



Nature-based solutions: Lessons from European and Chinese case studies

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Executive summary

In March 2022 at the United Nations Environment Assembly Countries adopted a resolution on nature-based solutions (UNEP/EA.5/Res.5) which provided framing of the concept and a multilaterally agreed definition on 'Nature-based Solutions': *"nature-based solutions are actions to protect, conserve, restore, sustainably use and manage natural or modified terrestrial, freshwater, coastal and marine ecosystems which address social, economic and environmental challenges effectively and adaptively, while simultaneously providing human well-being, ecosystem services, resilience and biodiversity benefits"*. The resolution also states that nature-based solutions *"respect social and environmental safeguards"*.

This paper describes four case studies in the European Union and China respectively chosen to investigate historical and contemporary application of nature-based solutions (NbS) in both regions. In-depth information, including information sourced from two current EU H2020 R&I Sino-Europe investigations of NbS, was a key element of this study as it has allowed for a 'deep dive' into the case studies. Based on an analysis of the case studies, conclusions and recommendations have been developed. We hope that the analysis will promote a better understanding of how NbS can be applied, thereby providing a stronger basis for dialogue and action in the future and support a mutually beneficial (and continuing) dialogue between China and Europe on NbS.

Consistent with the UNEA-5 definition NbS deliver multiple benefits to the health and well-being of people as well as to the environment (i.e. *ecosystem services, resilience, and biodiversity benefits*) and climate regardless of the main objective of the project. The table 1 summarises the objectives for each of the eight case studies described compared to the challenges referred to in UNEA resolution 5/5 and table 2 the same compared to the IUCN NbS Global Standard. For example, the 'Green and Blue Infrastructure' network of natural and semi-natural landscape 'green' and 'blue' elements in the Intercontinental Biosphere Reserve of the Mediterranean are designed, among other things, to protect biodiversity.

Actions carried out in the Mu Us Desert aim at restoring the landscape and reversing the process of desertification and have contributed to a significant reduction in the frequency of dust storms in the area and improved air quality. The Chengdu Park City developments are designed to promote low-carbon and environmentally sensitive economic development. One of the main aims of Milan's Parco Sud Agricolo as well as the Chengdu Park City is to provide nature-sensitive green spaces for leisure and recreation in an urbanised (and in the latter peri-urban agricultural) environment. The Intercontinental Biosphere Reserve of the Mediterranean involved public participation in the design of the green and blue infrastructure elements. The Industrial Forest Project in the Ruhr region of Germany demonstrates how trees and forests in urban and peri-urban areas can be used as an NbS alongside the principles of multifunctionality and connectivity envisioned in the concept of green infrastructure.

To achieve these objectives, the implementation of nature-based solutions needs to incorporate a range of mechanisms and appropriate incentives. The case studies included in this paper include several such mechanisms and incentives, including financing mechanisms, land-use planning, the need for detailed studies before the implementation of nature-based solutions and scientific research of their impacts. Finally, recommendations are made, firstly, for international experts, negotiators, policy advisors and secondly for future EU-China cooperation on nature-based solutions.

TABLE 1. Case studies compared to the objectives and ability to meet the challenges referred to in UNEA Resolution 5/5 UNEP/EA.5/Res.5 (2022)

Case study	Objectives/Meeting UNEA 5/5challenges								
	Climate mitigation	Reduce air / water pollution	Protect biodiverse habitat	Protect / restore landscape	Disaster risk reduction	Public health	Develop economy	Leisure & recreation	Public participation
Ecosystems – Land									
EU: The Industrial Forest project in the Ruhr region, Germany	✓	✓	✓	✓		✓		✓	✓
China: Desertification Control of the Mu Us Desert	✓			✓		✓	✓	✓	
Ecosystems – Water									
EU: Intercontinental Biosphere Reserve of the Mediterranean	✓		✓		✓		✓	✓	✓
China: Ecological Restoration of the Yellow Sea Wetlands in Yancheng	✓		✓	✓			✓	✓	
Ecosystems - Urban									
EU: Parco sud Agricolo	✓	✓		✓		✓		✓	
China: Chengdu Park City Construction	✓	✓				✓	✓	✓	
Financing Nature-based Solutions									
EU: Sustainable financing mechanism for Mediterranean Marine Protected Areas			✓				✓	✓	
China: Three Good Agriculture and Water Fund at Qiandao Lake	✓	✓		✓			✓	✓	

¹ Nature-based Solutions (NbS) are important for the global sustainable development agenda because they offer the potential to address, in an effective way, diverse challenges such as climate change, food and water insecurity, disaster impacts, and threats to human health and wellbeing, while reducing environmental degradation and biodiversity loss. UNEA Resolutions 5/5 (UNEP/EA.5/Res.5), UNEP (Oct 2022).

Understanding NbS in China and Europe

At the fifth session of the United Nations Environment Assembly (UNEA-5) (UNEP, 2022) a multilaterally agreed definition of Nature-based Solutions was agreed. Resolution 5² defines NbS as “*actions to protect, conserve, restore, sustainably use and manage natural or modified terrestrial, freshwater, coastal and marine ecosystems, which address social, economic and environmental challenges effectively and adaptively, while simultaneously providing human well-being, ecosystem services and resilience and biodiversity benefits.*” The same resolution acknowledged the need of “NbS in support of sustainable development” called for safeguarding the rights of communities and indigenous peoples and stated that nature-based solutions *respect social and environmental safeguards, in line with the three “Rio conventions” (the Convention on Biological Diversity, the United Nations Convention to Combat Desertification and the United Nations Framework Convention on Climate Change), including such safeguards for local communities and indigenous peoples respect environmental and social safeguards* (UNEP, 2022). NbS have been adopted in four Multilateral Environmental Agreements, including the UN’s Framework Convention on Climate Change (UNFCCC) and Convention on Biodiversity (CBD), as an instrument for achieving relevant targets and commitments.

The term ‘nature-based solutions’ (NbS) was first used circa 2002. Over the following years, it was used by several worldwide institutions and publications, including the UN Environment Programme’s Millennium Ecosystem Assessment (2005) and the World Bank (2008). The principles underlying it were to provide an approach in which the often-disparate objectives of conservation and development could be addressed within a single framework. In the widely cited paper entitled “*Core principles for successfully implementing and upscaling Nature-based*

Solutions” (2019)³, Emmanuelle Cohen-Shacham *et al.* outline three NbS principles: synergy with other solutions; landscape scale considerations; and policy integration. They also report that the Ecosystem Approach was the foundation for developing the NbS definitional framework, and that four specific ecosystem-based approaches (Forest Landscape Restoration, Ecosystem-based Adaptation, Ecological Restoration and Protected Areas) should be considered as falling under the NbS framework.

In 2022, UNEP identified several terms that refer to types of NbS that resonate with the Cohen-Shacham *et. al* paper e.g. Ecosystem-based adaptation but also list Ecosystem-based Disaster Risk Reduction, Natural infrastructure (or blue-green infrastructure - BGI); as well as actions that overlap with NbS, such as Ecosystem-based approaches, Natural Climate Solutions, and Nature-positive actions.⁴ In addition to the term itself, there are several terms and practices that can be related to the concept of NbS. Some describe actions that can be understood as specific types of NbS, and some cover a broader range of actions that can overlap with NbS. Some have widely accepted definitions, and some do not. Importantly, some can include types of action that would not qualify as NbS, as defined by UNEA-5. This presents a positional challenge in that the discourse on NbS can be littered with claims and counter-claims in much the same way as can be observed with sustainable development.

2 UNEP/EA.5/Res.5 <https://wedocs.unep.org/bitstream/handle/20.500.11822/39864/NATURE-BASED%20SOLUTIONS%20FOR%20SUPPORTING%20SUSTAINABLE%20DEVELOPMENT.%20English.pdf?sequence=1&isAllowed=y>

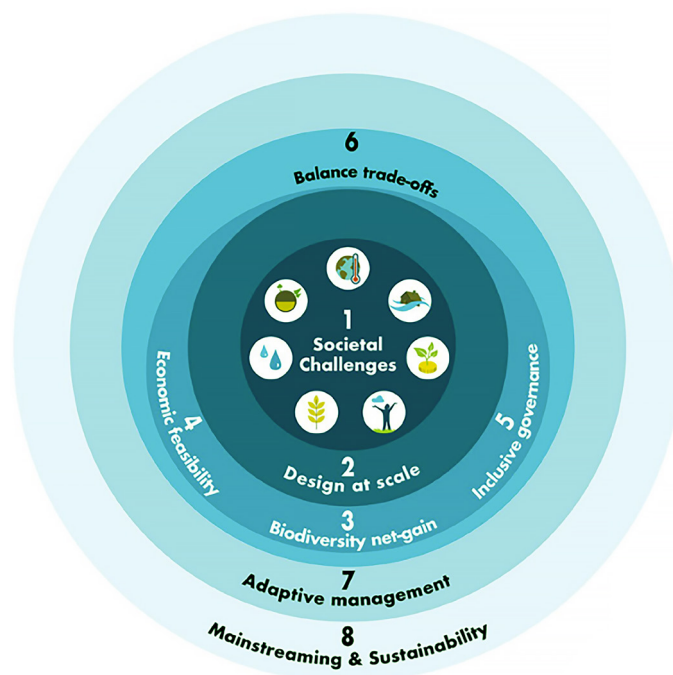
3 Emmanuelle Cohen-Shacham, Angela Andrade, James Dalton, Nigel Dudley, Mike Jones, Chetan Kumar, Stewart Maginnis, Simone Maynard, Cara R. Nelson, Fabrice G. Renaud, Rebecca Welling, Gretchen Walters. Core principles for successfully implementing and upscaling Nature-based Solutions, Environmental Science & Policy, Volume 98, 2019, Pages 20-29, ISSN 1462-9011, <https://doi.org/10.1016/j.envsci.2019.04.014>.

4 United Nations Environment Programme (2022). Nature-based Solutions: Opportunities and Challenges for Scaling Up. Nairobi: <https://wedocs.unep.org/handle/20.500.11822/40783>

Several consecutive IPCC reports and IPBES Assessments including the Global Assessment of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) (2019)⁵ and the Special Reports on 1.5 °C (IPCC SP1.5) (2018), on Climate Change and Land, on Ocean and Cryosphere (2019) and the 6th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC)⁶ (2022, 2023)) highlight the important role of ecosystems in addressing the climate emergency. More than two thirds of signatories to the Paris Agreement on climate change include nature-based solutions in their climate change mitigation and/or adaptation strategies; and all low-income countries include nature-based solutions in their Nationally Determined Contributions.⁷ At the UNFCCC COP27, nature-based solutions were endorsed for their potential to address climate change and featured in the Sharm el-Sheikh Implementation Plan and at COP28 NbS were included in the United Arab Emirates Consensus. Nature-based solutions are also relevant to the Kunming-Montreal Global Biodiversity Framework (specifically targets 8, 11 and 12), and NbS is also featured in resolution XIV.17 of the Ramsar Convention on Wetlands COP14.⁸

The IUCN Global Standard⁹ (Figure 1) whilst developed earlier than the UNEA-5 definition (the IUCN definition based on science has been the basis for the multilaterally agreed definition) is the only NbS standard on global level already successfully used in many countries, by companies and cities and other stakeholders. It remains a key instrument to the verification, design and upscaling of nature-based solutions (NB: IUCN are presently reviewing the global standard in an inclusive manner beyond IUCN membership with a likely future update to be adopted at the World Conservation Congress in 2025). A key purpose for the standard is to assist the deployment of NBS, both the practice and policy level and put 'flesh' on the concept of NbS which "may (otherwise) remain a general concept, only marginally contributing to the pressing sustainability needs and not realising its full potential". The NbS standard has been designed for a range of stakeholders, encompassing governments, business and civil society amongst

FIGURE 1. IUCN Global Standard



© IUCN.

others and is based on eight criteria, including those linked to the conventional pillars of sustainable development. The eight pillars shown in the figure are all interconnected. To support this standardisation, IUCN has developed a self-assessment tool, for which a Chinese language version has recently been developed.

In 2007, China first included 'ecological civilization' in the report of the 17th National Congress of the Communist Party of China (CPC). The concept of developing an 'ecological civilization' involves "seeking harmony between man and nature, environment and economy as well as individual and society". In 2012, the Communist Party of China ratified the concept in its Party Constitution at the 18th Party Congress. In 2017 the Party issued an Opinion on "ecological conservation red lines", which reorganises the governance of China's land based on its environmental vulnerability. It also proposed a comprehensive, quantified evaluation method for eco-civilisation and green development, with specific evaluation items at all levels of government.

In addition, some ecological restoration initiatives in China that pre-date the concept of NbS, can also be considered as shaping the current Chinese understanding of NbS. These include, for example, the Three-North Forest Shelter Program, popularly

5 <https://www.ipbes.net/global-assessment>

6 <https://www.ipcc.ch/srccl/>

7 <https://www.zurich.com/en/knowledge/topics/climate-change/net-zero-positive-why-biodiversity-metrics-make-for-more-effective-carbon-markets>

8 https://research-and-innovation.ec.europa.eu/research-area/environment/nature-based-solutions_en

9 <https://portals.iucn.org/library/sites/library/files/documents/2020-020-En.pdf>

known in English as China's 'Great Green Wall' (dating back to 1978), as well as restoration of the Mu Us Desert (from the early 1950s). These projects have a long history, and while they were not previously classified as NbS and have at times been criticised for certain unanticipated impacts, they are nature-based solutions in line with the multilaterally agreed definition adopted at UNEA 5.2 in 2022.

In the last decade and in alignment with international principles, China has seen the emergence of specific policies and practices that reflect a commitment to NbS (Yu and Mu, 2023¹⁰; An *et al.*, 2021¹¹). In recently issued central policies, NbS has been mentioned as a tool for climate mitigation, ecosystem conservation and restoration. Key policy initiatives, such as the "National Strategy for Adapting to Climate Change 2035," illustrate the integration of NbS with climate change adaptation, emphasising ecosystem service functions and strengthening overall adaptation capabilities. According to Yu and Mu (2023), China has made noteworthy progress in both NbS policy and practice, particularly in four areas: climate mitigation, biodiversity conservation, water security, and sustainable urban development. Xu *et al.* (2023) note that localised practice of NbS in China is characterised by the realisation of ecological product value and has already yielded positive outcomes. As an example, in June 2023, Haishu District in Ningbo released the local technical specifications of the "Biodiversity-Friendly Townships — Guidelines for Nature-Based Solutions Application". This appears to be the first time in China that the IUCN global standard for Nature-based Solutions (NbS) has been implemented, exemplifying pioneering steps in implementing global standards for NbS at the local level (The Paper, 2023¹²).

Keeping with China's overall policy framework, NbS is primarily shaped by government regulations and is supplemented by incentive policies designed to foster voluntary participation. However, there are challenges that have been noted during implementation and management. Xu *et al.* (2023) also note that in China there has been, in recent years, the

emergence of a significant number of projects centred around Ecosystem Product Value Realisation and posit that these projects demonstrate that NbS can align with China's concept of realising the value of ecological products¹³. Notwithstanding the challenges listed there is a positive trajectory such notably in the integration of NbS principles into environmental initiatives. Whilst decentralised the approach to NbS practice is spread across various governmental units which demonstrates a strategic inclusiveness in addressing ecosystems and societal issues.

