix of internal or external expertise in your project will depend on your context and funding availability.

Your project should draw on the stakeholder engagement and community facilitation processes described under stages 1 and 2 above and continue these during project implementation. Keeping all stakeholders engaged is always important. With the added complexity of multiple sectors and themes (ecosystem management and disaster risk management, among others), it is critical. The team should have a robust understanding of government structures, mandates, policies, planning and budgeting mechanisms, as well as relevant laws and regulations.

Principle 2 | Monitor to manage.
When you engage NbS, you should monitor both the performance and health of the ecosystems as well as other outcomes amongst the community. Your ecosystems experts should thus work closely with the monitoring team on socio-ecological monitoring — looking at the ecological impacts/performance, the extent to which they benefit the people, and the extent to which stewardship is taken up.

Make sure that community members as well as technical experts are integral to your monitoring efforts. For community-based outcomes, consider re-applying the resilience star in semi-annual intervals to track progress with the community.

Principle 3 | Use tangibles as mobilisers.
As discussed earlier, NbS may take time (for example, to restore degraded land), and therefore it can sometimes be hard to show the immediate benefits to communities. Actual protective benefits tend to be invisible (hazards not leading to disasters). In areas with infrequent hazards, the interval between the initial (project) investment and the materialisation of protective benefits (avoided losses after a hazard) tends to be long. Therefore, livelihood benefits provided by NbS can be critical in providing incentives and acting as mobilisers – for example, gaining food security or economic benefits from sustainable agriculture or agroforestry in the short-term.

Principle 4 | Build & maintain trust.
Given that NbS is a new area of work, it may require some additional trust building. Engage regularly with your communities, listen and build on their expertise. Engage all relevant groups, including women, youth and Indigenous Peoples, who may have specific knowledge and experience on NRM. Take note of potential conflicts around NRM and facilitate discussion, where possible — especially when dealing with multiple communities in different parts of an ecosystem.

Principle 5 | Nurture stewardship & cohesion.
A strong sense of stewardship is your best bet to sustainable results. For NbS, this is even more important than for many other structural measures. Ecosystems are dynamic by nature. If adjacent communities do not sufficiently care and protect them — or continue practices that led to them being harmed in the first place — then prospects for success are not good. If you fail to win the community, you're very likely to fail the project. Therefore, continue deep engagement.

Principle 6 | Ensure high technical quality.
As has been discussed throughout this document, technical expertise is critical for NbS to succeed in its objectives — whether they are to reduce disaster risk, enhance food security or enable adaptation to climate change. Let's take the planting of a protection forest on a hilly slope as an example. It may sound simple, but it is not. Selecting the wrong seedlings, planting at the wrong time of the year, or not sufficiently protecting the young plants from grazing livestock may lead to low plant survival rates.

Although you need to brace for occasional setbacks, ensure that you reduce the risk by operating with high technical standards. Following the detailed advice in external resources and investing in the right skills (see principle 1) will help you in the process.

Principle 7 | Adapt to remain agile.
Adaptive management is a key to nature-based solutions (see criterion 7 of the IUCN Global Standard). Ecosystems evolve, can be unpredictable, and require monitoring and learning on how best to protect, manage and restore them. Therefore, it is crucial that implementation and monitoring go hand in hand.

NbS Step 4B Analyse & learn

You have already learned about the importance of short feedback loops as a key to remain agile. Beyond continuous monitoring, invest in deep learning and analysis at regular intervals. Bring in external experts to facilitate learning amongst everybody involved in your effort.

Step 4B.a Systematically analyse outcomes.

Regular monitoring should aim to analyse the progress towards achieving outcomes (and outputs), as we have argued above. For instance, seasonal surveys of a small sample of the community can be used to analyse the seasonal variation of food security in the context of NbS projects focused on sustainable agriculture or sustainable fisheries.

However, a systematic and robust analysis of outcomes requires a larger effort: representative surveys with sufficiently high levels of precision to detect statistically significant changes (such as those deployed as baseline, midline and endline) require many person-days to prepare, conduct, and analyse. Similarly, comprehensive, and detailed reviews of the health status of ecosystems and their likely protective function and growth require substantial time and investment. Therefore, plan for these important reviews. As a rule of thumb, conduct at least one mid-term review for projects with a 3-4-year implementation period, and at least one such review every two years for longer projects.

Furthermore, consider commissioning thematic studies around NbS of key aspects that are crucial to your project. Examples include the analysis of institutional or legal options for conservation arrangements such as Marine Protected Areas (MPA) to enable the protective functions of restored mangroves, or of market conditions for alternative livelihoods based on sustainable agriculture in recovery stage of natural hazards.

Step 4B.b Conduct hazard event reviews.

The two dilemmas of DRR (the invisible success and the fact that 'avoided losses' are abstract) have been highlighted earlier. If your target area encounters a hazard event during or after implementation, conduct a hazard event review.

These can be extremely useful to a) illustrate and analyse the protective benefit of ecosystems, b) reveal lessons as to how the overall solution can be further enhanced and c) to identify damages to ecosystems and other structural measures (see Walz et al. 2021). Ultimately, these reviews can lead to more or renewed community engagement and to more effective arrangements. In many cases, they may make an invisible success visible.

The hazard event review tool in appendix F.7 may be used for this purpose. It includes sections on the hazard strength, the damages and losses, the performance of ecosystems and other structural and non-structural measures, a comparative section (with past hazards and no-action counterfactual as reference points), as well as on lessons learned and actions for improvements.

Step 4Bc Learn & adjust to maximise impact.
Systematic reviews of outcomes and performance of NbS before, during and after hazards are only as powerful as the extent to which their findings are used.

It is a great practice if members of the community DRR team, project steering committee and other stakeholders are closely involved in such studies. Make sure that the findings are communicated and widely understood by all. This allows everyone to get involved and to contribute to adjustments. By sharing your experiences and analyses openly, you may also inspire and guide others in similar ecosystems, facing similar problems and seeking nature-based solutions.

NbS Step 4C Share & expand

Step 4C.a Document your experiences well.
Use the case study templates in appendix F.8 (short version and long version) as well as the writing guide in appendix F.9 to write convincing NbS case studies, invite scientists to conduct research related to your efforts, and consider externally produced case studies (e.g. as a spin-off from an evaluation or mid-term review). These can be relevant and valuable for the RCRC network at large.

Step 4C.b Share openly and widely
Share your case studies and other experiences widely — within and beyond your target country, in online communities of practice, at conferences, webinars and workshops – those focused on the humanitarian sector, on DRR, on climate change, on the environment.

Importantly, allocate some funding for conference participation, workshops and regional exchanges. Work on ecoDRR and NbS in humanitarian contexts is a new domain of work, and we all have an important part in increasing learning, understanding and awareness. Also consider organising national and regional exchanges among practitioners.

Step 4C.c Advocate for and support replication.
You have already worked with governments and other stakeholders — now spread the word with them, share your learning and advocate for changes in local or national policies plans and laws. Bring strong evidence along (to what extent were damages and losses reduced through NbS? What other benefits were created?).

Utilise your understanding of government structures, policies, and budgeting mechanisms. Partner with other organisations and make advocacy a concerted effort. Take the initiative and approach government agencies, stakeholders, and communities interested in replicating NbS in other areas. Invite them to see and hear about your nature-based solution and its impacts from your community members.

Convince. The road to greater resilience through working with nature around the world remains long.

Checklist for Stage 4

Are you working with these principles in mind?

	Yes	No
1. Invest in your team	☐	☐
2. Monitor to manage	☐	☐
3. Use tangibles as mobilisers	☐	☐
4. Build & maintain trust	☐	☐
5. Nurture stewardship & cohesion	☐	☐
6. Ensure high technical quality	☐	☐
7. Adapt to remain agile.	☐	☐

And do you analyse and learn by:

	Yes	No
▸ Systematically analysing outcomes?	☐	☐
▸ Plan for hazard event reviews (if applicable)?	☐	☐
▸ Learn and adjust?	☐	☐

Finally,

	Yes	No
▸ Do you document your experiences well?	☐	☐
▸ Share then openly and widely?	☐	☐
▸ Advocate for, and support replication?	☐	☐

5. Nature in disaster response and recovery

Yogyakarta, Indonesia
Construction of a bamboo emergency shelter. This shelter, built in a couple of days without a single nail, can resist to earthquakes. Building of a prototype in Dlingo near Yogyakarta, August 2006

Photo: Phil Vine / IFRC

When an area has been struck by disaster, time is of essence: working for humanitarian organisations, it is part of our mandate to respond quickly and to help people recover swiftly.

Disaster response operations are hectic and complex. You may argue that there is no time for environmental concerns when saving lives is the rightful priority. Indeed, the basic systems to reduce environmental harm and enable ecosystem-based recovery must be put in place well ahead of a disaster. But there are many powerful reasons for greening humanitarian operations — most importantly, the imperative to 'Do No Harm', which in this context means minimising any impact we may have on the environment

With the right systems and strategies in place, mainstreaming environmental sustainability issues into response and recovery can avoid harm. But we can go even further – by sustainably managing our natural resources during response, and in particular during recovery, we can be yielding benefits that increase livelihood resilience and reduce risk of future disasters. Let's explore this by addressing four questions.

Question 1: Why should we mainstream environmental concerns and NRM in humanitarian action?

People need to live in a healthy environment, or their well-being is put in danger. This applies both to everyday life and to humanitarian crises. Environmental degradation reduces community resilience and affects income and livelihoods prospects as well as health and other dimensions of well-being. Humanitarian actions can also directly contribute to the climate and environmental crises, as discussed in chapter 1. We therefore need to reduce our impact and contribution to climate and environ-mental crises by "greening" our operations, as well as to manage the environment sustainably so it can continue providing the ecosystem services on which lives and livelihoods depend. In all aspects of humanitarian action, we should thus take environmental considerations into account.

Fig. 5.1 **The twofold relationship between the environment and humanitarian operations**

1. The environment impacts humanitarian operations.

a. A degraded environment can trigger or worsen a humanitarian crisis.
Climate change drives mass migration and is linked to disasters. Local degradation further increases risk, e.g. landslides in the wake of denuded slopes.

b. A healthy environment will allow for effective humanitarian operations.
Healthy ecosystems and overall environmental conditions provide resources for response and recovery (e.g. clean water, natural resources).

2. Humanitarian operations affect the environment.

a. They can damage the environment further.
Poor waste management or unsustainable procurement (e.g. timber) can further degrade the environment and increase longer-term risk.

b. They can improve environmental conditions, reduce future damage and the risk of crises.
Mainstreaming environmental concerns and integrating nature-based solutions can assist in the recovery of ecosystems and affected people.

As *figure 5.1* illustrates, the relationship between the environment and humanitarian operations is twofold.

Regarding the **first block** (the environment impacting operations), as humanitarian organisations we can integrate environmental sustainability in all our work (see chapter 1). Thereby, we can reduce our negative impact on the environment and minimise our contribution to global climate and environmental crises in the long run. However, once climate and environmental crises are underway, as incoming disaster teams there is little we can do to rapidly avert these crises.

Concerning the **second block** however, there is a lot we can do in response and recovery. We can minimise the damage to the environment during our humanitarian operations (whatever the crisis we are responding to) and reduce future risk. The 'Do No Harm' principle can translate to better waste management and avoided deforestation, for instance.

Going further, we can seek to actually improve ecosystem health by integrating environmental considerations into recovery pathways. This makes recovery activities more effective and contributes to disaster risk reduction and sustainable development.

Addressing environmental issues from the early phases of a crisis can bring several benefits, including:

- **Tackling** underlying environmental issues that may have contributed to the crisis, and reducing the risk of recurrence;
- **Securing** livelihoods by safeguarding the natural resources on which they depend;
- **Improving** communities' health and safety by reducing pollution (air, soil and water) and waste;
- **Reducing** the potential for conflict over scarce resources at the local level;
- **Protecting** people and the environment from future hazards through mitigation activities; and
- **Slowing** or reversing trends that lead to deforestation, desertification and pollution and thereby supporting community resilience, biodiversity, food and water security and economic development.

Following large-scale disasters such as the Indian Ocean Tsunami of 2004, Myanmar's Cyclone Nargis of 2008 and the Haiti Earthquake of 2010, humanitarian agencies have increasingly recognised the importance of addressing environmental considerations in their operations.

The RC/RC Green Response Working Group was formed in 2014 and seeks to progress initiatives that improve environmental outcomes of humanitarian action. The group works across the IFRC network to render the response of National Societies greener. See here to learn more about our Green Response work.

The Environmental Emergencies Centre (EEC) was established in 2012 by the Joint Environment Unit (JEU) of the United Nations Environment Programme (UNEP) and the UN Office for the Coordination of Humanitarian Affairs (OCHA). It features a rich resource base, a training programme, and numerous case studies. The JEU also runs the interagency Environment and Humanitarian Action Network (EHAN).

In 2013, the JEU also created **Environment Markers** and **Sector Guidance** to identify appropriate action for humanitarian projects. In 2018, the Nexus Environment Assessment Tool, the **NEAT+,** was launched, to enable environmental screening in humanitarian contexts.

The Sphere Handbook, the main reference for humanitarian standards, was revised in 2018 and now includes more concise guidance on environmental aspects. The thematic series sheets on environmental impact and disaster risk reduction highlight main aspects and make the link to main policy documents such as the Core Humanitarian Standards (CHS), the Sendai Framework for Disaster Risk Reduction (SFDRR), and the Sustainable Development Goals (SDG).

A 2020 study of humanitarian organisations found that 41% of surveyed organisations already had environmental policies in place, while 30% were in the process of developing them (Brügge et al 2020: 17). Increasingly, donors also require to document environmental performance of humanitarian projects (see Brangeon and Crowley 2020). The Climate and Environment

Charter for Humanitarian Organisations that IFRC and ICRC launched in May 2021 with many other humanitarian organisations is a manifestation of the move towards greener operations and integrating environmental sustainability in all our work (see figure 1.7 in chapter 1).

Question 2:
What are potential negative impacts of humanitarian operations?

While disaster response and recovery operations aim to save lives and alleviate suffering, numerous negative consequences on the environment can emerge. These occur mainly in the local area of the operation (e.g., deforestation as a result of unsustainably procuring timber for shelter construction).

However, the impact is not always locally restricted. For instance, communities downstream may experience greater flood risk. Groundwater pollution may affect a whole basin. Poor environmental standards and excessive packaging at production sites of relief items may degrade far-flung ecosystems. And carbon emissions from the operations (especially from our supply chain and logistics function) affect us all, in the end.

Figure 5.2 shows some of the common negative impacts that can be associated with response and recovery operations. This list is not exhaustive but

Fig. 5.2 **Key potential negative impacts of humanitarian action, and what we can do to reduce them.**

Cross-cutting aspects

Logistics
- Carbon emissions from the transport of goods and personnel (vehicle fleets and flights) contribute to climate change. Air pollution and waste from handling and transport of goods.
- ✓ Green your fleet, pre-position relief stock regionally, pool resources, enhance routing and selection of cargo planes
- ➡ **Resources**: Green Logistics Guide, Green fleet Costa Rica Red Cross case study

Supply chain
- Local impact at production site (waste, water, degradation), emissions from production and transport, life-cycle impact from products (use, disposal)
- ✓ Develop/revise a supply chain strategy that includes environmental criteria in the selection of supplies (lifecycle assessments of products)
- ➡ **Resources**: GRRT Module 5: Materials and the Supply Chain, EHA Materials and Supply Chain Guidance, IFRC Greening Supply Chains case study

Cash transfer programming (CTP)
- CTP can raise efficiency and reduce emissions from transport, but run risk of not accounting for environmental externalities of market-based solutions.
- ✓ Integrate environmental criteria in your market and CTP viability assessment. Give guidance and/or make conditions for the purchase of items.
- ➡ **Resources**: EHA Cash guidance, JEU report on CTP and the environment, URD report on the environmental impact of CTP

Shelter & settlements
- **Deforestation** caused by giving room for settlements, using wood for construction material and as fuelwood (cooking, heating);
- **Soil erosion** linked to unsustainable extraction of sand and gravel from rivers for construction
- **Degraded ecosystems** due to poor choice of settlement locations
- **Local pollution** from packaging and low-quality/non-durable items such as tarps
- ✓ **Recycle** material for construction (incl. debris), reuse form shapes
- ✓ **Mainstream** environmental considerations in design, site selection, and the construction process
- ➡ **Resources**: EHA shelter guidance, GRRT Modules 4 (Site selection), 5 (Materials) and 6 (Construction)

Water, sanitation & hygiene
- **Contamination of surface and ground water** due to sanitation activities (e.g. short distances between latrines and water points, poor faecal sludge management) and ground water contamination from the construction of boreholes
- **Water table depletion** due to unregulated or poorly coordinated pumping, lack of aquifer analysis
- **Plastic waste** from hygiene kits
- ✓ **Ensure** the sustainability of ground and surface water supplies by conducting assessments, through water conserving measures and the appropriate disposal of liquid waste
- ✓ **Use** best water management practices to avoid pollution & depletion.
- ➡ **Resources**: EHA WASH guidance, GRRT Module 7 (Water & sanitation)

Food security & livelihoods
- **Solid waste** creation from packaging of food items
- **Water pollution** from pesticides
- **Water table depletion** from excessive irrigation
- **Disturbance** of traditional seed management, loss of biodiversity
- **Deforestation** from clearing new fields or to collect firewood
- **Depletion of natural resources** due to ungoverned access around refugee and IDP camps
- ✓ **Assess** fuel conditions to inform food selection, and provide fuel with food
- ✓ **Use** cash or food for work projects to replenish natural resources
- ➡ **Resources**: EHA guidance on food security nutrition and livelihoods, GRRT Module 8 (Livelihoods)

Other sectors
- **Health**: improper disposal of medical waste poses environmental risks to population and nature
- ✓ **Health**: Ensure best practise in disposal of medical waste
- ✓ **Education**: provide sound environmental design for education facilities; mainstream or strengthen environmental education
- ➡ **Resources**: EHA health guidance , WHO guidance on medical waste , EHA education guidance ,

Tip 1: Seek positive environmental impact

Aside from mitigating or **avoiding the negative environmental impacts** of humanitarian action, there are countless opportunities to **create positive effects** on local ecosystems and for communities. The aftermath of a disaster has the inherent opportunity to **build back better, safer, and greener**. Although most of these options fall in the recovery phase, environmental considerations need to be integrated at the very early post-hazard stages. Benefits of green recovery include the positioning of new buildings outside hazardous and environmentally fragile zones, the mainstreaming of climate change adaptation, the strengthening of local capacity to sustainably manage natural resources and ecosystems. See chapter 4 for long-term recovery options and the Green Recovery and Reconstruction Toolkit.

Tip 2: Focus on waste

Waste management is crucial to prevent local pollution, ecosystem degradation, and often, increased risk. It is the responsibility of all sectors!
- ➡ **Resources**: IFRC Guideline on managing solid waste, UN Disaster Waste Management Guidelines

Tip 3: Focus on fuel and energy

In crisis settings, forests and other ecosystems are often degraded as a result of fuel wood collection for cooking and heating. Explore fuel options.
- ➡ **Resources**: Clean Cooking Alliance guidance, IASC Matrix on multi-sectoral fuel strategy

Fig. 5.3 **Steps in greening across the programme management cycle**

1. Assess

- ✓ **Include** environmental assessments as an integral component of the disaster assessment phase.
- ✓ **Conduct** an environmental assessment as soon as possible after the disaster. Investigate environmental drivers of the crisis and the main environmental impacts and risks to affected populations.
- ✓ **Invite** environmental actors to participate in environmental assessments. Request additional environmental expertise if necessary – consider the host government and national organisations for expertise.
- ✓ **Pay attention** to communities' perceptions of environmental concerns.

2. Design

- ✓ **Incorporate** the results of environmental assessments into the programme design
- ✓ **Translate** the results into mitigation activities and define solutions to identified environmental issues.
- ✓ **Use** local capacities to deal with environmental issues.
- ✓ **Make sure** the humanitarian needs, vulnerabilities, and risks which the response plan seeks to address reflect how environmental issues exacerbate or contribute to the crisis.
- ✓ **Include** environmental considerations in objectives, outcomes, and activities to ensure they are addressed throughout the response
- ✓ **Budget** for environmental activities.

3. Implement

- ✓ **Screen** planned humanitarian activities for their environmental impacts.
- ✓ If activities with negative environmental impacts are underway, **consider**:
  - ✓ **Postponing or cancelling** the activity if it will result in unacceptable environmental damage, but always prioritising the life-saving imperative;
  - ✓ **Adapting** ongoing activities or plans to incorporate environmental impact mitigation or avoidance measures; or
  - ✓ **Accepting** negative environmental impacts due to relief assistance as unavoidable and preferable to not providing assistance. In such a case, include impact mitigation and remediation actions in other elements of the relief or post-disaster recovery programmes.

4. Monitor & learn

- ✓ Based on programmatic assessments, **develop** an environmental mitigation and management plan
- ✓ **Monitor** the environmental impact of humanitarian activities against baseline information from environmental assessments
- ✓ **Incorporate** the perspectives of local communities on perceived environmental changes (e.g. changes to livelihood practices due to environmental issues)
- ✓ **Request** technical expertise and engage local environmental actors to help determine if measurements are appropriate. This can help where monitoring environmental impacts is difficult
- ✓ **Monitor** three key environmental impacts:
  - a) direct environmental consequences of the natural or technological hazard that caused the emergency,
  - b) environmental consequences of relief operations; and
  - c) the environmental impact of unmet basic needs of affected people
- ✓ **Define** clear indicators that relate to the type of emergency response and environmental context.

gives an idea of what is at stake. Although there is no doubt that the humanitarian imperative of saving lives and livelihoods must always be upheld, it is important that environmental considerations are mainstreamed in all processes, sectors, and activities.

Question 3: What can we do better in disaster response?

Fortunately, there is much we can do — and quite possibly, you have already been following some of the practices to reduce negative impact on the environment that are listed in *figure 5.2*. Every crisis and every disaster is different to another. To help you through the process once a disaster has hit and you pack your kits for deployment, consider the steps shown in *figure 5.3*.

The JEU Environment Marker and its associated Sector Guidance sheet are useful resources to keep at hand. The environment marker uses the **CAME** approach (**C**ontextualise, **A**ssess, **M**itigate, **E**nhance):

Contextualise projects given the environmental vulnerabilities of the areas they are located in.

- What are the main environmental problems in the country/ region/ community (deforestation, water scarcity, etc)?
- Are there sensitive/protected areas in the nearby area (such as forests, water sources)?
- What are natural resources traditionally used for?
- Do male and female users have different priorities?

Assess projects for potential negative environmental impacts, given this context.

- Does the project impact **directly** on the local environment, specifically on previously identified main environmental issues? This could be the overuse of scarce water resources, or the cutting of trees for construction works.

Case study K | **Revegetation half-moons**

Location: Sansané Haoussa, Niger
Partners: Niger Red Cross, IFRC

The Sahel, the transition zone in Africa between the Sahara desert to the north and the Sudanian savanna to the south is a climate change hot-spot and suffers frequent food crises. Niger is no exception, and in response to a recent food crisis, IFRC funded a cash-for-work project through its Disaster Response Emergency Fund (DREF). Implemented by Niger Red Cross, the project benefitted 2,000 villagers as well as the environment.

