IUCN | French Committee

Nature-based Solutions for Climate Change Adaptation & Disaster Risk Reduction






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EXECUTIVE SUMMARY

Climate change is one of the major challenge we have to face together with biodiversity loss. IPCC and IPBES global reports underline the wide and diverse range of climate change effects expected on our societies and ecosystems, and the magnitude of the Earth's sixth mass extinction. In addition, both climate and biodiversity are linked. Over 80% of ecological processes are impacted by climate change while nearly 40% of the mitigation needed to meet the 2°C Paris goal can be provided by nature-based solutions.

Nature-based Solutions are actions to protect, sustainably manage and restore ecosystems to answer both societal challenges and biodiversity conservation. They are flexible and adaptable, cost-effective and bring multiple benefits. This umbrella concept encompasses existing approaches such as ecological restoration, ecological engineering, ecosystem-based adaptation, ecosystem-based mitigation or ecosystem-based disaster risk reduction for example.

This publication documents the importance of biodiversity in climate resilience and makes a case for the implementation of joint approaches that contribute to both biodiversity conservation and climate change adaption and disaster risk reduction. Assessments of local and regional experiences on Nature-based Solutions also highlight the opportunities and entry-points to scale-up integrated approaches.

The 1st part of this report provides a conceptual background on the importance of biodiversity in climate change adaptation and disaster risk reduction, specifies the definition of Nature-based Solutions, existing associated concepts and the role protected areas can play as Nature-based Solutions.

The second part of this report underlines opportunities to mainstream Nature-based Solutions (NbS) as a crosscutting issue into policy and practice. It provides examples of local and regional initiatives in countries involved in the G20 implementing Nature-based Solutions, and highlights key challenges and recommendations to implement this integrated approach.

This report identifies 3 main drivers to scale-up the implementation of Nature-based Solutions:

First, existing projects must highlight Nature-based Solutions benefits in order to raise stakeholders' awareness on their many benefits for climate change adaption and biodiversity conservation but also on other co-benefits such as landscape maintenance or improvement, enhanced living environment, places for recreational or tourism activities...

Second, Nature-based Solutions are interdisciplinary as they address climate and/or disaster risk and biodiversity issues within a same project. These solutions require thus an integrated strategic planning including broad collaboration with local stakeholders and the implementation of a governance process involving the sharing and reconciling of project goals.
Nature-based Solutions can help to streamline sectoral policies by reconciling challenges and stakeholders. One way to implement the streamlining process is to integrate these solutions into strategies for action on climate and disaster risk reduction.

And third, various financial resources must be mobilised for ecosystem preservation, restoration or sustainable management projects with regard to the benefits they provide for climate change mitigation and adaptation. This funding must ensure the project's sustainability and therefore be a long-term process.
In highlighting the contribution of Nature-based Solution projects to climate change adaptation and disaster risk reduction, these projects can ask for other funding sources than those typically dedicated to biodiversity preservation projects, such as climate funds, disaster risks funds, etc. Innovative financial tools can also be used to support Nature-based Solutions. They are based on private and public funding, involving stakeholders on a broader scale including citizens and Nature-based Solution beneficiaries. Among these mechanisms, some examples of interest are: climate or green bond, payment for ecosystem services, eco-conditionality of public financial support, crowdfunding.

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CONTEXT

Humankind is presently facing two major challenges: climate change and biodiversity loss. Both are impacting our societies and modifying our environment. These crises are interconnected and cannot be resolved separately.

According to IPCC assessments[1], a wide and diverse range of climate change effects is to be expected on humankind and ecosystems:

o Exacerbated climatic events, such as change in rate, intensity, geographical distribution and duration of extreme weather conditions

o Disruption of many ecosystems (change in their functioning, in species and natural habitat ranges, increased desertification, ocean acidification…) potentially leading to the extinction of 20 to 30% of animal and plant species

o Food resource-related crises (decline of agricultural production, fishing…)

o Health hazards

o Population displacements related to the sea-level rise and desertification of specific areas.

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In the mean time the 2019 IPBES Global Assessment Report on Biodiversity and Ecosystem Services[2] states that around 1 million animal and plant species are now threatened with extinction, more than ever before in human history. Three-quarters of the land-based environment and about 66% of the marine environment have been significantly altered by human actions.
In addition to these major evidence of biodiversity decline, IPBES experts have identified five direct drivers of change in nature with the largest relative global impacts so far. These threats are, in descending order: (1) changes in land and sea use; (2) direct exploitation of organisms; (3) climate change; (4) pollution and (5) invasive alien species.

Climate change is now recognised as the third main threat to biodiversity, but biodiversity can help the mitigation and the adaptation of our societies to climate change. Nature based Solutions is a key concept aiming at promoting the solutions to this challenge (and others) provided by nature. Indeed, terrestrial and marine ecosystems play an important role in the global carbon cycle and, when adequately preserved, act as carbon sinks and stores. Worldwide, natural ecosystems absorb about half of CO_2 emissions generated by human activities each year[3].
In addition, functioning ecosystems have a buffer effect on climate and reduce the risks and impacts of extreme events such as storms, landslides and floods. Mountain forests for example contribute to soil stabilisation, and reduce the risk of landslides, thanks to the tree roots. Wetlands regulate flooding and protect water resources during droughts and mangroves and dunes act as natural barriers against winds and coastal erosion. These roles played by ecosystems are dependent on their ecological status and resilience.

A decisive step in the fight against climate change was taken in December 2015 during the 21st Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC – COP21). On this occasion, the States committed to maintain global warming below 2°C, compared to pre-industrial levels. They adopted the Paris Agreement on climate change, which has now come into force. This agreement clearly recognises the role played by forests, oceans and other natural ecosystems in absorbing carbon emissions and providing support for climate change adaptation of societies. This international agreement also reasserts the importance of maintaining the integrity of all ecosystems and protecting biodiversity when acting to fight against climate change.

In line with mobilisation to meet the climate challenge, States should now mobilise to the same level in order to meet the challenge of biodiversity loss, and Nature-based Solutions can jointly meet both of these challenges. They definitely play a key role in climate change mitigation and adaptation and provide real opportunities for reducing natural hazards.

Following its involvement on Nature-based Solutions (NbS) started at the COP21, the French Committee of IUCN is hereby publishing this report taking advantage on the momentum on biodiversity. Indeed, after the IPBES report release, environmental ministers of the G7 countries adopted in May 2019 the Metz charter on biodiversity[4] promoting the deployment of Nature-based Solutions for societal challenges.
This supports France's contribution to the G20 Climate Sustainability Working Group Adaptation Work Program (2018-2019), put forward under the Argentinian G20 presidency in 2018, and as mandated in the G20 Hamburg Climate and Energy Action Plan for Growth, put forward under the G20 presidency of Germany in 2017.

We hope this report will help advance further the activities of the working group under the Japanese G20 presidency, help to demonstrate the importance of Nature-based Solutions for climate change adaptation, and bring new commitments of the G20 after those of the G7.

[1] IPCC, 2014. Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp.

[2] https://www.ipbes.net/news/Media-Release-Global-Assessment

[3] European Commission, 2009. Nature's role in climate change.

[4] https://www.ecologique-solidaire.gouv.fr/sites/default/files/2019.05.06_EN_Biodiversity_Charter_Final.pdf

NATURE-BASED SOLUTIONS: DEFINITION AND CONCEPT

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1

What are Nature-based Solutions?

Nature-based Solutions are defined as 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[5].

This report focuses on climate change and disaster risk challenges, yet other major societal challenges can be addressed by Nature-based Solutions, e.g., human health, food security, water security, or sustainable socioeconomic development.

NATURE-BASED SOLUTIONS CONSIST OF THREE TYPES OF ACTIONS, WHICH CAN BE COMBINED WITHIN TERRITORIES:

- **preserving functional ecosystems in good ecological status;**
- **improving ecosystem management for sustainable use by human activities;**
- **restoring degraded ecosystems or creating ecosystems.**

5 IUCN, 2016. Motion 77: Defining Nature-based Solutions. https://portals.iucn.org/congress/motion/077

Figure 1: Nature-based Solutions refer to a concept encompassing various ecosystem-based approaches [6]

6 Cohen-Shacham E., Walters G., Janzen C. and Maginnis S. (eds.), 2016. Nature-based Solutions to address global societal challenges. Gland, Switzerland: IUCN. xiii + 97pp.

Whether terrestrial, coastal or marine, ecosystems that are healthy, resilient[7], functional and diversified can undoubtedly contribute to fighting against climate change, reducing disaster risks and achieving the sustainable development goals adopted in 2015[8].

The concept of Nature-based Solutions arose, spearheaded by the IUCN, during the 2009 Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) in Copenhagen, when forests were put forward as one of the solutions for climate change mitigation through the implementation of the REDD programme (Reducing Emissions from Deforestation and Forest Degradation). Consequently, IUCN included in 2013 the development and promotion of Nature-based Solutions as one of the three axes of its global programme. In 2015, the role of Nature-based Solutions was recognised in the Paris Agreement. In 2016, during IUCN World Conservation Congress, the IUCN General Assembly adopted a recommendation defining[9] Nature-based Solutions and another requesting States to integrate Nature-based Solutions into their climate change strategies[10].

Nature-based Solutions consist of three types of actions, which can be combined within territories:
• preserving functional ecosystems in good ecological status;
• improving ecosystem management for sustainable use by human activities;
• restoring degraded ecosystems or creating ecosystems.

Nature-based Solutions are an economically viable and sustainable option, generally more cost-efficient in the long term than technological investments or infrastructure construction and maintenance. Implementing these flexible and adaptable solutions can also avoid impacts on natural environments related to conventional engineered infrastructures, and allows to take action by adapting implemented measures to climate uncertainties. Finally, they provide benefits for biodiversity by integrating this goal into action design and implementation.

In order to be effective and to produce significant outcomes, these solutions should be implemented on an appropriate spatial scale and in the long term. Benefits generated by the protection, sustainable management or restoration of ecosystems are in fact not always immediately noticeable, and all actions implemented should take into consideration an area enabling optimal ecosystem functioning. Furthermore, the challenges met by these actions are also time-scaled in the long run.

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THE IMPLEMENTATION OF NBS HAS TO CONSIDER 8 CORE PRINCIPLES[11]:

1 They embrace nature conservation norms (and principles);

2 They can be implemented alone or in an integrated manner with other solutions to societal challenges (e.g., technological and engineering solutions); Implementing a joint project combining ecosystem preservation and artificial infrastructures can optimise the infrastructure's performance and reduce its cost. For instance, a dam will benefit from the presence of a forest, which will stabilise soil and reduce erosion[10];

3 They are determined by site-specific natural and cultural contexts that include traditional, local and scientific knowledge;

4 They produce societal benefits in a fair and equitable way, in a manner that promotes transparency and broad participation;

5 They maintain biological and cultural diversity and the ability of ecosystems to evolve over time;

6 They are applied at a landscape scale;

7 They recognise and address the trade-offs between the production of a few immediate economic benefits for development, and future options for the production of the full range of ecosystems services;

8 They are an integral part of the overall design of policies, and measures or actions, to address a specific challenge.

[7] Ability to recover from changes.