The NbS situation in Europe has evolved significantly in recent years not least due to activity within the European Union's flagship research and innovation funding programme Horizon 2020 (now superseded by Horizon Europe). An important statement is the "ambition of research and innovation policy to position the European Union as a leader in innovating with nature to achieve more sustainable and resilience societies"¹⁴. A new element to Horizon Europe is "Missions" which are described as "Sets of measures to achieve bold, inspirational and measurable goals within a set timeframe"¹⁵ within the clusters of pillar II, Horizon Europe "incorporates missions to increase the effectiveness of funding by pursuing clearly defined targets with a concrete impact on citizen's daily lives"¹⁶. The European Commission's nature-based solutions research policy states that these present a credible means to address key societal issues, such as biodiversity loss, climate change, and disaster risk reduction. Current research policy and funding and funding goals are to:¹⁷

- » mainstream nature-based solutions in research and innovation, policy and practice at EU, Member State and global level.
- » strengthen and widen the European research and innovation community on nature-based solutions.

10 Yu, R., & Mu, Q. (2023). Implementation Progress of Nature-based Solutions in China: a global comparative review. *Nature-Based Solutions*, 100075.

11 An, Y., Gu, B., Wang, Y., Tan, X., Zhai, H. (2021) Advances, problems and strategies of policy for Nature-based Solutions in the fields of climate change in China [J]. *Climate Change Research*, 2021, 17 (2): 184-194

12 The Paper (2023), 'Haishu District of Ningbo has released the country's first local standard on Nature-Based Solutions.', The Paper, Available at: https://m.thepaper.cn/newsDetail_forward_23135949 (Accessed: 24/11/2023).

13 Yishan Xu, Wenwu Zhao, Zhijie Zhang, The practice of nature-based solutions in China: Ecosystem product value realization, *Current Opinion in Environmental Science & Health*, Volume 36, 2023, 100514, ISSN 2468-5844

14 https://research-and-innovation.ec.europa.eu/research-area/environment/nature-based-solutions_en

15 https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe_en

16 <https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/programmes/horizon>

17 https://research-and-innovation.ec.europa.eu/research-area/environment/nature-based-solutions/research-policy_en

- » demonstrate the potential of nature-based solutions and provide the evidence base on their socio-economic cost-effectiveness and long-term sustainability.
- » advance the development, uptake and upscale of locally attuned nature-based solutions, including through co-creation, co-governance and citizen engagement.
- » improve financing solutions, including the access to finance, to accelerate the market uptake of nature-based solutions.
- » improve framework conditions for nature-based solutions, including through bringing learning for sustainability and nature-based solutions in education curricula at all levels.

Horizon Europe is maintaining the momentum of the outgoing Horizon 2020 programme. Al Sayah, *et al.*¹⁸ have investigated the documentation produced by 21 Horizon 2020 (H2020) projects for the use of NbS for climate change adaptation and identified a solid base of increasing experience but also significant gap in fundamental scientific basis behind NbS, as the concept favours its practical nature and places less emphasis on science. Another discourse of note is that in Europe most urban and rural planning is subject to the principle of subsidiarity meaning that policy is delegated to countries and regions. In this context Davies and Laforteza (2019)¹⁹ posited that nature-based solutions used in combination with spatial green infrastructure planning had the capacity to rival, replace or combine with existing grey infrastructure approaches but that 'path dependence', a concept where active memory conditioned by past decisions, has a controlling influence on decision making would need to be broken through a combination of reforms.

The European Commission has produced as part of the Biodiversity Strategy stated that European towns and cities of at least 20,000 inhabitants should "develop ambitious Urban Greening Plans" including "measures to create biodiverse and accessible urban forests, parks and gardens; urban farms; green roofs and walls; treelined streets;

urban meadows; and urban hedges."²⁰ Dorst, *et al.* (2019) links urban greening with nature based solutions and compares them with ecosystem-based adaptation, and green infrastructure noting that nature-based solutions provide a wide range of potential solutions to complex challenges, but require more performance-based planning approach, and a flexible approach, urban planning which accommodates integration of multiple land-use, and considers complexity²¹. Hence, the move towards Urban Greening Plans has significant potential for NbS.

For the most part, NbS in Europe, appears to be project based, and a significant resource of case studies on activities across Europe appears on the Oppla repository of nature-based solutions²². Calliari, *et al.*²³ identify-three core challenges to implementation of NbS in Europe: the lack of a comprehensive evidence base on the effectiveness of NbS to address targeted challenges; the need for a greater involvement of the private sector in financing NbS; and opportunities for enhancing stakeholder engagement in the successful design and implementation of NbS. Some writers have gone further and suggested a need to move beyond NbS towards a discourse on nature-based thinking. Randrup, *et al.* (2020)²⁴ have suggested that the current economic and political system may be inadequate to provide for nature-based solutions, and that the social and governance dimension, and a more balanced socio-ecological perspective is needed through a transformational process. On the other hand experience shows that implementation of nature-based solutions can trigger de facto transformative change on the ground. Considering this accelerating the implementation of nature-based solutions, ie accelerating actions to protect, conserve, restore, sustainably use and manage ecosystems

18 Mario J. Al Sayah, Pierre-Antoine Versini, Daniel Schertzer, H2020 projects and EU research needs for nature-based adaptation solutions, Urban Climate, Volume 44, 2022, 101229, ISSN 2212-0955, <https://doi.org/10.1016/j.uclim.2022.101229>.

19 Clive Davies & Raffaele Laforteza, Transitional path to the adoption of nature-based solutions, Land Use Policy, Volume 80, 2019, Pages 406-409, ISSN 0264-8377, <https://doi.org/10.1016/j.landusepol.2018.09.020>.

20 https://environment.ec.europa.eu/topics/urban-environment/urban-greening-platform_en

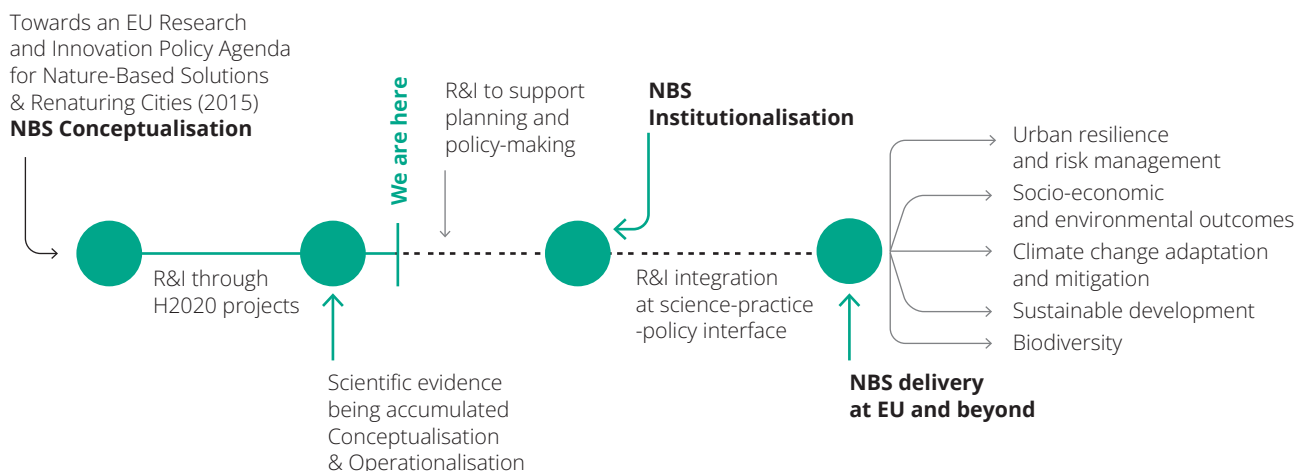
21 Dorst, Hade & van der Jagt, Alexander & Raven, Rob & Runhaar, Hens. (2019). Urban greening through Nature-Based Solutions – key characteristics of an emerging concept. Sustainable Cities and Society. 49. 101620. <https://doi.org/10.1016/j.scs.2019.101620>.

22 <https://oppla.eu/case-study-finder>

23 Elisa Calliari, Sergio Castellari, McKenna Davis, Joanne Linnerooth-Bayer, Juliette Martin, Jaroslav Mysiak, Teresa Pastor, Emiliano Ramieri, Anna Scolobig, Marjolein Sterk, Clara Veerkamp, Laura Wendling, Marianne Zandersen. Building climate resilience through nature-based solutions in Europe: A review of enabling knowledge, finance and governance frameworks, Climate Risk Management, Volume 37, 2022, 100450, ISSN 2212-0963, <https://doi.org/10.1016/j.crm.2022.100450>.

24 Randrup, T.B., Buijs, A., Konijnendijk, C.C. *et al.* Moving beyond the nature-based solutions discourse: introducing nature-based thinking. Urban Ecosyst 23, 919–926 (2020). <https://doi.org/10.1007/s11252-020-00964-w>

FIGURE 2. NbS pathway



Source: Davies, *et al.* 2021.

is a life insurance investment for our children and grandchildren.

Whilst there continues to be active debate about the direction of NbS in Europe. There seems to be agreement that “this is a journey that has started but has not yet finished” [Figure 2] (Davies, *et al.* 2021)²⁵. The authors state that “the journey continues through processes of multi-level government policymaking and the work of technocrats to embed NbS in policy and strategies and that it is evident that a radical change, or transition, in political will towards NbS implementation must be put into action to effectively tackle the current challenges of climate change that are severely impacting societies, the natural environment, and economy”. They quote UN’s Chief and Secretary-General, António Guterres, during the news conference on the eve of COP25, “We must stop digging and drilling and take advantage, instead, of the possibilities provided by renewable energies and nature-based solutions”. Meanwhile science is clear: challenges have been aggravating fast and we are facing a planetary emergency caused by interdependent climate change and biodiversity loss and we are getting dangerously close to trespassing irreversible cascading tipping

points (Armstrong *et al.*, 2022)²⁶. A vigorous reply through accelerating the implementation of technological and nature-based and societal solutions still within this crucial decade is necessary. We must stop the collision course with nature. (Scientists’ Warning 1992 <https://scientistswarning.org/1992/12/01/scientists-warning-to-humanity-1992/>). ‘Making peace with nature is the defining task of the 21st century’ (UN Secretary-General António Guterres) <https://www.un.org/en/climatechange/un-secretary-general-speaks-state-planet> UNGS Future of the Planet .

25 Clive Davies, Wendy Y. Chen, Giovanni Sanesi, Raffaele Laforzezza, The European Union roadmap for implementing nature-based solutions: A review, *Environmental Science & Policy*, Volume 121, 2021, Pages 49-67, ISSN 1462-9011, <https://doi.org/10.1016/j.envsci.2021.03.018>.

26 Armstrong *et al.* Exceeding 1.5°C global warming could trigger multiple climate tipping points *Science* Vol 377, Issue 6611, 2022 <https://www.science.org/doi/10.1126/science.abn7950>

Research and Innovation for EU-China engagement on NbS

Overview

Horizon 2020 was the European Union's flagship research and innovation funding programme from 2014 to 2020, with a budget of nearly €80 billion. A key programme within this was SOCIETAL CHALLENGES—climate action, environment, resource efficiency and raw materials. The specific objective of the programme was to achieve a resource- and water-efficient and climate change resilient economy and society, the protection and sustainable management of natural resources and ecosystems, and a sustainable supply and use of raw materials, to meet the needs of a growing global population within the sustainable limits of the planet's natural resources and ecosystems. Six broad lines of activities were agreed including protecting the environment, sustainably managing natural resources, water, biodiversity and ecosystems. Activities focused on furthering an understanding of biodiversity and the functioning of ecosystems, their interactions with social systems and their role in sustaining the economy and human well-being²⁷. Ninety-one (91) projects were funded under this programme of which 69 were linked to NbS.

Notable projects for NbS included NATURVA-TION (nature-based urban innovation), URBiNAT (co-creation of marketable NbS), URBAN GreenUP (re-naturing urban plans), UNALAB (urban nature laboratories), CONEXUS (co-producing NbS), Net-workNature (collaborative platform) and CLEVER Cities (co-design of value-added ecological solutions), amongst others. Two projects focused in on Europe-China collaboration, namely 'REGREEN'—fostering nature-based solutions for smart, green

and healthy urban transitions in Europe and China and 'CLEARING HOUSE'—Collaborative Learning in Research, Information-sharing and Governance on How Urban tree-based solutions (that) support Sino-European urban futures. These two sister projects run until the 29th of February 2024 and held a joint final conference in Brussels in November 2023.

The focus for REGREEN is to address the challenges of the urban environment using NbS and ecosystem services to mitigate climate change impact and promote human wellbeing. It comprises a consortium of 7 universities, 4 research institutes, 3 city authorities, 4 consultancies (SMEs) and 2 city networks. REGREEN works through the concept of Urban Living Labs (ULLs) located in Aarhus, Paris, Velika Gorica, Beijing, Shanghai and Ningbo. The ULLs are the central elements of the project, where co-creation of knowledge involving local citizens, schools, businesses, organisations and public administrations enable new forms of urban innovation and governance putting particular focus on the needs of vulnerable groups. The ULLs are the testbed where generic tools, together with scientific results, new ideas and methods are applied in the real context. This results in novel set of guidelines and standards for developing and deploying urban Nature-Based Solutions at a systemic and strategic level targeting urban planners, and the broader public. REGREEN also reiterates the importance of connecting NBS with the business and start-up community and explores innovative business cases, all with the aim of strengthening future NBS market.

The CLEARING HOUSE project unites European and Chinese cities in their quest to develop more resilient cities and liveable societies to improve human wellbeing. The focus is on tree-based green infrastructure as the basis for "urban forests as nature-based solutions". Urban Forests as nature-based solutions

FIGURE 3. REGREEN project list of key exploitable results

Key Exploitable Results	Work Package	Owner	Partners Involved
NBS Transition Handbook	WP7	ICLEI	All
NON valuation methods	WP4	UNEXE	AU
Cost-effectiveness of NES	WP2	AU	
Urban Eco-explorer APP	WP3	UFZ	
City Explorer toolkit	WP3	UKCEH	
Depaving mapping tool	WP7	IPR	
Interactive walkable floormaps (IWF)	WP5	UFZ	AAK, AU, JEPLAE
Depaving guidelines in cities	WP7	PR	
Online decision support tool	WP8	ZEZ	All
Field e-Books	WP5	AU	
Greenopolis	WP5	AU	INTO
Vigie-Nature école (VNE)	WP5	MNHN	
Training kit	WP7	IPR	

Source: REGREEN project D8.7.

(UF-NBS) are a subset of nature-based solutions that build on tree-based urban ecosystems to address societal challenges, simultaneously providing ecosystem services for human well-being and biodiversity benefits. UF-NBS include peri-urban and urban forests, forested parks, small woods in urban areas, and trees in public and private spaces. The CLEARING HOUSE project involves 26 partners in Europe and China and aims to provide evidence and tools that facilitate the mobilisation of the full potential of urban forest-based solutions (UF-NBS) for rehabilitating, reconnecting and restoring urban ecosystems.

Also of relevance for NBS stakeholders, DG Research & Innovation of the European Commission has compiled a list of [EU-funded Nature-based Solutions Resources](#). The document was initially shared during SBSTTA 25 (the CBD's Subsidiary Body on Scientific, Technical and Technological Advice), and is regularly updated.