The area around the village of Sansané Haoussa had been covered by forest until about 30 years ago but now features barren land. Niger Red Cross selected people to construct half-moon basins, and enabled them to buy food.

The technique of half-moon basins originated in Niger and is a common tool to prevent desertification, recover desert lands, and enable agricultural production. Dug with shovels and pickaxes, they are semi-circular basins 3-6 m in diameter.

These are arranged on gentle slopes and in a staggered arrangement (see photo). They catch the rain and let it sink into the ground, enabling grass to grow and turn barren land into greener pastures. Half-moon basins are effective for areas of less than 600 mm of rain annually.

In Niger, the newly greened areas are mainly used for cattle grazing. With manure added, they can enable the production of around one ton of sorghum grain per hectare.

The experience from Sansané Haoussa is exemplary in showing that short-term response operations can be used to create positive effects on the environment as well as long-lasting benefits to communities and their resilience.

- Does the project impact **indirectly** on the environment? This may stem from the use of material brought in from other areas, causing unsustainable harvesting of wood in those locations, or include the risk of deforestation due to increased population?

Mitigate impacts by modifying the project design or compensating for negative impacts.

- How can the direct and indirect impacts be reduced or avoided?Have you reviewed best practices, case studies etc. from other organisations doing similar type of activities?
- Have you consulted with the local community/government to identify traditional and environmentally responsible solutions?

Enhance environmental benefits in the project.

- After impact assessment and mitigation, what other enhancement measures can be added to the project?
- Can enhancement activities be combined with other sectors? (For example, planting native fruit trees as enhancement could also contribute to increased nutritional value and food security).

In the next disaster response and recovery operation you will be involved in, it is very likely that environmental considerations will play a role in cluster meetings and response. Make sure that you understand key concepts and tools and engage in or drive efforts to reduce the negative impacts and seek ways to create positive

Case study L | **Green recovery from Cyclone Idai**

Location: Mozambique
Partners: Mozambique Red Cross, IFRC

Photo: Corrie Butler, IFRC

In March 2019, Cyclone Idai left a trail of destruction in its path. The strongest cyclone ever to hit Africa, it killed 1,300 and affected three million people. Mozambique's north-central provinces were the areas affected the worst. In mid-2019, an environmental field advisor was deployed to the area to review the initial recovery plan (Emergency Plan of Action, EPoA) and to develop an environmental management plan.

The assessment identified limited negative consequences of the activities envisaged in the EPoA but provided a comprehensive list of opportunities to create positive environmental impact while also reducing future risk.

The report summarised key issues of environ-mental sensitivity related to deforestation, agriculture and fishing, waste management, water, energy, and climate sensitivity.

With this background in mind, it made 26 recommendations that covered all sectors as well as logistics, facilities and staff management.

The Environmental Management Plan led to adjustments of the initial EPoA and informed the overall recovery operation.

Key items of the Plan include:

- **WASH**: Groundwater assessments ahead of borehole drilling, rainwater harvesting, composting toilets, solid waste management mainstreamed in hygiene promotion;
- **Shelter**: Sustainable material supply, improved cook stoves, construction training with climate-smart practices integrated
- **Livelihoods**: Promotion of climate-smart agriculture, use of eco-fertilisers, cookstove distribution, market assessments on environmental impact of key items ahead of cash-based programming;
- **DRR**: Raising understanding of ecosystem benefits and exploring reforestation as multi-purpose solutions at vulnerable points.

benefits for the environment. See the tools and resources in figure 5.5 to learn more. Tools such as the JEU Environment Marker and NEAT+ are focused on small-scale geographical areas and for use by on-site field staff. They enable a simple assessment of the environmental impacts of the crisis and potential environ-mental risks, and suggestions to mitigate any negative effects of humanitarian assistance. They rely largely on the expertise at hand post-disaster to do this *environmental screening*, although, in exceptional cases, environmental experts could be considered as part of surge personnel, or indeed the process of environmental screening may highlight that specific expertise is required. Environmental screening is particularly relevant for the shelter, water and sanitation, and livelihoods and food security sectors. While the focus of such rapid environmental assessment tools is on "doing no harm" and on minimising negative environmental impact, they provide critical entry points for sustainable natural resource management actions as part of the broader disaster management cycle. They enable the inclusion of nature in response and recovery and can identify opportunities to build back better and greener, whilst increasing resilience and reducing future disaster risk.

Water management options can evolve from rainwater harvesting during response, through to integrated water management plans during recovery, which can help mitigate future drought. Avoiding deforestation during response can evolve to land restoration and revegetation (including as part of cash-for-work programmes) once shelters are decommissioned, and provide scope for

broader landscape restoration, which can prevent future soil erosion and landslides. Food security and livelihoods projects can promote sustainable agriculture practices during response and recovery, which can later be maintained as soil and water conservation measures that can help regulate droughts or flooding.

The case study from Niger (Case study K) shows how including natural resource management actions as part of a Disaster Response Emergency Fund (DREF) can be an entry point for longer-term disaster risk reduction and community resilience.

A natural resource management project – the agricultural practice of half-moon basins – was included as a cash-for-work-programme in the DREF. Whilst providing work during response to a drought, in the longer-term recovery phase the half-moon basins enable water capture and restoring degraded pastureland, making it more fertile for grazing.

This is an example of how a response action around natural resource management can, over time, evolve into recovery that can increase community resilience through strengthening livelihoods, reducing ecosystem degradation and risk from drought.

The case study from Mozambique shows the benefits of including environmental expertise (in this case an environmental field advisor) in the emergency phase, to influence planning, especially for recovery. In addition to assessing potential negative environmental impacts, opportunities for environmental benefits were identified, including around natural resource management such as climate-smart agriculture and reforestation.

Nature is there before, during and after disasters. We need further work, testing and understanding on how the role of nature, and nature-based solutions, can be harnessed for resilience throughout the disaster management cycle – including how smaller-scale natural resource management initiatives during short-term response operations can evolve, during recovery and beyond to longer-term, landscape-scale nature-based solutions that reduce disaster risk and increase community resilience (as discussed in chapter 4).

Fig. 5.4 **The role of ecosystems and ecosystem services in selected humanitarian clusters**

Humanitarian cluster	Relevance of ecosystems and ecosystem services
Water, sanitation and hygiene	▸ Small-scale solutions such as rainwater harvesting can provide fresh water. ▸ Larger-scale and longer-term solutions (e.g., integrated water resource management, integrated watershed management) can purify water, regulate diseases and regulate floods
Shelter	▸ Short-term solutions (such as sustainable forest management) can provide sustainable wood resources for shelter. ▸ Longer-term solutions at scale (e.g., forest protection and restoration) can provide protective benefits for shelter, such as protection from floods
Food security	▸ Short-term, smaller scale solutions (such as sustainable agriculture and fisheries) can provide food, nutrition and income. ▸ Longer-term solutions (e.g., agrobiodiversity or agroforestry) can provide fresh water, soil formation, employment.
Nutrition	
Health	▸ NbS at scale (e.g., protected or restored forests or wetlands) can provide clean air and water, as well as regulating diseases, promoting One Health approaches

Figure 5.4 above identifies some initial benefits and entry points. Conversely, we also need to explore how the types of nature-based solutions for disaster risk reduction discussed in chapter 4 can be better harnessed during humanitarian operations.

Question 4: What can we do on an organisational level?

If you have been working in disaster response operations, you already know how hectic and complex these usually are. Between needs assessments, cluster meetings, media enquiries and early planning for projects, there is little time for sleep. At this stage,

learning new tools and processes is the last thing you have time for. What does this mean for humanitarian organisations such as National Societies? If we want to mainstream environmental concerns and natural resource management in response and recovery operations, we must **prepare in advance**.

Action 1: Train your teams

At a minimum, this should include the **training** of disaster response personnel such as those enlisted in National Disaster Response Teams (NDRT) in how to integrate environmental considerations and the simple tools available.

Fig. 5.5 **Tools: greening response and recovery**

Resource bases

- EHA Connect is a hub aiming to bring humanitarian and environmental communities together to support environmentally sustainable disaster management.
- The Environmental Emergencies Centre (EEC) features a rich resource library with excellent search function, as well as online training courses. Hosted by the UNEP/OCHA Joint Environment Unit.

Guidelines and tools

- Green Recovery and Reconstruction: Training toolkit for humanitarian action (GRRT). WWF/American Red Cross, 2016
- Rapid Environmental Assessment tool (REA): operational manual, 2018
- Framework for Assessing, Monitoring and Evaluating the Environment in refugee-related operations toolkit (FRAME). UNHCR and CARE, 2009
- Flash Environmental Assessment Tool (FEAT) . This pocket guide supports initial disaster responders to determine risks posed by hazardous substances. JEU, 2017
- Nexus Environmental Assessment Tool (NEAT+) is a screening tool covering the overall environmental sensitivity of projects (shelter, WASH, food security)

Help desks

- **Joint Environment Unit (JEU):** For environment in humanitarian action coordination support, integration of environment into the Humanitarian Programme Cycle and ongoing humanitarian responses, contact the UN Environment/OCHA Joint Unit: ochaunep@un.org
- **Green Recovery Connect:** For environmental specialist support in disaster recovery, reconstruction, and risk reduction work, contact the Green Recovery Connect help desk run by WWF and partners: http://envirodm.org/helpdesk

The Green Recovery and Reconstruction Toolkit (GRRT) that was prepared by WWF and American Red Cross comes with the toolkit itself as well as presentations and trainer guides for all its modules. Its modular system also allows you to target trainings to your audience. Watch the GRRT introduction video to learn more.

The Environmental Emergencies Centre offers a range of short online courses that can be completed in 2-5 hours (e.g., on the Environment in Humanitarian Action).

The Greening Humanitarian Aid training course, supported by the European Commission, is another opportunity to raise the knowledge of your disaster management practitioners ahead of the next deployment. For additional and more specific tools, see *figure 5.5* on the left.

Action 2: Devise policies and strategies

To prepare your organisation for greener response and recovery, it is important to have a clear direction on how environmental sustainability should be integrated into humanitarian work.

Development of an environmental policy and inclusion of the environment in DRM strategies is critical to help drive change. IFRC has a toolkit to help National Societies develop their own environmental policy.

Such policies and strategies often combine how the organisation as a whole can be greener, especially in the critical area of logistics and supply chain, as well as the greening of humanitarian operations. Ask yourself: what is your target, and how do you want to achieve it? Refer to GRRT Module 10 (organisational operations) for guidance.

Action 3: Understand the local environmental context in advance

Both environmental impact assessments (focused on avoiding negative environmental impact) and ecosystem assessments (focused on promoting positive outcomes of protecting, managing, and restoring ecosystems for human well-being; see chapter 3) provide an overview of key environmental issues and drivers of degradation for a country.

This type of information can be gathered and assessed already *before* disaster strikes. These assessments can be tailored to specific sectoral needs. After disasters strike, they can be used as a starting point for site-specific environmental impact screening.

The IFRC Shelter Cluster has begun to develop so-called Environmental Country Profiles to inform shelter and settlements programming.

The profiles are country-wide in scope and provide a quick basic understanding of context and the most crucial factors for environmentally sustainable shelter related operations. It provides an environmental baseline and information to support humanitarian shelter actors. After a disaster, the information in the profiles is contextualised based on the impacts of the disaster.

Action 4: Develop partnerships

In addition to developing internal capacity, it makes sense to form partnerships with environmental organisations who can provide background information on the local environmental context, help you with more detailed environmental impact assessments (EIA) if required, and offer other technical support.

Case study M | Green belts in a camp

Location: Dadaab, Kenya
Partners: Kenya Red Cross

The Dadaab refugee complex is one of the largest in the world. Established in 1991 in the course of the civil war in neighbouring Somalia, Dadaab hosts more than 200,000 refugees and asylum-seekers across three camps. Many of the crises that refugees in Dadaab have fled are protracted, meaning that many people have grown up here. The camp is in Garissa county, a semi-arid area in north-eastern Kenya, prone to soil erosion and drought. Kenya Red Cross (KRC) has been active in the camp since its establishment.

Between 2012 and 2020, KRC supported the establishment of green belts. Due to increasing population in the camp, land was being cleared for firewood. The situation was exacerbated during the drought of 2011/12 in the Horn of Africa – impacting both the land around Dadaab, and also leading to a new influx of refugees. The need for land rehabilitation was identified as a priority. Specific land was set aside in the camp for this purpose, both to provide for livelihoods and to protect the camp itself from drought impacts.

The project began with a feasibility study by agronomists and foresters, in close collaboration with the Ministries of Agriculture and Forestry, to identify which tree varieties to use on the degraded land. Indigenous trees were selected, given their adaptability to the local arid conditions. Initial project activities included production of seedlings. These were planted and managed actively for a period of two years. Afterwards, the green belts have continued as natural regeneration, without required management and irrigation.

Community members were given a stipend to incentivise engagement and maintenance of the afforested areas. The initial activity was undertaken during recovery from drought. Over time, KRC has been involved in land rehabilitation of 5 green belts, leading to an increase in forest cover over a total area of 70 hectares. Land has been restored sufficiently to enable some wild animals to return to the habitat. The belts provide protection from sand and winds. Certain areas have also been opened up to provide pasture for livestock.

Livelihood and food security needs were rapidly identified as a related and important priority for the communities. Agroforestry was explored, to combine indigenous trees with fruit trees and vegetable crops. Fruit trees have also been planted in homesteads and in a fenced off section of the school compound. The produce has been used both local food, with surplus sold on the market and to the local hospital. Local diets were improved as a result.

The green belts focused on addressing ecosystem degradation and reducing disaster risk from droughts. Following the identified need for food security and livelihoods, initial activities were broadened to include agroforestry. While the agriculture methods used and mechanical irrigation needed have included non-nature based solutions, these hybrid approaches to agriculture and forestry have been critical in ensuring local food security and strengthening local livelihoods.

The initiative worked closely with local authorities to select the sites and varieties of trees to be reforested, and both refugees and host communities were engaged in the activities. Local environmental groups were created in schools and communities to maintain activities.

The project showcases the relevance of NbS for recovery from drought and the context of protracted crises. Land regeneration takes time (two years for natural regeneration in this case), but when combined with agriculture activities (e.g., vegetable growing) it can provide short-term livelihood benefits. Adding a livelihoods component to the project ensured community commitment.

Nature-based solutions require technical expertise, in this case on agriculture and forestry. KRC has invested in this expertise both within its own organisation, in addition to close partnership with Ministries of Agriculture and Forestry.

Philippine Red Cross volunteer Rhema Jhon M. Comillas carries a WASH kit as he prepares for the distribution for residents affected by Typhoon Odette (Rai) in San Jose, Dinagat Island, the Philippines. Photo: Lisa David

Joining the Green Response Working Group is also advisable, to benefit from the experiences of other National Societies.

Action 5: Strengthen systems

Revising and strengthening systems to reduce environmental impacts can include the integration of environmental standards, measurement of water and energy usage and waste, efforts to green the supply chain, as well as adjustments to fleet management and monitoring systems. See GRRT Module 10 for guidance.

Checklist: response & recovery

1.	Are you familiar with **environmental guidance and tools** for the humanitarian sector? Have you explored how you could apply it as part of your humanitarian operations?	Yes ☐ No ☐
2.	Have you developed **environmental partnerships** and sought environmental **expertise,** as part of your operations?	Yes ☐ No ☐
3.	Have you **analysed the main environmental vulnerabilities and problems** and use of natural resources in your country/region/community?	Yes ☐ No ☐
4.	Have you **assessed** the **potential negative environmental impacts** of your humanitarian projects (for instance, through the use of an environmental screening tool)?	Yes ☐ No ☐
5.	Have you considered options to include **natural resource management** into **humanitarian projects**, including as part of **DREF and EPoAs**?	Yes ☐ No ☐
6.	Have you considered how to enhance ecosystem benefits, including as part of mid-to long-term recovery and disaster risk reduction?	Yes ☐ No ☐
7.	Have you **modified humanitarian project design** to minimise negative impacts and maximise ecosystem benefits?	Yes ☐ No ☐
8.	Have you **raised awareness and/or trained your teams** on environmental issues, including the potential of nature-based solutions, environmental assessments and tools?	Yes ☐ No ☐
9.	Have you devised longer-term **environmental strategies** for your operations work?	Yes ☐ No ☐

Appendix

WHY TWO TOOLBOXES?

- The application toolbox contains all tools for the regular use of the Nature Navigator.
- The facilitation toolbox is intended for those who plan to facilitate a training course.

Appendix A **Solution overview**

What this overview is (and is not). This appendix features two tables that offer an overview of certain nature-based solutions for various hazards and ecosystem types. These are only examples. See more exhaustive lists in other key publications (appendix D).

A critical starting point is to **understand the connectivity** between and within ecosystems. How you manage your water will affect your land. How you manage your rivers will affect your coasts (see chapter 1).

To understand your specific context and to identify the right solution for you, you must **always conduct your full assessment of risks and ecosystems**, and engage communities and stakeholders (as explained in chapter 4).

These tables can give you ideas on what solutions may be applicable in your context. It is important to note that no two contexts are the same. **The two tables are not a concrete list of solutions for your area**. Instead, they are here to give you an idea of broad solutions that are available, and that come in different forms.

For instance, solution A.2 (coastal and wetland restoration) could include the restoration of different ecosystems: seagrass meadows, mangroves, marshes or dunes, depending on the ecosystems that exist along your coastline. The type of intervention in the specific ecosystem may also vary.

When looking at a mangrove ecosystem, NbS options include:

- the **protection** of mangrove ecosystems, so they maintain their natural surroundings – including through creation and maintenance of protected areas
- the **sustainable management** of mangroves, so they are managed in a way that does not lead to decline – including sustainable harvesting of mangrove resources for local artisanal production while maintaining protective functions, and
- the **restoration of the ecological functions** of degraded or lost mangroves, including natural regeneration (restoring hydrological flows), replanting and removing threats.

Mix and match. Since the solutions shown in the tables come in many forms and modes, you should consider mixing them to yield the most effective results. For instance, combining the restoration of seagrass meadows and coral reefs helps both ecosystems recover while also leveraging a greater effect to wave attenuation.

This might be further combined with other actions such as sustainable fishing and ecotourism to strengthen local livelihoods. So instead of selecting individual activities, see what actions can be complementary to each other and implemented across an ecosystem to maximise the resilience of communities and ecosystems.

Combine contexts and solutions. Furthermore, you can reach beyond the individual cells in the tables. In most cases, ecosystems and landscapes are interdependent. While the distinction between landscapes in the tables serve a purpose, these landscapes are connected to each other and often overlapping.

Just imagine you work in a city on the coast with a river running through it. Often, part of the solution to that city's problem is outside its boundaries — for instance, by restoring upper watersheds and their capacity to retain water after heavy rainfalls. Such 'ridge-to-reef' approaches are promising because they create benefits at many levels, and through multiple mechanisms.

Understand your hazards

Common hazards such as floods, landslides and storms have different underlying mechanisms. In order to address the hazard, we must identify the way it works. Only then can we identify the specific solution.

1. Floods

Three most common types are coastal, fluvial and pluvial floods. See this explainer and compare with a more detailed categorisation in the WWF Green Guide (pp. 150-153).

- **Coastal floods**: the flooding of coastal areas with seawater can occur as the result of high tides, storm surges, or earthquakes. **Tidal floods** occur during exceptionally high tides that surpass the height of coastal defences. **Storm surges** are the result of water being pushed onshore by strong winds (hurricanes, cyclones, typhoons). Tidal floods and storm surges can combine to particularly high floods. During extreme weather events such as cyclones, additional flood risk comes from extreme rainfall over land. Coastal floods deposit saltwater on land and often create longer-term damages to ecosystems, agriculture, and urban infrastructure.
- **Fluvial floods** occur when the water level of rivers, lakes or streams rise as the result of excessive rain or snowmelt. The severity of such floods is determined by the duration and intensity of rainfall, soil water saturation due to previous rainfall, and the terrain surrounding the river system.
- **Pluvial floods** include flash floods and surface water floods, and may occur independent of an overflowing water body. **Surface water floods** occur mainly when an urban drainage system is overwhelmed and water flows out into streets and nearby structures. They occur gradually and usually create no immediate threat to lives but may cause significant economic damage. **Flash floods** are characterised by an intense, high velocity torrent of water triggered by torrential rain falling within a short amount of time within the vicinity or on nearby elevated terrain. They can also occur via sudden release of water from an upstream levee or a dam. Flash floods are very dangerous and destructive not only because of the force of the water, but also the hurtling debris that is often swept up in the flow.

2. Storms

Wind is the movement of air caused by the uneven heating of the Earth by the sun. Warm air is lighter than cold air. The warm air rises (low pressure systems), and cold air rushes in from high pressure systems nearby. This **horizontal** movement is observed as wind.

Storms are complex mixes of **horizontal** and **vertical** movements of air. As they entail great pressure differences, the air achieves great speed as it moves from high to low pressure areas. The high wind speed alone can cause significant damages (for instance, it can uproot trees and cause damage as they fall, or unroof homes).

However, most **storm damage** comes usually not from the extremely fast airflow itself, but from the associated effects such as **storm surges** (i.e. when cyclones make landfall), extreme rainfall, hail and lightning). In order to reduce damages from future storms, explore first which aspects caused them.

3. Drought types

Droughts are periods of time when an area experiences below-normal precipitation. This leads to reduced soil moisture and groundwater levels and diminished stream flow. Droughts can

have severe impacts on agriculture, ecosystems and humans. They also make **wildfires** more likely and severe. Four types are commonly identified:

- **Meteorological drought** is specific to different regions, depending on the amount of normal precipitation. A decrease in precipitation compared to the historical average for that area would qualify as a meteorological drought.
- **Agricultural drought** accounts for the water needs of crops during different growing stages. For instance, not enough moisture at planting time may hinder germination, leading to low plant populations and a reduction in yield.
- **Hydrological drought** refers to persistently low water volumes in streams, rivers and reservoirs. Human activities, such as drawdown of reservoirs, can worsen hydrological droughts.
- **Socioeconomic drought** occurs when the demand for water exceeds the supply. Examples of this kind of drought include too much irrigation or when low river flow forces hydroelectric power plant operators to reduce energy production.

4. Heatwaves

Heatwaves are periods of abnormally high surface air temperatures relative to those normally expected. Definitions vary between countries; the World Meteorological Organisation (WMO) defines it as periods of five or more consecutive days during which the maximum daily temperature surpasses the average maximum temperature for that month by 5.0 C. They are usually caused by 'heat domes' - high pressure systems at high altitude that act like a lid on a cooking pot, preventing convection.

Definitions vary between areas: in the Netherlands for instance, five consecutive days above 25C, with at least three of them reaching above 30C, constitute a heat wave. In South Australia meanwhile, a heatwave is defined as a period of five consecutive days above 35C or three days above 40C.

Natural and built environments are adjusted to local climates, so it makes sense that definitions vary between geographic areas. Even so, heat waves (as defined for each area) affect human and animal health, agriculture and ecosystems.

In addition to these relative definitions, there are also absolute limits as to what temperatures can be survived. The heat index is a measure how hot it feels when relative humidity is factored with the actual air temperature. Heat index values (also known as wet bulb temperatures) of 33 (representing for instance 28C air temperature at 90% humidity) make it difficult to exercise and survive. Such extreme heat waves cause high rates of heat strokes and deaths.