[8] Sustainable Development Goals of the 2030 Agenda for Sustainable Development: www.un.org/sustainabledevelopment/sustainable-development-goals/

[9] IUCN, 2016. Motion 77: Defining Nature-based Solutions. https://portals.iucn.org/congress/motion/077

[10] IUCN, 2016. Motion 62: Integration of Nature-based Solutions into strategies to combat climate change. https://portals.iucn.org/congress/motion/062

[11] Ability to recover from changes.

2

How to identify Nature-based Solutions?

A NATURE-BASED SOLUTION MUST MEET THE TWO FOLLOWING CRITERIA:

• Directly contribute to a societal challenge, other than the conservation of biodiversity;

• Rely on ecosystems and produce benefits for biodiversity.

For a project to be a Nature-based Solution, it must be implemented both in order to respond to a societal challenge (other than biodiversity conservation) and to provide benefits for biodiversity. Project implementation must involve one or several of the three types of Nature-based Solutions actions: ecosystem protection, sustainable management, restoration. It is essential to monitor and assess the project's actual contribution to the targeted challenge(s).

Protected areas can be Nature-based Solutions insofar as they make an identified contribution to one of the listed challenges (climate change, disaster risk reduction, health, food security, water supply, or socioeconomic development). They can provide special areas for implementing actions that are Nature-based Solutions, particularly in IUCN protected areas categories V and VI, where human activities contribute to nature conservation.

Solutions inspired by nature or using natural resources without taking into account ecosystem conservation and benefits for biodiversity are not Nature-based Solutions. The use of natural resources for renewable energy production with no direct benefits for biodiversity will not be considered as a Nature-based Solution (for example, the use of fuelwood at the expense of forest ecosystem functioning and forest biodiversity).
As for biomimicry[12], it is not a Nature-based Solution according to the IUCN definition, because it is not directly dependent on ecosystem functioning and it does not necessarily provide direct benefits for biodiversity.

To enable effective transfer of NbS approaches from pilot to larger scale and to make this concept useful in planning and implementing society's responses to important challenges, IUCN members adopted a common definition and requested guidance to its application at the 2016 IUCN World Conservation Congress.

In line with the adopted definition, the IUCN is now working on a global Nature-based Solutions standard. The purpose of the standard is to generate a common understanding and consensus on what constitutes a good NbS. It will provide a straightforward yet robust hands-on tool that informs the planning, design and implementation of an NbS. The draft NbS standard currently comprise seven criteria, each of which is composed of several indicators. Based on the last version of the standard for the public consultation of spring 2019, **the criteria encompass the following topics:**

- **type of action and societal challenges,**
- **governance,**
- **benefits and trade-offs,**
- **scale of implementation,**
- **integration into politics and strategies.**

The criteria and indicators are not sequential, but are interrelated. Some indicators are related to processes and practices and others to outcomes, in order to cover all aspects that contribute to well-defined and, ultimately, successful NbS.

The standard's users are intended to include governments and authorities at all levels, non-governmental organisations, private companies, the financial sector and local communities - basically all stakeholders that may be the creators or implementers of NbS.
The self-assessment in respect of NbS standard should be carried out at different stages of the project cycle, to help identify non-anticipated outputs, weaknesses and strengths in order to improve or alleviate them. Therefore, the assessment should not be regarded as a judgement on an NbS project. Rather, it aims to ensure the delivery of anticipated societal benefits without compromising on nature. The self-assessment might use a traffic light system to indicate the status of the various indicators listed, whereby green shows that an indicator is fully carried out, orange suggests it is partially reached and red, no achievement.

Concurrently and in collaboration with IUCN Secretariat, the IUCN French Committee is working on guidelines to implement Nature-based Solutions for stakeholders and decision-makers. Since 2017, French experts have been working on the definition of these criteria and contribute to the global standard. They are currently working on a stakeholders' guide translating the standard in 7 questions that a project leader will have to respond to, for it to be considered as a Nature-based Solution.

Both of these projects will be launched at the IUCN World Conservation Congress in Marseille in June 2020.

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[12] A new science that studies nature's models and then imitates or takes inspiration from these designs and processes to solve human problems (Benyus J.M., 1997. Biomimicry : innovation inspired by nature. William Morrow and Co.)

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3

Nature-based Solutions an umbrella concept

Nature-based Solutions bring together various existing approaches such as ecological restoration, ecological engineering, green infrastructure, ecosystem-based management, forest landscape restoration, ecosystem-based adaptation, ecosystem-based mitigation and ecosystem-based disaster risk reduction[13]. These approaches match Nature-based Solutions if they are implemented to address a major societal challenge while providing benefits for biodiversity.

Several of these approaches are briefly defined below and illustrated with specific cases responding to the climate change and disaster risk reduction challenges:

ER

Ecological Restoration (ER) *is an intentional activity that initiates or accelerates the recovery of an ecosystem, which has been degraded, damaged or destroyed, with respect to its health, integrity and sustainability[14]. A fundamental distinction between ecological restoration and other forms of ecosystem repair is that ecological restoration seeks to assist recovery of an ecosystem rather than impose a new direction or form upon it. Ecological restoration aims to reach a reference ecosystem, which represents the site's ecosystem as it would be, had degradation not occurred, while incorporating capacity for the ecosystem to adapt to existing and anticipated environmental changes. Projects that focus solely on reinstating some form of an ecosystem functionality proportion of the native biota found in an appropriate native reference ecosystem would be best described as rehabilitation[15].*

For instance, restoring a drained and exploited peatland that could store carbon when it was in good conservation status is a Nature-based Solution, which enhances climate change mitigation.

EE

Ecological Engineering (EE) *involves the handling of natural materials, living organisms and physico-chemical environments to meet specific needs and address technical issues. It is based on the optimisation of ecosystem services provision.*
These actions can apply to ecosystem maintenance, restoration, rehabilitation and reallocation. Ecological engineering, unlike restoration, is not based on aiming at a reference status[16].

The case of a marram grass plantation on a dune for sand stabilisation and to help the ecosystem act as a buffer against erosion and marine submersion is a Nature-based Solution, achieving disaster risk reduction and using ecological engineering.

GI

Green Infrastructure (GI) *is a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services in both rural and urban settings[17]. Green infrastructures are particularly important in urban ecosystems, as they allow for natural or semi-natural areas to interconnect.*

Such projects could significantly reduce rising temperatures associated with climate change and the urban island effect, by means of additional green spaces.[18]

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EbMgt

Ecosystem-based Management (EbMgt) *is management driven by explicit goals, executed by policies, protocols, and practices. It is made adaptable by monitoring and research based on our best understanding of the ecological interactions and processes necessary to sustain ecosystem composition, structure, and function. Its purpose is to maintain healthy ecosystems and ensure their long-term resilience while enabling the sustainable use of their ecosystem goods and services[19] by human societies, thereby contributing to their well-being. This ecosystem approach seeks to address issues as a whole rather than individually by working on one particular species or ecosystem service. It thus requires to be implemented in a broad geographical scope.*

Integrated coastal area management illustrates ecosystem-based management, which can contribute to reducing coastal hazards (such as marine submersion) by means of coastal ecosystem protection (dunes, coral reefs, mangroves). It aims to combine the development of multiple activities existing in these areas with environmental preservation.

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FLR

Forest Landscape Restoration[20] (FLR) *is a process aiming at restoring an optimal balance of ecological, social and economic benefits provided by forests and trees in a landscape with a variety of uses. The aim is to restore the ecosystem's functions in order to meet present and future needs, and to provide multiples benefits that contribute to human well-being.*
It can be implemented through various actions, including forest restoration, plantation, natural regeneration, improved land management, agroforestry...
The «Bonn Challenge», which aims to restore 150 million hectares of degraded land and forest by 2020, contributes to making this concept operational and currently brings together 20 countries worldwide.

Degraded-forest restoration, by planting new local tree species and recreating diverse natural habitats, enables greater carbon capture, which contributes to climate change mitigation while enhancing forest biodiversity.

[13] Cohen-Shacham E., Walters G., Janzen C. and Maginnis S. (eds.), 2016. Nature-based Solutions to address global societal challenges. Gland, Switzerland: IUCN. xiii + 97pp..

[14] SER, 2004. The SER (Society for Ecological Restoration International Science and Policy Working Group) International Primer on Ecological Restoration.

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McLeod, K. L., Lubchenco J., Palumbi S. R., and Rosenberg A. A., 2005. Scientific Consensus Statement on Marine Ecosystem-Based Management. Signed by 221 academic scientists and policy experts with relevant expertise and published by the Communication Partnership for Science and the Sea.

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Mansourian S., Vallauri D. and Dudley N. (eds.), 2005. Forest Restoration in Landscapes: Beyond Planting Trees, Springer, New York, USA.

EbA

Ecosystem-based Adaptation (EbA)[21] *is the use of biodiversity and ecosystem services as part of an overall adaptation strategy in order to help populations to adapt to climate change*[22]*. It aims at maintaining and improving resilience, and at reducing the vulnerability of ecosystems and individuals in the event of harmful climate change effects.*

EbM

Ecosystem-based Mitigation (EbM) *is the use of biodiversity and ecosystem services to capture and store greenhouse gases. It contributes to climate change mitigation.*

Eco DRR

Ecosystem-based Disaster Risk Reduction (Eco-DRR) *refers to ecosystem protection, sustainable management and restoration in order to reduce natural disaster risks. Ecosystems can indeed contribute to soil stability thanks to the plant roots and thereby limit landslides, and also act as a buffer against storm damage, store and absorb water excess during floods, restrain the spread of fires and reduce coastal erosion. This emerging concept is linked to ecosystem-based adaptation, yet it focuses on natural disasters that may or may not be related to climate change*[23]*.*

Different approaches can be combined into one Nature-based Solution project. Indeed, initiatives combining ecological restoration and ecological engineering, for instance, commonly occur. The figure 2 summarises the connections between these approaches and the Nature-based Solution category listed in the figure 1 (page 9).

Ecosystem protection relies particularly on the approach of protected areas, which are clearly defined geographical spaces, recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural value[24]. These protected areas rely on regulatory, contractual or land protection.

For example, creating and managing a nature reserve to protect a mangrove can contribute to reducing an area's coastal disaster risk and to protecting its underlying human challenges, while preserving biodiversity.

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[21] IUCN, 2009. Ecosystem-based Adaptation (EbA). Position paper for the fifteenth session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP 15).

[22] CBD, 2009. Connecting biodiversity and climate change mitigation and adaptation. Report of the 2nd meeting of the Ad Hoc Technical Expert Group on Biodiversity and Climate Change.