Results and Impact

REGREEN has produced a wide range of deliverables including an exploitation and replication plan.²⁸ The stated purpose of this is to maximise the impact of the exploitation of the project's results. Key exploitable results beyond the life of the project have been identified alongside a target audience, including stakeholders, researchers, policy makers, and industry professionals interested in advancing nature-based solutions. In total 13 key exploitable results have been identified by the project in line with FAIR principles (findable, accessible, interoperable and reusable) (**Figure 3**). Included in the main communication and dissemination activities are fact sheets produced in both English and Chinese and guidelines on managing the transition process cycle

28 Deliverables for the REGREEN project can be found on the project website: <https://www.regreen-project.eu/resources/>

FIGURE 4. Hong Kong/Guangzhou/Shenzhen case study area for CLEARING HOUSE project



Image: CLEARING HOUSE project.

FIGURE 5. Leipzig-Halle case study area for CLEARING HOUSE project

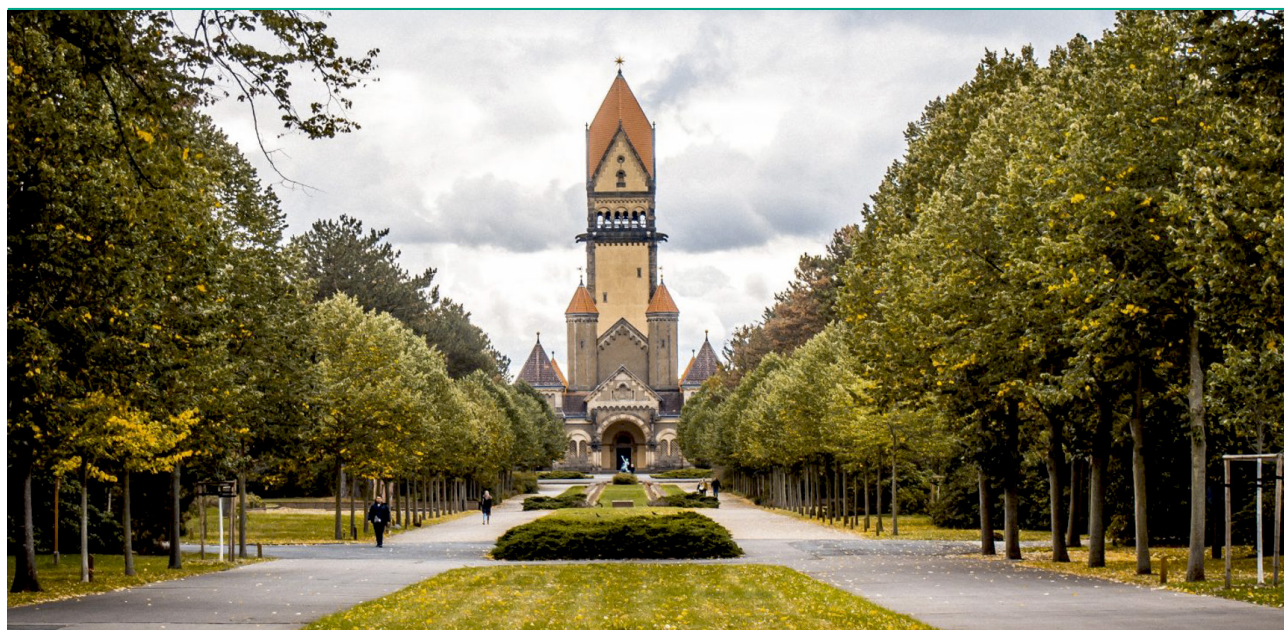


Image: CLEARING HOUSE project.

for moving towards nature-based solutions. A transition handbook provides evidence-based knowledge and insights that are transferable and made operational for both European and Chinese conditions.

CLEARING HOUSE project workstreams have majored on co-learning between China and Europe and despite travel limitations presented during the COVID-19 pandemic is working towards completion of a case study analysis between five urban forest nature-based solutions (UF-NbS) case studies in

Europe (Gelsenkirchen/Ruhr, Brussels, Leipzig-Halle, Kraków and Barcelona area) and five in China (Beijing, Hong Kong/Guangzhou/Shenzhen, Hangzhou, Huaibei and Xiamen).²⁹ The Chinese cities have asked for continued collaboration with European partners beyond the life of the project.

²⁹ Deliverables for the CLEARING HOUSE project can be found on the project website: <https://clearinghouseproject.eu/clearing-house-reports/>

FIGURE 6. CLEARING HOUSE project summary sheet of a guideline on cost-effective ecosystem restoration and ecological rehabilitation for urban forest as the nature of a solution (UF-NbS)



CLEARINGHOUSE
中欧城市森林应对方案

Cost-effective ecosystem restoration and ecological rehabilitation for urban forests as a nature-based solution.

Urban forests are more than just trees. They are complex networks of interconnected ecosystems where the well-being of one element influences the others. When one element of the urban forest declines, it affects the entire system. To ensure urban forests thrive in the face of climate change, it is crucial to restore and rehabilitate natural ecosystems within urban areas.

To ensure that urban forests provide locally effective nature-based solution practices for urban resilience follow these five steps:

- **Protect Biodiversity:** Safeguarding biodiversity is crucial for the restoration and maintenance of **healthy ecosystems and their services**.
- **Adapt the vegetation to your local context:** Choose tree species that are well-suited to the **local climate and soil conditions**, increase genetic and species diversity.
- **Implement ecological continuity strategies:** Counteract the fragmentation of green infrastructure by creating **ecological corridors to reconnect green spaces** and strengthen nature connectivity.
- **Restore and rehabilitate existing urban forests:** Use practices such as new plantings, soil reclamation, and maintenance of dead organic matter. Recognize the **increasing value of trees as they mature**. When the removal of a mature tree is necessary, significant compensatory plantings should be done to offset the loss.
- **Design green spaces that embrace multifunctionality and are socially inclusive:** Well-designed and managed urban forests can deliver **multiple societal benefits**. Design urban forests to **respond to the needs of various users** and ensure equitable access is provided, particularly for underprivileged communities.

*Find out more about **cost-effective ecosystem restoration and ecological rehabilitation for urban forests as a nature-based solution** with our detailed guideline:*



A methodology of city pairing has been used with for example Hong Kong/Guangzhou/Shenzhen being paired with Leipzig-Halle around a notable shared challenge, which, in this example, was UF-NbS for river catchment restoration, increasing attractiveness, ecological connectivity and water quality (Figures 4 and 5).

In addition to the case study analysis a substantive survey of societal, perceptions and demands towards UF-NbS in both China in Europe was undertaken as well as reports on business models and investment cases, an online application for developing modelling and assessing UF-NbS, an online benchmarking tool and the production of four thematic guidelines in both English and Chinese (figure 6).

In conclusion, both REGREEN and CLEARING HOUSE projects have been pathfinders for collaboration on NbS between China and Europe. Despite travel limitations presented due to the COVID-19 pandemic, they have succeeded in building innovative partnerships with long-lasting potential for advancing NbS.

Case studies: Ecosystems–land

EUROPE: THE INDUSTRIAL FOREST PROJECT IN THE RUHR REGION, GERMANY

Forests are often regarded as being part of rural landscapes and ecology, however, over the last 30 years, there has been growing recognition of the important role that ‘urban forests’ provide in terms of the delivery of ecosystem services to Europe’s urban communities. Given the diversity of urban form throughout Europe, urban forests generally reflect the cultural situation in the region in which they are located. For example, some forests, now close to or within the urban fabric have long historical roots, as can be observed in Budapest or Helsinki whilst others are more recent creations reflecting more recent human activity. Urban forests within or close to population centres are NbS with a high potential for the delivery of multiple benefits to cities, and the communities that live within them. Indeed, the Naturvation project³⁰ funded through the European Union’s Horizon 2020 research and innovation programme reported that with respect to urban forest and NbS, green space is getting increasing attention in building resilient cities and that a new understanding of urban forests is emerging which incorporates all vegetation and its supporting structures. The project also highlighted that the multiple benefits of urban forests is gaining increasing recognition and use by various local actors.

Project overview

The industrial forest project in the Ruhr region of Germany is an outstanding example of a forest that reflects human intervention and cultural ecosystem services. The project has become internationally

famous and is attracting international visitors interested to learn about the approach and how it might be transferred to other areas. The industrial forest project does not sit in isolation from other activities in the Ruhr region, not least the wider regeneration agenda which has already transformed it from its historic role in steel making and coal mining. Opportunistically for urban forestry, these latter activities have left many brownfield areas which have been the subject of renaturing.

The most significant of the Ruhr region’s regeneration projects ran from 1989 to 1999 and was known as the International Building Exhibition Emscher Park (IBA Emscher Park)³¹. The aim was to create momentum in structural change with a focus on landscape planning and urban development. 800 square kilometres were targeted for a combination of ecological, economic and cultural renewal. The IBA projects were grouped under six central guiding topics. A key outcome was the creation of the Emscher Landschaftspark (landscape park). In the Landscape Park novel landscapes were either created or allowed to naturally occur on brownfields left over from previous industrial activity. The new landscapes and ecological interventions, especially on spoil heaps, have become visitor attractions and notable landmarks.

The industrial forest project, which emerged from the IBA, has now been run for over 30 years by the forestry authority, which is otherwise absent in urban areas. The project is not simply about afforestation but aims to address a variety of environmental and social challenges. Whilst trees set the scene in the Industrial Nature Project, as suggested in the Naturvation project, it has also pursued an understanding

30 https://naturvation.eu/sites/default/files/result/files/snapshot_urban_forests_0.pdf

31 <https://www.internationale-bauausstellungen.de/en/history/1989-1999-iba-emscher-park-a-future-for-an-industrial-region/>

FIGURE 7. The urban forest station created from the former electrical switch house at the Rheinelbe Colliery



Source: Oliver Balke.

of urban forests which incorporates all vegetation including related buildings and its supporting structures. Alien plant and animal species are also tolerated as an expression of anthropogenic nature. It has also been flexible in adapting to new situations and has stayed true to an overarching objective, which is the creation and management of a sustainable and ecologically diverse forest landscape.

Results and impacts

The industrial forest project has fully embraced the concept of NbS by recognising that the urban forest is delivering multifunctional benefits and is ensuring ecological connectivity throughout the region. The Industrial Forest project also contributes to industrial heritage tourism which has become a regional brand for the Ruhr and collectively has stimulated a significant increase in tourism. For example, overnight stays in the region increased by over 60% between 1990 and 2009³². The focus on the creation of natural habitats and providing ecosystem services such as carbon sequestration, air purification and cooling and new soil development has already brought significant results. By converting brownfields into wooded green spaces, the industrial forest project has also improved the quality

FIGURE 8. The industrial urban forest seen from the Himmelstreppe at Rheinelbe, Gelsenkirchen



Source: Oliver Balke.

of life for residents by providing recreational opportunities for health and well-being. Since many of the sites in the industrial forest project are in the less prosperous parts of the region it is also contributing to environmental equity. Education has always been part of the project, and there is a focus on teaching sustainability and creating a sense of ownership and responsibility for the forest. The project was recognised as an important learning laboratory, and in that capacity became a case study for the Sino-Europe CLEARING HOUSE project, funded from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement 821242³³.

A notable site in the project is Rheinelbe a former coal mine in Gelsenkirchen. The former electrical switch house for the colliery has become a forest station and is also the base for a nature and education warden (Figure 7). A central sculpture has been placed atop the spoil heap called the Himmelstreppe (Stairway to Heaven) which was created by the artist Herman Prigann and from this viewing point the extent of the industrial forest project becomes obvious (Figure 8). The sculpture woods at Rheinelbe encapsulate other sculptures formed from the industrial artefacts left behind from the coal mining era. The area is now an established urban forest and much used by the local community.

32 Copic, Sonja & Đorđević, Jasmina & Lukic, Tin & Stojanović, Vladimir & Đukićin, Smiljana & Besermenji, Snežana & Stamenković, Igor & Tumaric, Aleksandar. (2014). Transformation of industrial heritage: An example of tourism industry development in the Ruhr area (Germany). *Geographica Pannonica*. 18. 43-50. 10.5937/GeoPan1402043C.

33 <https://clearinghouseproject.eu/project/gelsenkirchenruhr-area/>

CHINA: DESERTIFICATION CONTROL OF THE MU US DESERT³⁴

The Mu Us Desert is located at the junction of the Inner Mongolia Autonomous Region, Shaanxi Province and the Ningxia Hui Autonomous Region in China's northwest. It can be described as an 'ecotone' with a unique landscape, in that it sits in the transitional area from the Ordos Plateau to the Loess Plateau. It is an interlaced area of agriculture, forestry and animal husbandry mainly based on grasslands. This region has a temperate continental semi-arid climate. The main types of aeolian (shaped by action of the wind) landforms include moving dunes, semi-fixed dunes and fixed dunes. The vegetation zones in the Mu Us Desert transition from northwest to southeast, from desert grasslands to typical grasslands to meadow grasslands. In addition, various intrazonal vegetation, including desert, wetland, and salt-tolerant vegetation, are widely distributed throughout the Mu Us Desert.

The Mu Us Desert is sometimes referred to as 'the youngest desert' and a 'man-made desert'. Historically, it used to be a place with plenty of water and lush grass, herds of sheep and cattle, and beautiful scenery of vast lakes and clear rivers. However, after the mid-Tang Dynasty (618 to 907 AD), due to the expansion of human activities, excessive reclamation and grazing, war and other factors, coupled with climate change, the Mu Us region suffered gradual desertification and eventually formed contiguous tracts of deserts. With the continuous deterioration of the ecological environment in this region, shifting sand dunes invaded and buried towns and villages, grasslands were degraded, and the land became unsuitable for crops. As a result, the welfare of local communities was heavily impacted, and the Mu Us region became trapped in a passive situation of 'sand in and people out'.

Project overview

A series of measures have been conducted in the Mu Us Desert to control desertification:

1) *Policy-led building of green ecological barriers.* Since 1978, China has successively implemented ecological restoration projects such as the Northern Forest Shelter Programme (sometimes referred to in English as the 'Great Green Wall'), the Natural Forest

Protection Programme, and 'Grain for Green'. While actively promoting the development of key forestry projects, local governments have carried out afforestation, implemented ecological governance policies such as bans on grazing, establishing enclosures for afforestation, adjusted the structure of the agriculture and animal husbandry industries, encouraged the participation of various ownership systems in ecological protection, and increased investment in human and financial resources (Figure 9).

2) *Specific policies to encourage innovative models of desertification control.* After years of exploration and practice, generations of desertification controllers have summed up the models and experience suitable for the Mu Us Desert and put forward corresponding countermeasures according to differing conditions in control areas. For example, establishing a wind-sand prevention system based on the combination of 'belt, area and net'; carefully selecting a group of sand-fixing plants suitable for growing, such as the Korshinsk pea shrub (*Caragana korshinskii*), desert willow (*Salix psammophila*), sweetvetch (*Hedysarum scoparium*) and Scots pine (*Pinus sylvestris*); adopting a technique of planting a patchwork pattern of sand fixing plants for moving or semi-fixed dunes; adopting a method of 'aerial seeding + artificial enclosure' in moving dunes over wide areas as well as high and dense fluctuation; establishing a shrub-based biological isolation belt for wind prevention and sand fixation on the edge of desert and activated dunes; ensuring that anyone who contributes to afforestation can benefit, through preferential policies and measures such as allowing inheritance and transfer of the forests.