Urban areas are at particular risk of severe heat waves because of the heat island effect: they have more sealed surfaces that absorb heat and waste heat from air conditioning and vehicles. Mitigation options include tree planting, green roofs and infrastructure, as well as the use of white/cool roofs and the use of lighter-coloured surfaces on built environment.

5. Landslides

Landslides refer to several forms of **mass wasting** that may include a wide range of ground movements, such as rockfalls, deep-seated slope failures, mudflows, and debris flows. They occur in a variety of environments, characterised by either steep or gentle slope gradients, from mountain ranges to coastal cliffs.

Gravity is the primary driving force for a landslide to occur, but there are other factors affecting slope stability that produce specific conditions that make a slope prone to failure. In many cases, the landslide is triggered by a specific event (such as a heavy rainfall, an earthquake, or a slope cut to build a road, and many others).

Understand ecosystems and landscapes

An ecosystem is defined as "a functional unit consisting of living organisms, their non-living environment, and the interactions within and between them" (IPCC 2018:548).

There is a huge array of ecosystems. IUCN lists five realms, 25 biomes and 108 'ecosystem functional groups' in its updated Global Ecosystem Typology (Keith et al. 2020) — yet, these can be further sub-divided. Ultimately, each individual ecosystem is unique, complex, dynamic, and interdependent with other ecosystems. This is why we will always need specific ecosystem experts when we use nature-based solutions in our efforts to reduce risk and raise resilience. To give you an overview of typical ecosystems and associated NbS, we provide examples below by the landscape they are found in.

A. Coastal areas

Where land and water meet, there is unparalleled potential. Some 37% of the world's population live on the coast. Coastal ecosystems offer resources and protection. They include coral and shellfish reefs, kelp forests, seagrass, marshes and mangroves, dunes as well as coastal wetlands and forests. NbS usually seek to strengthen these ecosystems and their role for exposure reduction. To learn more about NbS related to coastal ecosystems, see TNC (2021). The Blue Guide to Coastal Resilience.

B. Rivers & watersheds

Watersheds are like the arteries of human populations: 90% live less than 10 kilometres away from a surface freshwater body (Kummu et al. 2011). Watersheds (or drainage basins) are land areas where precipitation collects and drains off into a common outlet. The watershed includes all the surface water from rain runoff, snowmelt, hail, sleet and nearby streams that run downslope towards the shared outlet, as well as the groundwater underneath the earth's surface. Rivers, and their banks as well as associated wetlands are crucial for biodiversity and humans alike. NbS in watersheds typically seek to restore the natural flow dynamics (think of the sponge function mentioned in chapter 1) and thereby reduce the negative impact of floods. To learn more about NbS related to watersheds, see WWF (2016): Natural and nature-based flood management: A Green Guide.

C. Forests

There are three main types of forest: tropical, temperate and boreal. Forests can be further classified by their many other characteristics — for instance, by their structure and dominant tree types, or their natural ability to cope with wildfires. To learn more about NbS related to forests, see Makino et al. (2021). The protective functions of forests in a changing climate.

D. Farm & grasslands

These areas include agricultural fields as well as lands for pastoral use (such as steppes and savannahs). To learn more about NbS related to farm and grasslands, see ecosystems and how they can be used for DRR, see Iseman et al. (2021). Nature-based solutions in agriculture – The case and pathway for adoption.

E. Urban areas

More than half of the world's population live in urban areas (cities, towns, suburbs). While ecosystems from other landscapes also occur in urban areas (e.g., coastal ecosystems in cities on the coast), there are unique conditions characterised by high levels of sealed surfaces, pollution, heat and light — IUCN now counts 'urban and industrial ecosystems' as one of the ecosystem functional groups. To learn more about NbS in urban areas, see World Bank (2021). A Catalogue of Nature-Based Solutions for Urban Resilience.

Hazard-centred overview

If this is your **hazard**,	These may be suitable **nature-based solutions**. These are indicative examples only, and the list is not exhaustive. Always assess the local context with ecosystem experts! Note that one solution may be suitable for more than one hazard context.				
Floods ▸ Coastal (C) ▸ Fluvial (F) ▸ Pluvial (P)	[B.1] **Upper watershed restoration** may be suitable to address fluvial and some pluvial floods by harnessing the 'sponge' function. Can benefit the whole watershed.	[A.1] **Reef restoration** may be suitable if you are in a coastal area with degraded reefs and want to gain protection from storm surges (C).	[D.2] **Climate-smart agriculture** includes more flood-tolerant crops or seeds and planting patterns /techniques. Can reduce flood damage loss and overall yield increases.	[A.2] **Coastal wetland restoration:** Dunes or mangroves can reduce storm surge (C). Inland wetlands can help address pluvial floods (and fluvial if connected to streams).	[E.5] **Integrated flood management** includes a large and systematic array of measures. Usually hybrid, they can include permeable surfaces, urban greening, flood canals (sponge cities).
Storms including typhoons, hurricanes, cyclones	[A.4] **Shelterbelts** may be suitable if you have available land. These reduce local wind speeds. Can be planted along the coast as well as around inland communities.	[D.3] **Agroforestry** includes the systematic planting of trees and crops. Reduces wind speed and thus soil erosion. Other benefits can include yield increases and climate resilience.	[E.1] **Urban greening** may be suitable to diffuse airflow and prevent damaging jet effects. Includes creation of parks and considerations of tree-planting along streets and buildings.	[C.1] **Conservation, protected areas, and zoning** can ensure that exisiting ecosystems and green spaces that act as wind buffers retain their protective function.	[A.2] **Coastal wetland restoration:** Mangroves and coastal forests diffuse air flows and reduce local wind speeds. Some systems also attenuate waves and prevent erosion risk.
Droughts **Wildfires** are more likely to occur during **droughts** and **heatwaves**, and more difficult to suppress under these conditions.	[E.4] **Rainwater harvesting** can be implemented at the household level creates buffers for drought periods. Easy to implement but requires investment in tanks, pipes and gutters.	[C.2] **Forest restoration** may be suitable if forests are degraded. Restored forests can offer more humid micro-climates and help replenish ground water supplies.	[D.1] **Soil conservation methods** for agriculture may be suitable for cropping in hilly terrain, both to control water run-off and to protect fields from hazards.	[B.5] **Integrated water resource management** is a systematic and coordinated approach to utilise water in an effective way at scale. Requires very strong coordination.	[D.3] **Agroforestry** includes the systematic planting of trees and crops. Reduces wind speed and thus soil erosion. Other benefits can include yield increases and climate resilience.
Heat-waves	[A.2] **Coastal wetland restoration**: Wetlands are natural heat sinks and can reduce local temperatures. Large bodies of water furthermore draw in warm air, creating wind & cooling.	[E.3] **Green roofs & facades** help insulate buildings and provide cooling and shading. Can be implemented at household level and with larger buildings.	[D.3] **Agroforestry** may be suitable in some conditions, as the shade of trees reduces exposure to sun and heat. Always check with experts on suitable plants (crops and trees).	[E.1] **Urban greening** helps reduce the 'heat island' effect and can include parks and forests in cities, as well as tree-planting along streets and buildings (shading effect).	[C.4] **Integrated wildfire management** reduces the fuel load and the risk of catastrophic fires. Some forest types are well-adapted to fires, which helps them flourish.
Landslides and other hazards along slopes (e.g., mudflows, rockfalls, avalanches)	[C.3] **Protective forests** Protective forests act as as stabilisers of slopes, as barriers to rockfalls etc, and also act as sponges that retain water.	[B.1] **Upper watershed restoration** helps to stabilise the slopes, thus reducing the risk of landslides. This can include revegetation of upland areas with bushes and grass.	[C.1] **Conservation, protected areas & zoning** can be critical to protect steep slopes from being degraded and unstable, e.g. due to deforestation and over-grazing from livestock.	[D.1] **Soil conservation methods** for agriculture may be suitable for cropping in hilly terrain, both to control water run-off and to protect fields from hazards.	[E.2] **Urban green & blue infrastructure** bioswales and other measures to increase permeation of water, as well as revegetation or hybrid tools along slopes to protect roads and buildings

Ecosystem-centred overview

If this is your **ecosystem/landscape**,	These may be suitable **nature-based solutions**. These are indicative examples only, and the list is not exhaustive. Always assess the local context with ecosystem experts! Note that one solution may be suitable for more than one ecosystem context.				
Coastal areas	[A.1] **Reef restoration** may be suitable if you are in a coastal area with degraded reefs and want to gain protection from storm surges (C). Wave attenuation can also reduce erosion.	[A.2] **Coastal wetland restoration** may be suitable if there are degraded or vulnerable mangroves, seagrass meadows, dunes, marshlands. etc. Useful to reduce erosion & flood risk.	[A.3] **Horizontal levees** use tidal and brackish marshes and are often combined with regular levees inland. These help to reduce coastal flood risk, erosion, and saline intrusion.	[A.4] **Shelterbelts** are long and narrow forests that help diffuse airflows and thus reduce the windspeed affecting nearby inland communities and fields.	[C.1] **Conservation, protected areas, and zoning** are usually suitable to help protect local ecosystems and enable the sustainable management. If you invest in the restoration of ecosystems, include regulatory arrangements to prevent recurring degradation.
Rivers & watersheds	[B.1] **Upper watershed restoration** may be suitable to increase the water retention in upland areas, thereby regulating the flow in watersheds (sponge function).	[B.2] **Riparian vegetation restoration** may be useful to reduce flow velocity of streams, to re-create flood basins, and restore important wildlife habitat.	[B.3] **Restoring river flows** help reduce flow velocity without while also being beneficial to fish and wildlife. Helps reduce the risk of fluvial floods.	[B.5] **Integrated water resource management** is a systematic and coordinated approach to utilise water in an effective way at scale. Requires very strong coordination.	
Forests	[C.2] **Forest restoration** When forests are degraded and if the cause of degradation can be and eliminated or reduced, restoration may be suitable to revive its functions for communities.	[C.3] **Protective forests** Protective forests act as as stabilisers of slopes, as barriers to rockfalls etc, and also act as sponges that retain water.	[C.4] **Integrated wildfire management** are suitable for some forest types: regular low-intensity burning helps these forests regenerate and to reduce the risk of catastrophic forest fires.	[B.1] **Upper watershed restoration** can support the health of forests and other ecosystems by helping to replenish groundwater flows.	
Farm & grasslands	[D.1] **Soil conservation methods** for agriculture may be suitable for cropping in hilly terrain, both to control water run-off and to protect fields from hazards.	[D.2] **Climate-smart agriculture** includes more flood-tolerant crops or seeds and planting patterns /techniques. Can reduce flood damage loss and overall yield increases.	[D.3] **Agroforestry** may be suitable in some conditions, as the shade of trees reduces exposure to sun and heat. Always check with experts on suitable plants (crops and trees).	[D.4] **Land restoration** aims for the restoration of soil (and plant) health. It includes numerous approaches, such as farmer-managed natural regeneration (FMNR)	
Urban areas	[E.1] **Urban greening** helps reduce the 'heat island' effect and can include parks and forests in cities, as well as tree-planting along streets and buildings (shading effect).	[E.2] **Urban green & blue infrastructure** may include bioswales and other measures to increase permeation of water, reducing the risk of urban flooding.	[E.3] **Green roofs & facades** help insulate buildings, provide cooling and shading, and also help reduce the risk of urban flooding if applied at scale.	[E.4] **Rainwater harvesting** can support water security for urban dwellers. Easy to implement but requires investment in tanks, pipes and gutters.	

Appendix B **Solution factsheets**

Navigation

- Click on the title of a tile to jump to a solution factsheet.
- To return to this tile view, click on the bottom right corner of each solution factsheet.

Colour codes

- The tile colours indicate the landscape/ecosystem context that these solutions tend to be associated with.
- For further details, see appendix A and note that one solution may be suitable for more than one context.

Coastal areas

Rivers & wetlands

Forests

Farm & grasslands

Urban areas

A.1 **Reef restoration**	A.2 **Coastal wetland restoration**	A.3 **Horizontal levees**	A.4 **Shelterbelts**
B.1 **Upper watershed restoration**	B.2 **Riparian vegetation restoration**	B.3 **Restoring river flows**	B.4 **Naturally reinforced embankments**
B.5 **Integrated water resource management**	C.1 **Conservation, protected areas, and zoning**	C.2 **Forest restoration & sustainable forest management**	C.3 **Protective forests**
C.4 **Integrated wildfire management**	D.1 **Soil conservation methods**	D.2 **Climate-smart agriculture***	D.3 **Agroforestry**
D.4 **Sustainable land management & land restoration**	E.1 **Urban greening**	E.2 **Green & blue infrastructure**	E.3 **Green roofs & facades**
E.4 **Rainwater harvesting**	E.5 **Integrated flood management**		

* Note that while climate-smart agriculture (solution D.2) is a specific term and concept, all solutions should consider and seek to address climate risk factors. See also figure 1.8 on climate-smart programming.

A.1 Reef restoration

What is it? Reefs are underwater ecosystems whose protective benefit for coastlines is derived from the absorption of wave energy. Two distinctive types exist.

Coral reefs are formed by coral polyps and grow best in warm, shallow, clear, sunny and agitated water. While spread over less than 0.1% of the world's ocean expanse, they are home to 25% of all marine species. They flourish in nutrient-poor waters and are fragile due to their sensitivity to water conditions. As such, they are under threat from climate change (oceanic acidification and rising ocean temperatures) as well as local factors (nutrient runoff from fertilisation, overfishing and harmful development practices, such as coral mining).

Shellfish reefs are made of bivalve shellfish (such as oysters or mussels) that attach to existing shells, creating large reefs made of thousands of generations of shellfish. Shellfish feed on plankton and other organic matter, and thus assume an important water filtering function. These reefs also stabilise shorelines by promoting sediment deposition and buffering wave energy, thereby allowing other habitats, such as sea grass beds and marsh areas, to form, while simultaneously decreasing erosion of the shoreline. Many shellfish reefs have been lost over past decades or are under threat.

Conservation of reefs is by far the best and least costly option, compared to **natural reef rehabilitation** or **artificial restoration**. These two measures are expensive and technically challenging, requiring expert scientific advice and guidance.

What are the benefits? Reefs act like natural breakwaters and absorb up to 86% of incoming wave energy (Ferrario et al. 2014). This reduces the impact of tidal floods and storm surges on coastlines (especially erosion). In addition, reefs have numerous other benefits — including their value for tourism (coral reefs), fishing, and biodiversity.

What are the requirements? In order to apply this solution, your target area must have reefs (degraded or intact). Note that reef restoration tends to be technically challenging and expensive (although cheaper than artificial breakwaters).


Photo by Francesco Ungaro on Unsplash

Funding will need to be available for assessments, implementation and monitoring. This solution requires **technical expertise**. **Assessments** should cover the health status of the reefs and the potential effect for risk reduction (including the sustainability under climate change scenarios).

What to avoid? Avoid investing in expensive restoration unless you have robust assessment data from experts first. If the level of reef of degradation is minor, eliminating the factors that caused the degradation may suffice. Consider conservation arrangements (see C.1), which are comparatively inexpensive and can be very effective in retaining reefs and their ecosystem services.

Hazard context
- ■ Floods
- ■ Storms (surges only)
- ☐ Droughts
- ☐ Heatwaves
- ☐ Landslides

Ecosystem context
- ■ Coastal areas
- ☐ Rivers & watersheds
- ☐ Forests
- ☐ Farm & grasslands
- ☐ Slopes & mountains
- ☐ Urban areas

Costs
- ☐ $
- ■ $$
- ■ $$$

Time
- ☐ Short (less than 2 years)
- ■ Medium (2-5 years)
- ■ Long (more than 5 years)

Scale
- ■ Site
- ■ Neighbourhood
- ■ Community
- ■ Larger-scale

Community type
- ■ Urban (coastal)
- ■ Suburban (coastal)
- ■ Rural (coastal)

Guidance
- **Overview**: TNC (2021): The Blue Guide to Coastal Resilience. Protecting coastal communities through nature-based solutions. A handbook for practitioners of disaster risk reduction. See appendix A.2 (p. 54-59).
- **Coral reefs:** Shaver et al. (2020): A Manager's Guide to Coral Reef Restoration Planning and Design.
- **Shellfish reefs:** Fitzsimons et al. (2019): Guidelines for Shellfish Reefs.

Case studies
- Grenada, TNC 2017: At the water's edge (video)
- Caribbean: Resilient Islands project website with case studies, support tools and other resources
- Panorama's section on marine and coastal solutions features 250 solutions and case studies, including many that include reef restoration

Return to solution overview

A.2 Coastal wetland restoration

What is it? Coastal wetlands include seagrass meadows, intertidal flats, tidal salt-marshes, mangrove forests, and tidal freshwater wetlands (Perillo et al. 2019:5). The protective effect relates to wave attenuation and erosion control. If these ecosystems are degraded, adjacent coastal communities are thus at increased risk from high waves, storm surges, floods, and erosion. Restoring these wetlands can greatly reduce disaster risk. If these coastal wetlands are intact and healthy, ensure that they are protected, and their health monitored (see solution C.1 on protection & zoning).

While the process of restoration varies between mangroves, seagrass meadows and saltmarshes, they all must be based on a solid understanding of the causes of degradation and the prospects of eliminating or reducing the causal factors.

Based on this understanding, technical options may include:

- **natural restoration**: improving the ambient conditions by reducing disturbances, restoring hydrology or taking measures to enhance water quality; and
- **artificial restoration** includes replanting areas with seedlings (mostly raised in nurseries; transplanting is sometimes also possible in the case of seagrass). This option tends to be more cost-and labour-intensive and is usually only applied if a) natural restoration has failed on its own or b) ecosystem assessment results indicate that natural restoration is unlikely to succeed.

What are the benefits? There are numerous benefits of coastal wetlands, including:

- **protective**: relatively narrow mangrove belts (100m in width) can reduce the height of wind and swell waves with an initial height of 70cm by up to 66% (McIvor et al. 2012:3). Wider mangrove belts can also attenuate storm surges; rates of surge height reduction by 4-48 cm per kilometre of passage through mangroves have been recorded (Spalding et al. 2014:51). Mangroves, seagrass meadows and marshlands furthermore help with sedimentation and thus, erosion control.
- **economic** benefits (that are in addition to the protective ones) stem from the greater availability of fish (noting that seagrass and mangroves are important nurseries) as well as other factors. The value of mangroves for fish resources has been measured at USD 66 million in the Caribbean alone (Heck et al. 2019:7).

Mangrove forest in Bangladesh.
Photo: Maitheli Maitra on Unsplash

- **environmental** benefits include carbon sequestration and biodiversity gains. Mangroves alone are estimated to sequester 31.2-34.4 million tonnes of carbon per year (UNEP 2020:5).

What are the requirements? Ensure that you conduct a thorough ecosystem assessment before planning interventions. Factors that caused degradation in the past must be minimised or eliminated. Community stewardship and strong stakeholder management are further requirements.

What to avoid? Shortcuts: avoid the move to planting without first assessing conditions (and possibly, natural restoration). Furthermore, avoid using single species for mangroves and marshlands — instead, understand the different zones and then seek to approximate natural conditions.

Hazard context
- [x] Floods
- [x] Storms (surges only)
- [ ] Droughts
- [ ] Heatwaves
- [ ] Landslides

Ecosystem context
- [x] Coastal areas
- [x] Rivers & watersheds
- [ ] Forests
- [ ] Farm & grasslands
- [ ] Slopes & mountains
- [ ] Urban areas

Costs
- [x] $
- [x] $$
- [ ] $$$

Time
- [ ] Short (less than 2 years)
- [x] Medium (2-5 years)
- [x] Long (more than 5 years)

Scale
- [x] Site
- [x] Neighbourhood
- [x] Community
- [x] Larger-scale

Community type
- [x] Urban (coastal)
- [x] Suburban (coastal)
- [x] Rural (coastal)

Guidance
- **Overview**: TNC (2021): The Blue Guide to Coastal Resilience. See the overviews in appendices A.3 (mangroves), A.4 (seagrass) and A.5 (Marshes and swamps).
- **Mangroves:** UNEP (2020): Guidelines for Mangrove Ecosystem Restoration […].
- **Mangroves:** Lewis III et al. (2019): Methods & criteria for successful mangrove forest restoration.
- **Seagrass**: Björk et al. (2008): Managing seagrasses for resilience to climate change.
- **Salt marshes**: Adam, P. (2019): Salt marsh restoration.

Case studies
- The Economist (2020). Mangroves: how they help the ocean (video about the broader functions of mangroves and a blue carbon project in Kenya, 11min).
- DW (2021): How seagrass helps fight climate change (video on the Maldives, 6 min)
- This case study on community-based seagrass restoration in Madagascar is just one of many on the Panorama Solutions case study collection (see page 110 for further case study collections).

Return to solution overview

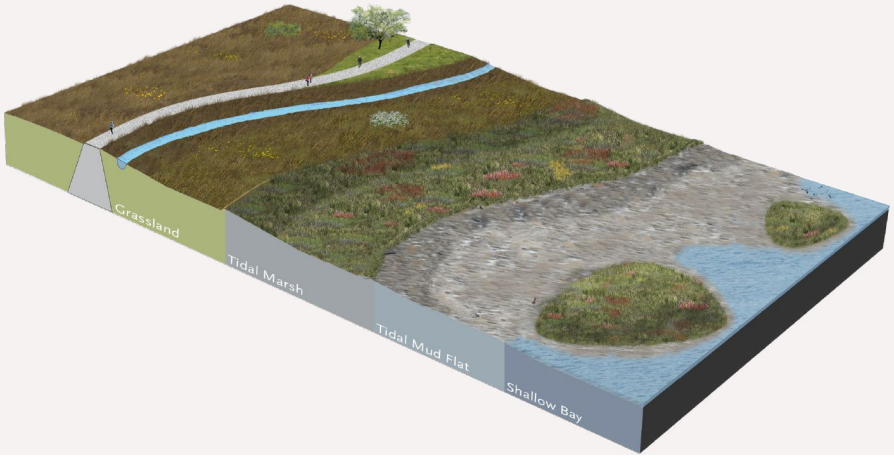
A.3 Horizontal levees (Hybrid solution)

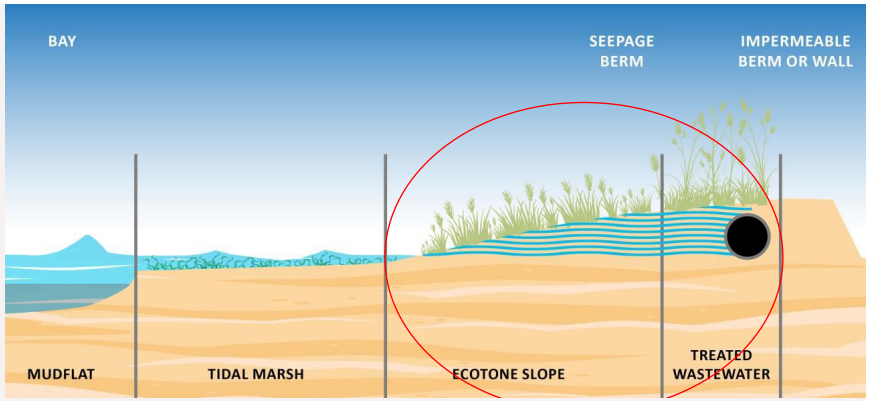
What is it? A horizontal levee consists of a hardened structure (levee) that is set back from the coastline with a wide expanse of natural habitat – often a coastal marsh – between the water and the levee. As such, horizontal levees can be classified as hybrid solutions.