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Figure 2: Nature-based Solution categories and examples [25]

Nature-based Solution Category	Examples of associated approaches
ECOSYSTEM RESTORATION	Ecological restoration
	Ecological engineering
	Forest landscape restoration
ECOSYTEM-BASED MANAGEMENT	Integrated coastal area management
	Integrated water resource management
ECOSYSTEM PROTECTION	Conservation including protected area management
ISSUE-SPECIFIC	Ecosystem-based adaptation
	Ecosystem-based mitigation
	Ecosystem-based risk reduction
INFRASTRUCTURE	Green infrastructure

25 Cohen-Shacham E., Walters G., Janzen C. and Maginnis S. (eds.), 2016. Nature-based Solutions to address global societal challenges. Gland, Switzerland: IUCN. xiii + 97pp.

The above table (figure2) includes the five categories of Nature-based Solutions defined in the figure 1, comprising the 3 Nature-based Solution categories specified in page 9 (ecosystem preservation, sustainable management and restoration), and 2 additional ones (issue-specific and infrastructure), which are approaches generally combining several of the 3 previous categories.

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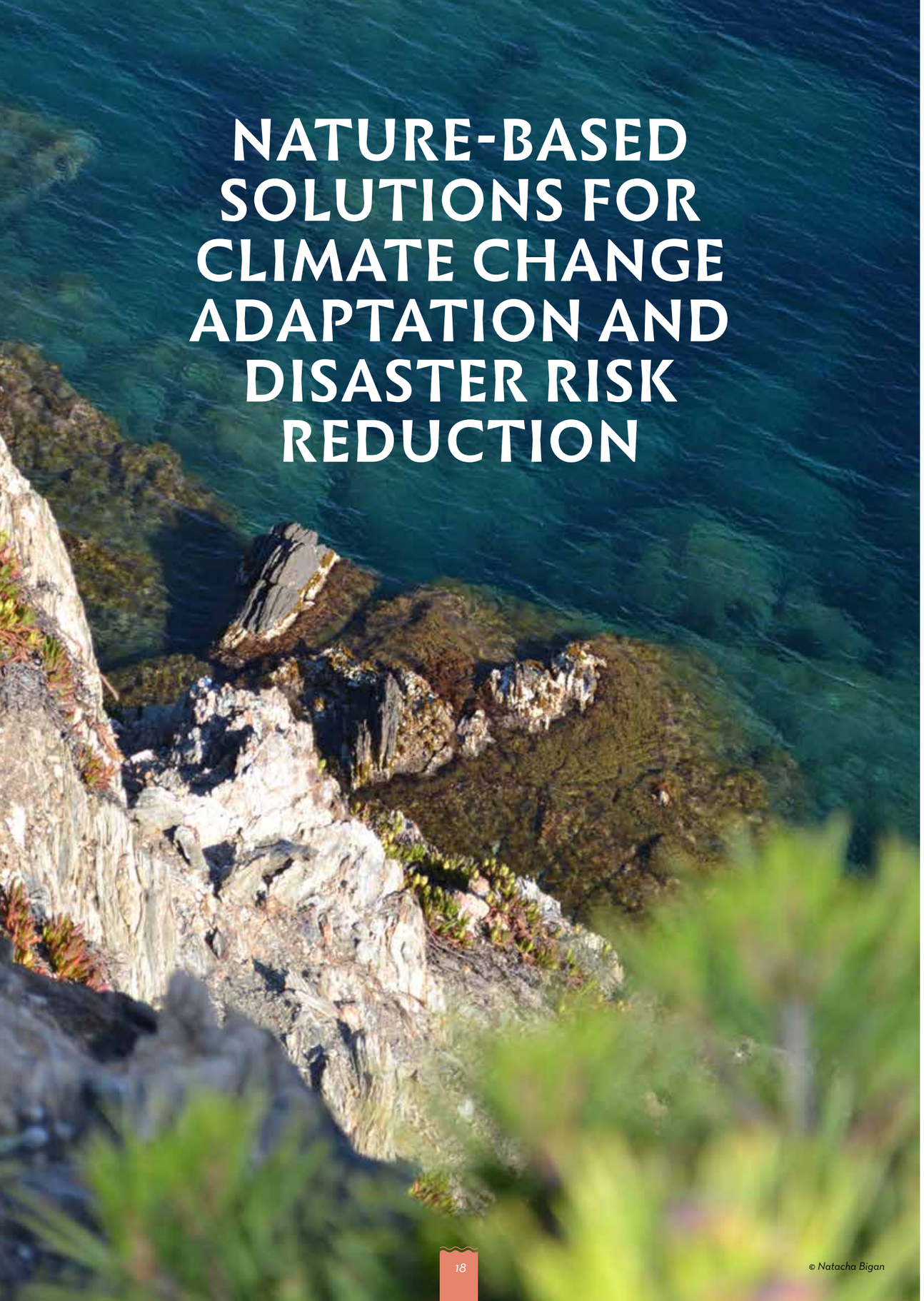
NATURE-BASED SOLUTIONS FOR CLIMATE CHANGE ADAPTATION AND DISASTER RISK REDUCTION



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1

Biodiversity and climate: interdependent processes

Climate defines and influences living conditions around the world. Any change in the climate regime will thus have effects on living beings, their geographical distribution, ecosystem functioning and the biochemical cycles to which they contribute.

At the same time, biodiversity and ecosystems influence climate and in particular contribute to temperature and rainfall regulation.
Terrestrial and marine ecosystems play a crucial part in the global climate system by contributing to biosphere-atmosphere interactions involving energy, water, matter and carbon cycle (key component of organic matter that constitutes living beings). They also provide the world's main natural carbon stores and absorb most of human activity-generated heat.

Ecosystems' various living components are the basis for gas exchange with the atmosphere mainly through the photosynthesis and respiration processes. Thanks to plants, photosynthesis enables organic matter production and therefore carbon capture and storage in all living organisms and throughout trophic webs. In addition, evapotranspiration enables air cooling[26].

Marine ecosystems play a major role in energy exchanges with the atmosphere. Indeed, the ocean absorbs, stores and conveys solar energy and influences air temperature and atmospheric circulation. The ocean's ability to store this heat is very effective (absorption of 93% of excess energy resulting from the increase in greenhouse gas concentration in the atmosphere due to human activities) and much greater than that of continents (3%) and the atmosphere (1%)[27]. The ocean returns this heat more slowly than continents and contributes to coastal areas' more temperate climate. Hence, the ocean is an essential climate regulator[28].
This excess heat stored in oceans, together with the increase in absorbed carbon, nonetheless has serious consequences for the ocean's properties and dynamics, for its interaction with the atmosphere, and for marine ecosystems (changes in currents, acidification, marine biodiversity modification and loss...)[29].

Climate-biodiversity feedback accounts for the environment in which human societies have developed. This dynamic balance is currently affected both by climate and ecosystems alteration, with increasingly severe consequences. Strategies and actions to fight against climate change should not only significantly reduce greenhouse gas emissions to limit its impacts, but also invest in the preservation of ecosystems that contribute to (i) mitigating these changes and (ii) human societies adapting to their effects.

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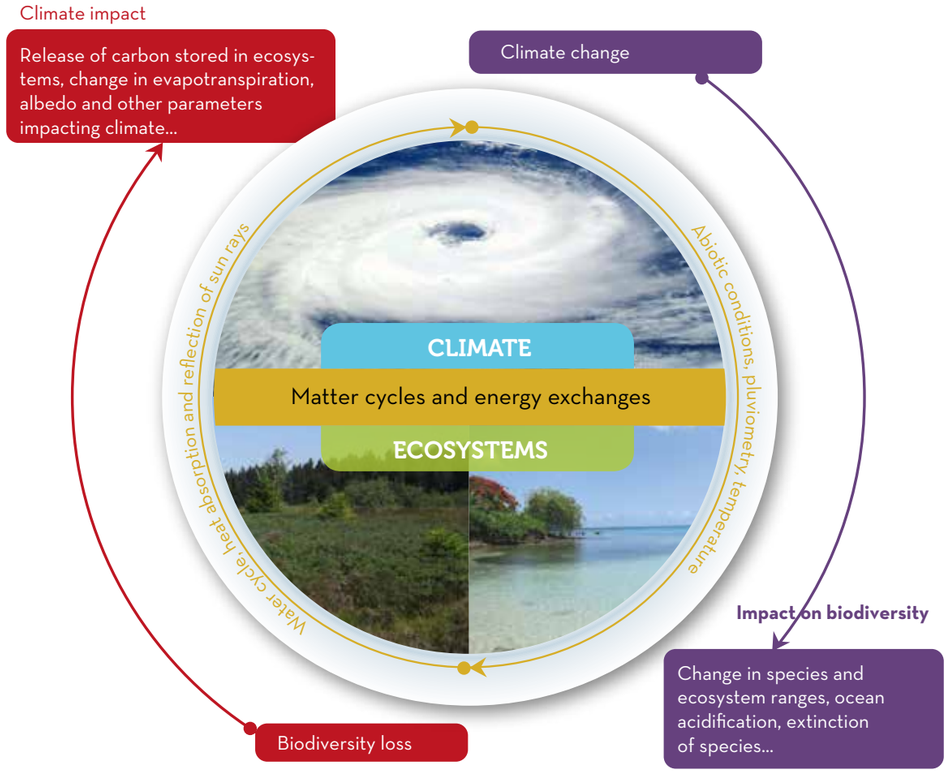
[26] Campbell A., Kapos V., Scharlemann J. P. W., Bubb P., Chenery A., Coad L., Dickson B., Doswald N., Khan M. S. I., Kershaw F. and Rashid M., 2009. Review of the Literature on the Links between Biodiversity and Climate Change: Impacts, Adaptation and Mitigation. Secretariat of the Convention on Biological Diversity, Montreal. Technical Series No. 42, 124 pages.

[27] Ocean & Climate platform, 2015. Ocean, heat reservoir. www.ocean-climate.org.

[28] Ocean & Climate platform, 2015. Ibid.

[29] Laffoley, D. & Baxter, J. M. (editors), 2016. Explaining ocean warming: Causes, scale, effects and consequences. Full report. Gland, Switzerland: IUCN. 456 pp.

Figure 3: Biodiversity-climate interactions: in yellow, interactions under normal conditions; in red, consequences of biodiversity loss for climate; and in purple, consequences of climate change for biodiversity. Both disturbances will modify ecosystem/climate interactions.



2 Ecosystem-based mitigation

Ecosystems play a central part in the global matter cycle, and in particular that of carbon and water, due to ecological processes and physico-chemical mechanisms such as ocean circulation and water infiltration into the soil, or biological mechanisms such as photosynthesis (figure 3).