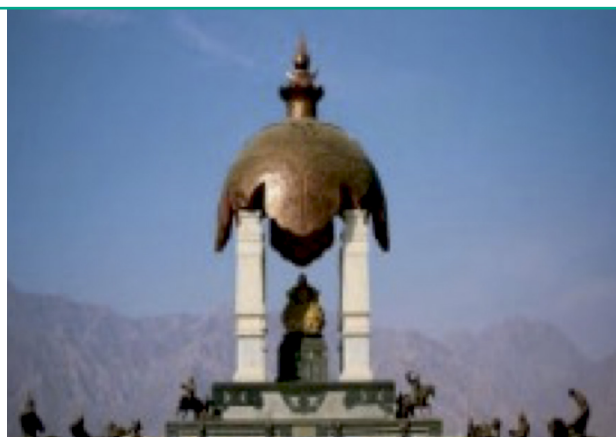
3) *Combining prevention and utilization to promote the development of the forestry and sand industries.* Efforts in sand control and prevention drives the development of the forestry and sand industries, which in turn reduces challenges for environmental governance. By virtue of the unique light, heat and soil resources in sandy areas, the Mu Us Desert has seen vigorous development of the local forestry and sand industries, combining sand control with sand use to achieve win-win results in terms of ecological, economic and social benefits. For example, a sand processing industry has developed as a result of using plants that grow in sandy and unstable soils. Ecological restoration has also provided a basis for tourism in the region. Specifically, this includes using the biological habitat of sandy shrubs that require regular pruning to obtain renewable biomass materials as fuel for biomass power generation; using aeolian sand for industrial mineral processing, and the residual products after mining which are widely

FIGURE 9. Desertification control using straw patchwork planting (left), and afforestation by Aerial seeding (right)



Source: Li, Wang, 2022.

FIGURE 10. Spirulina breeding park (left) and monument in a desert ecological park (right)



Source: Li, Wang, 2022.

used as raw materials in the glass, ceramics, metallurgy, electronics, medicine and chemical industries; and, the development of spirulina breeding and deep processing industries (Figure 10).

Results and impact

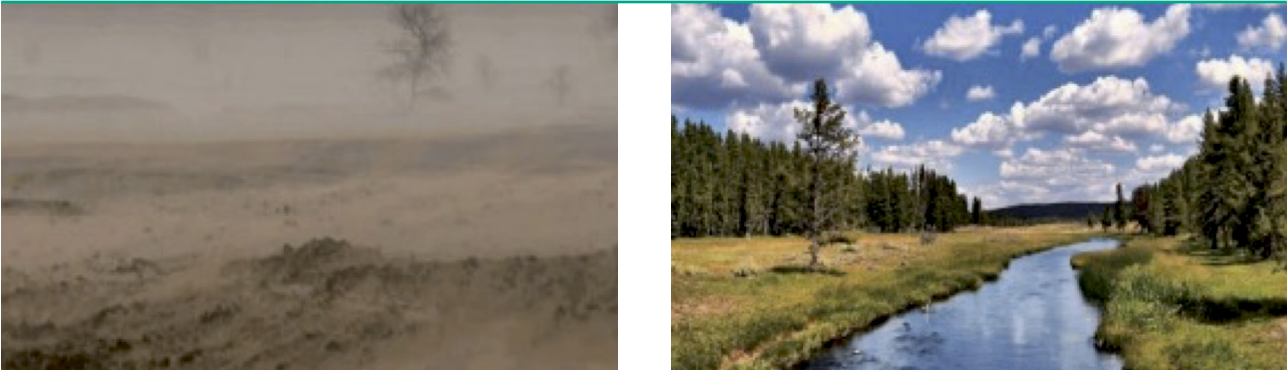
In the past half century, desertification control in the Mu Us Desert has seen remarkable results, and the level of desertification has been reversed. Both the area of sand and the intensity of desertification have been reduced. Between 2009 and 2014, the area of severely and extremely severely sanded land in the Mu Us Desert has decreased by 6.3 million mu (419 thousand hectares)³⁵. Relying on national forestry projects and local ecological restoration policies and measures, such as Northern Forest Shelter Programme and Returning Farmland

to Forests and Grasslands Programme, the area of sand-covered land in Uxin Banner, Inner Mongolia Autonomous Region clearly decreased from 2000 to 2017 (Figure 11). The vegetation coverage has been improved. Vegetation cover is an important way to control desertification (Figure 12). Looking at representative regions, the vegetation coverage of Uxin Banner increased from 28% in the 1970s to 80% in 2018; the control rate of sanded land in Yulin reached 93.2%, and the forest coverage rate increased from 0.9% to 34.8%; at the end of 2019, the forest area of Ejin Horo Banner reached 3 million mu, the forest coverage rate reached 36.9%, and the vegetation coverage rate reached 88%.³⁶

35 1 mu=1/15 hectare

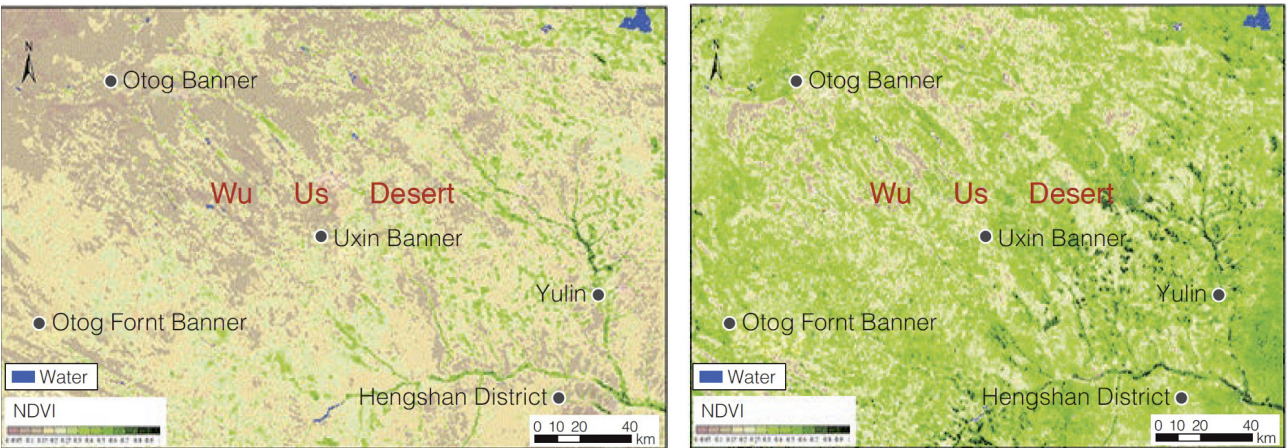
36 Global Practices of Nature-Based Solutions, A Synergistic Exploration Towards the Net-zero Future, Institute of Climate Change and Sustainable Development at Tsinghua University, China Environment publishing group, Beijing, 2022, Page 53.

FIGURE 11. Historical changes of the Mu Us desert. Before treatment (left) and after treatment (left)



Source: Li, Wang, 2022.

FIGURE 12. Vegetation index comparison of the Mu Us Desert. (July 2000 left), (July 2019 right)



Source: Li, Wang, 2022.

Carbon sinks in the ecosystems have increased. According to the long-term measurement of the typical desert ecosystem at the southern edge of the Mu Us Desert in Yanchi, Ningxia by the National Positioning Observation and Research Station, the shrub ecosystem with *Artemisia*, sweet vetch and desert willow as typical vegetation plays a vital role as a carbon sink over longer periods of time (absorbing 80g of carbon per square meter annually).

The living environment and climate have been improved. Climate improvement is an important ecological benefit of desertification control. Taking Yulin City as an example, the frequency of dust storms has decreased from more than 100 days to less

than 10 days annually. In 2017, the number of days with excellent air quality in Yulin reached 285 days, and the climate was greatly improved. Sandstorms and dust storms in Ejin Horo Banner have also decreased significantly where the number of days with sandstorms decreased from 23 days per year in 2000 to 13 in 2019, thus clearly demonstrating the positive impacts of restoration.³⁷

37 Ibid. Page 54

Case studies: Ecosystems

– water

EUROPE: GREEN AND BLUE INFRASTRUCTURE IN THE INTERCONTINENTAL BIOSPHERE RESERVE OF THE MEDITERRANEAN, SPAIN AND MOROCCO

The Intercontinental Biosphere Reserve of the Mediterranean (IBRM) was established in 2006 as a joint initiative of the governments of Spain and Morocco. The northern section of the IBRM is located in the Spanish provinces of Cádiz and Málaga. The southern section of the IBRM covers four provinces in north Morocco, namely Tanger, Tetouan, Larache, and Chefchaouen. It also includes the marine area of the Strait of Gibraltar (Figure 13). The reserve contains a high diversity of species on both its European and African shores since this is a migratory route between the African and European continents. The area is inhabited by 40 species of mammals and 117 species of birds, and many species of reptiles and amphibians. Almost 70 per cent of the Spanish area and 30 per cent of the Moroccan area are protected.

While both sides of the reserve share similar ecological characteristics, human activities have shaped each landscape very differently. Woodland/forest is the dominant ecosystem on both sides, but agricultural land is also present extensively in the Moroccan section. Rapid socio-economic and technological developments have caused rapid population growth and significant expansion of economic activities.

As part of the Horizon 2020 AQUACROSS project, recommendations were provided for the establishment of Blue-Green Infrastructures (BGI) and examples of best practices for the management and planning of transboundary water ecosystems.³⁸ BGI

—sometimes GBI— is one of the types of NbS identified by the UNEP in Section 1. It refers to a strategically planned network of natural and semi-natural landscape made up of “green” (land) and “blue” (water) elements with other environmental features designed and managed to deliver a wide range of ecosystem services. The GBI concept is about maintaining, strengthening and restoring ecosystems and the services they provide. It builds on an earlier concept of Green Infrastructure (GI), promoted by an EU ‘Green Infrastructure Strategy’ in 2013, spearheaded by DG Environment. GI was also part of the EU 2020 Biodiversity Strategy, released in 2011. In this formulation, GI should be integrated into most EU policies, particularly regarding fisheries, transport, energy, and culture.³⁹

Although the reserve is home to several remarkable protected sites, a high variety of biodiversity and an important cultural heritage, pressures from human activities in the area are threatening these values. The aim of the project examined here was to use diverse data and stakeholder input to understand the social and ecological systems and design a multifunctional network of areas to allow conservation, exploitation and restoration, and to also identify ideal sites for restoring degraded freshwater, coastal and marine ecosystems.

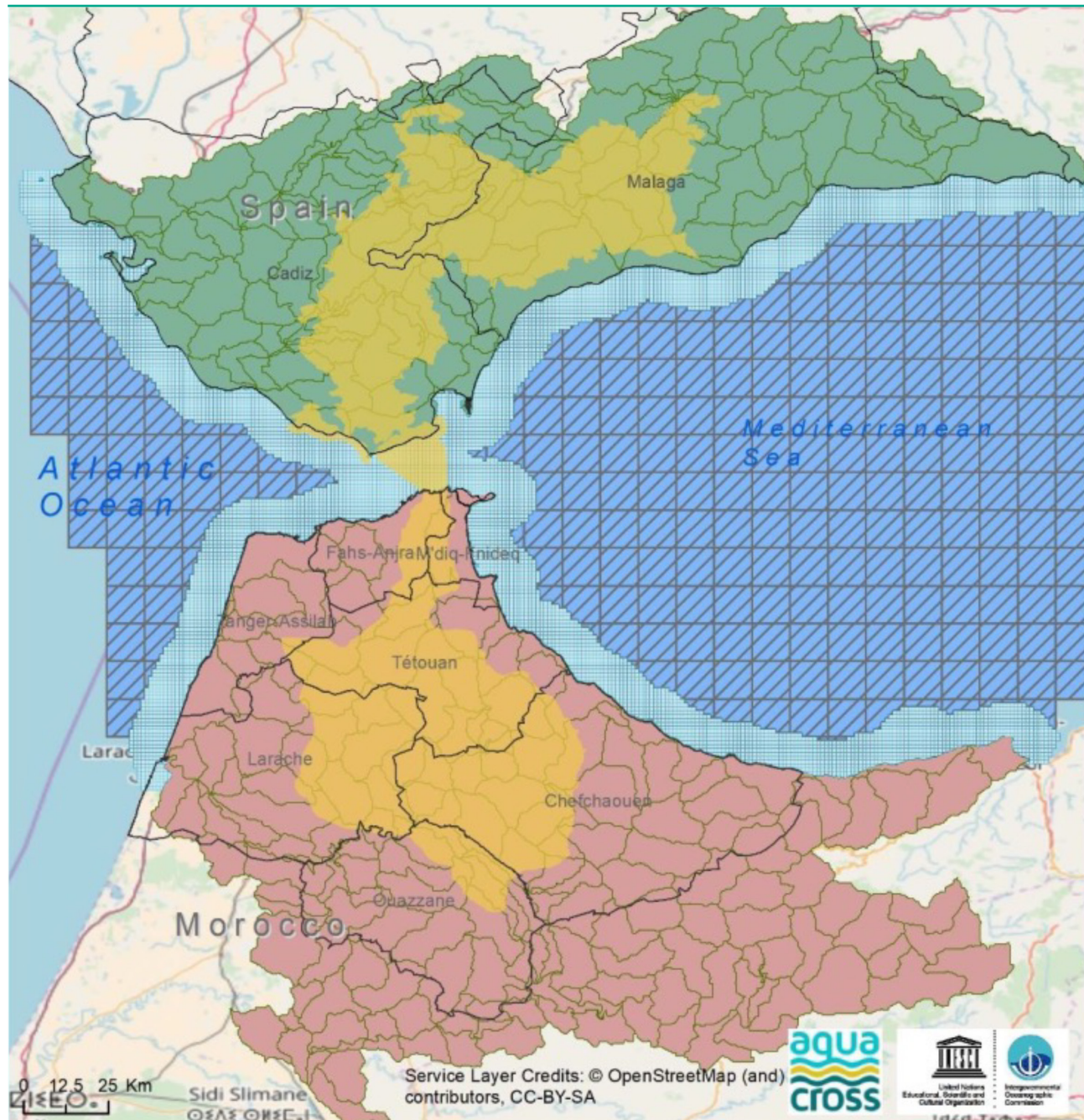
Project overview

The project was carried out between 2015 and 2018 by a team of researchers coordinated by Ecologic Institute as part of the ‘Knowledge, Assessment, and Management for AQUatic Biodiversity and Ecosystem Services aCROSS EU policies’ (AQUACROSS)

38 *Aquacross Case Study 2 Report: The Intercontinental Biosphere Reserve of the Mediterranean: Andalusia (Spain) – Morocco* (European Commission, 2018). https://aquacross.eu/sites/default/files/D9.2_CS2_28092018_FINAL.pdf

39 *Building a Green Infrastructure for Europe* (European Commission, 2014). <https://op.europa.eu/en/publication-detail/-/publication/738d80bb-7d10-47bc-b131-ba8110e7c2d6/language-en>

FIGURE 13. Intercontinental Biosphere Reserve of the Mediterranean: Andalusia (Spain) – Morocco (IBRM) and its area of influence (Aol). The areas coloured in yellow refer to the IBRM, while the area in red delineates the Moroccan Aol of the IBRM and the area in green colour outlines the Spanish Aol of the IBRM



Planning units and case study boundaries

- Intercontinental Biosphere Reserve of the Mediterranean (IBRM)
- Coastal sea planning units (1 sq. km grid)
- Marine planning units (10 sq. km grid)
- Freshwater planning units (Sub-catchment level 12)
- Northern section of the case study (IBRM Aol)
- Marine IBRM case study
- Southern section of the case study (IBRM Aol)
- Out of the study area

Data Sources:
 © HydroSHEDS for river basins and sub-catchment (Lehner, B., Verdin, K., Jarvis, A., 2008)
 © European Environmental Agency (EEA) (2015) coastline - definition of 10 km buffer;
 © Open Street Map for base map;
 © REDIAM for IBRM administrative boundaries;



programme. It aimed to support EU efforts to protect aquatic biodiversity and ensure the provision of aquatic ecosystem services. Funded by Europe's Horizon 2020 research programme, AQUACROSS sought to advance knowledge and application of ecosystem-based management for aquatic ecosystems to support the timely achievement of the EU 2020 Biodiversity Strategy targets.