By protecting the coastal habitats and moving the hardened structure back away from the coast, the marshes provide a natural buffering capacity to reduce the impacts of coastal flooding, storm surge and wave action.

As a result, the hardened features are reduced in size when compared with levees that do not have a buffer or a setback from the coast. This reduces the overall cost of constructing the levee relative to more traditional approaches. This also maintains the natural coast, allowing for the continued provision of habitat and recreational opportunities associated with marshes and other coastal habitats.

What are the benefits? By including natural habitats on the waterside of a hardened structure, a horizontal levee system reduces coastal erosion issues and shoreline flooding by relying on the ability of the coastal habitats to absorb wave energy and slow down floodwaters. In essence, by including a natural edge, the flood reduction associated with the levee now occurs along a horizontal gradient as well as a vertical one.





Compared to traditional levees, horizontal levees do not need to be as high (and are thus cheaper to construct) because the tidal marshes and ecotone slopes absorb much of the wave energy. Furthermore, maintenance costs are expected to be lower. The integration or expansion of tidal marshes also benefits biodiversity. Finally, in urban contexts water treatment can be integrated (Cecchetti et al. 2020).

What are the requirements? The main requirement is land along coastal stretches on which the levee can be established. Furthermore, freshwater (or treated wastewater) may be required for irrigation of grasslands (depending on climatic context).

What to avoid? It should be noted that horizontal levees are relatively new and have mainly been adopted on the U.S. west coast.The design of horizontal levees in other contexts should not be copied without first checking for suitability of this solution — especially regarding the use of grass species on the ecotone slope.

Guidance
- Naturally Resilient Communities. Solution: horizontal levees.
- Cecchetti, A. et al. (2020). The horizontal levee: a multi-benefit nature-based treatment system that improves water quality and protects coastal levees from the effects of sea-level rise. Water Research X 7(2020) 100052

Case studies
- City of Palo Alto (2020) Horizontal levee pilot project
- This article further explains the design considerations of horizontal levees.

Hazard context
- [x] Floods
- [x] Storms (surges only)
- [ ] Droughts
- [ ] Heatwaves
- [ ] Landslides

Ecosystem context
- [x] Coastal areas
- [x] Rivers & watersheds
- [ ] Forests
- [ ] Farm & grasslands
- [ ] Slopes & mountains
- [ ] Urban areas

Costs
- [ ] $
- [x] $$
- [x] $$$

Time
- [ ] Short (less than 2 years)
- [x] Medium (2-5 years)
- [ ] Long (more than 5 years)

Scale
- [x] Site
- [x] Neighbourhood
- [x] Community
- [x] Larger-scale

Community type
- [x] Urban (coastal)
- [x] Suburban (coastal)
- [x] Rural (coastal)

Return to solution overview

A.4 Shelterbelts

What is it? Shelterbelts consist of natural or strategically planted trees in multi-row settings that help reduce the leeward wind speed over extended areas, up to 40 times the height of the trees. Planting of trees as windbreaks has been around for centuries and is a common practice in agroforestry to reduce erosion and increase yield.

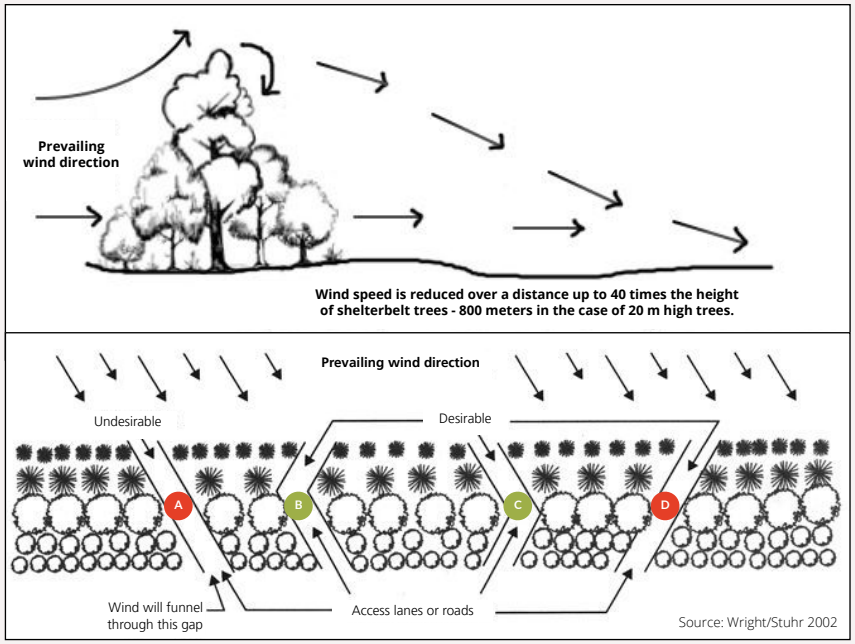
What are the benefits? The reduced windspeed on the leeward side has numerous benefits for increased crop yield and livestock. They can incorporate fruit trees top bring direct benefits for livelihoods and food security. If shelterbelts are designed to withstand the extreme wind speeds that are typical for tropical cyclones, they can reduce the risk of homes and assets being damaged or destroyed. Analysis of aerial imagery taken in the Philippines after Typhoon Haiyan (2013) indicated that one factor on typhoon damage appeared to be the extent to which villages were protected by surrounding trees.

What are the requirements? Essential elements include the **availability of land** (are land owners willing to give land for the shelterbelts?), a high level of **community engagement**, and **technical expertise** to identify the most effective design, most suitable trees/shrubs, and to explore possible side effects.

What to avoid? Shelterbelts must not be based on a single species, and their design should take resistance to maximum expected wind speeds into account (can the trees withstand cyclones?). Funnel effects (with locally higher wind speeds, as shown under point A in the lower illustration) should be avoided.

Design considerations Consider the following factors when designing a shelterbelt:

- **The type of trees:** Identify the most suitable trees, considering root structure, suitability to soil and weather conditions, strength, porosity, and potential for direct economic benefits (see Calvert 2011). The combination of various types is likely the most appropriate and effective design.
- **The structure**: The shelterbelt should feature low-growing shrubs on the wind-ward side, then medium-sized trees, and then high-growing species. This will help redirect the wind upward while not leaving any one row fully exposed to the storm load.



Ensure that the belt does not block access. Avoid funnels that create higher than ambient wind speeds (designs B and C above are ideal options).

- **Gaps to buildings**: Anticipating that trees may be unable to withstand storm loads, the distance between shelterbelt and buildings should be greater than the maximum height of the highest tree rows (at maturity). Falling trees cause damage!
- **Livelihood benefits**: Investments in risk mitigation tend to be more sustainable when they bring ongoing tangible benefits to a community. The inclusion of fruit trees and other 'productive' species should therefore be considered. Bamboo (fast-growing and flexible) could also bring such benefits while providing construction material after future storm damage.

Guidance

- **Overview**: TNC (2021): The Blue Guide to Coastal Resilience. Protecting coastal communities through nature-based solutions.See appendix A.7 (p. 74-75).
- **More details:** Wright/Stuhr (2002): Windbreaks: An agroforestry practice and Brandle et al. (2009): Windbreak practices.
- **Tree suitability:** Calvert (2011): An assessment of tree susceptibility and resistance to cyclones (examples from on northern Australia).

Case studies

- Viet Nam, GIZ 2018: Reforestation and rehabilitation of sandy coastal protection forest along with short-term livelihoods development for local communities.

Hazard context

- ☐ Floods
- ■ Storms
- ☐ Droughts
- ☐ Heatwaves
- ☐ Landslides

Ecosystem context

- ■ Coastal areas
- ■ Rivers & watersheds
- ☐ Forests
- ■ Farm & grasslands
- ■ Slopes & mountains
- ■ Urban areas

Costs

- ■ $
- ■ $$
- ☐ $$$

Time

- ☐ Short (less than 2 years)
- ■ Medium (2-5 years)
- ■ Long (more than 5 years)

Scale

- ■ Site
- ■ Neighbourhood
- ■ Community
- ■ Larger-scale

Community type

- ■ Urban
- ■ Suburban
- ■ Rural

Return to solution overview

B.1 Upper watershed restoration

What is it? Upper watersheds are the hilly inland terrains at the source of rivers and streams. The type and density of vegetation in this area plays an important role on the water flow and flood risk downstream. Areas with dense vegetation cover have a strong sponge function: much of the rainfall is intercepted by vegetation, while the roots help water to infiltrate the groundwater. Downstream flood risk can be reduced if optimum interception and infiltration can be maintained or restored in the upper part of the watershed: compared to denuded slopes, water runoff is greatly reduced.

Watershed restoration takes place at scale and can include a range of different, mutually supportive NbS options. Revegetation is the most common approach in upper watershed restoration (see also B.2). However, this can be combined with soil conservation and bio-engineering methods, such as contour planting and terracing (see D.1). Furthermore, such measures should be combined with protection and zoning (see C.1) to prevent future degradation (e.g. from over-grazing or other unsustainable land management practices).

What are the benefits? The numerous benefits of upper watershed restoration include reduced flood risk downstream (if applied at scale) as well as reduced local risk from landslides, mudflows, avalanches and rockfalls. Furthermore, the soil quality is retained, thereby enabling higher agricultural on terraces or low-gradient fields. The greater water infiltration and base flow can also render watersheds more drought-resilient.

What are the requirements? To design the most effective restoration options, we need to have a good understanding of the hydrology, soil conditions, and native vegetation cover. Communities, landholders and local governments must be closely engaged in and committed to the restoration process. This includes having in place shared land management plans, given the scale of such approaches. Trees and grass species should be selected that are native and that offer high levels of water interception and infiltration. Decreasing the erosivity, a measure of vulnerability of soil to erosion, is often considered in the design.

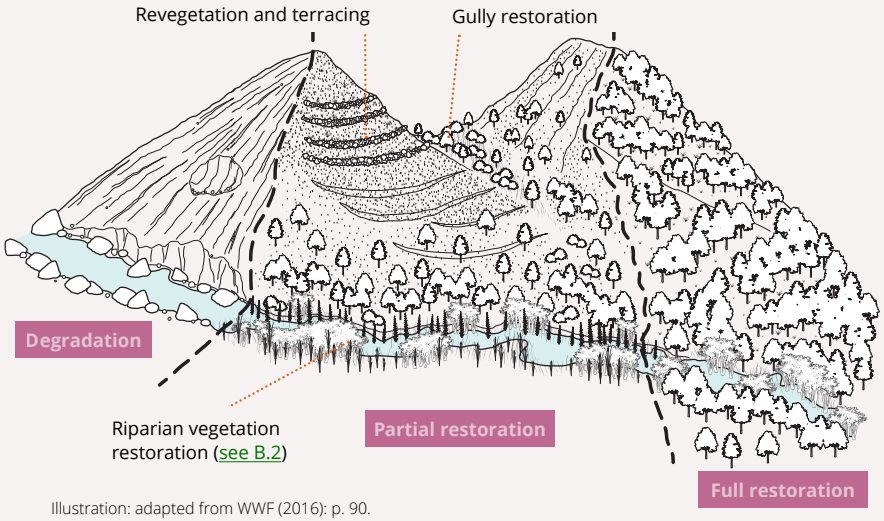


Illustration: adapted from WWF (2016): p. 90.

Trade-offs between maximum restoration and local agricultural use of hilly terrains must be carefully managed. Zoning and protection arrangements should be maintained or improved to prevent unsustainable land development and use.

What to avoid? Efforts in upper watershed restoration should avoid the use of non-native species and one-model-fits-all approaches: ecosystem assessments need to identify the different zones of upper watersheds (in terms of soil conditions, hydrology, altitude, gradient, and other topographic features) and then lead to appropriate designs for each of these zones. Approaches that fail to address the interests of key stakeholders, such as pastoralists and farmers, must be avoided at all cost. For instance, graziers whose herds may have contributed to degradation will need to be offered alternative models or techniques for income generation. In areas that feature relatively high population density, a combination of revegetation and soil conservation techniques should be explored.

Guidance

- **Overview**: WWF (2016): Natural and nature-based flood management: a green guide (see pages 89 - 90)
- **Specific technical guidance:** See Harari et al. (2017): Where people and their land are safer for different solutions and case studies

Case studies

- See the Adaptation at Altitude portal for a wide range of case studies from around the world.

Hazard context
- [x] Floods
- [ ] Storms
- [ ] Droughts
- [ ] Heatwaves
- [x] Landslides

Ecosystem context
- [ ] Coastal areas
- [x] Rivers & watersheds
- [ ] Forests
- [ ] Farm & grasslands
- [x] Slopes & mountains
- [ ] Urban areas

Costs
- [x] $
- [x] $$
- [ ] $$$

Time
- [ ] Short (less than 2 years)
- [x] Medium (2-5 years)
- [x] Long (more than 5 years)

Scale
- [x] Site
- [x] Neighbourhood
- [x] Community
- [x] Larger-scale

Community type
- [ ] Urban
- [ ] Suburban
- [x] Rural

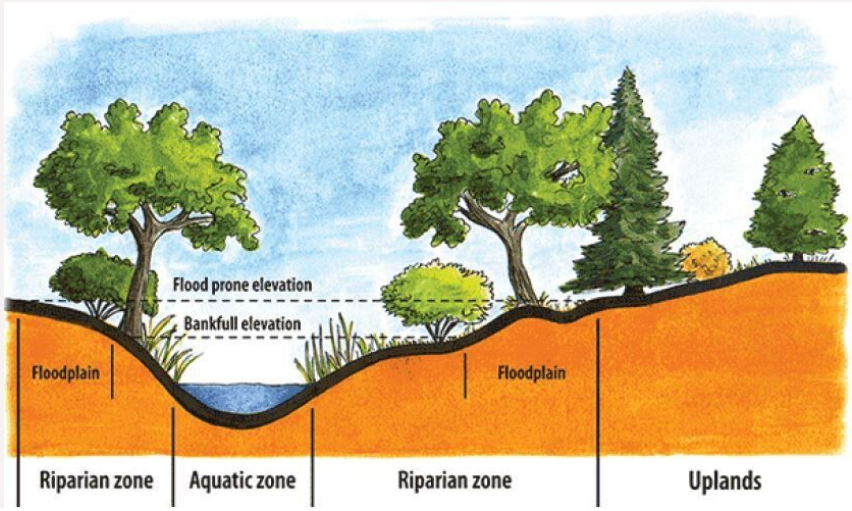
Return to solution overview

B.2 Riparian vegetation restoration

What is it? Riparian zones are the interfaces between rivers and land. They have important functions for biodiversity, soil stabilisation, and water filtration, and can be part of broader watershed restoration efforts. The vegetation in riparian zones plays a critical role towards in enhancing water quality and infiltration, as well as in reducing riverbank erosion and water flow velocity. Riparian zones include flood basins that are critical to absorb excess water after heavy precipitation upstream.

Conversely, where riparian zones are degraded, we typically find increased flood and erosion risk. Restoring riparian zones can include replanting with native hydrophilic plants (depending on the area, these may include bamboo or willows) and the protection of the riparian zones (e.g., fencing areas off for livestock). In urban areas or where erosion and degradation is severe, hybrid solutions are often pursued. This tends to be more costly and includes both re-vegetation and structural engineering.

What are the benefits? Restoring riparian vegetation can have two groups of benefits. First, local and direct benefits are generated adjacent to the restoration site:



in particular, the level of erosion can be substantially reduced and soil protected. Second, if restoration is pursued on a larger scale (watershed), there are substantial benefits in terms of reduced flood risk along restored sections and further downstream. For instance, excess water after heavy precipitation is absorbed in flood plains, infiltration is improved, and flow velocity is reduced (which further reduces erosion risk). Riparian vegetation restoration is thus most effective if applied at scale.

What are the requirements? A robust ecosystem assessment must precede any intervention and inform the choice of appropriate solutions (e.g., protection, revegetation, hybrid models). It is critical to involve landholders and communities. For larger-scale interventions and hybrid models, significant funding must be secured (i.e. for earthmoving, structural adjustments, and sometimes land acquisition).

What to avoid? Avoid process short-cuts: always seek ecosystem expertise when designing appropriate solutions (minor degradation may require little input aside from protection/zoning). Also avoid the use of non-native species in restoration.

Guidance
- Overview: WWF (2016). Natural and nature-based flood management: a green guide. (see pages 108-109).
- Farm and grasslands: Sustainable Farms (2018): Riparian restoration. Four-page brochure
- Urban settings: Beesley et al. (2017): Riparian design guidelines to inform the ecological repair of urban waterways.

Case studies
- Rwanda, Ecoplanet Bamboo (2022): Rwanda Riparian Restoration Project (video, 4:41)
- United States, Alliance for the Chesapeake Bay (2020): Riparian Restoration 101: Stream restoration (video, 6:38)

Hazard context
- [x] Floods
- [ ] Storms
- [ ] Droughts
- [ ] Heatwaves
- [ ] Landslides

Ecosystem context
- [ ] Coastal areas
- [x] Rivers & watersheds
- [ ] Forests
- [ ] Farm & grasslands
- [ ] Slopes & mountains
- [ ] Urban areas

Costs
- [x] $
- [x] $$
- [ ] $$$

Time
- [ ] Short (less than 2 years)
- [x] Medium (2-5 years)
- [x] Long (more than 5 years)

Scale
- [x] Site
- [x] Neighbourhood
- [x] Community
- [x] Larger-scale

Community type
- [x] Urban
- [x] Suburban
- [x] Rural

Return to solution overview

B.3 Restoring river flows

What is it? Restoring the flows of rivers and creeks is a solution to increase the conveyance of flood and storm water flows and to thereby reduce flood risk. Three measures that also have environmental benefits are listed below.

Natural drainage path restoration: Natural drainage paths (gullies, small streams, sloping land strips) are often modified or eliminated with urbanisation and agriculture. Many of these drainage paths are not perennial and often cannot be easily identified as waterways during dry periods. Drainage paths often get blocked with debris, silted, overgrown with weeds, or intentionally cut or filled. Restoring and maintaining them is often comparatively easy and low-cost.

Where higher peak flows are expected, measures may include the replacement of narrow culverts (grey infrastructure) and/or the replacement of concrete embankments with natural alternatives (see B.4). Larger-scale efforts include river renaturation, where rivers are redirected from straight and artificial canals into their original riverbeds.

Waste and debris removal: In small streams with habitual high velocities, regular removal of large woody debris, weeds, and waste can substantially reduce the local flood risk, especially for flash floods. Streams in urbanised or agricultural areas are often overgrown with weeds that block the natural flows, and regular weeding is required. Floating weeds can be removed by mechanical collectors, and emergent and submerged weeds can be removed by volunteer weeding groups.

Regular removal of large trash (plastic items, rags, cardboard) is also important in urban streams. Large trash may include polythene/plastic bags, discarded household items (containers, furniture, electrical items), packaging material and rags. Such items accumulate in river beds, bends or narrow points in channels, and culverts or control structures (sluices, weirs), and they block water flow.

These clean-up activities are usually done manually by municipal workers, environmental volunteers or community groups in periodic stream cleaning programs.

Living weir in Thailand. Photo: GIZ

Living weirs: Living weirs are common in Thailand and other parts of South-East Asia, and are built by using bamboo grid constructions in the river that hold degradable sand bags. Along the riverbanks a combination of Banyan trees and other leguminous plants are then planted to stabilise soils. The wide rooting banyan trees are planted on both side of the weir.

The roots that they are forming will nurture from the manure and will penetrate in the bamboo construction over the next decades to form a "living weir". This technology entails several benefits such as improving ground water recharge, which can increase crop yields, biodiversity, including fish habitats and plant variety, and strengthen unity among related stakeholders. Terraces also allow fish to move upstream. Maintenance costs and efforts for this methodology are low and can be pursued by local communities.

Guidance
- Overview: WWF (2016). Natural and nature-based flood management: a green guide. (see pages 107 and 109).
- Srichaiwong, P. et al. (2020): The live weir innovation at Chi river watershed, Chaiyaphum province, Thailand.

Case studies
- Thailand: GIZ 2016: Living weirs as flood buffers.
- Thailand: Srichaiwong, P. et al. (2020): The live weir innovation at Chi river watershed, Chaiyaphum province, Thailand.
- Australia, Kelly, A. et al. (2021): Yarra river regeneration guide.

Hazard context
- [x] Floods and erosion
- [ ] Storms
- [ ] Droughts
- [ ] Heatwaves
- [ ] Landslides

Ecosystem context
- [ ] Coastal areas
- [x] Rivers & watersheds
- [ ] Forests
- [ ] Farm & grasslands
- [ ] Slopes & mountains
- [ ] Urban areas

Costs
- [x] $
- [x] $$
- [ ] $$$

Time
- [x] Short (less than 2 years)
- [x] Medium (2-5 years)
- [ ] Long (more than 5 years)

Scale
- [x] Site
- [x] Neighbourhood
- [x] Community
- [x] Larger-scale

Community type
- [x] Urban
- [x] Suburban
- [x] Rural

Return to solution overview

B.4 Naturally reinforced embankments (Hybrid solution)

What is it? Flooding and high flow velocities commonly incur riverbank erosion, especially if riverbeds and embankments are already degraded (sometimes as a result of unsustainable practices such as riverbed drenching). In many cases, riparian vegetation restoration (see B.2) are a preferable solution. However, where this is not feasible or sufficient (due to severe degradation and/or the need to protect adjacent communities and assets from floods), hybrid solutions to reinforce embankments can be considered.

One such example concerns bio-dykes. These combine biological, mechanical and ecological concepts to stabilise slopes of river banks. They typically include flood walls and gates as well as bioengineering to vegetate the slopes. Bamboo fences and spurs are placed along the river. Plants and grasses are then planted on top of the sandbags, creating a green and stabilised embankment.

Aside from bio-dykes, existing levees/dykes can be revegetated to protect existing these structures — a practice that is common in Bangladesh and Viet Nam.

What are the benefits? Bio-dykes prevent erosion and help protect communities from riverine floods. Construction costs are lower than comparable grey solutions, especially in the context of most community-based projects.

What are the requirements? A good analysis of the hydrology, flood risk and soil conditions is essential before embarking on implementation. Design inputs are required from experts (engineers, hydrologists, and ecosystem experts).

What to avoid? Avoid constructing naturally enforced embankments without a strong analysis and expertise on board. Note that these solutions may have limitations and communicate residual risk with communities. Avoid the use of non-native species for vegetation.