Ecosystem alteration and land-use changes thus generate changes in matter and energy exchanges, thereby affecting environments' abiotic characteristics (Earth's surface temperature, air humidity, albedo, soil permeability, carbon stock...)[30]. For instance, studies carried out in Australia revealed that the replacement of a region's forests by farm plots modified local bioclimatic parameters: cloud formation above the deforested area was reduced and resulted in a decrease in rainfall over that area[31]. The clearing work, which involved 13 million hectares of forest, thus required irrigating farm plots, while clouds still form above the forest area nearby[32]. More examples illustrate the forest cover's role in regulating rainfall and temperature[33].

Climate change mitigation thanks to Nature-based Solutions is thus related to ecosystems' ability to capture and store carbon. Forests, mangroves, and peatlands capture and store a significant amount of carbon. This carbon is stored both in living matter (aerial and underground parts) and in soil[34], in different forms. Indeed, carbon is stored in soil in the form of free organic matter, rapidly decaying (several years at most), or in the form of organic matter trapped in soil aggregates, or bound to soil minerals. The time extent of carbon sequestration in the soil is particularly longer than in the aerial parts of ecosystems, ranging from a decade to a millennium.

At a global level, in all forests (tropical, temperate and boreal), approximately 31% of the carbon stored is in the biomass and 69% in the soil. Preserving forest soil, and vegetation-covered soil in general, is thus a major issue for long-term carbon storage.

Peatlands also constitute one of the main carbon storage issue due to the fact that, within relatively

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small surface areas on a global scale (3% of land surface), they comprise twice as much carbon as forests overall[35].

Besides these terrestrial ecosystems, the ocean also plays a key part in the carbon cycle. Indeed, ocean carbon is both captured by physico-chemical processes and also stored in living matter, either by reaction with calcium to form mineral limestone-based ($CaCO_3$) skeletons and shells of some marine organisms, or by accumulation within the food web interconnecting the various living marine organisms. Marine ecosystems thereby absorb a quarter of human activity-generated CO_2 every year[36]. They form the largest living carbon stores and their carbon concentration is 50 times higher than the atmosphere's (figure 4).

Figure 4: Distribution of global carbon stocks (in Gigatons)[38]

DYNAMIC RESERVOIRS	***Atmosphere***	760 Gt_c in CO_2 10 Gt_c in methane CH_4
	Biosphere	610 Gt_c in plant and animal ordanic matter
	Hydrosphere	39,000 Gt_c mainly dissolved in oceans
NON DYNAMIC RESERVOIRS	50,000,000 Gt_c in sediment, rocks and fossil fuels	

© Hirbec

[30] Orée, 2015. Climat et biodiversité. Enjeux et pistes de solutions. Acteurs d'aujourd'hui et de demain à la croisée des enjeux du climat et de la biodiversité.

[31] Lyon T.J., 2002. Clouds form preferentially over native vegetation. School of Environmental Science, Murdoch University.

[32] FRB, 2015. Climat et biodiversité – Meeting with IPCC and IPBES French experts. Scientific conference overview. 6 November 2014.

[33] Foley et al., 2005. Global consequences of land use. Science 309, 570.

[34] FAO, 2003. Instruments related to the United Nations Framework Convention on Climate Change and their potential for sustainable forest management in Africa.

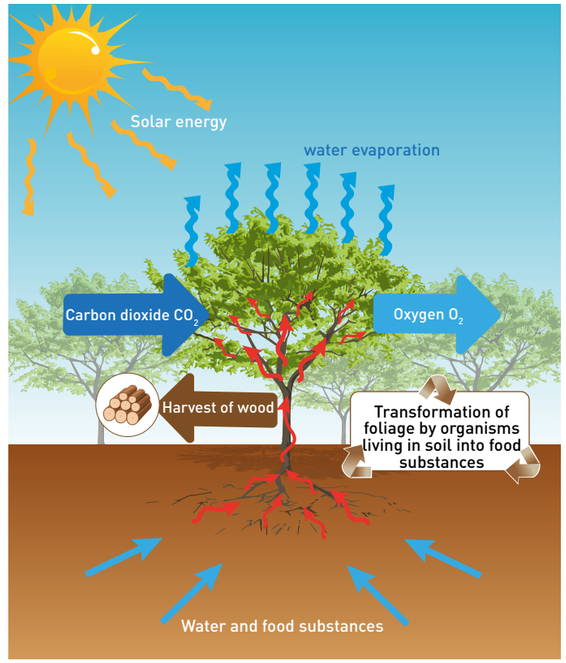
[35] Nitrogen pollution and climate change reduce carbon storage and biodiversity of peatlands. Biodiversa Policy Brief. www.biodiversa.org/policybriefs

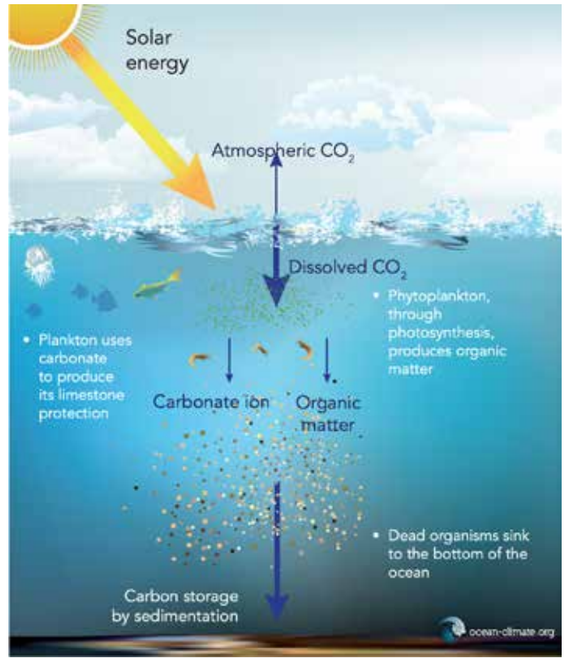
[36] The interactions between ocean and climate. Ocean & Climate platform. ocean-climate.org

[37] http://www.environnement.public.lu/forets/dossiers/climat/changement_et_foret/index.html

[38] CNRS website. http://www.cnrs.fr/cnrs-images/sciencesdelaterreaulycee/contenu/dyn_ext2-1.htm

Figure 5: Diagrams of the carbon cycle in forests[37] and the ocean's biological carbon pump (Ocean & Climate platform).





The role of ecosystems in capturing and storing carbon is essential, yet the effectiveness of the involved processes largely relies on their ecological status and their management methods. Thus, for example, the carbon footprint of a managed forest not only depends on its good health and diversity (diversity of carbon capture and storage compartments such as old and large timber, dead timber, diversity of forest strata, and soil quality...), but also on logging procedures. Extended forestry cycles and, as a result, the increased age of forest play a significant role in carbon storage capacities. Carbon is stored more sustainably and in large quantity in relatively undisturbed soil, within sustainably managed forests[39]. In forests, soil type is the most significant factor involved in carbon storage among the 3 main storage factors (climate, soil type and tree species)[40]. Carbon storage also varies according to the species considered. Coniferous trees store carbon quicker during the first years of the forest's life; however, the trend is reversed thereafter and deciduous trees are more efficient as regards medium- to long-term carbon storage. Finally, a multi-layered stand will provide better carbon storage[41], as lower layers can capture carbon released from soil[42].

When preserved, these ecosystems therefore act as carbon sinks (they capture more carbon than they emit) and stores. Worldwide, natural ecosystems absorb on a yearly basis about half of human activity-generated CO_2 emissions[43]. Protected areas, hosting preserved natural ecosystems, hold at least 15% of the world's terrestrial carbon stores[44].

Conversely, when these ecosystems are degraded or disappear, this causes a reduction in carbon stocks they hold, thereby resulting in CO_2 emissions in the atmosphere. Deforestation as well as forest and peatland degradation account for approximately 15% of annual anthropogenic CO_2 emissions on a global scale[45].

Ecosystem preservation and sustainable management are thus crucial not only to protect biodiversity, but also to maintain natural carbon stores constituted over thousands of years and to preserve their ability to capture CO_2 released in the atmosphere by human activities.

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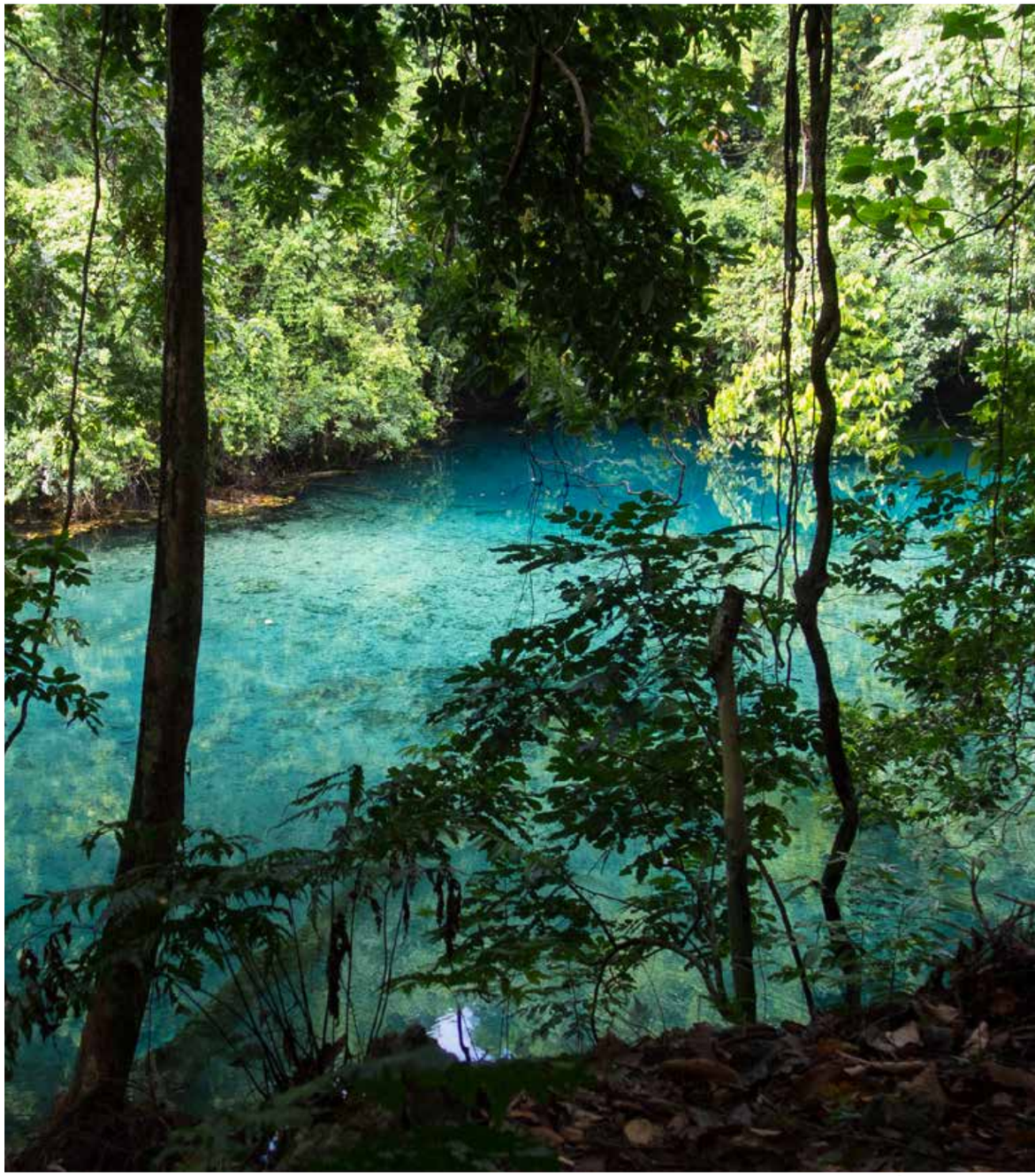

© Rossi

[39] Rossi M., André J., Vallauri D., 2015. Le carbone forestier en mouvements. Éléments de réflexion pour une politique maximisant les atouts du bois. Lyon, REFORA Report, 40 pages.