GBI are landscape ecological approaches that consider connectivity as well as the multiple functions that natural environments can provide to human well-being, while at the same time, they respond to local population demands, by allowing public participation during their design. This makes GBI a useful tool for an integrative spatial planning at the IBRM that addresses the conservation and societal goals existing in the Reserve (see below).

In collaboration with the regional and local governments of Andalusia (Spain) and Morocco, the project team applied the AQUACROSS Assessment Framework to identify the most effective and efficient network of multi-purpose protected areas (also known as Green and Blue Infrastructure). This included:

- » Using satellite and local data to analyse regional activities, pressures, ecosystem condition, biodiversity, and key aquatic ecosystem services.
- » Understanding stakeholder objectives (including economic objectives) for the reserve to identify synergies, conflicts, and opportunities for improvement.
- » Using models to identify the best locations for protected and semi-protected areas, i.e where biodiversity is high or can be cheaply restored, whilst still allowing human activities (such as fishing or recreation) in neighbouring or other areas.
- » Co-creation: local stakeholders reviewed and contributed at two rounds of workshops held in Tarifa (Spain) and Tangier (Morocco).

Results and impact

The AQUACROSS project demonstrated that ecosystem-based management and restoration measures could be explicitly included in an optimal spatial planning process of a GBI, while minimising costs and conflicts between conservation and exploitation trade-offs previously identified by the stakeholders in the study area. The recommended measures protected and enhanced biodiversity and

ecosystem conditions while at the same time promoting economic growth using natural resources in a sustainable way. The results were applicable to both marine and terrestrial conservation planning across three different realms – freshwater, coastal, and marine – allowing for transboundary and comprehensive management.

The project identified priority areas which could allow the conservation of biodiversity, the maintenance of ecosystem services capacity, and the restoration of degraded ecosystems, while allowing for economic activity and minimising costs. The results suggest that using ecosystem-based management restoration measures when designing Green and Blue Infrastructure may increase protected area coverage, while improving connections between protected areas.

According to the project implementers, local policymakers in Andalusia (REDIAM - Environmental Information Network of Andalusia), and in Morocco (the Regional Observatory for Environment and Sustainable Development Tangier-Tetouan-Al Hoceima) highly valued the analytical cartography, the spatial data and the storytelling tool produced in AQUACROSS. Indeed, REDIAM report that they will deploy the methodology, "to estimate ecosystem condition of habitats and a network of multifunctional and interconnected areas (Green and Blue Infrastructure) not only in the case study area but in other areas in Andalusia".⁴⁰

40 Case Study 2: Analysis of transboundary water ecosystems, Green and Blue Infrastructures in the Intercontinental Biosphere Reserve of the Mediterranean (IBRM) (AQUACROSS). https://aquacross.eu/sites/default/files/D3_3_16.pdf

FIGURE 14. The natural World Heritage site of Yellow Sea Wetlands in Yancheng, China. Location map (left), natural landscape (right)



Source: Migratory birds fly in the wetlands of Yancheng, east China's Jiangsu Province, November 19, 2023. (Photo by Ji Haixin/People's Daily Online).

CHINA: ECOLOGICAL RESTORATION OF THE YELLOW SEA WETLANDS⁴¹

With an area of 455,300 hectares, the Yellow Sea Wetlands in Yancheng in eastern China, is the largest relatively well-preserved coastal wetland remaining on the west coast of the Pacific Ocean and the edge of the Asian continent, it is also the largest coastal mudflat in China (Figure 14). Furthermore, a dedicated project for Migratory Bird Sanctuaries along the Yellow Sea-Bohai Gulf Coast (Phase I) covers about 186 thousand hectares⁴², and is home to more than 680 vertebrate species. The sanctuary serves as a central node along the most threatened East Asian-Australian migratory bird route and as a resting, moulting, and wintering ground for millions of migratory birds. It provides habitat for 23 internationally important bird species and supports the survival of 17 species on the IUCN Red List, including one critically endangered species: the Spoon-billed Sandpiper (*Calidris pygmaea*), and five endangered

species: Black-faced Spoonbill (*Platalea minor*), Oriental White Stork (*Ciconia boyciana*), Red-crowned Crane (*Grus japonensis*), Spotted Greenshank (*Tringa guttifer*) and Great Knot (*Calidris tenuirostris*).

Project overview

Over the years, management of the Yellow Sea Wetland has adhered to the motto 'from nature, to nature'. This has involved restoring the wetland ecosystem and its ecological function, building a new model of harmonious coexistence between humans and nature, wetland protection and sustainable development, and providing technical support for the protection of the heritage site's ecology. Yancheng authorities established the Yancheng Wetland and Natural World Heritage Conservation and Management Centre, introduced *Regulations on the Conservation of Yellow Sea Wetlands in Yancheng* and a *Three-Year Action Plan for the Conservation, Management and Sustainable Development of the Yellow Sea Natural Heritage Site in Yancheng (2019-2021)*, to provide a basis for legal and scientific protection.

Yancheng also established the Yellow Sea Wetland Institute in 2017, strengthening international

⁴¹ Case Source: C+NbS Cooperation Platform

⁴² Covering part of Yancheng Wetland National Nature Reserve for Rare Birds (Yancheng Nature Reserve), the whole area of Dafeng Elk National Nature Reserve, Yancheng Tiaozini Wetland Park and wetland protection areas.

FIGURE 15. Chuanshui Port Location and layout



Source: Global Practices of Nature-based Solutions: A Synergistic Exploration Towards the Net-zero Future. Edited by: Li Zheng, Wang Binbin. Beijing: China Environmental Science Press, August 2022 ISBN 978-7-5111-5151-3.

exchanges with and recruiting a team of special experts and scholars renowned at home and abroad from relevant international organizations and universities. The team has carried out research on coastal wetland conservation, migratory bird conservation, ecological restoration, alien species control and other topics. The 'Nature-based Research Station for Ecological Conservation and Restoration of Yellow Sea Wetlands' was set up at the Yellow Sea Wetland Institute in 2020 for the promotion, practice and application of NbS, highlighting problems such as wetland protection, ecological restoration, and control of invasive alien species (e.g., Smooth Cordgrass), and conducting related training activities.

A series of successful pilot projects in the ecological restoration of the Yellow Sea Wetlands have been carried out in Yancheng.

Ecological Restoration Demonstration Project of Coastal Wetlands in Chuanshui Port

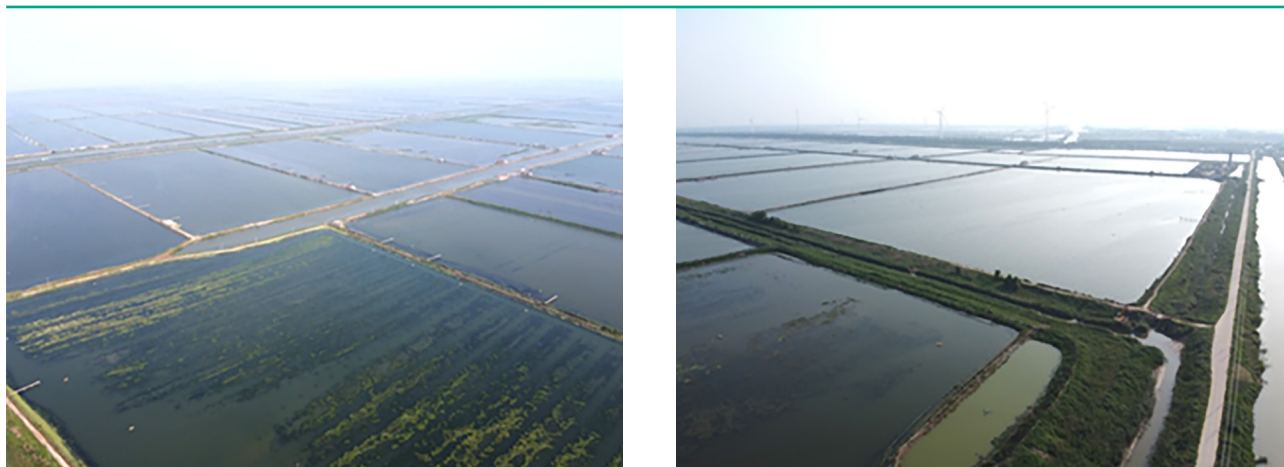
Chuanshui Port is located within the area of migratory bird sanctuaries along the Yellow Sea-Bohai Gulf Coast. Located in the middle of Jiangsu's coastal wetland ecosystem, it is an important node along the migration path for rare migratory birds from Chongming Island in Shanghai to the core area of Yancheng Wetland National Nature Reserve, providing essential resting and feeding places. The Chuanshui Port is adjacent to the core area of the

Dongsha Island Heritage Site, which is important habitat for plover and snipe. Following restoration of the area's ecology, it was expected to become an extensive area of high tide habitat and feeding source for these birds. In addition, Chuanshui Port used to be inhabited by red-crowned cranes. However, there are now fewer, red-crowned cranes in the southern part of the heritage site due to the reduction of natural wetlands and lack of food in winter. Once restored, the southern part of the site was expected to become an important living space for red-crowned cranes (Figure 15).

This project is an example for a large scale NbS. It involved the restoration of the wetland ecosystem, giving full play to the ecological services of the ecosystem, providing technical support for conservation at the site to promote wetland conservation and sustainable development. An integrated model was developed for the comprehensive management and restoration of degraded coastal wetland ecosystems based on the creation of multiple types of habitats,⁴³ water level regulation and multi-level topographic reshaping, and a model for the restoration of salt marsh wetlands and seasonal seawater mudflats based on a combination of tidal regulation, ecological control of Smooth Cordgrass, and natural evolution of coastal ecosystems.

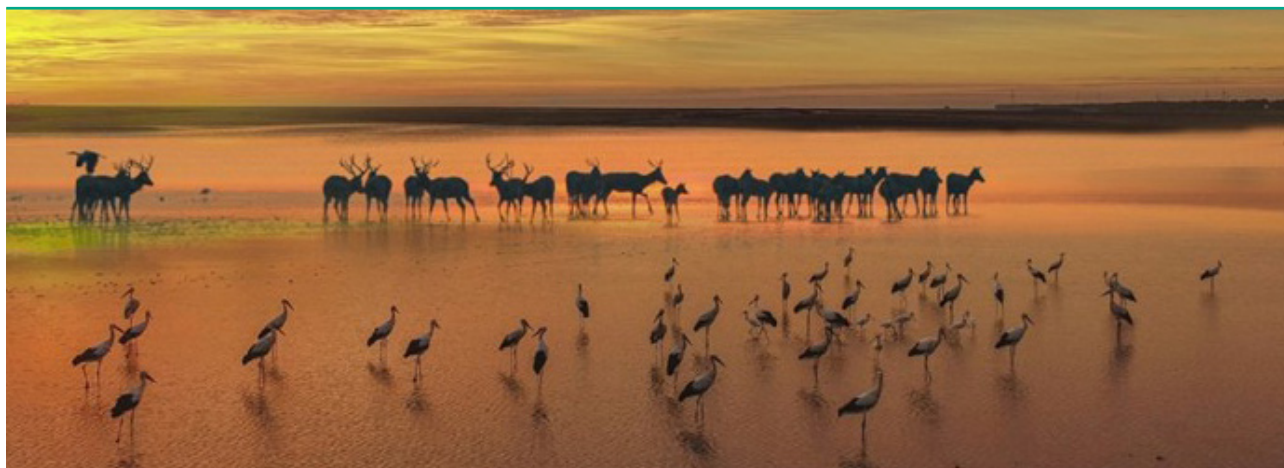
43 Includes seawater habitat, freshwater habitat, and mixed seawater-freshwater habitat.

FIGURE 16. Abandoned aquaculture ponds in Doulong port



Source: Global Practices of Nature-based Solutions: A Synergistic Exploration Towards the Net-zero Future. Edited by: Li Zheng, Wang Binbin. Beijing: China Environmental Science Press, August 2022 ISBN 978-7-5111-5151-3.

FIGURE 17. Wild Elk in Yeludang



Source: m.thepaper.cn.

Ecological Restoration Programme in Doulong Port. Most of the area of Doulong Port consists of abandoned freshwater aquaculture ponds, with a relatively homogeneous ecological environment that inadequately protects migratory birds (**Figure 16**). In the context of NbS, a policy of ‘focusing on natural ecological restoration’ supplemented by moderate artificial intervention was adopted to create, protect, or restore natural ecosystem elements as much as possible, combining ecosystem elements with hard engineering interventions forming a hybrid infrastructure.

Wildlife Habitat Conservation Project in Yeludang. Since 2009, Dafeng District Government in Yancheng and NGOs have initiated campaigns to protect Yeludang, specialising in scientific research, culture and nature conservation. At the same time,

a coastal wild plant germplasm bank was jointly built with the Jiangsu Laboratory of Coastal Wetland Bioresources and Environmental Protection (JLCBE), which now possesses nearly 300 specimens and seeds from the 485 species of wild plant in the coastal area and carries out groundwork for the conservation of wild plants in the coastal area (**Figure 17**).

Smooth Cordgrass Invasion Prevention Project. *Spartina alterniflora* Loisel (commonly known as smooth cordgrass) has been spreading rapidly in the Chinese coastal belt, posing a threat to the biodiversity of most coastal mudflats. It is one of the main reasons for the degradation of Yancheng coastal wetlands (**Figure 18**). Seeking a ‘Yancheng solution’ to the prevention and treatment of Smooth Cordgrass, the government has carried out control programmes in the Yellow Sea Wetlands with a view

FIGURE 18. Status of *Spartina alterniflora* Loisel invasion in the heritage site



Source: Global Practices of Nature-based Solutions: A Synergistic Exploration Towards the Net-zero Future. Edited by: Li Zheng, Wang Binbin. Beijing: China Environmental Science Press, August 2022 ISBN 978-7-5111-5151-3.

to strengthening the containment of the grass, accelerating the protection and restoration of the coastal zone ecosystem, and providing experience and approaches for its control on a larger scale across China.