Bio-dyke construction in Bardiya, Nepal
Photo: Practical Action

Fully developed bio-dyke
Photo: Practical Action

Hazard context
- [x] Floods and erosion
- [ ] Storms
- [ ] Droughts
- [ ] Heatwaves
- [ ] Landslides

Ecosystem context
- [ ] Coastal areas
- [x] Rivers & watersheds
- [ ] Forests
- [ ] Farm & grasslands
- [ ] Slopes & mountains
- [ ] Urban areas

Costs
- [x] $
- [ ] $$
- [ ] $$$

Time
- [x] Short (less than 2 years)
- [x] Medium (2-5 years)
- [ ] Long (more than 5 years)

Scale
- [x] Site
- [x] Neighbourhood
- [x] Community
- [x] Larger-scale

Community type
- [x] Urban
- [x] Suburban
- [x] Rural

Guidance
- Practical Action (2018): Bio-dyke, an environment-friendly solution to protect river banks. Technical Brief.
- Islam, M. S. et al. (2014): Bio-technical solution for dyke protection in saline zone of Bangladesh

Case studies
- Nepal, Flood Resilience Portal 2018: Bio-dykes: saving communities and instilling confidence in them.
- Vietnam, Dac Thanh 2019: Woman takes leaf out of Mother Nature's book to protect eroding riverbanks. VN Express International

Return to solution overview

Indonesia
After a day of planting mangrove saplings, a volunteer shows a grown mangrove tree in Aceh Jaya.

Photo: Jenelle Eli, American Red Cross

B.5 Integrated water resources management (IWRM)

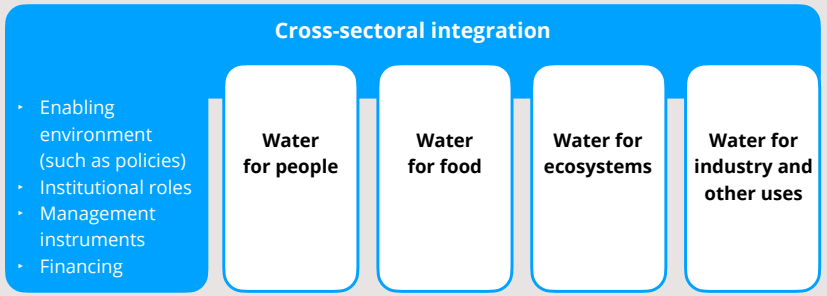
What is it? IWRM has been defined as a process that "promotes the the coordinated development and management of water, land and related resources, in order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of ecosystems" (Global Water Partnership, GWP). IWRM seeks to ensure a) social equity, b) economic efficiency, and c) environmental sustainability of water management ('the three E's').

The basis of IWRM is that the many different uses of finite water resources are inter-dependent. High irrigation demands and polluted drainage flows from agriculture, for example, mean less freshwater for drinking or industrial use; contaminated municipal and industrial wastewater pollutes rivers and threatens ecosystems; if water has to be left in a river to protect fisheries and ecosystems (environmental flows), less can be diverted to grow crops. There are plenty of other examples of the basic theme that unregulated use of scarce water resources is wasteful and inherently unsustainable.

IWRM is a high-level, multi-sector and multi-stakeholder approach that features as an indicator in the Sustainable Development Goals (SDG): indicator 6.5.1 'degree of integrated water resources management implementation' assesses the enabling environment, institutions and participation, managing implements, and financing for IWRM (see progress tracker).

Mountain river in central Kyrgyzstan. Photo: Patrick Bolte

Integrated water resources management (IWRM)



While IWRM is applied at large scale (watershed, national or supra-national), RC/RC Societies and NGOs should be aware of existing IWRM arrangements and seek to align interventions with these broader plans (see figures 3.7 and 4.10). The IWRM guidelines at river basin level offer concise steps that should be considered.

What are the benefits? If applied well, IWRM offers more equitable and efficient use of water as well as environmental benefits for ecosystems. In terms of programming by NGOs and RC/RC Societies, IWRM offers the opportunity for aligned and embedded actions — that can be geared to reduce flood and drought risk, to restore ecosystems, and to enhance livelihoods and overall resilience.

What are the requirements? RC/RC Societies and NGOs should explore and understand current IWRM arrangements and then explore possible plug-ins — i.e., where and how local actions with communities can support and benefit from IWRM arrangements.

Guidance

- **Overview:** The IWRM Action Hub of the Global Water Partnership (GWP) features a wide array of tools, guidelines, research papers, case studies and country profiles. The IWRM Curator lets you choose your main objective, and then narrows down the set of tools.
- UNESCO (2009): IWRM Guidelines at river basin level.
- **Framework**: Granit, J. et al. (2017): A conceptual framework for governing and managing key flows in a source-to-sea continuum. Water Policy 19 (2017):673-691.
- **Current status**: UNEP (2021): Progress on Integrated Water Resources Management. Global indicator 6.5.1 updates and acceleration needs.

Case studies

- Austria, 2017: Restoration of Mur River - ecological values and hydropower generation aligned
- Benin, 2019: Promoting efficient and sustainable management of investment […]

Hazard context

- [x] Floods
- [x] Storms
- [x] Droughts
- [x] Heatwaves
- [x] Landslides

Ecosystem context

- [x] Coastal areas
- [x] Rivers & watersheds
- [ ] Forests
- [x] Farm & grasslands
- [ ] Slopes & mountains
- [x] Urban areas

Costs

- [ ] $
- [ ] $$
- [x] $$$

Time

- [ ] Short (less than 2 years)
- [ ] Medium (2-5 years)
- [x] Long (more than 5 years)

Scale

- [ ] Site
- [ ] Neighbourhood
- [ ] Community
- [x] Larger-scale

Community type

- [x] Urban
- [x] Suburban
- [x] Rural

Return to solution overview

C.1 Conservation, protected areas, and zoning (for all ecosystems)

What is it? The saying that prevention is better than the cure holds true for ecosystems: preventing the degradation of ecosystems from occurring in the first place is the most effective and often the least costly approach to ensure that their services are maintained. Conservation and zoning arrangements are relevant for all ecosystems, and in all hazard contexts. Where ecosystems are intact, protecting them through arrangements for zoning and conservation is an important measure to retain the ecosystem benefits for communities. Where ecosystems have suffered minor damage, conservation arrangements may suffice to enable natural regeneration. Even where ecosystems are severely degraded — necessitating active support through restoration — conservation arrangements should be aimed for to prevent recurring degradation. In short, conservation arrangements that restrict or limit access and use of ecosystems to maintain natural habitats are critical instruments that should be considered alongside sustainable management and restoration efforts.

Many types of conservation arrangements exist: these can either be based on legal frameworks or community-led initiatives, or both. In the context of marine and coastal areas, for instance, there are Marine Protected Areas (MPA) that are formally designated by governments, Marine Conservation Agreements (MCA) that are often led by NGOs and landholders, and Locally Managed Marine Areas (LMMA) that are locally led.

IUCN defines protected areas as "a clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values." (Dudley, N. 2013:8). IUCN has established six categories: Strict nature reserve, wilderness area, national park, natural monument for nature, habitat/species management area, protected landscape/seascape, and protected area with sustainable use of natural resources (ibid: 12-24). While arrangements to protect ecosystems help retain or regain the protective benefits for communities, there are also other arrangements whose primary purpose lies in risk reduction. These include no-build zones in hazard-prone areas or other forms of zoning as part of regional development and/or land use plans (i.e. restricting development in wildfire interface zones or agricultural practices on steep and unstable slopes). Considerations of ecosystem integrity are often included in zoning models (Qiu et al. 2022).

Environmental protection area outside Berlin, Germany. Photo: Leonhard Lenz

What are the benefits? There are numerous positive effects from conservation and zoning arrangements to local communities in terms of protective, economic, social, cultural, health and environmental benefits. This includes carbon sequestration potential and biodiversity conservation.

What are the requirements? The effectiveness of protection arrangements is bound in the level of commitment by government, communities and key stakeholders, as well as by supportive legislation and regulations, the availability of staffing, resources, enforcement and resource monitoring. RC/RC Societies and NGOs should seek opportunities to strengthen protection through community stewardship and advocacy, among others.

Guidance
- **Coastal areas**: TNC (2021): The Blue Guide to Coastal Resilience. Protecting coastal communities through nature-based solutions.See appendix A.1 (p. 52-53). Furthermore, see the introduction to Marine Conservation Agreements (MCA), this field guide and this MCA checklist.
- **General guidance:** Dudley, N. (ed.) (2013): Guidelines for applying protected area management categories. IUCN.
- 30x30 Campaign for Nature: an initiative to protect 30% of land and ocean areas by 2030.

Case studies
- Brazil, Indonesia, The Netherlands, Burkina Faso/Niger, Guatemela/Mexico, United States, Switzerland: Nehren, U. et al. (2014): The ecosystem-based DRR case study source book.
- Costa Rica, University of Costa Rica (n.d.): Connectivity, ecosystem services and nature-based solutions in land-use planning in Costa Rica.
- Thailand, Koning, A. (n.d.): Grassroots reserves have strong benefits for river ecosystems in the Salween river basin.

Hazard context
- Floods
- Storms
- Droughts
- Heatwaves
- Landslides

Ecosystem context
- Coastal areas
- Rivers & watersheds
- Forests
- Farm & grasslands
- Slopes & mountains
- Urban areas

Costs
- $
- $$
- $$$

Time
- Short (less than 2 years)
- Medium (2-5 years)
- Long (more than 5 years)

Scale
- Site
- Neighbourhood
- Community
- Larger-scale

Community type
- Urban
- Suburban
- Rural

Return to solution overview

C.2 Forest restoration and sustainable forest management

Photo: Ollivier Girard, CIFOR

What is it? Forest restoration is not only (and often not at all) about planting trees. It refers to actions to re-instate ecological processes that accelerate the recovery a) of forest structure, b) its ecological functioning and c) its biodiversity levels.

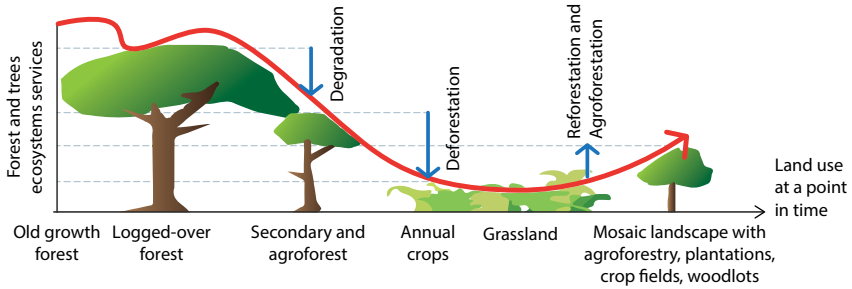
Forest restoration may include efforts to improve soil and hydrology, replanting, the control of invasive and harmful species, and sustainable management practices. Critically, the degradation drivers must be reduced or eliminated as part of forest restoration. Forest restoration is a specialised form or reforestation in that its primary goals are biodiversity and environmental protection (afforestation is the establishment of a forest in an area where there was no previous tree cover).

Sustainable forest management (SFM) meanwhile is "the sustainable use and conservation of forests with the aim of maintaining and enhancing multiple forest values through human interventions. People are at the centre of SFM because it aims to contribute to society's diverse needs in perpetuity." (FAO 2022)

What are the benefits? Intact forests have a huge array of benefits for local communities and adjacent ecosystems as well as for planetary health (see ch. 1 and C.1). Restoring forests that have been degraded, and sustainably managing exisiting forests, helps to regain or retain the level of ecosystem services. Specifically, there are protective, economic, health, food security, environmental, social and cultural benefits from healthy forests and thus, restoration and sustainable forest management.

What are the requirements? Ecosystem assessments, strong stakeholder management, government support (Incl. Ministries of Agriculture and Forestry), and community engagement are critical to forest restoration as well as SFM. Detailed guidance for forest restoration is available in Stanturf et al. (2019): this includes a good overview of the process and a decision tree following initial assessments. For SFM, see the FAO's SFM toolbox that features training modules, tools and case studies.

What to avoid? Efforts to restore and sustainably manage forests must avoid shortcuts: do not assume that 'planting trees' is the best and only way but ensure that you have a good understanding of the different zones, species, ecological functions and interdependencies. Forest restoration takes time and must be pursued with the needs of communities and stakeholders in mind.



The "forest transition curve," along which restorative activities such as native habitat conservation, natural forest regrowth, commercial tree plantations, woodlots, enrichment plantings, and agroforestry systems are implemented along with soil restoration and conservation measures. Source: CGIAR 2021:6.

Guidance

- Overview: WWF: What is forest restoration and how do we do it well?
- CGIAR (2021): Forest and land restoration. Ten years of forests, trees and agroforestry research in partnership with sustainable development.
- Stanturf, J. et al. (2019): Implementing forest landscape restoration. A practitioner's guide. International Union of Forest Research Organizations (IUFRO).
- FAO (2022): Sustainable forest management (SFM) toolbox. Includes tools and case studies.

Case studies

- Armenia, Armenia Tree Project: an organisation committed to reforestation following the severe deforestation during the country's economic and energy crisis in the 1990s.
- Lao PDR, UNDP (2022): Sustainable forest and land management in the dry Dipterocarp forest ecosystems of Southern Lao PDR.
- United States, IUCN (2015): Forest and landscape restoration is more than planting trees - the case studies from the United States.

Hazard context

- [x] Floods
- [x] Storms
- [x] Droughts
- [x] Heatwaves
- [x] Landslides

Ecosystem context

- [ ] Coastal areas
- [ ] Rivers & watersheds
- [x] Forests
- [ ] Farm & grasslands
- [ ] Slopes & mountains
- [ ] Urban areas

Costs

- [x] $
- [x] $$
- [ ] $$$

Time

- [ ] Short (less than 2 years)
- [x] Medium (2-5 years)
- [x] Long (more than 5 years)

Scale

- [x] Site
- [x] Neighbourhood
- [x] Community
- [x] Larger-scale

Community type

- [ ] Urban
- [ ] Suburban
- [x] Rural

Return to solution overview

C.3 Protective forests

What is it? Protective forests are forests that mitigate or prevent the impact of hazards such as rockfalls, avalanches, erosion, landslides, debris flow or flooding on communities in mountainous areas. A protective (or protection) forest generally covers the sloping area between a hazard potential (such as an unstable rock cliff or avalanche release zone) and the endangered or exposed communities and assets.

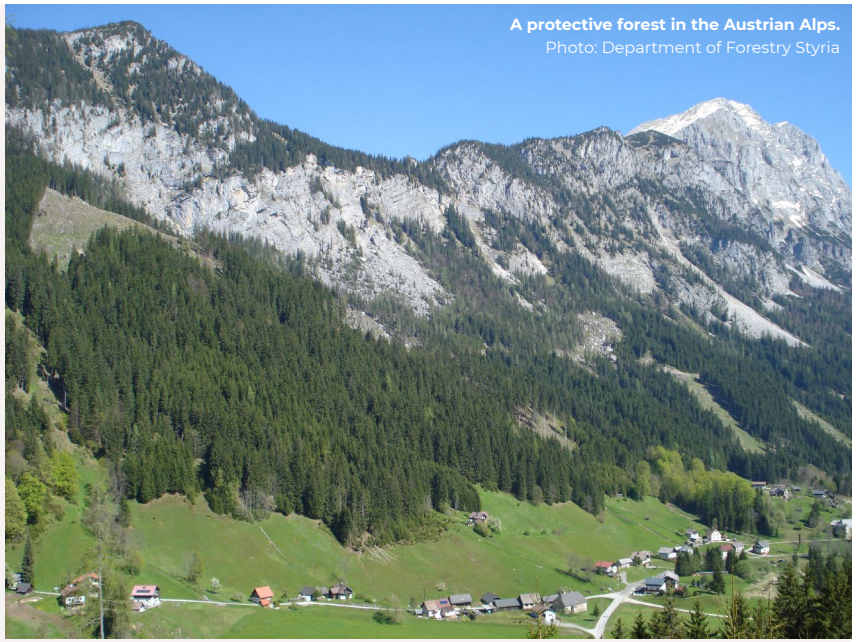
In Europe, all countries that cover part of the Alps mountain range have legislation in place for protective forests, with zoning (see C.1) being particularly common in Switzerland and Austria. Across Central Asia and the Caucasus, 89.1% of forests are designated for their protective function (FAO 2019:15).

Protective forests may be considered a case of upper watershed restoration (see B.1) but are explicitly planted or zoned for their role in protection and exposure reduction. Better protecting existing forests in mountainous areas may be a very cost-effective DRR measure: a study on Central Asia and the Caucasus describes the threats to these forests from grazing and fuelwood collection, among others (FAO 2019:53).

What are the benefits? Protective forests have proven to be effective at reducing damages to communities and ecosystems in mountainous areas. Where needed (on sites where planting is not possible), they can be combined with grey measures, such as avalanche barriers.

The primary purpose (and benefit) of protective forests is the prevention of gravitational hazards: The forests are barriers to intercept avalanches, rockfalls and mudflows (Perzl et al. 2021). They furthermore help to stabilise the soil, reducing the risk of landslides. These forests also help reduce flood risk (Markart et al. 2021) and have numerous other benefits (value for tourism, carbon sequestration, biodiversity protection).

What are the requirements? Protective forests are designated, planted and maintained in settings that are sensitive to gravitational hazards. As such, they must be carefully nurtured: any land use that can harm their protective effect must be avoided.



A protective forest in the Austrian Alps.
Photo: Department of Forestry Styria

Conservation arrangements (see C.1) should be in place and enforced well. Where new forests are planted, thorough assessments of soil conditions and risk are indispensable; these should inform the most appropriate selection of species along the various slope zones. Continuous monitoring and community engagement are critical, and trade-offs should be carefully managed (i.e., consideration of alternative livelihoods for those who previously utilised the slopes).

What to avoid? Avoid planting tree without first analysing the ground conditions (select native trees that are fit for their protective purpose). Avoid the creation of new risks — for instance, keep distances between forests and community assets, and include systems to manage forest fire risk (see C.4).

Hazard context
- [x] Floods
- [x] Storms
- [ ] Droughts
- [ ] Heatwaves
- [x] Landslides

Ecosystem context
- [ ] Coastal areas
- [ ] Rivers & watersheds
- [x] Forests
- [ ] Farm & grasslands
- [x] Slopes & mountains
- [ ] Urban areas

Costs
- [ ] $
- [x] $$
- [x] $$$

Time
- [ ] Short (less than 2 years)
- [x] Medium (2-5 years)
- [x] Long (more than 5 years)

Scale
- [x] Site
- [x] Neighbourhood
- [x] Community
- [x] Larger-scale

Community type
- [x] Urban
- [x] Suburban
- [x] Rural

Guidance
- **Overview**: Protective Forest Hub (Austria)
- Perzl, F., Bono, A., Garbarino, M., Motta, R. (2021): Protective effects of forests against gravitational natural hazards.
- Makino, Y. & Rudolf-Miklau, L. (2021): The protective functions of forests in a changing climate - European experience. Forestry Working Paper No 26. FAO/Austrian Federal Ministry for Agriculture, Regions and Tourism.

Case studies
- Switzerland, ClimateAdapt (2018): Nature-based measures against rockfalls over forests in the Engadin Region, Switzerland.
- Austria, Markart, G. et al. (2021): Flood protection by forests in Alpine watersheds: lessons learned from Austrian case studies.
- See further solutions/case studies in these two 'Mountains adapt' publications (both UNEP 2022): Solutions from the South Caucasus and Solutions from East Africa.

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C.4 Integrated wildfire management

What is it? Whereas major forest fires are a hazard that threaten communities and the environment, fires also have important ecological functions, especially in fire-dependent ecosystems (many areas in the Americas, Africa and Australia). Integrated wildfire management aims to harness these positive aspects while reducing the risk of major fires that threaten communities (Myers 2006). It integrates three key aspects of fire management, fire ecology and fire culture (see illustration) and often includes indigenous fire management practices. As the frequency of disastrous wildfires around the world has increased in the wake of rising temperatures, severe droughts and heatwaves, integrated wildfire management is applied in many parts of the world, including Australia, Portugal, Guatemala and the United States (see Wollstein et al. 2022).

What are the benefits? Fire has several benefits that include **the regulation of invasive species** (native species in fire-dependent ecosystems will recover quickly from moderate intensity fires whereas invasive species do not) and **the prevention of high-intensity fires** that can be catastrophic to communities and ecosystems (prescribed burns reduce the overall fuel load and in particular the 'ladder fuels' that enable the formation of severe 'crowning fires'). Other benefits can include gains in biodiversity, pollination, as well as social and cultural benefits (see Pausas & Keeley 2019).

What are the requirements? A very good understanding of fire behaviour and the role of fires on ecosystems is absolutely essential to avoid negative impacts. Integrated fire management is typically pursued by forestry and fire management agencies. Applying indigenous practices should be considered where these exist.

What to avoid? NEVER start a forest fire without proper analysis of the ecosystem, fire behaviour, and precautionary measures. It is not the role of Red Cross and Red Crescent Societies to manage fires unless they have qualified fire-fighting units. Fire can have very negative consequences on biodiversity in fire-independent or fire-sensitive ecosystems (i.e. those that naturally experience very few fires). If controlled burns are not properly managed, they can lead to disasters.


Forest firefighters work during a prescribed burn in Guatemala as part of the country's integrated forest fire management approach.
Photo: C. Gómez

So what's the role of the Red Cross/Red Crescent? National Societies and their branches based in fire-dependent areas (e.g., the Mediterranean, Australia, and many parts of North America) should understand ecosystems and fire behaviour and the associated risk to communities. This enables them to work with fire and forestry services and to utilise integrated wildfire management as part of a multi-stakeholder process. National Societies and community-based organisations could complement the work of fire and forestry agencies by engaging and educating communities in prevention, preparedness, and recovery from wildfires. Safe Communities Portugal for instance is an example of an effective approach to reduce risk from wildfires.

Guidance

- Myers, R.L. (2006). Living with fire. Sustaining ecosystems and livelihoods through integrated fire management. Global fire initiative, The Nature Conservancy.
- Wollstein, K. et al. (2022). Toward integrated fire management to promote ecosystem resilience.
- Pausas, J. & Keeley, J. (2019). Wildfires as an ecosystem service.
- Corona, P. et al. (2015). Integrated forest management to prevent wildfires under Mediterranean environments.

Videos

- Vox (2021) How decades of stopping forest fires made them worse (8 min, discusses the use of fire as a management tool in the United States).
- CBS (2021) Bring your own brigade. (120 min, documentary that looks into the causes and responses of 2018 wildfires in California and more broadly, at the 'global fire crisis'. Features the role of ecosystem management as a means for risk reduction.

Hazard context

- ☐ Floods
- ☐ Storms
- ■ Droughts
- ■ Heatwaves
- ☐ Landslides

Ecosystem context

- ☐ Coastal areas
- ☐ Rivers & watersheds
- ■ Forests
- ■ Farm & grasslands
- ■ Slopes & mountains
- ☐ Urban areas

Costs

- ■ $
- ■ $$
- ☐ $$$

Time

- ☐ Short (less than 2 years)
- ■ Medium (2-5 years)
- ■ Long (more than 5 years)

Scale

- ■ Site
- ■ Neighbourhood
- ■ Community
- ■ Larger-scale

Community type

- ☐ Urban
- ■ Suburban
- ■ Rural

Return to solution overview

D.1 Soil conservation methods

What is it? Soil conservation refers to methods to prevent a) the loss of the top layer of soil from erosion (incurred by wind or water) and b) the reduction of soil fertility and health (that may be incurred by unsustainable usage, acidification, salinisation or contamination, or a combination of these factors.

Soil has a critical function as a substrate for plant growth. The composition and condition of the soil (e.g., the soil organic carbon content, nutrients, moisture levels) are important factors for fertility and thus for agricultural productivity and, more broadly, ecosystem health. Furthermore, healthy soils with high carbon contents have greater capacity to store water and support water infiltration. This sponge effect helps reduce water run-off, erosion and flood risk.