[40] De Vos et al., 2015. Benchmark values for forest soil carbon stocks in Europe: Results from a large scale forest soil survey. Geoderma, vol. 251-252.

[41] Rossi M., André J., Vallauri D., 2015. Ibid.

[42] Rossi M., André J., Vallauri D., 2015. Ibid.

[43] European Commission, 2009. Nature's role in climate change.

[44] Campbell et al 2008. Carbon storage in protected areas: Technical report. UNEP World Conservation Monitoring Centre.

[45] Van der Werf G. R., Morton D. C., DeFries R. S., Olivier J. G. J., Kasibhatla P. S., Jackson R. B., Collatz G. J., Randerson J. T., 2009. CO_2 emissions from forest loss. Nature Geoscience, 2(11).

3

Adaptation and ecosystem-based disaster risk reduction

Every year, natural hazards kill about 90,000 people and affect close to 160 million people worldwide. Natural disasters include earthquakes, tsunamis, volcanic eruptions, landslides, hurricanes, floods, wildfires, heat waves and droughts. They have an immediate impact on human lives and often result in the destruction of the physical, biological and social environment of affected people, thereby having a long-term impact on their health, well-being and survival[46].

In many contexts, healthy ecosystems contribute to reducing natural hazard exposure and the impacts of extreme events. For instance, wetlands regulate floods and protect water resources during droughts. As for mangroves or dunes, they act as natural barriers against winds and coastal erosion. A mountainside forest can reduce avalanche-related hazards by securing the snow cover thanks to the trees, maintaining a cooler temperature (thereby limiting avalanche release) and slowing down avalanche speed once it is released.

In cities, climate change adaptation requires green spaces that help fight against heatwave effects by contributing to air cooling while concurrently improving its quality. A study[47] thus showed that, at the scale of a residential area in Munich (including over 50% of greened surface area), a 10% increase in green areas can contribute to lowering the temperature by one degree within a radius of 100 meters. City greening also contributes to reducing flood risks by facilitating water infiltration and limiting runoff.

IUCN European Regional Office works with European cities to develop the evidence base for the benefits of Nature-based Solutions in tackling climate change and conserving urban biodiversity. They are a partner in the ENABLE project[48], funded by Biodiversa, which demonstrate that in European and North American cities there is a the need to consider the unequal distribution of urban green spaces and their benefits amongst residents.

To address this, justice and fairness should be integrated into projects and strategies for Nature-Based Solutions from the beginning, based on an understanding of how different population groups perceive and use green spaces.

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© *Anne Trouillon*

Protected and/or sustainably managed ecosystems provide a wide range of benefits to human populations: maintenance of living soil enabling water infiltration and carbon storage, protective physical barrier on coasts and mountains, buffer area, water storage and redistribution...

Several strategies and conventions are relevant to disaster risk reduction on a global, national and local level. The Sendai Framework, adopted for the 2015-2030 period, thus suggests a multi-risk and multi-stakeholder approach for natural disaster risk reduction on a global level. It calls for the integration of risk prevention in all countries' public policies.

Furthermore, many cities find it challenging to fund development and maintenance of Nature-based Solutions. To support city authorities in mobilising finance, IUCN European Regional Office recently organised a conference[49] on the topic in the context of the Horizon 2020-funded GrowGreen project[50] on Nature-Based Solutions for climate and water resilience in cities. Engaging stakeholders and potential investors early in project development is key, and natural capital accounts that indicate the value of the cities' natural assets and data on the performance of Nature-Based Solutions support the case for their use. Lastly, Nature-Based Solutions are most effective for climate change adaptation and biodiversity protection when they are embedded in a systemic, city-wide approach to urban sustainable development.

Nowadays, the expected effects of climate change, besides mean temperature increase on the Earth's surface, include sea-level rise, change in pluviometry, and increased frequency and intensity of extreme events (storms, floods, submersion, avalanches, wildfires, droughts). These extreme events' increased intensity is greater in tropical climates than in temperate or Mediterranean climates[51]. The limitation of these impacts should be ecosystem-based, ensuring that their resilience capacities are maintained or strengthened, particularly to facilitate the return to normal ecosystem functioning following a disaster.

The protection and sustainable management of ecosystems, whether terrestrial, coastal or marine, will contribute to strengthening or maintaining their resilience and adaptation capacity in the face of coastal, flood, wildfire or drought hazards, and thereby to reducing the impact of these disasters on human societies.

[46] WHO website https://www.who.int/environmental_health_emergencies/natural_events/en/

[47] CERTU, 2007. Végétaliser les villes pour atténuer les îlots de chaleur urbains.

[48] http://projectenable.eu/

[49] http://growgreenproject.eu/conference-innovative-financing-green-cities/

[50] https://www.iucn.org/regions/europe/projects/growgreen-embedding-nature-based-solutions-cities

[51] ONERC, 2012. Les outre-mer face au défi du changement climatique. Rapport au Premier ministre et au Parlement. La documentation Française.

4

Protected areas and Nature-based Solutions

Protected areas are not spared by climate change impacts. It is therefore essential to implement adaptive management of these areas, to limit the impacts on natural ecosystems and species they contain. However, protected areas are also excellent solutions to fight against climate change effects, though their role in the fight against climate change and disaster risk reduction is yet insufficiently recognized.

Protected areas are established for the primary purpose of preserving biodiversity and reducing the pressure on ecosystems and species. Nonetheless, the presence of a protected area and/or specific management actions they involve can contribute to protecting populations against extreme climate events and to reducing their vulnerability to these hazards. For example, the preservation of mangroves by creating a protected area will contribute to reducing shoreline retreat and marine submersion risks. Such actions integrating both biodiversity preservation and disaster risks management goals thus constitute Nature-based Solutions.

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THE ROLE OF PROTECTED AREAS AS NATURAL SOLUTIONS IN THE FACE OF CLIMATE CHANGE AND IN DISASTER RISK MANAGEMENT, CAN BE ENHANCED BY:

• Clearly identifying and detailing (or further quantifying) the contributions of protected areas regarding climate change or disaster risk reduction;

• Implementing Nature-based Solutions within protected areas (particularly in IUCN protected areas categories V and VI) in order to combine disaster risk reduction challenges and biodiversity preservation for a specific territory and to stimulate the implementation of similar projects in other territories;

• Integrating the creation of protected areas into strategies to fight against climate change and reduce disaster risks, as they enable the long-term sustainability of benefits provided by preserved ecosystems;

• Using protected areas as special places for observing and acquiring knowledge on the role of ecosystems in the fight against climate change and disaster risk reduction.

SPREADING NATURE-BASED SOLUTIONS FOR CLIMATE CHANGE ADAPTATION AND DISASTER RISK REDUCTION

The recommendations put forward hereafter aim to facilitate the propagation of Nature-based Solutions within territories. They are illustrated with examples of projects in G20 countries underlying some of the lessons learned, such as the monitoring of action-derived benefits, the implementation of an integrated strategic reflection within the territory, and the use of innovative financial tools.

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1

Highlighting the benefits of Nature-based Solutions

To promote the use of Nature-based Solutions, it is essential for stakeholders to be aware of and understand the many benefits they bring.

Informing and awareness-raising of Nature-based Solutions' usefulness, by showing positive and tangible results, particularly in terms of the climate and biodiversity challenges, are essential prerequisites to promoting their diffusion.

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a/ Monitoring the effectiveness of actions carried out

In order to convince decision-makers and managers of the usefulness of implementing a Nature-based Solution approach, the benefits and outcomes of these projects should be measurable and verifiable to account for their relevance in relation to other types of solutions.

To this end, the indicators and various monitoring procedures to be implemented should be defined as from the project design stage, including their frequency and associated means.
Monitoring should be planned to measure actions' effectiveness regarding the targeted challenge (climate change and/or disaster risk), and the contribution to biodiversity preservation.

Established monitoring processes should be maintained in the medium or long term. Ecosystem restoration is indeed a process often requiring several years of hindsight before a full evaluation of the outcomes can be made. Moreover, it involves a number of multiparametric phenomena (soil-plant exchanges, gas exchanges, flows of matter, trophic interactions...) that fluctuate over time. It requires thereby monitoring on a regular basis and for an extended period of time to enable the identification of general trends beyond one-time occurrences.

Monitoring will enable to adjust actions to climate and ecosystem evolution. Measuring previously defined indicators should also facilitate assessing the effect of action taken and comparing this to the goals set within the project's framework.

NIGG BAY COASTAL REALIGNMENT[52]

Main promoter
THE ROYAL SOCIETY FOR THE PROTECTION OF BIRDS

Location
CROMARTY FIRTH, SCOTLAND

Types of ecosystems involved
COASTAL ECOSYSTEMS

Targeted societal challenge
FLOODS, SEA LEVEL RISE, STORM SURGES

Type of NbS
ECOSYSTEM RESTORATION

Timeframe for implementation
2003

Funders **/**

Detailed project description
Nigg Bay is subject to sea level rise and storm surges. In 2003, two 20-meter breaches were created in an existing eroded sea wall to allow for the tide to re-enter a 25 ha field, known as "Meddat Marsh", on the edge of Nigg Bay. This allowed this area to be reconnected to the sea for the first time since the 1950s and intertidal habitat to be created. The coastal realignment was a success, with salt marsh habitat and wintering water birds colonizing the area, as well as improving coastal flooding protection.

Other required engineering works, specifically the blocking of culverts to a drainage channel behind the sea wall, were also undertaken.