Results and impact

Taking biodiversity protection as an example, Yancheng Wetland National Nature Reserve for Rare Birds has enlarged the buffer zone to restore fishponds to wetland. Nearly 6,667 hectares of fishponds have been restored to habitat for birds. Jiangsu Dafeng Elk National Nature Reserve has taken measures such as internal regulation, silage supplementation, grid management, seine rotation, water system renovation and vegetation restoration to scientifically regulate and manage the elk population as well as to effectively restore and improve the habitat of the elk or Père David's deer (*Elaphurus davidianus*), also known as the milu. The milu is endemic to China and became extinct in the wild in the late 19th century. It was successfully reintroduced to the wild from 1985. The Nature Reserve's 5,681 elk account for more than 60% of the world population, including 1,820 wild elk. On July 5, 2019, the Yellow Sea Wetlands in Yancheng, representing Migratory Bird Sanctuaries along the Yellow Sea-Bohai Gulf Coast (Phase I), was inscribed on the World Heritage List at the 43rd session of the World Heritage Committee, becoming the first intertidal wetland World Heritage site in China and the second in the world due to its 'outstanding universal value'.

The ecological recovery brought about by restoration of the Yancheng wetlands is delivering increasingly significant social and economic benefits. Firstly, the restoration contributes to ecological tourism development. Through the implementation of measures such as restoring fishponds to wetland, the natural environment has been greatly improved, and the attraction of scenic spots has been enhanced, promoting the development of ecological tourism in the area.

Secondly, since 2020, Yancheng Port Agricultural Science and Technology Group has explored an "ecology + agriculture" restoration model with Dafeng District. In the restoration area, crops were planted in an ecologically friendly way without using chemical fertilizers and pesticides. A partial harvest model was adopted, retaining part of the crops to feed the birds. Meanwhile, the straw also provides a place for birds to breed, roost and protect themselves. It is expected that in the near future income from grain sales will help to finance the management and protection of the area, creating a positive virtuous cycle of "ecology + agriculture" development.

Yancheng takes wetland ecological protection as the entry point and is actively exploring the path of high-quality industrial, urban and ecological development. Yancheng has divided its 2035 urban planning into three stages:

- » First, by 2021 Yancheng planned to become an international wetland city, the Yellow Sea Wetland World Heritage Site would be fully protected,

a migratory bird migration route alliance will be established with Yancheng as the hub, and a preliminary framework for cooperation would be formed around the Yellow Sea Ecological-Economic Circle (the coastal region of the Yellow Sea);

- » Second, by 2025 the Yellow Sea Wetland World Heritage Site will have realised a scientific approach to environmental protection,

preservation of natural heritage, and sustainable use. The Yellow Sea Ecological-Economic Circle cooperation framework will become a platform for achieving mutual benefit and trust between regions; and

- » Third, by 2035, Yancheng will have achieved significant results in urban development, presenting a picture of harmonious coexistence between people and nature.

Case studies: Urban

EUROPE: PARCO SUD AGRICOLO

Milan is Italy's second largest city, and its wealthiest; it is one of the most developed and vibrant cities in Europe. It is also the capital of Lombardy, the country's main economic and industrial region. However, like other typical modern commercial and industrial cities, it faces environmental challenges including high levels of traffic and local air pollution.

Project overview

Urban redevelopment and regeneration, underway for several decades, has offered the opportunity to achieve environmental and social targets through the adoption of nature-based solutions. The 'Carta of Milan', the city's strategic environmental plan, recognised 'green infrastructure' as the best way to achieve environmental targets, promote social development and improve social welfare. The city plan is situated within the Lombardy region's green infrastructure actions for ecological connections and the creation of ecosystems. The regional plan provides guidelines to the different municipalities for the management and creation of ecosystems and outlines funding mechanisms.⁴⁴

The construction of urban and peri-urban gardens and parks has helped to involve Milan's residents in the management of urban green spaces.⁴⁵ The intention is to develop urban forests, public parks and gardens, including shared gardens used by citizens or neighbourhood associations to grow vegetables, as meeting places or activity centres. These green urban areas would provide Milan with important ecosystem services while the planned Green Rays and Green Belts were intended to connect the green areas using pedestrian and cycling paths. Eight Green

Rays, between 7 and 12 km in length, were planned to connect the city centre to the agricultural hinterland, passing through regenerated suburbs. In the end only two were developed, and only partially, but the concept fed into the Milan 2030 territorial plan, which foresees the creation of 20 new parks. What makes the Milan 2030 Plan revolutionary - not so much the dramatic increase in green areas but the desire to make the greening of the city systematic.

Parco Agricolo Sud, a key area of the Green Belt offers a good example of governance in the management of the rural landscape on the city outskirts. The area is referred to as a regional park with a particular reference to nature, cultural and recreational use alongside the development of agricultural activities aimed at encouraging economic, social and cultural community activity. The Parco Agricolo Sud (in English the South Milan Agricultural Park) was established by regional law n. 24 in 1990, which was replaced by regional law n. 16 in 2007 and entrusted to the management of the Metropolitan City of Milan. In total it includes the agricultural and forestry areas of 60 municipalities, covering a total of 47,000 hectares. The territory is almost totally flat and crossed by numerous waterways of different flow rates (Lambro, Vettabia, Ticinello, Addetta, Muzza) and by an extensive artificial water network which finds its maximum expression in the Naviglio Grande and the Naviglio Pavese.

The Park, (**Figure 19**) has a strong agricultural focus, with a clear prevalence of cultivated areas over naturalistic ones, but at the same time it preserves areas in which stretches of the ancient wooded areas that covered the Po Valley in past centuries have remained unchanged, a large variety of plant and animal species typical of the different environments that compose them and some peculiarities that make the Agricultural Park a rare example of safeguarding and perpetuating biodiversity.⁴⁶ In the Park there are approximately 1,000 forests that

44 'Case study: Milan – NBS for urban regeneration' (at [Oppla](#), EU, the EU Repository of Nature-Based Solutions).

45 'The new Milan is green. And it designs its future through nature'; <https://www.designatlarge.it/milan-design-green-landscape-future/?lang=en>.

46 https://www.cittametropolitana.mi.it/parco_agricolo_sud_milano/natura/index.html

FIGURE 19. Parco Sud Milano



Source: CC-BY-SA-3.0.

meet the requirements established by the forestry law for a total area of 1,477.5 ha. although these are predominantly small. Two forests of note provide evidence of what the Po Valley was like before its agricultural exploitation and contain evidence of the ancient lowland forest: the Cusago Forest and the Riazolo Forest in Cislano.

Results and impacts

At Parco Sud Agricolo Management plans have been developed for Natura 2000 sites alongside an agricultural sector plan. It exemplifies the ability to use the planning system to achieve environmental outcomes at scale. The park should not be regarded as a single entity as it includes, many points of interest for which management plans exist.

It is also an exemplar of multilayer governance, which includes a board of directors, an assembly of Mayors, an agricultural technical committee, a landscape commission and regulations. A series of impacts relate to rural tourism, improved accessibility to natural areas, local food produce, access to

history, culture, and local traditions and information provision for visitors. In respect of nature-based solutions, the integration of agriculture, ecosystem services and city planning make this a valuable case study for cities across Europe and China, where agriculture is being impacted by urban expansion.

CHINA: CHENGDU PARK CITY CONSTRUCTION⁴⁷

Located in southwestern China and the western part of the Sichuan Basin, the city of Chengdu is the capital of Sichuan Province. In a humid subtropical monsoon climate, it has a flat terrain, criss-crossing river networks, rich soils, and a developed agricultural system. It was referred to as the 'Land of Abundance' in ancient times. As of 2019, Chengdu has a built-up area of 950 square kilometres, with a permanent population of around 16 million, a

47 Case Source: C+NbS Cooperation Platform

population density of 1,180 people per square kilometre, and an urbanization rate of about 75%.

Chengdu is an international sustainable development pilot city for UN-Habitat, and part of China's third batch of Low-carbon Development Pilot Cities. It has identified its development positioning as 'becoming a focal point for economic development in western China, building global comparative advantages, nation-leading economic growth, and high-end value chains'. However, the rapid development of urbanization and industrialization in recent years has intensified the inflow of residents from surrounding cities. The total population of Chengdu continues to increase, the number of high-rise buildings keeps growing, and car ownership ranks second in China. However, problems such as a sharp decrease of forested land, decreasing arable land, water pollution, fragmentation of ecosystems, and reduction of biodiversity have gradually become more prominent.

Project overview

In February 2018, Chinese President Xi Jinping visited Sichuan Province, and gave a clear development direction to 'highlight Chengdu's characteristics as a Park City and incorporate ecological benefits into development'. As the first city to put forward the concept of Park City, Chengdu is focussed on building a 'Beautiful and Liveable Park City' and has released a long-term plan to achieve this by 2035. Through protection, restoration and sustainable management of ecosystems – ie through nature-based solutions in line with UNEA Resolutions 5/5 - , it effectively responds to various social challenges, and provides a better life for residents. It strives to create a high-quality all-for-one park system that is accessible, participatory and educational, while creating a sense of awareness and appreciation by providing a 'Chengdu model' in urban NbS application.

The Park City concept is an advanced form of active and coordinated protection of nature and urban development within an ecological civilization, and a new model for sustainable urban development in the modern era. The existing urban development model should undergo three changes. The first is the shift from 'industry, city, and people' to 'people, city, and industry'. Return from industry-based logic to human-centric logic, relying on a healthy ecological environment and public welfare to attract talent and enterprises, drive industrial prosperity, and achieve the harmonious development of people, city and industry.

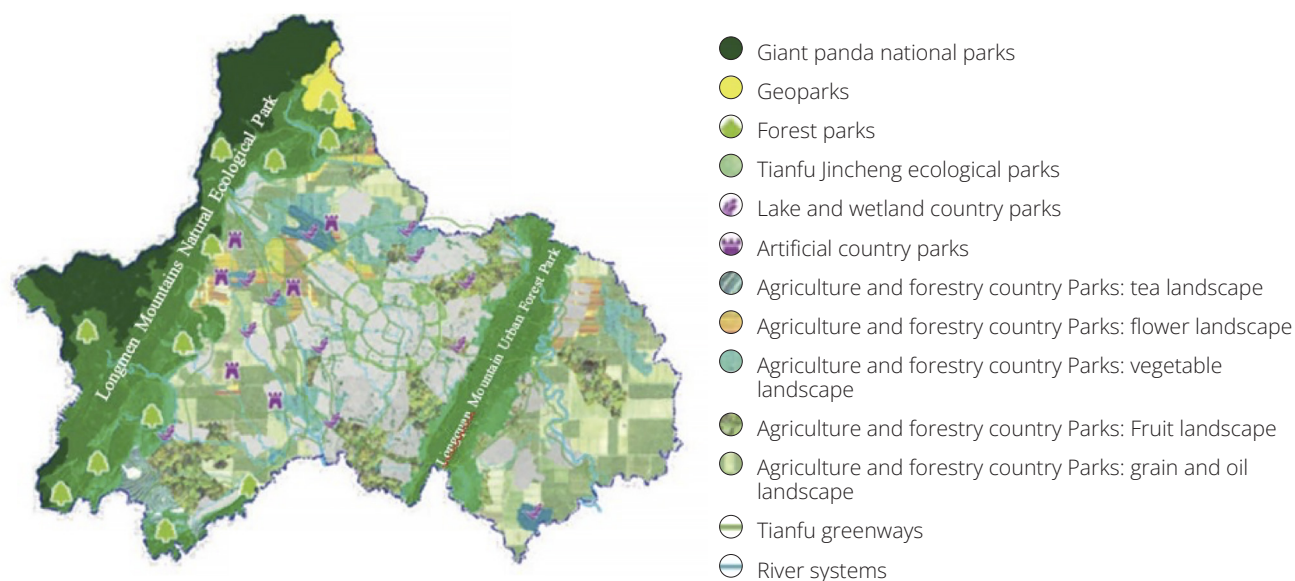
The second is the shift from 'building a park in a city' to 'building a city in a park'. Urban development should recognise the ecological, aesthetic, cultural, economic and morphological role of parks, and integrate the park within the urban space. The third change is shifting from 'space construction' to 'scene creation'. Focusing on people's needs, through embedding of facilities and functional integration, comprehensively build the scenery of urban life, including consumption and innovation, to enhance the sense of spatial belonging. As an important model for responding to the needs of the built environment in the new era, as well as shaping the competitive advantage of the city, the park city reflects the value that the Chinese government places on 'clean water and green mountains', and the economic value of green and low-carbon development. The Park City planning and development in Chengdu consists of forest parks, country parks, urban parks and green spaces, and greenways (Figure 20).

In addition, Chengdu is implementing a carbon inclusive mechanism through the Low Carbon Tianfu Initiative. This aims to quantify the energy-saving and carbon-reduction behaviour of small and micro enterprises, communities, households and individuals, by establishing a mechanism combining policy encouragement, business incentives and emissions trading to influence citizens' behaviour, thus mobilizing society to practice green and low-carbon practices from the bottom-up, and actively connecting with the national strategy to tackle climate change. The mechanism is the first in China to propose the construction of a 'two track' incentive mechanism for the public, enterprises and institutions, which includes 'public carbon emission reduction credits' and 'project carbon emission reduction development and operation'. Through this mechanism, the environmental benefits of carbon reduction show their economic value in the form of carbon credits. For example, according to the Low Carbon Tianfu methodology, Jincheng Greenway can reduce 4,200 tons of carbon dioxide equivalent emissions each year for carbon trading and realize ecological value.

Results and impact

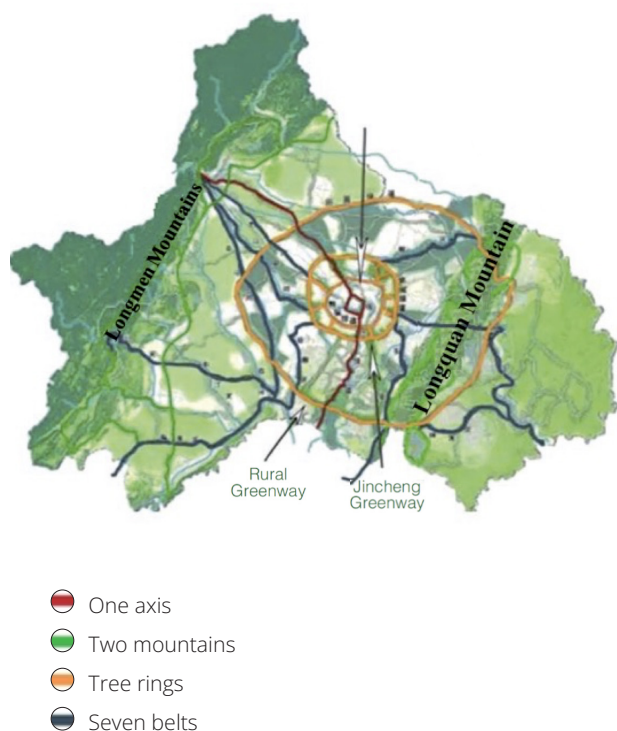
Since 2018, Chengdu has been implementing a philosophy for city planning that aims to 'build a city within a park', while creating a city full of parks, harmony between parks and urban life, and harmony between the city and its people'. It connects forests, countryside and urban green spaces with greenways and water networks to form seamless green space transitions and a connected park system. By 2035,

FIGURE 20. Planning of Chengdu Park City



Source: Chengdu Tianfu City Park Research Institute.