There are numerous soil conservation methods. These are geared to slow surface water velocity (on slopes) and exposure to wind (both are key erosion drivers), to promote water infiltration, and/or to restore soil organic content and nutrients.

Methods include:

- **Bench terraces/terrace farming**: these terraces create level fields and thus allow water to sink into the soil rather than run off the slope. These should be carefully designed and can be costly/labour-intensive to set up and maintain.
- **Slope stabilisation**: there are numerous tools to stabilise slopes (bio-engineering with fascine drains and slope vegetation, often with planters).
- **Contour lines** are shallow lines dug along moderate slopes to retain water.
- **Small check dams or barriers, retention ditches** are other low-cost means to reduce water run-off and erosion.
- **Low or zero tillage** are practices that be applied in most contexts to reduce erosion
- **Mulching and composting, organic fertilisers** are some ways to replenish nutrients to the soil where needed.

This list is not exhaustive. The most suitable practices always depend on the local context. In addition to the resources listed below, check for local guidance from agricultural departments. Also note that other solutions such as agroforestry (see D.3) and riparian vegetation restoration (see B.2) commonly have positive effects on soil health and can be added.

Photo: Steven Weeks on Unsplash

What are the benefits? The most direct benefit from soil conservation practices is increased agricultural yield, based on more fertile soil. Furthermore, fields are often less sensitive to droughts due to greater water retention (within limits; see D.2 for additional measures) as well as to floods. If applied at scale, the increased sponge function helps reduce flood risk downstream (see also B.1).

What are the requirements? Most of the methods (except for bench terracing) are low-cost options that can be implemented with strong community over the course of typical DRR project timeframes (2-3 years or less).

Guidance

- Harari, N. et al. (2017): Where people and land are safer. Centre for Development and Environment (CDE)
- Nancy, K. (2009): Manual for best practices in soil conservation and soil fertility management for farmers in the Seychelles. Seychelles Agricultural Agency.
- Namirembe, S. et al. (2015). A guide for selecting the right soil and water conservation practices for small holder farming in Africa. Nairobi, Kenya: World Agroforestry Centre (ICRAF)

Case studies

- Harari, N. et al. (2017) includes very well-documented techniques and case studies, including those on drainage fascines (p.85) and participatory slope stabilisation (p. 91) in Honduras, terra preta raised garden beds in Haiti (p.91), as well as soil and water conservation channels (p.99) and bench terracing (p. 191) in Chad.

Hazard context

- [x] Floods
- [ ] Storms
- [x] Droughts
- [ ] Heatwaves
- [x] Landslides

Ecosystem context

- [ ] Coastal areas
- [ ] Rivers & watersheds
- [ ] Forests
- [x] Farm & grasslands
- [x] Slopes & mountains
- [ ] Urban areas

Costs

- [x] $
- [ ] $$
- [ ] $$$

Time

- [x] Short (less than 2 years)
- [x] Medium (2-5 years)
- [ ] Long (more than 5 years)

Scale

- [x] Site
- [x] Neighbourhood
- [x] Community
- [x] Larger-scale

Community type

- [ ] Urban
- [ ] Suburban
- [x] Rural

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D.2 Climate-smart agriculture

What is it? Climate-smart agriculture (CSA) is an integrated approach to managing landscapes — cropland, livestock, forests and fisheries — that addresses the interlinked challenges of food security and climate change. CSA seeks to achieve three outcomes of **a) increased productivity** (produce more and better food to improve nutrition and boost incomes), **b) enhanced resilience** (reduce vulnerability to drought, pests, diseases and other climate-related risks and shocks; and improve capacity to adapt and grow in the face of longer-term stresses like shortened seasons and erratic weather patterns), and **c) reduced emissions** (pursue lower emissions for each calorie or kilo of food produced, avoid deforestation from agriculture and identify ways to absorb carbon out of the atmosphere).

Numerous practices and technologies can be combined to meet and maximise the three CSA outcomes. These relate to soil management, crop production, water management, livestock management, agroforestry (see D.3 for details), aquaculture, and energy management. Examples of such practices include precision farming, zero/minimal tillage, intercropping, the introduction of drought-tolerant varieties or different types of crops and livestock, or the use of organic and slow-release fertilisers.

The ideal combination of technologies and practices will always depend on the local context as well as the observed and expected climate change impact in the target area.

What are the benefits? CSA benefits farmers, communities, and local ecosystems. The practices can greatly improve income and food security, and render communities more resilient. The benefits can extend far beyond the target area in which CSA is applied (e.g., reduced flood risk and pollution in downstream communities) — especially if CSA technologies are broadly applied at landscape scale.

What are the requirements? The adoption of new practices takes time. You will need to have a good analysis of current agricultural practices, the stressors and challenges faced by farmers, the soil, water and ecosystem conditions, as well as climate and weather-associated risk (e.g., shifts in seasonal patterns and extreme weather events).

Supported by an FAO project, a farmer in Liberia applies CSA technologies on her paddy field. Photo: FAO

When promoting and supporting new agricultural practices, you need to recognise that you deal with the farmers' livelihoods (who cannot afford crops to fail). Therefore, carefully explain the merits and invite them to try new techniques on demonstration plots so that they can see for themselves. The use of local champions (farmer-promoters) can also be effective, as this case from Cambodia illustrates.

What to avoid? Although the concepts of climate-smart agriculture and nature-based solutions overlap to a considerable extent, CSA techniques are not a NbS be default: therefore, ensure that CSA has net benefits to local ecosystems (and that it meets other criteria of the IUCN Global Standard) and avoid approaches that create disbenefits to ecosystems. Avoid promoting techniques and practices that have not been tested in similar settings.

Guidance

- FAO (n.d.): Climate-smart agriculture online hub
- World Bank (2021): Climate-smart agriculture guide.
- FAO (2013): Climate-smart agriculture sourcebook.
- CGIAR (2014-2022): Climate-smart agriculture country profiles (available for 34 countries).
- Rainforest Alliance (2021): what is climate-smart agriculture?
- Global Alliance for Climate-Smart Agriculture (GACSA), links to regional alliances

Case studies

- Tanzania, Kurgat, B. et al. (2020): Adoption of climate-smart agriculture technologies in Tanzania. Frontiers in Sustainable Food Systems 4 (55).
- Global, FAO (2021): Climate-smart agriculture case studies 2021. Projects from around the world.
- CGIAR (2014): Climate-smart agriculture: what it's all about. Short video (3:34min) that includes cases from India, Viet Nam, Mali and Kenya

Hazard context
- [x] Floods
- [x] Storms
- [x] Droughts
- [x] Heatwaves
- [ ] Landslides

Ecosystem context
- [ ] Coastal areas
- [ ] Rivers & watersheds
- [ ] Forests
- [x] Farm & grasslands
- [ ] Slopes & mountains
- [ ] Urban areas

Costs
- [x] $
- [x] $$
- [ ] $$$

Time
- [x] Short (less than 2 years)
- [x] Medium (2-5 years)
- [ ] Long (more than 5 years)

Scale
- [x] Site
- [x] Neighbourhood
- [x] Community
- [x] Larger-scale

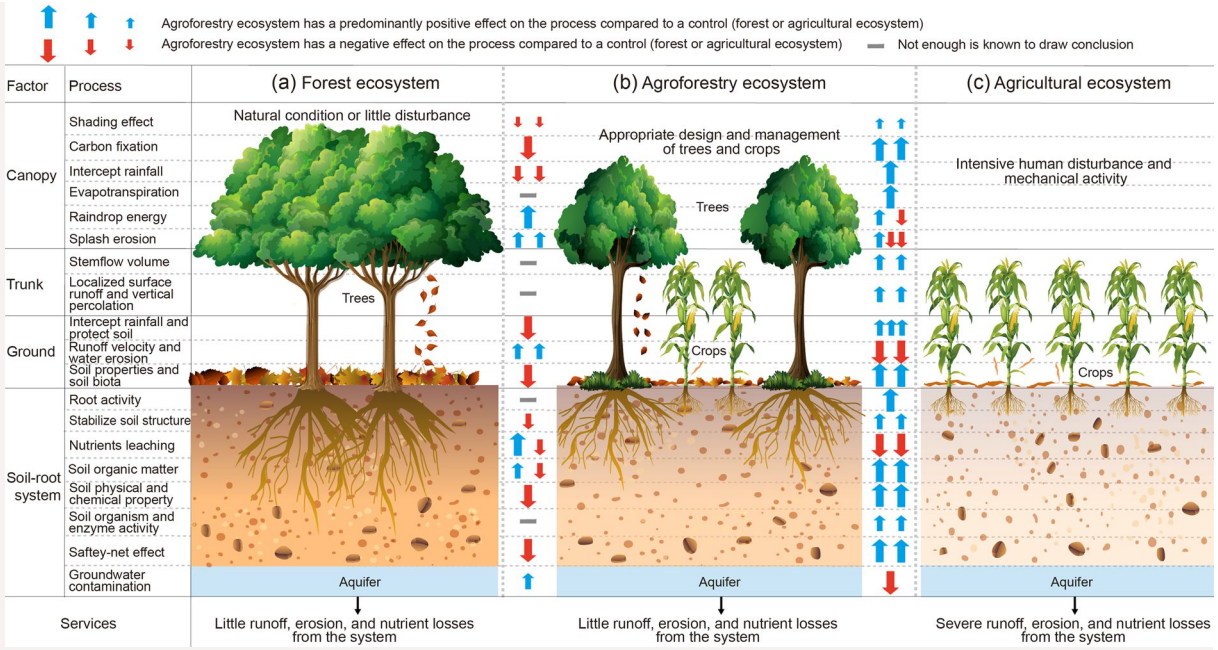
Community type
- [ ] Urban
- [ ] Suburban
- [x] Rural

Return to solution overview

D.3 Agroforestry

What is it? Agroforestry is an ecologically-based land use management system in which trees or shrubs are grown around or among crops or pastures. Several practices exist, including silvo-arable forestry (agroforests with shaded perennial crops such as coffee, cacao and tea), silvopastures (integrating trees, forage and livestock production), linear tree plantings (windbreaks, shelterbelts, and living fences), and riparian buffer strips.

What are the benefits? Agroforestry has multiple benefits, such as greatly enhanced yields from staple food crops, enhanced farmer livelihoods from income generation, increased biodiversity, improved soil structure and health, reduced erosion, and carbon sequestration (see illustration). A meta-study by Zhu et al. (2020) quantified the benefits related to reduced water, soil and nutrient losses.



Agroforestry traits and their potential impact on processes of reductions in water, soil and nutrient losses, and associated water contamination compared to the natural forest and conventional agriculture. Source: Zhu et al. (2020): 48

Agroforestry thus can help reduce the impact of extreme weather events such as floods, storms, droughts, heatwaves and landslides, and is often used as part of climate-smart agriculture (see D.2). If applied at scale, the benefits of agroforestry extend far beyond the fields on which they are applied. The practices can benefit farmers, communities and ecosystems alike.

What are the requirements? There are many different techniques; choosing the most suitable one will be determined by the climate, soil and ecosystem context, the prevailing use (crop types, pastures), and your primary objectives. Therefore, seek professional advice from environmental, agricultural and forestry departments or organisations to assist you in the process. Engage the landholders/farmers and lay out the potential benefits of agroforestry. Often, it may be useful to initially encourage farmers to set aside small demonstration plots (so that direct benefits can be shown by comparing yields from conventional and agroforestry plots). Time is a key requirement (it takes time for trees to reach maturity, and for farmers to adopt agroforestry more broadly). Also note that for protective benefits to wider communities and ecosystems, a certain scale is required.

What to avoid? Avoid the introduction of agroforestry without having obtained sufficient technical expertise. Avoid the use of invasive species.

Guidance

- World Agroforestry Centre (2013): An agroforestry guide for field practitioners.
- ASEAN (2018): ASEAN guidelines for agroforestry development.
- Zhu et al. (2020): Reductions in water, soil and nutrient losses and pesticide pollution in agroforestry practices: a review of evidence and processes. Plant soil 453(4): 45-86
- The World Agroforestry Centre as well as the CGIAR Research Program on Forests, Trees and Agroforestry each have substantial resource bases with more detailed guidance and studies.

Case studies

- France, INRA 2016: Agroforestry: agriculture of the future? The case of Montpellier.
- Fiji, University of Adelaide 2020: Fiji case study: Helping Pacific communities increase incomes through agroforestry. (video, 13:42 min)
- Ethiopia, World Agroforestry Centre (2014): A tale of two villages (video, 10:49 min)
- Germany, Deutsche Welle (2021): Agroforestry: A solution to farming's biggest problems? (video, 10:26)

Hazard context

- [x] Floods
- [x] Storms
- [x] Droughts
- [x] Heatwaves
- [x] Landslides

Ecosystem context

- [x] Coastal areas
- [ ] Rivers & watersheds
- [ ] Forests
- [x] Farm & grasslands
- [x] Slopes & mountains
- [ ] Urban areas

Costs

- [x] $
- [x] $$
- [ ] $$$

Time

- [x] Short (less than 2 years)
- [x] Medium (2-5 years)
- [x] Long (more than 5 years)

Scale

- [x] Site
- [x] Neighbourhood
- [x] Community
- [x] Larger-scale

Community type

- [ ] Urban
- [ ] Suburban
- [x] Rural

Return to solution overview

D.4 Sustainable land management & land restoration

What is it? **Sustainable land management** (SLM) is "the use of land resources, including soils, water, animals and plants, for the production of goods to meet changing human needs, while simultaneously ensuring the long-term productive potential of these resources and the maintenance of their environmental functions." (UNCCD)

Land restoration refers to the process of ecological restoration of a site to a natural landscape or habitat that is safe for humans, wildlife, and plants. Land restoration may include re-naturalisation or re-wilding, and aims to restore ecosystems and their services. Land restoration is applied where ecosystems have been degraded as a result of natural hazards, climate stressors, and direct human activity (e.g., unsustainable land use, chemical accidents/spills).

The two concepts are closely related to each other: while SLM refers to ongoing practices to ensure sustainable land use (preventing degradation), land restoration efforts are applied where land has already been degraded. Under the UN Decade on Ecosystem Restoration, both concepts play a critical role. Numerous techniques exist to restore land (see detailed SLM case studies in Harari et al. 2017) - one approach is farmer-managed natural regeneration (FMNR, see Rinaudo et al. 2019).

FMNR is a low-cost, simple, sustainable land regeneration practice that communities can use to restore their land, increase their productivity and raise resilience relatively quickly and efficiently. It is based on three principles:

1. The systematic pruning and management of existing indigenous trees and shrubs by the land user.
2. An overall increase in tree/shrub coverage and biomass across the landscape.
3. An improvement in the ecological functionality and therefore human well-being (economically and socially) in the landscape being managed with FMNR.

What are the benefits? Generally, SLM seeks to sustain and/or restore land resources, to provide a foundation for sustainable development, and to ensure that land can maintain productive potential and environmental functions.

Photo: FMNR Hub

FMNR for instance is an approach that can bring numerous benefits such as reduced flood risk as well as improved resilience to floods and droughts, and water and food security. Regrown trees and shrubs help restore soil structure and fertility, reduce erosion and soil moisture evaporation, rehabilitate springs and the water table, and increase biodiversity. Some tree species also impart nutrients such as nitrogen into the soil. FMNR can be combined with other solutions such as those highlighted in solution factsheets D.1, D.2, D.3, and C.1.

What are the requirements? Most SLM practices require few resources but should be based on community engagement and stewardship. They can be embedded into community resilience projects and be implemented over typical project timeframes. Large-scale restoration efforts as well as restoration in contexts with severe degradation require considerable time, funding, and technical expertise.

What to avoid? Avoid investing in land restoration without knowing and addressing the factors that caused land degradation to occur in the first place.

Hazard context
- [x] Floods
- [ ] Storms
- [x] Droughts
- [ ] Heatwaves
- [ ] Landslides

Ecosystem context
- [ ] Coastal areas
- [ ] Rivers & watersheds
- [ ] Forests
- [x] Farm & grasslands
- [x] Slopes & mountains
- [ ] Urban areas

Costs
- [x] $
- [x] $$
- [ ] $$$

Time
- [x] Short (less than 2 years)
- [x] Medium (2-5 years)
- [ ] Long (more than 5 years)

Scale
- [x] Site
- [x] Neighbourhood
- [x] Community
- [x] Larger-scale

Community type
- [ ] Urban
- [ ] Suburban
- [x] Rural

Guidance
- UN Decade on Ecosystem Restoration 2021-2030 online hub
- UNCCD Knowledge Hub: Sustainable land management
- Rinaudo, T. et al. (2019): Farmer-managed natural regeneration manual. World Vision.
- Sacande, M. et al. (2020). Restoration in action against desertification. FAO.
- Herrick, J. & Abrahamse, T. (2019): Land restoration for achieving the sustainable development goals. An international resource panel think piece. UNEP.

Case studies
- WRI's Global Restoration Initiative features numerous case studies and resources, and links to regional initiatives in Africa (AFR100) and Latin America (Initiative 20x20).
- Ethiopia, Wondmnow, B. et al. (2022): Landscape Management Plus: Improving the local climate of the Ethiopian Gubalafto Watersheds.
- Malawi/Ethiopia, Bathe,D.(2016): How FMNR helps to ease the climate change. (Video, 6:11min)

Return to solution overview

E.1 Urban greening

What is it? Urban greening here refers to the creation or restoration of public places such as urban forests and wetlands, open green spaces and parks, and green corridors that span across and connect different suburbs.

Urban forests can be varied in size and composition, ranging from micro-forests to larger expanses. Certain forests (phytoremediation) can grow on polluted soils such as landfills and help detoxify contaminants in soil and groundwater. Urban forests can either be restored (if degraded) or created on available land. Fast-growing micro-forests that mimic natural compositions can be effective where space is limited.

Urban wetlands may be natural or constructed, and fulfil numerous functions for biodiversity, flood management, and the reduction of air pollution. Constructed wetlands are also used to help treat wastewater,

Open green spaces such as parks and nature playgrounds not only offer direct benefits to residents (recreational activities) but to ecosystems and risk management as well.

Green corridors complement and connect other green spaces in the city, and allow biota to move, survive, and propagate. They can often be created along rivers, rail tracks, and bicycle paths.

An urban Miyawaki forest in Cambridge, United Kingdom.
Photo: Dino Kuznik

Kallang Riverside park in Singapore
Photo: Pixabay

What are the benefits? Urban greening creates buffers from extremes (heat-waves, extreme rainfall, storms) while providing numerous continuous benefits (air and water filtration, biodiversity, tourism/recreation, carbon sequestration).

What are the requirements? In the urban space, land is a high-priced commodity, and land for urban greening must not only be available but should also be adequately designated to sustain them. Land owners and city administrations must be closely involved, and community engagement is critical. Many cities have developed high-level strategies for urban greening that community efforts can be linked to.

What to avoid? Urban ecosystems are exposed to numerous stressors (e.g., pollution, disrupted hydrology, contaminated and compressed soils). Avoid creating new green spaces without a proper analysis of conditions and stressors to inform design and plant selection, in order to ensure the sustainability of these new green spaces.

Guidance

- **Overview**: World Bank (2021): A catalogue of nature-based solutions for urban resilience. See 'urban forests' (p.42), 'open green spaces' (p.98), and 'green corridors' (p.112).
- Victorian Department of Environment […] (2017): Planning a Green-Blue City. A how-to guide for planning urban greening and enhanced stormwater management in Victoria.
- Naturally Resilient Communities: see waterfront parks and urban trees & forests.

Case studies

- European Union (n.d.): Urban GreenUp - solutions. Includes case studies from an EU-funded programme.
- India, IUCN (2021): Chennai Smart City - Environment Initiative
- India, Nargi, L. (2019): The Miyawaki Method: A Better Way to Build Forests?
- Pakistan, Global Village (2021): Recreating 'Native Forests' using the Miyawaki Forest
- Singapore, Newman, P. (2014): Biophyllic urbanism - a case study of Singapore.

Hazard context

- [x] Floods
- [ ] Storms
- [ ] Droughts
- [x] Heatwaves
- [ ] Landslides

Ecosystem context

- [ ] Coastal areas
- [ ] Rivers & watersheds
- [ ] Forests
- [ ] Farm & grasslands
- [ ] Slopes & mountains
- [x] Urban areas

Costs

- [ ] $
- [x] $$
- [ ] $$$

Time

- [ ] Short (less than 2 years)
- [x] Medium (2-5 years)
- [ ] Long (more than 5 years)

Scale

- [ ] Site
- [ ] Neighbourhood
- [x] Community
- [x] Larger-scale

Community type

- [x] Urban
- [x] Suburban
- [ ] Rural

Return to solution overview

E.2 Green & blue infrastructure (Hybrid solution)

What is it? Green and blue infrastructure refers to preserving, enhancing or restoring elements of natural systems for the functions they provide, such as the regulation of flood waters. In practice, green and structural (grey) infrastructure measures are often combined to maximise the desired functions, in particular in urban areas.

Numerous techniques are grouped under the umbrella of green and blue infrastructure. These include the restoration or creation of **urban wetlands** (see E.1), **urban tree canopies** (planted along roads and public spaces to intercept rain and reduce stormwater runoff, while also providing shade and cooling), as well as measures to create **sustainable drainage systems** that increase water infiltration and natural storage capacity.

Technical measures can include:

- **Permeable pavements** are porous paved surfaces that allow rain to infiltrate the soil.
- **Bioswales** are depressions in which vegetation is grown in an engineered soil mixture that is placed above a gravel drainage bed. They provide storage, infiltration, and evaporation of both direct rainfall and runoff captured from surrounding areas. As linear features, bioswales cells are particularly well suited to being placed along streets and parking lots.
- **Infiltration trenches** are narrow ditches filled with gravel that intercept runoff from upslope impervious areas. They provide storage volume and additional time for captured runoff to infiltrate the native soil below.

What are the benefits? Key benefits include reduced risk of urban flooding as well as a reduced urban heat island effect. Mixing multiple types of measures and applying them at scale can significantly increase the sponge capacity of urban areas, thereby reducing flood risk and degradation of urban ecosystems.

Furthermore, urban designs that make extensive use of tree canopies and green corridors help reduce heat and protect against heatwaves while also improving air quality and biodiversity.

Bioswale in Wisconsin, US.
Photo: Aaron Volkening on Flickr

What are the requirements? Green and blue infrastructure should be carefully designed based on robust assessments of ambient conditions and existing. The implementation of green and blue measures must be embedded in urban design plans and should include the engagement of neighbourhoods and communities where possible. Funding should be secured from local infrastructure budgets. RC/RC Societies and NGOs should consider such measures in community resilience or DRR projects and advocate for their implementation with local governments.

What to avoid? Avoid designs (plant selection, hydrology) that reduce one risk but create others. For instance, avoid planting of trees that may fall on power lines or that offer little storm resistance (falling branches can kill).