Broad monitoring was undertaken in four main areas:

- Vegetation: the colonisation by saltmarsh plants, and development of saltmarsh communities
- Benthic invertebrates: particularly species important as food sources to wintering waterbirds
- Use by wintering waterbirds
- Sedimentation and geomorphology

It was undertaken pre-breach and post breach annually for 4 years (until 2007), as a PhD study. After that monitoring was completed in 2009, 2011 and 2014.

MAIN CURRENT OUTCOMES

- **Increase in the saltmarsh area by 23% in Nigg Bay**
- **There has been 20-30cm of sedimentation in some parts of the site and saltmarsh creek systems have developed**

PROJECT BENEFITS

- **Biodiversity benefits from saltmarsh recolonisation, and 25 species of water birds now use the newly created area**
- **The new sea defence around the site remains strong and the whole area provides greater protection from coastal flooding to inland areas than the original sea wall**

52 GIZ, 2018. Solutions in Focus: Ecosystem-Based Adaptation from Mountains to Oceans. How people adapt to climate change by using nature. Bonn and Eschborn.

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b/ A multitude of benefits

Cities, companies and public organisations could invest much more in Nature-based Solutions as there is increasing evidence of their cost-efficiency and their multiple co-benefits such as:

• landscape maintenance or improvement;

• enhanced living environment;

• places for recreational or tourism activities;

• maintenance or diversification of farming- or fishing-related economic activities.

Furthermore, their cost-benefit ratio is often of greater interest than the investment in and maintenance of grey infrastructures or new technologies. These solutions are also adaptive and reversible, as they do not make use of heavy and impacting infrastructures.

These benefits require to be better known and taken into account in decision processes. To this end, assessments of ecosystem services can be carried out and provide local stakeholders with qualitative and quantitative elements for decision-making. These can be environmental and/or economic assessments.

In France, a new skill, the so-called GEMAPI skill (aquatic environment management and flood prevention), assigned by 2020 at the latest to municipalities or public institutions for inter-municipal cooperation managing their own tax system, enables reconciling waterway restoration and flood prevention. This illustrates a policy that facilitates the implementation of Nature-based Solutions.

RESTORATION OF CACHE LA POUDRE RIVER[53]

Main promoter
CITY OF FORT COLLINS

Location
FORT COLLINS, COLORADO, USA

Types of ecosystems involved
RIVER AND WETLANDS

Targeted societal challenge
FLOODS, CLIMATE CHANGE ADAPTATION

Type of NbS
ECOSYSTEM RESTORATION, ECOSYSTEM-BASED MANAGEMENT, ECO-DRR

Timeframe for implementation
2010-2015

Funders
CITY OF FORT COLLINS

Detailed project description

The Cache la Poudre River is a seasonal, snowmelt driven river originating in the Rocky Mountains, running east into the lower-elevation plains.
Today, land use changes in the river's historic floodplain including gravel mining and urbanization, diminish the river's ability to scour and deposit sediment within the river channel and constrain flooding events onto the floodplain that nourishes riparian vegetation with water and vital nutrients. Likewise, growing water demands to support agricultural and municipal needs have modified the river's hydrology through alterations in base flow, timing and duration of flooding events, and negative physical and chemical changes in low flow periods. Finally, regional climate change predictions complicate the ability to understand how the river's hydrology and ecology may respond to warming climate scenarios and climate change models suggest that more extreme events will add to these pressures in the future.
Since 2011, a suite of river restoration projects has been implemented by the City of Fort Collins and its partners under the 2011 management plan.

53 Biohabitats and Bachand. 2016. Case Study 1 - Restoration of Cache la Poudre River to recover ecological function and reduce flood risk in Fort Collins, Colorado, In: Cohen-Shacham et al. (2016). Nature-based Solutions to address global societal challenges. Gland, Switzerland: IUCN. xiii + 97pp.

Overall, actions taken included in particular :
• the removal of high, artificial banks created along the riverbank during gravel mining operations to connect the river with its floodplains,
• creating additional shallow wetland habitat in the ponds,
• and removing a dam to restore natural river flow, enable fish passage and improve the riverbed as fish habitat.
The sediment that had built up behind the structure was excavated and redistributed in the channel and on the upstream banks for stabilisation. Revegetation of the riparian area was also carried out, with native wetland vegetation and floodplain trees and shrubs, as the riparian forest had almost been lost due to lack of flood flows that nourish the floodplain with water, nutrients and sediment.

MAIN CURRENT OUTCOMES

• Restoration of two kilometres of the river's channel and riverbank, creation of over five hectares of riparian floodplain forest, and several hectares of wetlands. The projects planted 1,200 trees, 25,000 shrubs and 60,000 wetland grass plugs

• Removal of hard infrastructure reconnecting more than 1,500 metres of river with its floodplain

PROJECT BENEFITS

• Multiple ecological benefits including lowering river water temperatures, eliminating fish barriers

• Enhancing public safety for recreational float boating

• Development of trails and river fishing access points within the project area

• Support for environmental education: boulders are placed to help visitors understand the importance of functional floodplains, and the necessity of high river flows to spill out of its channel

• Drinking water

• River flood prevention

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2

Engaging an integrated strategic planning

Nature-based Solutions, by definition, are interdisciplinary as they address climate and/or disaster risk and biodiversity issues within a same project. These solutions thus require land-use planning that includes broad collaboration with local stakeholders and the implementation of a governance process involving the sharing and reconciling of project goals.

a/ Integrating Nature-based Solutions in climate and disaster risk reduction strategies

Nature-based Solutions can help to streamline sectoral policies by reconciling challenges and stakeholders. One of the ways to implement the streamlining process is to integrate these solutions into strategies for action on climate and disaster risk reduction.

They can, for example, be fed into the following existing strategies:

• ***on an international level:*** United Nations Framework Convention on Climate Change, Sendai Framework for Disaster Risk Reduction, Sustainable Development Goals...
• ***on a national level,*** if they exist: national climate plan, national climate change adaptation plan, national shoreline management strategy...

Thereby, non-expert stakeholders in the field of biodiversity can be aware of innovative land-use planning options legitimating Nature-based Solutions as a valid alternative to usual civil engineering infrastructures.

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© S-De-Danieli
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CONTROLLING YANGTZE RIVER FLOODS[54]

Main promoter
CHINESE GOVERNMENT

Location
YANGTZE RIVER BASIN, CHINA

Types of ecosystems involved
WETLANDS

Targeted societal challenge
FLOODS

Type of NbS
ECOSYSTEM RESTORATION

Timeframe for implementation
1998 ONWARDS

Funders **DIVERSE :CHINESE GOVERNMENT, VARIOUS CHINESE PROVINCES AND LOCAL GOVERNMENTS...**

Detailed project description
The Yangtze is one of the most important rivers in China and is subject to flooding in the summer monsoon season. The growing risk to people, ecosystems, and the economy of flooding in the central and lower Yangtze region was partly due to reclamation of floodplains for agriculture and increasing siltation from erosion in the watershed. There is also increasing concern that climate change may cause more frequent extreme floods in the Yangtze basin. As local levee banks are up to 37 metres high, breaks in these levees can cause catastrophic damage. Up to 1998, government policies focused on building larger levees and cutting off floodplain lakes from the river channels, but this exacerbated the flood risks.

Following the 1998 floods, the Chinese government mandated its cross-sectoral National Development and Reform Commission (NDRC) to develop an integrated policy. This policy is a long-term (to 2030) and ecosystem-based approach to controlling floods which was the first time the government didn't choose engineering-focused solutions. The 1998 policy comprised three major elements :
• Increasing forest coverage by enhancing forest protection and afforestation of steep farmlands
• Restoring floodplains by removing embankments
• Returning agricultural polders to floodplains to increase floodwater retention capacity.

The key element of the policy is the restoration of floodplains. In the central Yangtze River basin, the plan focused on restoring floodplains through the removal of dikes that formed polders for rice production, especially around the two biggest lakes, Dongting and Poyang.

In addition to the 1998 policy, WWF worked with government authorities to implement a second approach: reopening sluice gates to restore floodplain, wetlands and reconnect them to the river. This enabled additional storage of flood waters and the restoration of more wetlands.

This program has informed China's national policies through national five-year plans with measures aiming at reconciling people and nature, and urban and rural communities. The inclusion of ongoing floodplain restoration measures in the 2007 National Climate Change Programme illustrates how sound adaptive management and incremental implementation of 'no regrets' climate change adaptation measures can deliver benefits for people and nature.

MAIN CURRENT OUTCOMES

- **Restoration of 2,900 square kilometres of floodplains**

PROJECT BENEFITS

- **Added flood retention capacity of 13 billion m^3**
- **Improved biodiversity conservation (increase in fish stocks, return of extirpated species, increased use of floodplain lakes by birds)**
- **Improved water quality**
- **Improved livelihoods of local people**

54 Pittock J. and Xu M., 2010. Controlling Yangtze River Floods: A New Approach. World Resources Report Case Study. World Resources Report, Washington DC.

b/Appropriate governance and broad stakeholder involvement

The development of Nature-based Solutions demands appropriate governance and coordination. To facilitate the implementation of actions and their acceptability, it is indeed essential to request participation and discussion on behalf of the various relevant stakeholders as from the project design stage (e.g. based on feasibility studies).

The governance process implemented should facilitate consultation and sharing of issues among stakeholders involved with biodiversity, climate, disaster risk, land-use planning, etc., and ensure project sustainability as well as long-term monitoring.
It should include a wide range of expertise consistent with the project's challenges and contexts. Nature-based Solutions can indeed be implemented using different ecosystems, and in various environmental and socioeconomic contexts.
It is essential that projects take into consideration local specificities and skills, while maximising the integration of some solutions that proved to be relevant in other contexts.
Finally, the broad inclusion of local stakeholders enhances transparency and can increase the scope of a risk prevention project, for instance, to an actual territorial project, with the implementation of integrated management thereby facilitating upstream-downstream and rural-urban solidarity considerations.

RECONCILE FOREST FIRE PREVENTION & BIODIVERSITY MANAGEMENT[55]

Main promoter
ALPILLES REGIONAL NATURAL PARK

Location
ALPILLE, FRANCE

Types of ecosystems involved
FORESTS AND AGROECOSYSTEMS

Targeted societal challenge
FIRE

Type of NbS
ECOSYSTEM SUSTAINABLE MANAGEMENT

Timeframe for implementation
2006 -2018

Funders
LIFE PROGRAMME (EUROPEAN FUNDS) AND LOCAL AUTHORITIES (DÉPARTEMENT DES BOUCHES DU RHÔNE, RÉGION PROVENCE-ALPES-CÔTE-D'AZUR) & STATE (DREAL PROVENCE-ALPES-CÔTE-D'AZUR)

Detailed project description
Climate change in the Mediterranean region could worsen heatwaves, leading to an increase in frequency and severity of forest fires. Moreover, coniferous plantations in this territory during the 19th and 20th century have caused replacement of Mediterranean hills, covered with scrubland and dry grasslands, by very inflammable pine forests. Promoting a grazing-based management of these Mediterranean hills could allow a new balance between human activities and nature, ensuring a rich biodiversity. That is why one of the objectives of the Alpilles Regional Natural Park is to reclaim several hundreds of hectares and in order to manage them by grazing to make them less vulnerable to fire.