FIGURE 21. Greenway planning of Chengdu



Source: Chengdu, Tianfu Park City Research Institute.

the city aims to have established 1,275 square kilometres of Longquan Mountain Urban Forest Park and 16,900 kilometres of Tianfu Greenway will be built (about 3,700 kilometres of which were already completed by 2020). In total, 38.9 million square meters of green space will be added, the city's forest coverage rate will reach 40%, and the green coverage for the built-up area will reach 43.5%.

To take the Tianfu Greenway as an example, it is already the longest greenway in the world, with a total investment of ¥34.1 billion. Chengdu is using *Greenway+* to generate economic value through ecological protection, with the theme of constructing 'a path to build the city, promote the economy, and make people happy'. The project will help to realize improvements in the ecological landscape, slower traffic, leisure tourism, urban and rural integration, cultural creativity, space for physical activity, agriculture tourism and protection against natural disasters (Figure 21).

The revolutionary layout of Tianfu Greenway is the test of Chengdu's long-term NbS operation, maintenance and sustainable development capabilities. The Tianfu Greenway strategy is government-led, market-based and commercially viable. Global investments are also welcomed via methods such as facility leasing, joint operations and resource equity

participation. The social investment in Tianfu Greenway accounts for more than 70% of its total value.

In the case of the Jincheng Greenway the value of surrounding land increased and promoted the development of modern service industry clusters by hundreds of billions of Yuan. It attracts hundreds of millions of tourists every year, created more than 100,000 jobs, attracted high-quality talent, and promotes innovation and entrepreneurship.

According to the Institute of Mountain Hazards and Environment, Chinese Academy of Sciences, Chengdu, and the preliminary estimates of 18 ecological service value indicators, including climate regulation, carbon fixation and oxygen release, soil conservation, and water conservation, the annual ecological service value of Jincheng Greenway is about ¥26.9 billion. It is expected to produce sustainable benefits for more than 40 years, with a total value of more than ¥1 trillion.⁴⁸

FIGURE 22. Integration of the streets of The Tianfu City Park project



Source: Chengdu Tianfu City Park Research Institute.

48 Global Practices of Nature-Based Solutions, A Synergistic Exploration Towards the Net-zero Future, Institute of Climate Change and Sustainable Development at Tsinghua University, China Environment publishing group, Beijing, 2022, Page 137.

Case studies: Financing nature-based solutions

EUROPE: SUSTAINABLE FINANCING MECHANISM FOR MEDITERRANEAN MARINE PROTECTED AREAS

Marine Protected Areas (MPAs) are crucial tools for the long-term conservation of the marine environment, including its species, habitats, ecosystems and the services it provides, with the aim of ensuring sustainable management and sustainable use of marine resources. MPAs can support achievement of key environmental goals, such as the 30 by 30 target (Target 3 of the Kunming Montreal Global Biodiversity Framework), as well as national contributions under the Paris Agreement on climate change. They can also support broader efforts including multiple Sustainable Development Goals, such as targets 13 (climate), 15 (environment) and target 2 (no hunger).

The protection and restoration of marine ecosystems can play an important role in local and regional economies. In the Mediterranean a regional system of MPAs has been developed to enhance economic benefits as well as protecting biodiversity. MPAs support local economies through:

1. Increased Tourism: Protecting marine ecosystems in the Mediterranean can help to attract more tourists, who come to enjoy the beauty and biodiversity of the area. This increased tourism can help to generate more revenue for local businesses, as well as create jobs in the tourism industry.
2. Sustainable Fisheries: Preserving marine ecosystems in the Mediterranean helps ensure that local fisheries are managed sustainably and responsibly. This helps ensure that fish stocks remain healthy and abundant, providing a reliable source of income for the local fishing industry.
3. Healthy Ecosystems: Protecting marine ecosystems in the Mediterranean helps to maintain a

healthy and balanced ecosystem, which can help to reduce the impacts of climate change and provide a healthier environment for both humans and wildlife. This can help to protect local communities from extreme weather events, such as floods and droughts.

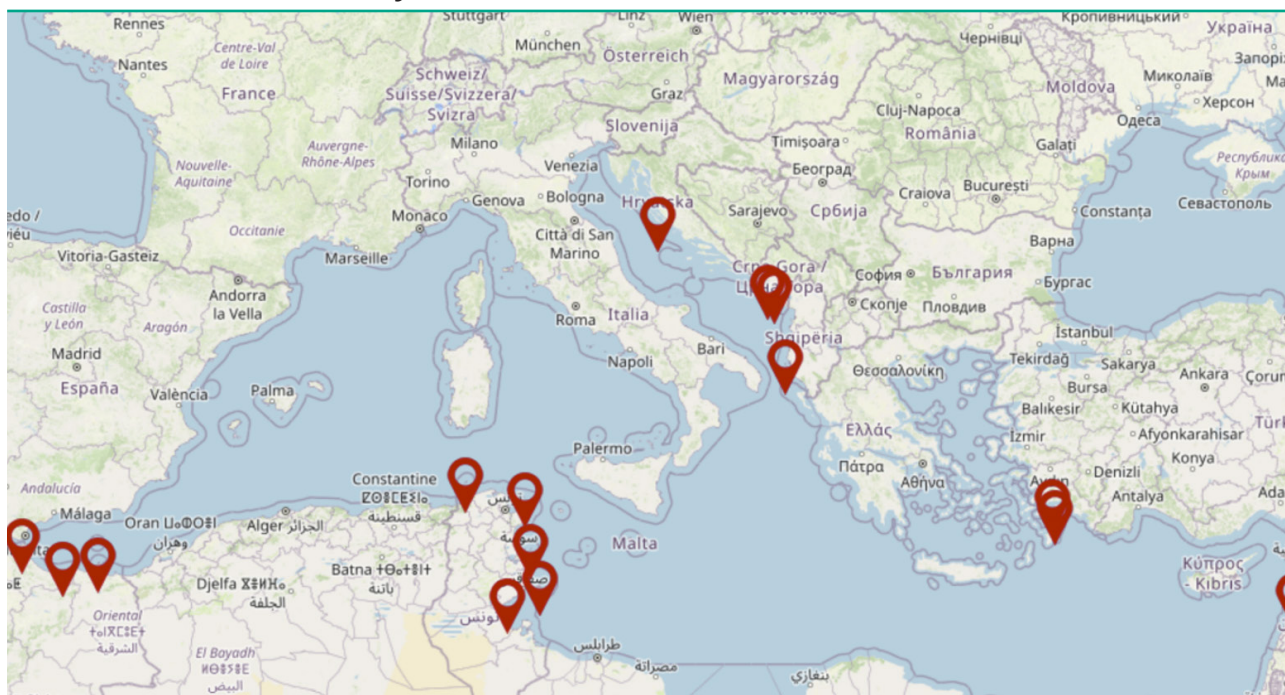
4. Cultural Heritage: Protecting marine ecosystems in the Mediterranean helps to preserve the cultural heritage of the region, which can help to attract more tourists and provide a valuable source of income for local businesses. This can also help to generate more interest and awareness of the region's unique culture.

The success and sustainability of MPAs are directly dependent on their size and the degree of effective management, including the question of funding (including staff costs, equipment, monitoring, research, training and management, delimitation of borders, law enforcement, etc.). In many cases around the world, MPAs remain underfunded, resulting in less effective protection than originally intended.

Project overview

While representing less than 1 per cent of the world ocean area, the Mediterranean is one of its biodiversity hotspots: the 21 Mediterranean coastal states count between 4 and 18 per cent of all known marine species and the second highest percentage of endemic species in the world. The Mediterranean is also, however, one of the maritime areas where human activity is the most intensive. Since the 1960s, heavy fishing pressure, high population density, from both inhabitants and tourists, growing pollution, and future temperature increase have justified the need for protection of species and habitats, through the creation of MPAs. As of 2019, approximately 9.7% of the Mediterranean Sea, or 245,950 km², had been designated as MPAs, mainly in the

FIGURE 23. MPAs Granted, by The MedFund



Source: The MedFund.

northern Mediterranean.⁴⁹ In the light of the absence of long-term financial mechanisms to support MPAs in the Mediterranean region, an initiative was launched jointly by France, Monaco, and Tunisia during the high-level session of the International Marine Protected Areas Congress (IMPAC3), in October 2013, to fill this gap. The topic was also raised at the Network of MPA Managers in the Mediterranean (MedPAN) workshop in Albania in November 2014. In 2015, the Association for the Sustainable Financing of the Mediterranean MPAs (M2PA), a non-profit organisation based in Monaco, was created, bringing together states and civil society. It is open to:

- » States that have confirmed their commitment to implementing an ambitious policy to support MPAs and explicitly shown their support for the initiative (to date: Albania, France, Monaco, Morocco, Tunisia and Spain).
- » Regional organisations involved in the conservation of Mediterranean marine and coastal ecosystems (to date: Specially Protected Areas Regional Activity Centre, MedPAN, WF

Mediterranean, IUCN Mediterranean Programme, Prince Albert II of Monaco Foundation, Monaco Oceanographic Institute, Conservatoire du Littoral, Mediterranean Small Islands Organization and the Critical Ecosystem Partnership Fund).

M2PA established a regional conservation trust fund (the MedFund) to enhance the management effectiveness of Mediterranean MPAs through improving their long-term financial sustainability. M2PA benefits from financial support from public and private stakeholders including, among others, the Global Environment Facility (GEF) and Le Fonds Français pour l'Environnement Mondial (FFEM), to design the most appropriate institutional, legal and financial structure to manage the trust fund and to fund pilot MPAs in Mediterranean countries. This fund is to be financed by the contributions of public and private donors, states, multilateral donors, foundations, companies and private patrons.

By 2025, the MedFund's goal is to reach a capital of 30 million euros in the mid-term, which will make it possible to generate regular and sufficient interest to provide a long-term support to around 20 MPAs in the Mediterranean covering 7,000km². According to the fund's website, it is to-date supporting 6,400km² in 15 MPAs, with 5 million euros of capitalization already mobilized (Figure 23).

49 Gomei M., Abdulla A., Schröder C., Yadav S., Sánchez A., Rodríguez D., Abdul Malak D. (2021) [original 2019]. Towards 2020: how Mediterranean countries are performing to protect their sea. https://wwf-eu.awsassets.panda.org/downloads/wwf_towards_2020_how_mediterranean_countries_are_performing_to_protect_their_sea.pdf

Most recently, in January 2023, the MedFund's Highly Protected Mediterranean Initiative, financed by the MAVA Foundation, approved financial support for two new marine protected areas for a period of 5 years: Datça Bozburun in Turkey and the Telascica Natural Park in Croatia. This support, amounting to 600,000 Euros, was granted to local civil society organizations that work alongside MPA agencies, and will contribute to the financing of activities essential to preserve marine ecosystems and the populations that depend on them.

Results and impact

MPAs are globally important management tools that provide protection from the effects of human exploitation and activities, supporting the conservation of marine resources, habitats and the processes they host, biological diversity, and exploited species such as commercial fish stocks.⁵⁰ Various studies have shown the diversity of environmental, social and economic benefits they can deliver, including maintaining or recovering habitat quality and/or quantity; protecting resident species of fish and wildlife, increasing their abundance and controlling biological invasions; protecting genetic diversity and gene pools; increasing ecosystem stability and promoting resilience; facilitating marine ecosystems' adaptation to climate change; maintaining existing resources and providing new potential resources; and producing economic benefits for local populations.

According to the Med Fund, MPAs maintain and improve a wide range of ecosystem services and open up many prospects for sustainable development for neighbouring areas. By involving professionals of the sea in the management, MPA managers support the transition towards sustainable fishing practices, and promote the development of short supply chains. The efficient management of an MPA leads to the recovery of fishery resources and significantly increases the yields of small-scale fishermen in surrounding areas. In addition, since they promote the development of environmentally friendly tourism and leisure activities, MPAs provide real

development opportunities and direct benefits for local populations.⁵¹

As noted above, however, a shortage of funding can severely restrict MPAs' ability to deliver these outcomes. In a study of MPAs in the Mediterranean, official data from 14 countries showed that total available resources for MPAs reached nearly €52.8 million per year, or €18,500 per km² per year on average.⁵² For effective management, however, the study's authors estimated a total financing need of €700 million a year, and for the full achievement of Aichi Target 11, they estimated €7 billion from 2015 to 2020.

M2PA, and subsequently the MedFund, is an attempt to help fill that gap. It aims to enhance existing MPAs to deliver their ecological, social and economic value, also encouraging the creation of additional MPAs. It is aimed at mobilising funding to supplement current Mediterranean MPA funding, including through innovative mechanisms, and at fostering long-term financing, particularly for MPA activities that receive little funding but are essential for the effective management effectiveness.

While it is a regional mechanism focusing solely on the Mediterranean, it can be replicated in other regions, bringing together states and relevant existing organisations and civil society as well local communities and scientific expertise in a regional context. It can complement and be closely coordinated with existing international, regional and national programmes, especially those carried out under the Barcelona Convention, and contribute to the implementation of the national strategies related to MPAs, which can be replicated elsewhere. Lastly, it can also be relevant to regional networks supporting MPA managers (capacity-building, exchanges of experience, etc.).

50 Marcos C, Díaz D, Fietz K, Forcada A, Ford A, García-Chartron JA, Goñi R, Lenfant P, Mallol S, Mouillot D, Pérez-Marcos M, Puebla O, Manel S and Pérez-Ruzafa A (2021), 'Reviewing the Ecosystem Services, Societal Goods, and Benefits of Marine Protected Areas', *Front. Mar. Sci.* 8:613819. DOI: 10.3389/fmars.2021.613819

51 *The Environmental Fund for Mediterranean Marine Protected Areas*, Leaflet (The MedFund, 2021). https://themedfund.org/wp-content/uploads/2021/11/brochure-2021_EN_VFFINAL.pdf

52 Binet et al, 2016.

FIGURE 24. View of Qiandao Lake



Source: Pauloleong2002.

CHINA: 'THREE GOODS' AGRICULTURE AND WATER FUND IN HANGZHOU⁵³

Since 2020, Qiandao Lake has been a source of drinking water for about 10 million people in the region of Hangzhou and surrounding cities, accounting for at least 50% of the drinking water supply in Hangzhou. The overall water quality of Qiandao Lake Basin is good, ranking high in terms of water quality nationally, but it still faces pressure from diffuse agricultural pollution, ecological fragility and other challenges (Figure 24). Diffuse pollution, also called non-point source pollution, is dispersed, concealed, latent and indistinct. This makes it difficult to monitor, quantify, study and control, and there is a lack of effective long-term governance mechanisms.

Climate change also has an important impact on the ecology of surrounding waters, the agricultural industry and the lives of local residents. The increase in high temperatures and dry weather has caused water shortages, which have seriously affected the safety of domestic drinking water for local residents. In addition, due to natural geographical conditions, Qiandao Lake Basin is extremely vulnerable to

extreme weather, such as flash flooding, landslides and mudslides, which are common.

Taking the Longwu Reservoir in Hangzhou as an example, since the 1980s and 1990s, local villagers began to plant a large amount of moso bamboo after profiting from its economic value and using large amounts of fertilizer to increase yields. This resulted in increased amounts of nitrogen, phosphorus and reduced dissolved oxygen detected in the reservoir.