Guidance

- US EPA (n.d.): Different shades of green. Green infrastructure research at the U.S. EPA
- Naturally Resilient Communities: see bioswales, green streets, green parking lots, and daylighting rivers and streams.
- Gehrels, H. et al. (2016): Designing green and blue infrastructure to support healthy urban living. TO2 federatie.
- Browder, G. et al. (2019): Integrating Green and Gray: Creating Next Generation Infrastructure.
- Eisenberg, B. & Polcher, V. (2020): Nature-based solutions technical handbook. UNaLab Horizon. See ch. 1 (greening interventions, p. 5) & ch. 5 (water-sensitive design, p.49)

Case studies

- Belgium, City of Antwerp (n.d.): Improving the Antwerp green and blue infrastructure based on multi-functional ambition levels.
- Serbia, Dinić-Branković, M. et al. (2018): Bioswales as elements of green infrastructure - foreign practice and possibilities of use in the district of Niš, Serbia

Hazard context
- [x] Floods
- [x] Storms
- [x] Droughts
- [x] Heatwaves
- [x] Landslides

Ecosystem context
- [ ] Coastal areas
- [ ] Rivers & watersheds
- [ ] Forests
- [ ] Farm & grasslands
- [ ] Slopes & mountains
- [x] Urban areas

Costs
- [ ] $
- [x] $$
- [x] $$$

Time
- [ ] Short (less than 2 years)
- [x] Medium (2-5 years)
- [x] Long (more than 5 years)

Scale
- [x] Site
- [x] Neighbourhood
- [x] Community
- [x] Larger-scale

Community type
- [x] Urban
- [x] Suburban
- [x] Rural

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E.3 Green roofs & facades (Hybrid solution)

What is it? This solution refers to the addition of a green surface layer to building roofs and/or facades, thereby providing cooling/insulation and opportunities to improve air quality and capture, store, and reuse stormwater. These solutions can be integrated into new building designs or retrofitted to existing buildings (see requirements below).

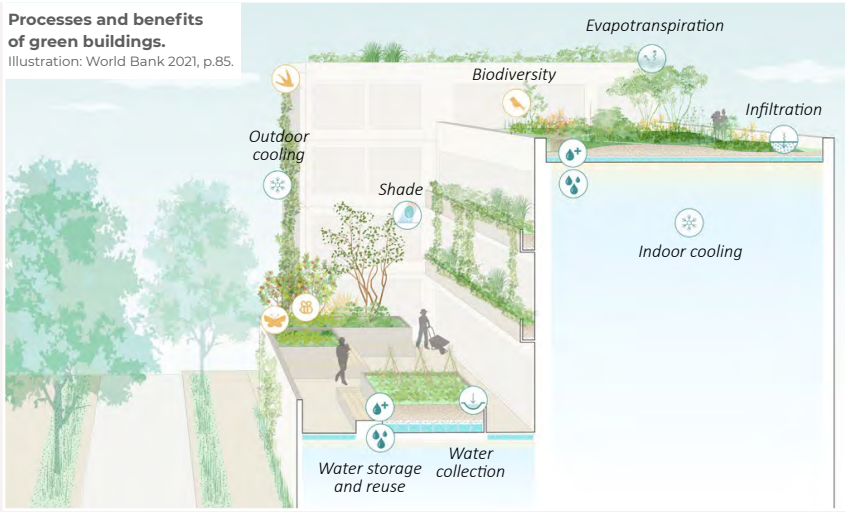
Four main techniques exist:

Extensive green roofs have several layers added for waterproofing, insulation, root barriers, water drainage, soil/substrate, and vegetation. The roofs should use low-growing and drought-resistant grass or vegetation that can withstand variations in temperature and sun exposure.
Intensive green roofs have a thicker substrate layer to support a higher variety and height of vegetation. They can feature rooftop gardens for urban farming and be coupled with rainwater harvesting. Intensive green roofs are more costly to set up and have greater structural requirements.
Ground-based green facades refer to green walls with climbing plants that are rooted in ground planters. Plants are used that grow directly on the building wall or on special frames connected to the wall.
Facade-bounded greening refers to the use of planters based at multiple levels along the wall (i.e., at 1, 2, 3 meters of height). They require more initial set-up and maintenance (irrigation) and allow for a greater variety of plants.

What are the benefits? Green roofs and facades assist in temperature control (insulation, shading) - they offer energy savings for heating/cooling and provide benefits to cope with heat waves. If applied at scale, they help reduce the urban heat island effect. Furthermore, green roofs (especially intensive green roofs) help control stormwater run-off and thus the risk of pluvial flooding.

They have biodiversity benefits and, depending on the design, can be used for food production. Retrofitting green roofs and facades furthermore can add the market value of buildings and offer spaces for recreational activities.

Processes and benefits of green buildings.
Illustration: World Bank 2021, p.85.



What are the requirements? Green roofs and facades add weight to buildings that must be considered: retrofitting options must consider whether the building structure can sustain the additional weight (this is particularly important for intensive green roofs). Structural engineers as well as experts on suitable plant types should be consulted before adding green roofs or facades. It is also important to ensure an adequate design of the multiple layers for green roofs to prevent water and root damage to concrete structures, as well as an adequate selection of plants. Note that regular monitoring of green roofs may be required. While some low-cost solutions are available (see Nigeria case study), note that green roofs and facades may require considerable cost to building owners.

What to avoid? Avoid the addition of green roofs without having obtained technical feasibility by structural engineers. Green roofs add weight (especially when saturated with rainwater) that buildings must be able to withstand.

Hazard context
- [x] Floods
- [ ] Storms
- [x] Droughts
- [x] Heatwaves
- [ ] Landslides

Ecosystem context
- [ ] Coastal areas
- [ ] Rivers & watersheds
- [ ] Forests
- [ ] Farm & grasslands
- [ ] Slopes & mountains
- [x] Urban areas

Costs
- [x] $
- [x] $$
- [x] $$$

Time
- [x] Short (less than 2 years)
- [ ] Medium (2-5 years)
- [ ] Long (more than 5 years)

Scale
- [x] Site
- [x] Neighbourhood
- [x] Community
- [ ] Larger-scale

Community type
- [x] Urban
- [x] Suburban
- [x] Rural

Guidance
- World Bank (2021): A catalogue of nature-based solutions for urban resilience. See 'building solutions' (p. 84-97).
- Naturally Resilient Communities - see green roofs
- Eisenberg, B. & Polcher, V. (2020): Nature-based solutions technical handbook. UNaLab Horizon. See chapter 3 (vertical greening, p.19) and chapter 4 (green roof, p.37).
- US GSA (2011): The benefits and challenges of green roofs on public and commercial buildings.

Case studies
- Italy, IUCN Urban Alliance 2021: Bosco Verticale, architectural biodiversity - a new alliance between forests and agriculture.
- Austria, Ecologic Institute 2020: Green façade for heat wave buffering on a public administration building in Vienna
- Nigeria, Akinwolemiwa, O. et al., 2018: Building community-driven vertical greening systems for people living on less than £1 a day: A case study in Nigeria

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E.4 Rainwater harvesting (Hybrid solution)

What is it? Rainwater harvesting refers to the collection of rainwater and storage for later use. It is commonly applied at the scale of homes and larger buildings (such as schools and warehouses). Rainwater harvesting has been used for thousands of years in places like India and the Middle East and offers a low-cost source of freshwater. In many arid and drought-prone areas such as the Pacific islands or Australia, rainwater harvesting is very common. In rural areas of Thailand (where the government subsidised rainwater tanks throughout the 1980s), 40% of homes use rainwater harvesting.

Basic rainwater harvesting systems consist of a catchment surface (typically a roof), gutters, pipes, and a tank or cistern. Pre-flushing filters collect the initial rainwater and prevent leaves and dust from entering the tank. More complex systems include pumps and advanced treatment systems (UV lights, additional filtering).

The collected rainwater can be used for drinking (after filtering), other domestic use, livestock, and irrigation.

What are the benefits? Rainwater can be a cost-effective source of water. It also offers an alternative or supplementary water source where groundwater (wells) is depleted and other sources (such as piped water) are non-existent. Rainwater harvesting can render households more drought-resilient, especially where storage capacity exceeds the typical water demands over dry seasons. Rooftop systems can be combined with green roofs and thus extend the 'sponge' (slow release) effect. If applied at scale, rainwater harvesting can contribute to a reduction of flood risk. At scale, there is an indirect benefit to ecosystems, as it reduces demand on groundwater and thus can help to prevent the depletion of groundwater levels.

What are the requirements? Rainwater harvesting requires suitable roofs and space for water storage. Costs and technical requirements for basic systems tend to be low. Locally available materials should be used, and home-owners be trained in the installation, maintenance and use of rainwater harvesting systems. Designs should be based on basic calculations of harvesting potential (rainfall, catchment area, storage capacity), water use/demand, and the expected time with minimal or no rain (taking climate change into account). Note that it may not always be possible to completely rely on rainwater harvesting alone (consider back-up sources).

Rainwater harvesting on a home in Leyte, the Philippines. Photo: Patrick Bolte, Banyaneer

Training of rainwater harvesters must include practices to maintain storage tanks and water filtering: although rainwater as such is a safe water source, pollutants from the collection and storage must be filtered out prior to consumption.

What to avoid? Avoid the use of technically advanced systems that are hard or costly to maintain with local resources and capacities. Avoid fully-funded systems and ensure that local residents contribute to construction process and costs.

Hazard context
- ☐ Floods
- ☐ Storms
- ■ Droughts
- ☐ Heatwaves
- ☐ Landslides

Ecosystem context
- ☐ Coastal areas
- ☐ Rivers & watersheds
- ☐ Forests
- ☐ Farm & grasslands
- ☐ Slopes & mountains
- ■ Urban areas

Costs
- ■ $
- ■ $$
- ☐ $$$

Time
- ■ Short (less than 2 years)
- ☐ Medium (2-5 years)
- ☐ Long (more than 5 years)

Scale
- ■ Site
- ■ Neighbourhood
- ■ Community
- ■ Larger-scale

Community type
- ■ Urban
- ■ Suburban
- ■ Rural

Guidance
- **Basic systems:** Taher et al. (2017): Manual for rooftop rainwater harvesting systems in the Republic of Yemen.
- **Advanced systems:** Rainwater Harvesting Association of Australia (2018): Rainwater Harvesting: Residential design specification.
- **Training:** South Pacific Applied Geoscience Commission (2004): Harvesting the Heavens. A manual for participatory training in rainwater harvesting.

Case studies
- Peru, Welthungerhilfe (2016): Rainwater harvesting for facing drought and soil moisture reduction and promoting ground water recharge.
- India, Patel, A (2015): Rainwater harvesting - a case study of Amba township, Gandhinagar. Conference paper.
- Bangladesh, Rana, M (n.d.): Rain water harvesting for drinking in rural area (A case study on three villages of Paikgacha Thana in Khulna District)

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E.5 Integrated flood management (Hybrid solution)

What is it? Integrated flood management (IFM) is a broad concept that employs strategies to maintain or augment the productivity of floodplains or coastal zones, while at the same time providing protective measures against human losses due to flooding. Integrated flood management integrates land and water resources development in a river basin or coastal zone as a whole.

IFM seeks to integrate five categories of measures:

- **Reduction of flood hazard** (e.g., wetland restoration (A.2), green infrastructure (E.2))
- **Flood protection** (e.g., Embankments, flood barriers)
- **Land use regulation** (e.g., setback lines, building restrictions, flood proofing),
- **Raising preparedness** (e.g., early warning systems, evacuation plans),
- **Residual risk mitigation** (e.g., emergency response, insurance, recovery plans).

Qnuli stormwater park in China
Photo: Turenscape

Essentially, IFM combines green and grey, structural and non-structural measures that could be considered as an overarching hybrid concept.

In China, IFM has been rolled out since 2015 in over 30 cities under the 'Sponge City' programme, under which green measures feature prominently. These include the protection of ecologically sensitive areas, the restoration or creation of green corridors, wetland, and parks, and mandatory integration of green measures and flood-proof designs in future development (Peng & Reilly 2021).

The Associated Programme on Flood Management features a large resource base on policy development, flood management and technical tools.

What are the benefits? The primary benefit of IFM relates to the reduction of flood-induced damages and losses — however, depending on the design, the numerous other benefits can include environmental and social benefits, and render covered areas more resilient to other hazards such as drought, heatwaves, and storms.

What are the requirements? IFM is a high-level planning concept that must include local governments and a wide array of departments and stakeholders. NGOs and RC/RC Societies should seek to link activities to such IFM frameworks where they exist, and connect DRR and community resilience efforts to these plans.

Hazard context
- [x] Floods
- [ ] Storms
- [ ] Droughts
- [ ] Heatwaves
- [ ] Landslides

Ecosystem context
- [x] Coastal areas
- [x] Rivers & watersheds
- [ ] Forests
- [ ] Farm & grasslands
- [ ] Slopes & mountains
- [x] Urban areas

Costs
- [ ] $
- [ ] $$
- [x] $$$

Time
- [ ] Short (less than 2 years)
- [ ] Medium (2-5 years)
- [x] Long (more than 5 years)

Scale
- [ ] Site
- [ ] Neighbourhood
- [x] Community
- [x] Larger-scale

Community type
- [x] Urban
- [x] Suburban
- [ ] Rural

Guidance
- Associated Programme on Flood Management (2017): Selecting measures and designing strategies for integrated flood management. A guidance document.
- WWF (2016). Natural and nature-based flood management: A Green Guide.

Case studies
- China, Peng, Y. & Reilly, K. (2021): Using nature to reshape cities and live with water: an overview of the Chinese sponge city programme and its implementation in Wuhan.
- China, DW (2022): China turns cities into sponges to stop flooding.
- APFM collection of case studies.
- See also: ARUP (2022): Global Sponge City snapshot.

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Haiti
Representatives of the community of Constant, Fond de Boudin, take a well-deserved break after having constructed Vetiver ramps for the creation of progressive terraces.

Photo: Swiss Red Cross

Case study collections

Seeking further inspiration and guidance for your specific context? You are in luck!

The eight portals featured on this page collectively include more than 4,000 NbS case studies. Most come with a good set of filters, so that you can easily find those that are most relevant to your context.

1. Panorama - Solutions for a Healthy Planet

Panorama is the broadest collection of 'solutions' that are presented with key building blocks. You can search by ecosystem type, theme, geography, or challenge, and apply countless additional filters. Many case studies come with step-by-step guides, photos, and background stories.

Search Panorama

2. European Union OPPLA NbS case studies

Oppla features around 300 case studies, many of whom relate to NbS in urban contexts. Search by keyword, scale, or main type. Note that most case studies are from Europe.

Search OPPLA

3. Naturally Resilient Communities - Case studies

This portal features 23 NbS case studies from the United States, plus 30 well-documented solutions. Despite the narrow geographical focus of the NRC site, many cases apply also outside North America.

Search NRC

4. University of Oxford NbS initiative

This site includes more than 100 case studies that are well-documented (e.g., outcomes are provided in detail). Search by country, ecosystem, intervention type, or climate change challenge.

Search Oxford NbS

5. WOCAT Sustainable Land Management Database

This database includes a rich set of sustainable land management (SLM) technologies and approaches. The descriptions are very detailed; numerous filtering functions allow you to narrow down to those cases that are most relevant to your context.

Search WOCAT

6. Adaptation at Altitude Solutions Portal

As the name suggests, this portal focuses chiefly on NbS specific to mountainous regions. You can filter by scale, ecosystem, solution type, sector, and impact category.

Search Adaptation at Altitude

7. World Bank NbS Knowledge Hub

The World Bank hub has a thus far limited range of case studies but is nevertheless useful for background and research reports as well as strategy papers.

Search World Bank NbS

8. Nature4Climate Case studies

This site has around 100 short case studies, categorised by main intervention approaches (restore, protect, manage), plus several more detailed studies (such as the case of flood-resilient 'sponge cities' in China).

Search Nature4Climate

Appendix C
Literature

Anderson, C., Renaud, F., Hanscomb, S. & Gonzalez-Ollauri, A. (2022): Green, hybrid, or grey disaster risk reduction measures: what shapes public preferences for nature-based solutions? Journal of Environmental Management 310 (2022):114727. https://doi.org/10.1016/j.jenvman.2022.114727

Asian Development Bank (2016). Nature-based solutions for building resilience in towns and cities: Case studies from the Greater Mekong subregion. https://www.adb.org/publications/nature-based-solutions-building-resilience-towns-cities-gms

Björk, M., Short, F., Mcleod, E., & Beer, S. (2008). Managing seagrasses for resilience to climate change. IUCN Global Marine Programme. https://www.reefresilience.org/pdf/Managing_Seagrasses_for_Resilience_to_Climate_Change.pdf

Brandle, J., Hodges, L., Tyndall, J. & Sudmeyer, R. (2009). Windbreak practices. In: Garett, H. (ed.). North American agroforestry: An integrated science and practice. Second edition. https://www.kansasforests.org/rural_forestry/rural_docs/NAAgroforestry%20Chapter%205%20WB%20Yield%20Brandle.pdf

Brangeon, S., Crowley & F. (2020). Environmental footprint of humanitarian assistance funded by DG ECHO. Scoping review. Groupe URD. https://reliefweb.int/sites/reliefweb.int/files/resources/Groupe-URD-Inspire-studypublic.pdf

Browder, G., Ozment, S., Rehberger Bescos, I., Gartner, T., Lange, G. (2019). Integrating Green and Gray : Creating Next Generation Infrastructure. Washington, DC: World Bank and World Resources Institute. https://openknowledge.worldbank.org/handle/10986/31430

Brügge, C., Pinochet, J., Hansen, S., & Vichitlekarn, V. (2020).Environmental mainstreaming in humanitarian interventions. UNEP/OCHA Joint Environment Unit (JEU). https://www.eecentre.org/wp-content/uploads/2020/04/EMHIT_FINAL-REPORT-with-WWF-good-practice-2.pdf

Calvert, G. (2011). An assessment of tree susceptibility and resistance to cyclones — with particular reference to Severe Tropical Cycone Yasi in Townsville on 2nd February 2011. Townsville: Greening Australia https://www.greeningaustralia.org.au/wp-content/uploads/2017/11/RESEARCH_Yasi_TreeReport_NewFormat.pdf

CARE (2019). Climate vulnerability and capacity analysis handbook. Informing community-based adaptation, resilience and gender equality. CVCA version 2.0. https://careclimatechange.org/wp-content/uploads/2016/06/CARE-CVCA-Handbook-EN-v0.8-web.pdf

Chevallier, R. (2019). Marine and coastal ecosystem-based adaptation for enhanced resilience in Southern Africa: Synthesis Report. South African Institute of International Affairs. https://media.africaportal.org/documents/Special-Report-chevallier_Synthesis-Report-Southern-African.pdf

Corona, P., Ascoli, D., Barbati, A., Bovio, G. et al. (2015). Integrated forest management to prevent wildfires under Mediterranean environments. Annals of silvicultural research 39 (1): 1-22. http://dx.doi.org/10.12899/asr-946

Costanza, R., Groot, R., Sutton, P., Van der Ploeg, S., Anderson, S., Kubiszewski, I., Farber, S., & Turner, R. (2014). Changes in the global value of ecosystem services. Global Environmental Change, 26, 152–158. https://doi.org/10.1016/j.gloenvcha.2014.04.002

CRED (2020). Human cost of disasters. An overview of the last 20 years. 2000-2019. Centre for Research on the Epidemiology of Disasters (CRED) and UNDRR. https://www.undrr.org/publication/human-cost-disasters-overview-last-20-years-2000-2019

Daly, H.E. (1990). Toward some operational principles of sustainable development. Ecological Economics 2 (1990), 1-6.

FAO & UNEP (2020). The state of the world's forests. Forests, biodiversity and people. Rome: FAO and UNEP. https://doi.org/10.4060/ca8642en

Ferrario, F., Beck, M. W., Storlazzi, C. D., Micheli, F., Shepard, C. C., & Airoldi, L. (2014). The effectiveness of coral reefs for coastal hazard risk reduction and adaptation. Nature Communications, 5 (May). https://doi.org/10.1038/ncomms4794

Fitzsimons, J., Branigan, S., Brumbaugh, R.D., McDonald, T. & zu Ermgassen, P. S.E. (eds) (2019). Restoration Guidelines for Shellfish Reefs. The Nature Conservancy, Arlington VA, USA. https://www.natureaustralia.org.au/content/dam/tnc/nature/en/documents/australia/TNC_Shellfish_Reef_Restoration_Guidelines_WEB.pdf

Gann, G.D., McDonald, T., Walder, B., Aronson, J., Nelson, C.R., Jonson, J., Hallett, J.G., Eisenberg, C., Guariguata, M.R., Liu, J., Hua, F., Echeverría, C., Gonzales, E., Shaw, N., Decleer, K., & Dixon, K.W. (2019). International principles and standards for the practice of ecological restoration. Second edition. Restoration Ecology 27(S1): S1–S46.