An important multi-stakeholders work has been done to adapt forest planning documents to biodiversity management challenges and to fire prevention.
A careful analysis of the territories and a broad association of decision-makers (private owners and local elected) together with the forest sector, environmentalists and grazing stakeholders helped to design common solutions to increase traditional open ecosystems beneficial for biodiversity. These spaces will be grazed to maintain the ecosystems open.

MAIN CURRENT OUTCOMES

- **A hundred hectares in the first programme and 170 ha since 2016 have been reopened and grazed**

PROJECT BENEFITS

- **Reduce combustible materials quantity to reduce fire risk**
- **Improve habitats for 13 species of birds**

55 UICN France, 2018. Les Solutions fondées sur la Nature pour lutter contre les changements climatiques et réduire les risques naturels en France. Paris, France.

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MELBOURNE URBAN FOREST STRATEGY[56]

Main promoter
CITY OF MELBOURNE

Location
MELBOURNE, AUSTRALIA

Types of ecosystems involved
URBAN ECOSYSTEMS

Targeted societal challenge
CLIMATE CHANGE ADAPTATION, URBAN HEAT ISLAND

Type of NbS
ECOSYSTEM CREATION AND RESTORATION

Timeframe for implementation
2012-2032

Funders
CITY OF MELBOURNE

Detailed project description
The City of Melbourne is faced with both strong population growth and increasing climate extremes, such as heavy rains, floods, heatwaves, droughts, and bushfires. These challenges affect urban greenspaces and undermine the quality of life and well-being of citizens.
The Urban Forest Strategy is a timely and effective response to these challenges. Its aim is the systematic provision and maintenance of green spaces in combination with soft and grey infrastructure approaches to :
- adapt to current and future climate change impacts,
- mitigate the urban heat island effect,
- create healthier ecosystems,
- create a more water-sensitive city,
- and involve the community in these endeavours to support long-term sustainability.

This strategy has defined concrete targets including:
- increase canopy cover,
- increase urban forest diversity,
- improve vegetation health,
- improve soil moisture and water quality,
- and improve urban ecology.

The design and implementation of the strategy is based on both technical expertise and local (citizen) knowledge.

Concrete implementation actions include the development of neighbourhood-scale strategies with intense citizen involvement, Tree Capital Program (planting 3,000 trees per year), Urban Forest Visual (the municipality's individually mapped tree data), and the E-mail-a-tree campaign.
From 2010, citizens have been increasingly involved in contributing visions and suggestions for the city's green future in various co-governance forums, such as the on-line Participate Melbourne, as well as pop-up face-to-face sessions, and stakeholder workshops. Locals were involved in developing the Precinct Plans based on sense of place, hopes, and aesthetic preferences with regard to streetscape design, canopy cover, and tree placements.
Working with e-governance tools, such as the E-mail-a-tree campaign and social media exchanges between citizens at a site-specific level, allowed the city to engage with voices often silenced (children, elderly) by dominant groups.
The city also organised trainings for interested "citizen foresters" in urban tree care and made the municipality's tree data accessible for the public «with the urban forest visual allowing residents to identify trees.

The Urban Forest Strategy outlines a scientifically-vetted, long-term process to renature the city for and with citizens.

MAIN CURRENT OUTCOMES

- **3,000 native trees planted per year**
- **Changes in social values, by promoting narratives around trees being friends rather than barriers**
- **Changes in regulative frameworks and related actions, via co-developed neighbourhood strategies**

PROJECT BENEFITS

- **The Urban Forest Visual provides a platform for social learning and supports citizen co-management of urban greenery**
- **Reduction of the impacts of climate change in the city, increased use of floodplain lakes by birds**

56 Naturvation, 2017. Snapshot - Melbourne SNAPSHOT - MELBOURNE: URBAN FOREST STRATEGY.

3

Various financial mechanisms

Mobilising financial resources to fund ecosystem preservation, restoration or sustainable management projects is a key point in the implementation of Nature-based Solutions, which involve multi-year operations. This funding must ensure the project's sustainability and therefore be a long-term process. Communication and exchange between professionals with technical knowledge of NbS and finance specialists[57] can help mobilise new financial tools and guarantee their relevance.

In highlighting the contribution of Nature-based Solution projects to climate change adaptation and disaster risk reduction, these projects can ask for funding sources other than those typically dedicated to biodiversity preservation projects, such as:

• Funding for «climate» projects (carbon credits, climate plans...);

• Financial tools for «disaster risk prevention» projects;

•Specific tools for Nature-based Solutions: call for projects financed by the European Commission, programme financed by private companies or public institution (as programme Nature 2050[58])...

Other types of financial tools can be used to support Nature-based Solutions. These are innovative mechanisms based on private and public funding, involving stakeholders on a broader scale including citizens and Nature-based Solutions beneficiaries.

Here are **five main examples** of interest that would be worth developing in Nature-based Solutions implementation:

1/ Crowdfunding: *this mechanism facilitates the raising of financial contributions (generally small amounts) from a large number of private individuals using a dedicated platform on internet to finance a wide range of projects (social, environmental, cultural...).*

[57] WWAP (United Nation World Water Assessment Programme)/UN-Water, 2018. The United Nations World Water Development Report 2018: Nature-based Solutions for Water. Paris, UNESCO.

[58] http://www.nature2050.com/acteurs/cdc-biodiversite/

[59] WWAP (United Nation World Water Assessment Programme)/UN-Water, 2018. Ibid.

[60] International Capital Markets Association, 2015. Green Bond Principles, 2015. Voluntary Process Guidelines for Issuing Green Bonds.

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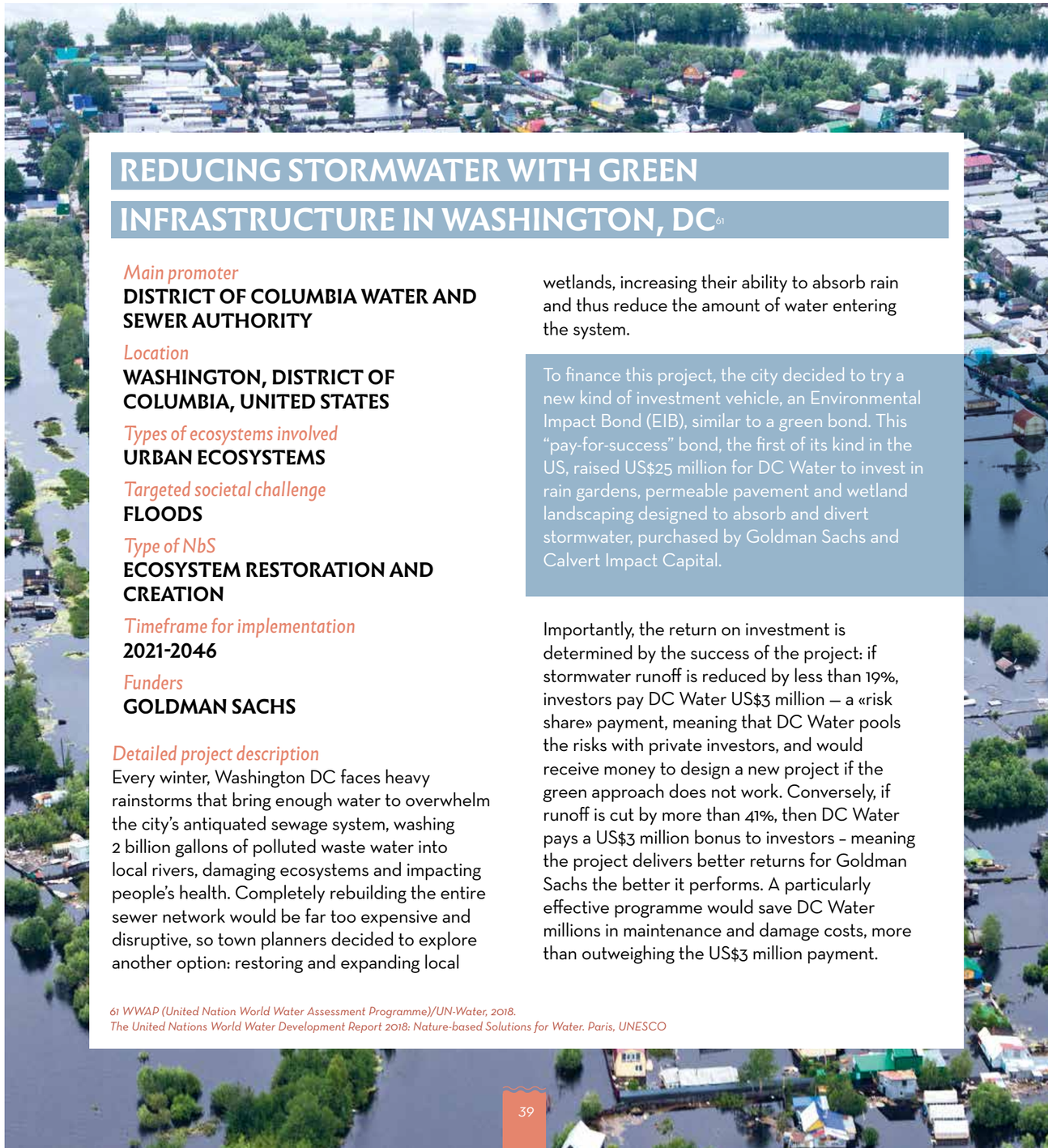
2/ Climate or green bond: *this is a loan mechanism to demonstrate the economic advantages of environment-positive investments and assets[59]. A climate/green bond signifies a commitment to use the funds raised exclusively to finance climate/environmentally beneficial projects, assets or business activities[60].*

[62] Greiber T. (Ed), 2009. Payments for Ecosystem Services. Legal and Institutional Frameworks. IUCN, Gland, Switzerland. xvi + 296 pp.

[63] WWAP (United Nation World Water Assessment Programme)/UN-Water, 2018. The United Nations World Water Development Report 2018: Nature-based Solutions for Water. Paris, UNESCO.



REDUCING STORMWATER WITH GREEN INFRASTRUCTURE IN WASHINGTON, DC[61]

Main promoter
DISTRICT OF COLUMBIA WATER AND SEWER AUTHORITY

Location
WASHINGTON, DISTRICT OF COLUMBIA, UNITED STATES

Types of ecosystems involved
URBAN ECOSYSTEMS

Targeted societal challenge
FLOODS

Type of NbS
ECOSYSTEM RESTORATION AND CREATION

Timeframe for implementation
2021-2046

Funders
GOLDMAN SACHS

Detailed project description

Every winter, Washington DC faces heavy rainstorms that bring enough water to overwhelm the city's antiquated sewage system, washing 2 billion gallons of polluted waste water into local rivers, damaging ecosystems and impacting people's health. Completely rebuilding the entire sewer network would be far too expensive and disruptive, so town planners decided to explore another option: restoring and expanding local wetlands, increasing their ability to absorb rain and thus reduce the amount of water entering the system.

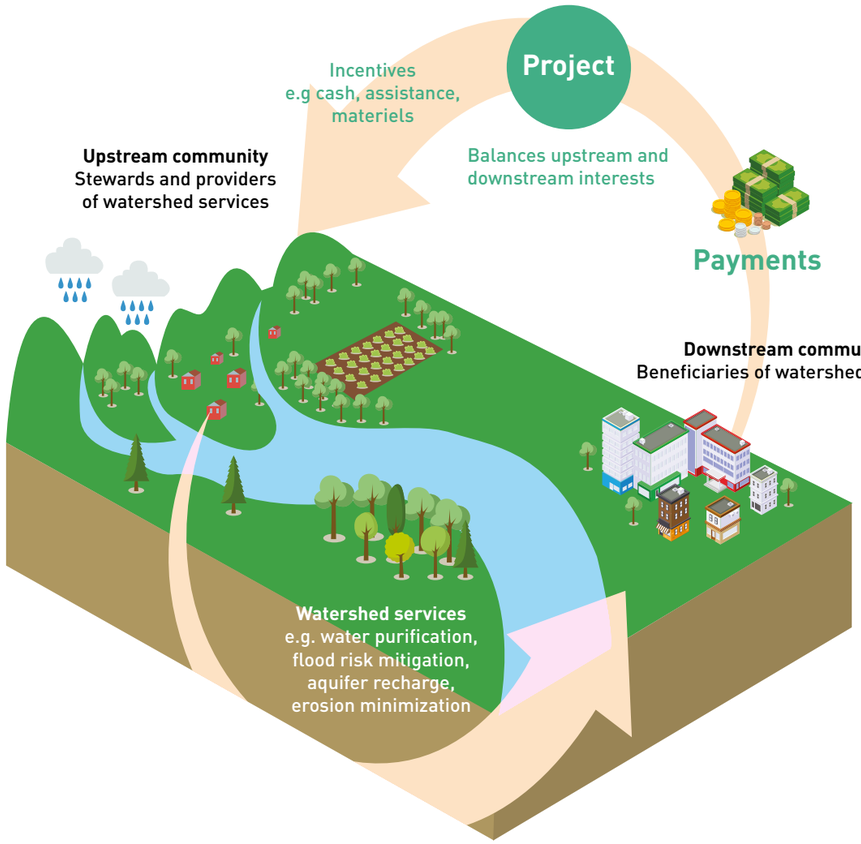
To finance this project, the city decided to try a new kind of investment vehicle, an Environmental Impact Bond (EIB), similar to a green bond. This "pay-for-success" bond, the first of its kind in the US, raised US$25 million for DC Water to invest in rain gardens, permeable pavement and wetland landscaping designed to absorb and divert stormwater, purchased by Goldman Sachs and Calvert Impact Capital.

Importantly, the return on investment is determined by the success of the project: if stormwater runoff is reduced by less than 19%, investors pay DC Water US$3 million — a «risk share» payment, meaning that DC Water pools the risks with private investors, and would receive money to design a new project if the green approach does not work. Conversely, if runoff is cut by more than 41%, then DC Water pays a US$3 million bonus to investors – meaning the project delivers better returns for Goldman Sachs the better it performs. A particularly effective programme would save DC Water millions in maintenance and damage costs, more than outweighing the US$3 million payment.

61 WWAP (United Nation World Water Assessment Programme)/UN-Water, 2018. The United Nations World Water Development Report 2018: Nature-based Solutions for Water. Paris, UNESCO

3/ Payment for Ecosystem Services (PES): *a PES is a payment arrangement in which those who pay are aware that they are paying for an ecosystem service that is valuable to them or to their constituencies – and those who receive the payments engage in meaningful and measurable activities to secure the sustainable supply of the ecosystem service in question*[62]. *Introducing such schemes requires to clearly establish the cause-and-effect relationships between the provider and ecosystem use practices and the provision of services for users, identifying and organising the stakeholders who have effective control of these practices, and reaching a sustainable agreement under the constantly changing market as well as the political and social conditions*[63].

Figure 6: a typical watershed PSE scheme [64]



[64] Adapted from Benett G., Nathaniel C. and Hamilton K., 2013. Charting New Waters: State of Watershed Payments 2012. Washington DC, Forest Trends.

4/ Eco-conditionality of public financial support: *funds or other public financial support granted in exchange for respect of good environmental practices in the proposed project.*

5/ Natural capital financing facility: *investments and grants facilitated by the European Investment Bank to support projects delivering on biodiversity and climate adaptation through tailored loans and investments, backed by an EU guarantee.*

WETLANDS AND RICE PADDY FIELDS CONTRIBUTE TO BIODIVERSITY CONSERVATION, FLOOD CONTROL AND THE LOCAL ECONOMY[65]

Main promoter
MIYAGI PREFECTURAL GOVERNMENT, LOCAL FARMERS

Location
MIYAGI PREFECTURE, JAPAN

Types of ecosystems involved
RIVER AND WETLANDS

Targeted societal challenge
FLOODS

Type of NbS
ECOSYSTEM RESTORATION, ECO-DRR

Timeframe for implementation
1970 ONWARDS

Funders
MIYAGI PREFECTURE

Detailed project description

In the northern part of the Miyagi Prefecture, 92% of wetlands have disappeared, converted to rice paddies or dry-fields for non-rice crops. The Kabukuri-numa wetlands, covering 100 hectares, comprise one of the few remaining wetlands in the area, their conservation being ensured due to their recognised function in terms of disaster risk management.

As the prefecture's extensive lowland floodplain is often damaged by heavy rains, the government has developed and used the Kabukuri-numa wetlands and their surrounding rice paddies as a flood-control basin since 1970.

The government is committed to sustainable agricultural practices, notably through the restoration of the wetland function of rice paddies by supporting the new practice of 'winter-flooded rice paddy'. This practice started in 2003 when a group of local farmers decided to flood their rice paddies in the winter. Flooding rice paddies that are usually left dry in the winter creates more habitat for migratory birds in the winter season, thereby dispersing the roosts of the geese (which were previously concentrated in the Kabukuri-numa wetlands and led to substantial loss of grain for the farmers) and improving the wetland function.

Following collaborative discussions, measures were taken to improve flood control and conserve and restore the existing landscape. For example, a clay overflow levee that took landscape and environmental factors into consideration was chosen instead of a concrete one. This is an uncommon practice in Japan. Recognition as a wetlands of international importance under the Ramsar Convention in 2005 was a big step forward in accelerating and scaling up the efforts in the Kabukuri-numa wetland. This was the first Ramsar site to intentionally include rice paddies within a wetland area.

Local government subsidies compensate farmers for the costs involved in managing water in the rice paddies during the winter season. This compensation scheme attracted the national government's attention and in 2011 the Ministry of Agriculture, Forestry and Fisheries started a national Payment for Ecosystem Services scheme for environmentally friendly farming practices, based on this compensation system in the Kabukuri-numa wetlands area. Winter-flooding of rice paddies is now practiced in many parts of Japan.

MAIN CURRENT OUTCOMES

- The area of the wetlands has increased from 100 hectares to 150 hectares
- Since 1999 the number of migratory geese in these wetlands and surrounding rice paddies has increased threefold
- Restoration of 2,900 square kilometres of floodplains

PROJECT BENEFITS

- Restoration of wetlands and associated biodiversity (white-fronted geese)
- Alternative income-generating eco-tourism opportunities during non-farming months as visitors come to observe the migratory birds during winter
- Successful branding and ecolabelling of the product (as «premium rice») almost doubled the retail price and a local sake brewery purchases winter-flooded rice at premium cost, selling it as limited edition sake
- Improved livelihoods of local people
- Flood control

65 Furuta, 2016, Case Study 2 - Japan: Wetlands and rice paddy fields contribute to biodiversity conservation, flood control and the local economy. In: Cohen-Shacham et al. (2016). Nature-based Solutions to address global societal challenges. Gland, Switzerland: IUCN. xiii + 97pp.

CONCLUSION

Nature-based Solutions (NbS) can take up both climate change and biodiversity challenges. They allow an integrated answer to States' commitments within the international conventions on climate (United Nations Framework for Climate Change) and on biodiversity (Convention on Biological Diversity). They are also a concrete and appropriate answer to contribute to several sustainable development goals (SDG) by 2030.

IPCC and IPBES's reports both support the implementation of ambitious actions to tackle climate change and biodiversity loss. The role of preserved and functional ecosystems is therefore essential for the mitigation and adaptation to climate change and disaster risk reduction and for the protection of biodiversity.

Nature-based Solutions provide significant opportunities to meet these objectives in which it is crucial to invest today in a targeted and ambitious way. These multifunctional actions must now be fully integrated into climate change and natural hazard action plans, from the global to the local level, and carried out worldwide.

All stakeholders are concerned :

• Each State must integrate Nature-based Solutions in its climate change and disaster risk reduction plans and in its Nationally Determined Contribution (NDC) to the Paris agreement.

• Local and subnational authorities must also integrate and support Nature-based Solutions within the framework of local climate plans and land-use planning documents.

• Businesses are also concerned and should develop Nature-based Solutions in their projects and innovation work, building on research and development.

• Environmental NGOs and managers of natural areas should promote and support Nature-based Solution implementation at a regional and local level.

Spreading NbS needs to be fast forwarded quickly and to be supported by the implementation of operational and proactive policies translated into actions and outcomes on territories and sites.

The international agenda to come is a great opportunity to promote NbS and initiate a new alliance with nature, in which we belong and depend for a sustainable future. "Invest in biodiversity for people and the planet", this is the message sent out by the 196 parties to the convention on biological diversity in Egypt in october 2018 which needs to be implemented by decisions during the next international conferences : G20, G7, IUCN World Conservation Congress (june 2020, Marseille) and CBD COP15.

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IUCN | French Committee

FRENCH NATIONAL COMMITTEE OF IUCN
INTERNATIONAL UNION FOR CONSERVATION OF NATURE

Created in 1992, the French National Committee of IUCN is the network of organizations and experts of the International Union for Conservation of Nature in France. It brings together, in a unique partnership, 2 ministries, 9 public bodies, 42 non-governmental organizations and more than 250 experts, gathered in specialized commissions and thematic working groups.
Through this diverse membership, it is a unique platform for dialogue, expertise and action on biodiversity issues, also involving businesses and local authorities.

The French National Committee of IUCN aim at conserving biodiversity and manage natural resources in a sustainable and equitable way.






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