Global Commission on Adaptation (2019). Adapt now: a global call for leadership on climate resilience. https://gca.org/reports/adapt-now-a-global-call-for-leadership-on-climate-resilience/

Hallegate, S., Vogt-Schilb, A., Bangalore, M., & Rozenberg, J. (2017). Unbreakable. Building the resilience of the poor in the face of natural disasters. World Bank. https://openknowledge.worldbank.org/handle/10986/25335

Harari, N., Gavilano, A. and Liniger, HP. (2017). Where people and their land are safer: A Compendium of Good Practices in Disaster Risk Reduction. Bern and Lucerne, Switzerland: Centre for Development and Environment (CDE), University of Bern, and Swiss NGO Disaster Risk Reduction (DRR) Platform, with Bern Open Publishing. https://www.wocat.net/library/media/122/

Heck, N., Narayan, S., Beck, M. W. (2019). Benefits of Mangroves and Coral Reefs in the Caribbean. Policy Brief. The Nature Conservancy. http://media.coastalresilience.org/Resilient_Islands/BenefitsOfMangrovesAndCorals_TechReport.pdf

IFRC (2011). Breaking the waves. Impact analysis of coastal afforestation for disaster risk reduction in Viet Nam. https://www.preventionweb.net/files/globalplatform/entry_bg_paper~mangroveimpactreportfinallowapril2011.pdf

IFRC (2014). IFRC framework for community resilience. https://www.ifrc.org/sites/default/files/IFRC-Framework-for-Community-Resilience-EN-LR.pdf

IFRC (2018). Strategy 2030. Platform for change: Global reach, local action. https://www.ifrc.org/sites/default/files/2021-06/S2030-EN.pdf

IFRC (2019). The cost of doing nothing. The humanitarian price of climate change and how it can be avoided. https://media.ifrc.org/ifrc/the-cost-of-doing-nothing/

IFRC (2020). Come Heat or High Water. World Disasters Report 2020. https://www.ifrc.org/sites/default/files/2021-05/20201116_WorldDisasters_Full.pdf

IFRC (2021). Road Map to Community Resilience v2. Operationalising the framework for community resilience through the Enhanced Vulnerability and Capacity Assessment (EVCA). https://www.ifrcr2r.org/_files/ugd/0e4ccc_1bf51f8d5f8542e29a924b0fb8f1b2b6.pdf

IFRC & WWF (2022). Working with nature to protect people. How nature-based solutions reduce climate change and weather-based disasters. https://www.ifrc.org/document/working-nature-protect-people

IPCC (2018). Annex I: Glossary [Matthews, J.B.R. (ed.)]. Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty. https://www.ipcc.ch/sr15/

IUCN (2020). Global Standard for Nature-based Solutions. A user-friendly framework for the verification, design and scaling up of NbS. https://portals.iucn.org/library/sites/library/files/documents/2020-020-En.pdf

Iseman, T. & Miralles-Wilhelm, F. (2021). Nature-based solutions in agriculture – The case and pathway for adoption. Virginia. FAO and The Nature Conservancy. https://doi.org/10.4060/cb3141en

Keith, D., Ferrer-Paris, J., Nicholson, E. & Kingsford, R. (eds.) (2020). The IUCN Global Ecosystem Typology 2.0: Descriptive profiles for biomes and ecosystem functional groups. Gland, Switzerland: IUCN. https://doi.org/10.2305/IUCN.CH.2020.13.en

Kummu, M., de Moel, H., Ward, P., & Varis, O. (2011). How close do we live to water? A global analysis of population distance to freshwater bodies. *PloS one*, *6*(6), e20578. https://doi.org/10.1371/journal.pone.0020578

Losada, I. J., Menéndez, P., Espejo, A., Torres, S., Díaz-Simal, P., Abad, S., Beck, M. W., Narayan, S., Trespalacios, D., Pfiegner, K., Mucke, P., & Kirch, L. (2018). The Global Value of Mangroves for Risk Reduction. Technical Report. https://doi.org/10.7291/V9DV1H2S

Makino, Y. & Rudolf-Miklau, F. (2021). The protective functions of forests in a changing climate – European experience. Forestry Working Paper No. 26. Rome. FAO and the Austrian Federal Ministry for Agriculture, Regions and Tourism. https://doi.org/10.4060/cb4464en

Mcivor, A., Möller, I., & Spencer, T. (2012). Reduction of Wind and Swell Waves by Mangroves. Natural Coastal Protection Series: Report 1. https://www.conservationgateway.org/ConservationPractices/Marine/crr/library/Documents/wind-and-swell-wave-reduction-by-mangroves.pdf

Myers, R.L. (2006). Living with fire. Sustaining ecosystems and livelihoods through integrated fire management. Global fire initiative, The Nature Conservancy. Arlington, VA. https://www.conservationgateway.org/Documents/Integrated_Fire_Management_Myers_2006.pdf

Narayan, S., Beck, M., Reguero, B., Losada, I., van Wesenbeeck, B., & Pontee, N. (2016). The Effectiveness, Costs and Coastal Protection Benefits of Natural and Nature-Based Defences. PLoS ONE 11(5): e0154735. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0154735

Narayan, S., Bitterwolf, S., & Beck, M. (2019). The costs of mangrove and reef restoration relative to coastal protection structures in the Caribbean. Policy brief, The Nature Conservancy. https://media.coastalresilience.org/Resilient_Islands/CoastalProtection_TechReport.pdf

Nehren, U., Sudmeier-Rieux, K., Sandholz, S., Estrella, M., Lomarda, M. and T. Guillén. (2014). The Ecosystem-Based Disaster Risk Reduction Case Study and Exercise Source Book, Geneva and Cologne: Partnership for Environment and Disaster Risk Reduction and Center for Natural Resources and Development. https://www.researchgate.net/profile/Udo_Nehren/publication/270588316_The_ecosystem-based_disaster_risk_reduction_case_study_and_exercise_book/links/54afe4270cf2431d3531bd23/The-ecosystem-based-disaster-risk-reduction-case-study-and-exercise-book.pdf

Pausas, J. & Keeley, J. (2019). Wildfires as an ecosystem service. Frontiers in ecology and the environment 15 (5): 289-295 https://doi.org/10.1002/fee.2044

Perillo, G., Wolanski, E., Cohoon, D. & Hopkinson, C. (2019). Coastal wetlands. An integrated ecosystem approach. Second edition. Amsterdam: Elsevier. https://www.google.com.au/books/edition/Coastal_Wetlands/xpgnDQAAQBAJ?hl=en&gbpv=1

Red Cross Red Crescent Climate Centre (2020). Climate Action. Examples from the Red Cross Red Crescent and partners. https://www.climatecentre.org/downloads/files/RCCC_Climate%20Action%20V10.pdf

Reid, H. & Ali, L. (2018). Ecosystem-based approaches to adaptation: strengthening the evidence and informing policy. Research results from the incentive-based Hilsa Conservation Programme, Bangladesh. London: IIED. https://pubs.iied.org/sites/default/files/pdfs/migrate/17625IIED.pdf

Rinaudo, T., Muller, A.,. & Morris, M. (2019). Farmer-Managed Natural Regeneration (FMNR) Manual. World Vision Australia. https://fmnrhub.com.au/wp-content/uploads/2019/03/FMNR-Field-Manual_DIGITAL_FA.pdf

Schipper, L. (2020). Maladaptation: when adaptation to climate change goes very wrong. One Earth 3. https://doi.org/10.1016/j.oneear.2020.09.014

Secretariat of the Convention on Biological Diversity (2019). Voluntary guidelines for the design and effective implementation of ecosystem-based approaches to climate change adaptation and disaster risk reduction and supplementary information. Technical Series No. 93. Montreal. https://www.cbd.int/doc/publications/cbd-ts-93-en.pdf

Seddon, N., Chausson, A., Berry, P., Girardin, C., Smith, A. and Turner, B. (2020). Understanding the value and limits of nature-based solutions to climate change and other global challenges. Phil. Trans. R. Soc. B 375: 20190120. http://dx.doi.org/10.1098/rstb.2019.0120

Shaver E. C., Courtney, C. A., West, J. M., Maynard, J., Hein, M., Wagner, C., Philibotte, J., MacGowan, P., McLeod, I., Boström-Einarsson, L., Bucchianeri, K., Johnston, L., & Koss, J. (2020). A Manager's Guide to Coral Reef Restoration Planning and Design. NOAA Coral Reef Conservation Program. NOAA Technical Memorandum CRCP 36. https://www.coris.noaa.gov/activities/restoration_guide/docs/Shaver2020_NOAA_CRCP_TM36_ManagersGuideToRestorationPlanning.pdf

Shultz, J.M., Russell, J., Espinel, Z. (2005) Epidemiology of Tropical Cyclones: The Dynamics of Disaster, Disease, and Development, *Epidemiologic Reviews*, Volume 27, Issue 1, July 2005, Pages 21–35. https://doi.org/10.1093/epirev/mxi011

Smith, A., Tasnim, T., Irfanullah, H., Turner, B., Chausson, A. and Seddon, N. (2021). Nature-based Solutions in Bangladesh: Evidence of Effectiveness for Addressing Climate Change and Other Sustainable Development Goals. Front. Environ. Sci. 9:737659. https://doi.org/10.3389/fenvs.2021.737659

Tanner, T., Surminski, S., Wilkinson, E., Reid, R., Rentschler, J., Rajput, S. (2015). The triple dividend of resilience. Realising development goals through the multiple benefits of disaster risk management. Overseas development Institute. https://www.gfdrr.org/sites/default/files/publication/The_Triple_Dividend_of_Resilience.pdf

The Nature Conservancy (2021). The Blue Guide to coastal resilience. Protecting coastal communities through nature-based solutions. A handbook for practitioners of disaster risk reduction. The Nature Conservancy. Arlington, VA. https://floodresilience.net/resources/item/the-blue-guide-to-coastal-resilience/

UNDRR (2019). Global Assessment Report on Disaster Risk Reduction 2019. Geneva, United Nations Office for Disaster Risk Reduction (UNDRR). https://gar.undrr.org/sites/default/files/reports/2019-05/full_gar_report.pdf

UNDRR (2021). Nature-based Solutions for Disaster Risk Reduction: Words into Action. Geneva, Switzerland, United Nations Office for Disaster Risk Reduction (UNDRR). https://www.undrr.org/publication/words-action-nature-based-solutions-disaster-risk-reduction

UNDRR (2022). Global Assessment Report on Disaster Risk Reduction 2022. Our world at risk: transforming governance for a resilient future. https://www.undrr.org/gar2022-our-world-risk#container-downloads

UNEP (2019). Ecosystem-based Adaptation: Selected Case studies from Africa. on Mangrove Ecosystem Restoration for the Western Indian Ocean Region. https://wedocs.unep.org/bitstream/handle/20.500.11822/28524/EbaAfrica.pdf?sequence=1&isAllowed=y

UNEP (2020). Guidelines on Mangrove Ecosystem Restoration for the Western Indian Ocean Region. https://wedocs.unep.org/bitstream/handle/20.500.11822/33253/GMER.pdf?sequence=1&isAllowed=y

UNEP (2020a). Emissions Gap Report 2020. https://www.unep.org/emissions-gap-report-2020

UNEP (2021). State of finance for nature. Tripling investments in nature-based solutions by 2030. Nairobi, UNEP. https://www.unep.org/resources/state-finance-nature

Walz, Y., Janzen, S., Narvaez, L., Ortiz-Vargas, A., Woelki, J., Doswald, N. & Sebesvari, Z. (2021). Disaster-related losses of ecosystems and their services. Why and how do losses matter for disaster risk reduction? International Journal of Disaster Risk Reduction 63 https://doi.org/10.1016/j.ijdrr.2021.102425

Wollstein, K., Creutzburg, M., Dunn, C., Johnson, D., O'Connor, C. & Boyd, C. (2022). Toward integrated fire management to promote ecosystem resilience. Rangelands (20):1-8. https://doi.org/10.1016/j.rala.2022.01.001

World Bank (2021). A Catalogue of Nature-Based Solutions for Urban Resilience. World Bank, Washington, DC. https://openknowledge.worldbank.org/handle/10986/36507

Wright, B. & Stuhr, K. (2002). Windbreaks: An agroforestry practice. Agroforestry Notes (USDA-NAC) 25. https://digitalcommons.unl.edu/agroforestnotes/25

WWF (2016). Natural and nature-based flood management: A Green Guide. https://www.worldwildlife.org/publications/natural-and-nature-based-flood-management-a-green-guide

Appendix D
Key resources

The resources listed here are a small selection of manuals and reports that allow you to explore certain aspects more deeply.

Click on the title to view the documents.

COMMUNITY RESILIENCE

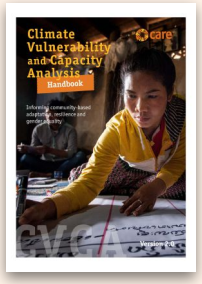
IFRC (2021). The Road Map to Community Resilience v2

This new version of the Road Map integrates the Enhanced Vulnerability and Capacity Assessment (EVCA) and guides through the process of strengthening community resilience.

DEFINING NBS

IUCN (2020). Global Standard for Nature-based Solutions.

This guide illustrates the eight criteria of the global standard with case studies and provides detailed indicators.



COMMUNITY ASSESSMENTS

CARE (2019). Climate vulnerability and capacity analysis handbook

This updated second edition includes a range of great tools for community-based risk assessments. Can be used to complement the IFRC Road Map.

NBS IN COASTAL AREAS

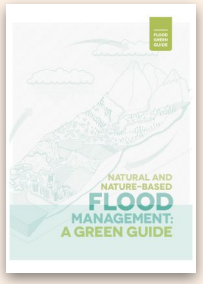
TNC (2021). The Blue Guide to coastal resilience.

A step-by-step guide to using NbS for DRR in coastal areas, the Blue Guide also links to more detailed manuals for specific ecosystems.

OVERVIEW OF NBS

UNDRR (2021) Nature-based Solutions for Disaster Risk Reduction: Words into Action.

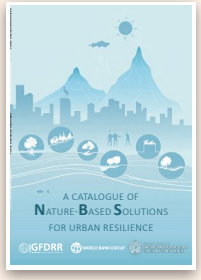
This publication offers an excellent overview of NbS and links to the Sendai Framework. The section on main-streaming and upscaling is useful to link with government policies.



FLOOD MANAGEMENT

WWF (2016): Natural and nature-based flood management: A Green Guide

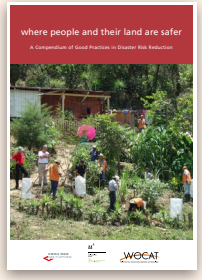
A comprehensive guide for reducing flood risk in different landscapes/ecosystems as well as for specific flood types.



NBS IN URBAN AREAS

World Bank (2021). A Catalogue of Nature-Based Solutions for Urban Resilience.

This book looks at principles on integrating NbS into urban resilience planning, and features a catalogue of 14 solutions for the urban context.



SUSTAINABLE LAND MANAGEMENT

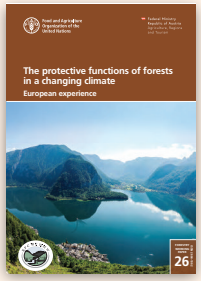
Harari (2017). Where people and their land are safer: A Compendium of Good Practices in Disaster Risk Reduction.

This detailed overview of sustainable land management practices shows how altered practices can reduce disaster risk. Includes very detailed descriptions of practices.

DISASTER COSTS & PROJECTIONS

IFRC (2019): The cost of doing nothing. The humanitarian price of climate change and how it can be avoided

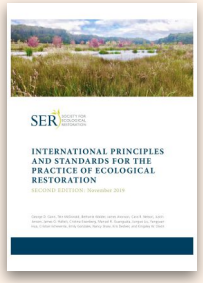
In this report, the IFRC looks at the impact of climate change under different scenarios, and what it means for the humanitarian world.



NBS AND FORESTS

Makino et al. (2021). The protective functions of forests in a changing climate.

This publication highlights how forests can protect people and infrastructure. It contains many detailed country reports from across Europe.



RESTORATION PRINCIPLES

Gann et al. (2019): International principles and standards for the practice of ecological restoration

This standard reference offers excellent guidance on ecological restoration. It also includes great monitoring tools.

DISASTERS & CLIMATE CHANGE

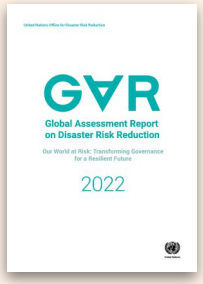
IFRC (2020): Come Heat or High Water. World Disasters Report 2020

The report analyses climate disaster trends and shows how humanitarian impacts of the climate crisis can be tackled.

NBS AND AGRICULTURE

Iseman et al. (2021). Nature-based solutions in agriculture – The case and pathway for adoption.

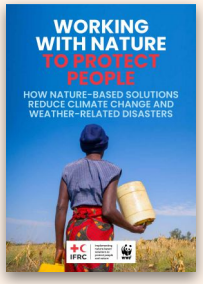
This book offers an overview of NbS for agriculture. It looks at farmer perspectives, policy implications, and includes four case studies.



DISASTER RISK REDUCTION

UNDRR (2022): Global Assessment Report on Disaster Risk Reduction

The status of disaster risk reduction, with an outlook and recommendations.



NBS FOR DRR

IFRC & WWF (2022): Working with nature to protect people.

This new report highlights the power of nature to protect people. It is a call to action for governments, National Societies, organisations, businesses, and communities.

Appendix E
Glossary

Cannot find the term you're looking for?
Explore these glossaries:

- IPBES
- IPCC
- FAO
- UN Terms

Adaptation Source: IPCC 2018: 542	The process of adjustment to actual or expected changes and their effects, in order to moderate harm or exploit beneficial opportunities. Adaptation can be proactive (adjustment to expected changes) or reactive (adjustment to changes that have occurred), or a mixture of both.
Adaptative capacity Source: IPCC 2018: 542	The ability of systems, institutions, humans, and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences.
Agroforestry Source: FAO 2018	The collective term for land-use systems and technologies in which woody perennials (e.g. trees, shrubs, palms or bamboos) and agricultural crops or animals are used deliberately on the same parcel of land in some form of spatial and temporal arrangement.
Biodiversity Source: IPCC 2018:543	Biological diversity means the variability among living organisms from all sources, including, inter alia, terrestrial, marine, and other aquatic *ecosystems* and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.
Climate change Source: IPCC 2018:544	Climate change refers to a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer.
Climate change adaptation	See **adaptation**
Climate change mitigation	See **mitigation**

Community Source: IFRC 2014:10	A community is a group of people who may or may not live within the same area, village or neighbourhood, share a similar culture, habits and resources. Communities are groups of people also exposed to the same threats and risks such as disease, political and economic issues, and natural disasters.
Cost-benefit analysis Source: IPCC 2018: 546	Monetary assessment of all negative and positive impacts associated with a given action. Cost–benefit analysis enables comparison of different interventions, investments or strategies and reveals how a given investment or policy effort pays off for a particular person, community, or country.
Disaster	See **hazard vs. disaster**.
Disaster risk management Source: IPCC 2018: 547	Processes for designing, implementing, and evaluating strategies, policies, and measures to improve the understanding of disaster risk, foster disaster risk reduction and transfer, and promote continuous improvement in disaster preparedness, response and recovery practices, with the explicit purpose of increasing human security, well-being, quality of life and sustainable development.
Disaster risk reduction Source: UNISDR 2015	The policy objective of anticipating and reducing risk is called disaster risk reduction (DRR). Although often used interchangeably with DRR, disaster risk management (DRM) can be thought of as the implementation of DRR, since it describes the actions that aim to achieve the objective of reducing risk.
Ecosystem Source: IPCC 2018: 548	An ecosystem is a functional unit consisting of living organisms, their non-living environment, and the interactions within and between them.
Ecosystem services Source: IPCC 2018: 548	Ecological processes or functions having monetary or non-monetary value to individuals or society at large. These are frequently classified as (1) supporting services such as productivity or biodiversity maintenance, (2) provisioning services such as food or fibre, (3) regulating services such as climate regulation or carbon sequestration, and (4) cultural services such as tourism or spiritual and aesthetic appreciation.
Ecosystem-based adaptation (EbA) Source: CBD 2009	Ecosystem-based adaptation is the use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people to adapt to the adverse effects of climate change.
Ecosystem-based disaster risk reduction (Eco-DRR) Source: PEDRR	Ecosystem-based disaster risk reduction (Eco-DRR) is the sustainable management, conservation, and restoration of ecosystems to provide services that reduce disaster risk by mitigating hazards and by increasing livelihood resilience.
Exposure Source: IPCC 2018:549	The presence of people, livelihoods, species or ecosystems, environmental functions, services, and resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected.

Food security
Source:
FAO 2001

A situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life.

Gender
Source:
USAID, Guide to Gender Integration and Analysis: Additional Help for ADS Chapters.

Gender is a social construct that refers to relations between and among the sexes, based on their relative roles. It encompasses the economic, political, and sociocultural attributes, constraints and opportunities associated with being male or female.

As a social construct, gender varies across cultures and is dynamic and open to change over time. Because of the variation in gender across cultures and over time, gender roles should not be assumed but investigated. Note that "gender" is not interchangeable with "women" or "sex."

Green response & recovery
Source:
IFRC 2020

Green response is all about improving the environmental sustainability of our work and avoiding, minimising, and managing the damage we cause to the environment and climate.

Hazard vs **disaster**
Sources:
IPCC 2018:551*, 547**

A **hazard** is the potential occurrence of a natural or human-induced physical event or trend that may cause loss of life, injury or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems and environmental resources.*

A **disaster**, by contrast, concerns severe alterations in the normal functioning of a community or a society due to hazardous physical events interacting with vulnerable social conditions, leading to widespread adverse human, material, economic or environmental effects that require immediate emergency response to satisfy critical human needs and that may require external support for recovery.**

When a hazard event overwhelms the capacity of a system to cope with its effects, it leads to a disaster.

Landscape
Source:
IPBES

An area of land that contains a mosaic of ecosystems, including human-dominated ecosystems.

Land subsidence
Source:
WWF 2016: 189

Land subsidence occurs when large amounts of groundwater have been withdrawn from certain types of rocks, such as fine-grained sediments. The rock compacts because the water is partly responsible for holding the ground up. When the water is withdrawn, the rock falls in on itself. Land subsidence is most often caused by human activities, mainly the removal of subsurface water.

Livelihoods
Source:
IPCC 2018: 553

The resources used and the activities undertaken in order to live. Livelihoods are usually determined by the entitlements as well as the human, social, natural, physical and financial assets to which people have access.

Mitigation
Sources:
(1) IPCC 2018: 554
(2) UNISDR 2017

The term mitigation is used in in two different ways.

(1) In the context of **climate change**, it refers to human interventions to reduce emissions or enhance the sinks of greenhouse gases.

(2) In the context of **disaster risk management**, it refers to the lessening or limitation of the adverse impacts of hazards and related disasters. For instance, constructing flood defences, planting trees to stabilise slopes and implementing strict land use and building construction codes.

Natural resources
Source:
UN Terms

Naturally occurring resources such as land, water resources, uncultivated forests and deposits of minerals that have an economic value.

Natural resource management
Source:
UN Terms

The management of natural resources to bring into being development that is economically viable, socially beneficial, and ecologically sustainable.

Nature-based solutions
Source:
IUCN 2016

Actions to protect, sustainably manage and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits.

Common societal challenges are climate change, food security, disaster risks, water security, social and economic development as well as human health.

Preparedness (disaster preparedness)
Source:
UNISDR 2017

The knowledge and capacities of governments, professional response and recovery organisations, communities and individuals to effectively anticipate, respond to and recover from the impacts of likely, imminent or current hazard events or conditions. For instance, installing early warning systems, identifying evacuation routes and preparing emergency supplies.

Resilience
Sources:
Walker & Salt 2005:1
IFRC 2014: 6

DescriptionResilience is the ability of a system to cope with adverse impact and return to a state that allows it to resume its original functions.

Community resilience is the ability of communities to anticipate, prepare for, reduce the impact of, cope with and recover from the effects of shocks and stresses without compromising their long-term prospects.

Risk Source: IPCC 2018: 557	The potential for adverse consequences where something of value is at stake and where the occurrence and degree of an outcome is uncertain. Risk results from the interaction of vulnerability (of the affected system), its exposure over time (to the hazard), as well as the (climate-related) hazard and the likelihood of its occurrence.
Sensitivity	The quality or state of a system to be receptive to an external stimulus. In the context of disaster risk management and climate change, sensitivity refers to the susceptibility of a system to be affected by a hazard or stressor. For instance, making buildings, infrastructure, systems, business, livelihoods and households more robust means they are less sensitive and can better withstand direct physical effects.
Shocks Source: CARE 2019:7	Shocks are short-term events or disruptions that have negative effects on people's well-being, assets, livelihoods, safety or their ability to withstand future shocks. Rapid-onset hazards such as earthquakes, cyclones and floods, as well as economic crises, industrial accidents and terror attacks are examples.
Stewardship (environmental)	The responsible use and protection of the natural environment through conservation and sustainable practices.
Stresses Source: CARE 2019: 7	Stresses are continuous, long-term trends or pressures that negatively impact people's lives and the systems they live in.
Sustainability Sources: OECD 2010:36	The ability to be maintained at a certain rate or level. The term has two connotations: From a **project management** perspective, it refers to the continuation of benefits from a development intervention after major development assistance has been completed. Project outcomes are likely to be sustained if local actors are willing and able to pursue the activities underpinning the outcome. In **ecology**, sustainability refers to the avoidance of the depletion of natural resources in order to maintain an ecological balance.
Vulnerability Sources: IPCC 2018: 560 CARE 2019:7	The propensity or predisposition to be adversely affected. Vulnerability to the same risks may differ based on gender, wealth, mobility, and other factors. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.

A creek runs through rice terraces on Sumbawa island, Indonesia
Photo: Patrick Bolte, Banyaneer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