Most of the farmers around Qiandao Lake grow tea as their main source of income and the quality of tea is threatened by the poor quality of the water from the reservoir used to irrigate tea plantations. Therefore, water source protection is also important for realising ecologically sustainable development. Building long-term mechanisms for water source protection, changing the current production model and improving environmental awareness among farmers in the Qiandao Lake Basin have become a top priority.

Project overview

Ecological protection requires the participation of a broad range of stakeholders. To explore and effectively implement a long-term mechanism for

protecting the water source, Alibaba Foundation and Min Sheng Tong Hui Foundation jointly established the 'China Water Source Protection Charity Trust' with Wanxiang Trust in 2017. In 2018, as the first project funded by the Charity Trust, the 'Qiandao Lake Water Fund' programme was launched in Hangzhou.

The project aimed to solve agricultural diffuse pollution in a scientific way and promote the development of ecological industry in the basin through green consumption, and ultimately realise a long-term protection mechanism for the Qiandao Lake water source. A key action to realise this goal is changing production modes and improving the environmental awareness of farmers in the region.

The innovative aspect of the 'Qiandao Lake Water Fund' is the introduction of a charitable trust to stimulate the potential for environmental protection, which has some unique advantages. The primary goal of the trust is to reduce environmental pollution and ensure economic benefits. Through flexible and creative financial design, it has introduced diverse and influential channels for private investment, for example, through payment for ecosystem services, in addition to traditional philanthropic sources of funding. It has also expanded the scope of public and charity projects to raise additional financing. The charity trust status allows for openness and transparency of fund management, decision-making and information disclosure.

At present, agricultural diffuse pollution in the Qiandao Lake Water Source Area is primarily caused by soil erosion and improper use of fertilizers and pesticides. The natural gradient of farmland in the catchments means that soils are prone to erosion which is exacerbated by unsustainable agricultural practices. To control diffuse pollution in the basin and reform agricultural practices, the 'Qiandao Lake Water Fund' programme promotes regenerative agricultural practices that combine green manure mulching, straw covering, natural fruit harvesting, and inter-planting of diverse species that can support the local economy. Pilot projects have been carried out to demonstrate how diffuse pollution can be controlled in the basin. To give full play to the economic value of 'clear waters and green mountains', the programme puts forward a business model of 'Three Goods Agriculture':

- » 'Good products' aims to raise public awareness by publicising ecological methods and approaches for growing agricultural products and governance on water stewardship as well as water

source protection. Ant Group's blockchain technology can seamlessly and dynamically trace agricultural products and provide information to consumers on the health benefits and sustainability of products, thus enhancing their market competitiveness.

- » 'Good marketing' means establishing a complete sustainable marketing channel based on good products. Brands are built for high-quality crops in the Qiandao Lake Water Source Area through interactive platforms such as e-commerce livestreaming and online stores, helping local villagers expand the market and ensuring economic income sources.
- » 'Good tourism potential' means promoting the popularity of local villages and striving to develop characteristic tourism products. Promoting ecotourism and developing experience activities such as Qiandao Lake marathons, homestays and tea culture. Under the principle of environmental protection, the realization of a sustainable tourist industry and service industry is one of the ways to guarantee sustainable development and protection of the ecosystem.

The project team is also devoted to research and development and practice of environment protection education courses. 'Ecological protection' research courses attracted primary and secondary school students as well as executives from Beijing, Shanghai and other regions to practice and learn. The dedicated course, 'Thinking of the Source while Drinking: Research and Study Route of Qiandao Lake Water Source Protection Programme' was rated as an 'Excellent Course of Sustainable Development Education' by the UN Regional Centre of Expertise on Education for Sustainable Development. The Environmental Protection Research and Research Base was awarded as 'Ecological and Environmental Protection Volunteer Service Base of Zhejiang A&F University' in 2019.

Results and impact

As the largest water fund programme in China at the time, the 'Qiandao Lake Water Fund' programme cooperated with Anyang City, Henan Province, to build the first comprehensive treatment demonstration base of 'source reduction, process interception and end treatment' in the Qiandao Lake Basin. The programme has successfully integrated public welfare, scientific research, finance and commerce organically, and created a platform

which attracts the joint participation of farmers, governments, enterprises, NGOs and other social subjects. This project makes environmental governance, industrial investment and business cooperation work together for the long-term sustainable development of ecological water.

In 2020, the extent of ecological water conserving agriculture in Qiandao Lake was extended to 5,157 mu, covering rice, tea, fruits, pecans and other major agricultural products in the typical basin through recommendation of farmers by government, as well as farmers referrals, exceeding the Phase I goal of 5,000 mu. In 2024, after the Phase II construction of the 'Qiandao Lake Water Fund' programme, ecological water conservation agriculture is expected to extend to 75,000 mu in the whole Qiandao Lake Basin, which is equivalent to 1% of key land protection and could bring about a 10% reduction of non-point source pollution in the basin.⁵⁴

The project team selected two pilot sites to explore the long-term approach, namely Shangwu Stream in Chun'an County and Wulong Stream in Jiande County. The team carried out micro-level management of the pilot farmland around the basin, unified prevention and control of pests and diseases, and unified spraying of biological agents and pesticides by drones. As a result, the amount of pesticides has been greatly reduced, also reducing the application cost. Meanwhile, ecological tea gardens have seen an increase in income of 30%-40% per mu for tea growers. In rice planting, agricultural

non-point source pollution prevention and control also achieved breakthroughs.

The development of protective 'Three Goods Agriculture' achieved greenhouse gas emissions reduction through reducing the use of chemical fertilizers and implementing optimized fertilization and green manure projects. According to the estimate of the team at The Nature Conservancy, the Qiandao Lake Optimized Fertilization Project reduces greenhouse gas emissions by about 39 kg of carbon dioxide equivalent per mu, which can achieve an emission reduction of 195 tons of carbon dioxide equivalent based on the Phase I target of 5,000 mu and finally an emission reduction of 2,925 tons of carbon dioxide equivalent based on the Phase II target of 75,000 mu; the Qiandao Lake Green Manure Project reduces greenhouse gas emissions by about 47 kg of carbon dioxide equivalent per mu, which can achieve an emission reduction of 235 tons of carbon dioxide equivalent based on the Phase I target of 5,000 mu and finally achieve an emission reduction of 3,525 tons of carbon dioxide equivalent based on the Phase II target of 75,000 mu.⁵⁵

In addition, taking the ecological characteristics of Qiandao Lake into account, the project team developed brands such as 'Qiandao Clear Spring Tea' and 'Qiandao Clear Spring Rice' and obtained the qualification to use the regional brand of 'Qiandao Lake Tea', realizing the innovation of agricultural added value and improving the living standards of residents.

54 Global Practices of Nature-Based Solutions, A Synergistic Exploration Towards the Net-zero Future, Institute of Climate Change and Sustainable Development at Tsinghua University, China Environment publishing group, Beijing, 2022, Page 73.

55 Ibid. Page 74

Conclusions and recommendations

The UNEA Resolution (UNEP/EA.5/Res.5) has provided framing and a multilaterally agreed definition of nature-based solutions. The implementation of nature-based solutions in line with UNEA definition delivers human well-being, ecosystem services, resilience and biodiversity benefits.

The case studies included in this document describe how nature-based solutions can meet multiple objectives in both China and Europe. Table 2 is the result of a 'mapping exercise', comparing the key features of the case studies compared to the IUCN global standard. Several key points emerge from this. Firstly, only two of the case studies score highly throughout, namely in Europe the 'Industrial Forest project in the Ruhr region', Germany and in China the 'three Good Agriculture and Water Fund at Qiandao Lake'. The general area of weakness is in the governance arrangements, which are often high-level/top down and this is the primary reason why the two projects mentioned above score highly throughout. In the German example, community participation is a notable feature and encouraged by the state actors involved and in the Chinese example, the setting up of a Charitable Trust and attracting investment to this is a notable achievement.

Reflecting on the case studies, several features emerge strongly. The first is meeting societal challenges as defined by the UNEA. All the case studies score highly in this regard albeit which challenge varies between projects/programmes. For example, these range from marine protection through to climate change. Another consistently high area is being 'designed to scale'. Clearly, any selection of case studies will demonstrate selection bias, but even accepting this, there is ample evidence that policy makers and others are considering projects and programmes at the 'landscape scale' which is arguably where nature-based solutions can have the greatest impact in terms of halting environmental degradation and nature recovery.

Based on the findings of this review in both European countries and in China there is gathering evidence

that the use of nature-based solutions (NbS) is progressing, although not always recognised by name. Evidence from the projects in the European Union's Horizon 2020, Research and Innovation programme CLEARING HOUSE and REGREEN are valuable proof in this regard. The case studies also make clear that many historic projects are in practice (or substantially feature) nature-based solutions, when compared with the IUCN Global standard. Equally, based on the case studies, some NbS are working in a hybrid form with grey infrastructure in a similar way that the integration of grey, green (and blue) infrastructure has been prominently described in the academic discourse since 2006 (Cilliers (2012)⁵⁶ after Davies et al (2006)⁵⁷.

The case studies included in this paper reveal a process of public participation albeit to different degrees, the use of financing mechanisms and a core role for land-use (and marine) planning in identifying specific areas for NbS interventions. Another common element is the benefit of research and innovation programmes in what remains an emerging area. As with relatable concepts, such as ecological networks and green infrastructure, the benefits of multifunctionality and connectivity emerge alongside inter- and trans-disciplinary approaches.

56 Cilliers, Elizelle. (2012). Urban green compensation. Int. J. of Green Economics. 6. 346 - 356. 10.1504/IJGE.2012.051494.

57 http://www.greeninfrastructurenw.co.uk/resources/North_East_Green_Infrastructure_Planning_Guide.pdf

TABLE 2. Case studies compared to the objectives and meeting the IUCN global standard for NbS

Case study	Objectives/Meeting IUCN Global standard for nature-based solutions ⁵⁸							
	Societal challenges	Designed to scale	Biodiversity net gain	Economic feasibility	Inclusive governance	Balance, trade-offs	Adaptive management	Mainstreaming & sustain
Ecosystems – Land								
EU: The Industrial Forest project in the Ruhr region, Germany	● High: nature and social benefits	● High: covers EU's largest conurbation	● High: biodiversity is a prime objective	● High: low cost	● High: significant community involve	● High: use of nature-first principle	● High: natural regeneration	● High: sustainable change
China: Desertification Control of the Mu Us Desert	● High: reversing desertification	● High: very large scale	● Medium: some biodiversity net gain	● High: state backing	● Low: centralised	● Medium: learning by doing	● High: through interventions	● High: sustainable change
Ecosystems – Water								
EU: Intercontinental Biosphere Reserve of the Mediterranean	● High: ecosystem restoration	● High: very large scale	● High: significant species benefit	● High: methodological development	● Low: centralised	● High: implicit in approach	● Medium: Interventionist	● Medium: demonstration project
China: Ecological Restoration of the Yellow Sea Wetlands in Yancheng	● High: ecosystem restoration	● High: large-scale	● High: significant species benefit	● High: achieved	● Low: centralised	● High: implicit in approach	● High: through interventions	● High: sustainable change
Ecosystems - Urban								
EU: Milan Parco Agricolo Sud	● High: ecosystem sensitive agriculture	● High: very large scale	● High: benefits in park developments	● High: public funds and enterprise	● High: multi-level	● High: between agriculture and nature	● Medium: agriculture remains dominant	● High: robust planning and laws
China: Chengdu Park City Construction	● High: city 'green' transformation	● High: large and ambitious	● Medium: yes, as a co-product	● High: resources in place	● Low: centralised	● Low: directive	● Low: change at scale is design led	● High: sustainable change

58 <https://portals.iucn.org/library/sites/library/files/documents/2020-020-En.pdf>

Case study	Objectives/Meeting IUCN Global standard for nature-based solutions ³⁸							
	Societal challenges	Designed to scale	Biodiversity net gain	Economic feasibility	Inclusive governance	Balance, trade-offs	Adaptive management	Mainstreaming & sustain
Financing Nature-based Solutions								
EU: Sustainable financing mechanism for Mediterranean MPA	● High: marine protection	● High: large scale and ambitious	● High: fulfilment will bring benefits	● Medium: limited fund innovation required	● Low: centralised	● High: Implicit in the approach	● Low: implicit but not directly addressed	● High: replicability potential
China: Three Good Agriculture and Water Fund at Qiandao Lake	● High: address climate change impacts	● High: large scale	● High: improved water quality	● High: secured private investment	● High: charitable trust set up and stakeholders involved	● High: addresses diffuse pollution impacts	● High: educational role	● High: sustainable framework

RECOMMENDATIONS

Several of the case studies included in this paper are still being implemented, or only in pilot phase, or are still being planned whilst others are very new. Systematic analyses of their challenges and outcomes, and to promote learning from similar solutions applied in different contexts, will require more studies especially to identify the time depth (temporal) and spatial (locational) considerations that will benefit the rollout of the concept. Nevertheless, it is evident that NbS is already becoming a significant consideration in both Europe and China, when it comes to decisions on how to tackle environmental challenges, notably within the framework of sustainable development.

Recommendations for international experts, negotiators and influencers

1. There is an on-going need to promote nature-based solutions that can address global priorities, including the objectives of the Paris Agreement on climate change, the Kunming Montreal Global Biodiversity Framework and the Sustainable Development Goals. Encouragingly, nature-based solutions featured at COP28 and is an example of a high-level profile forum where promotion can bring political and strategic benefits. The World Economic Forum, the Global Covenant of Mayors and the G20 Intergovernmental Forum are important 'targets' in terms of political and strategic influence for NbS.
2. Further study into the potential of 'sustainable use' of ecosystems would be beneficial as sustainable use and management of ecosystems is included in the UN Environment Assembly definition of nature-based solutions. How this is positioned in the discussions leading up to what may replace the current Global Sustainability Goals in 2030 will be significant for further accelerating the implementation of NbS after this date.
3. It is likely that as the use of NbS becomes more mainstream, some stakeholders will promote projects that are marketed as NbS but are not. Avoiding greenwashing will need the development of clear methodologies for assessing the environmental, social and economic benefits of nature-based solutions over both the short and long term. An essential component of this is the

NbS global standard produced by IUCN along with their on-line self-assessment tool⁵⁹.

4. Research and innovation on how traditional biodiversity conservation approaches such as the establishment of protected area systems on land and sea can support nature-based solutions at scale, even if NbS was not the original intent of these initiative could bring early results. Such an approach would open a greater understanding of the role of nature in supporting society as well as the deployment of nature-based solutions at the landscape scale, for example at national, regional and transboundary level.

Recommendations for EU-China cooperation on nature-based solutions

1. Conduct further case studies on both sides, including the systematic collection of descriptions of the projects and studies of their outcomes, consistent analysis of the challenges faced and how, or if, they were overcome. As an extension of this carry out lesson-sharing activities between the EU and China. The EU has longer experience in implementing nature-based solutions, which could support better understanding and practices in China; but there are lessons to learn from China for the EU too, especially with regards to up-scaling and ambition.
2. Explore options for multi-faceted financial support for nature-based solutions, and financial mechanisms that could be integrated within them. Financial support is essential to ensuring successful and sustainable nature-based solutions, and it could be a specific area for bilateral cooperation. In this regards the private sector is an important audience. Much of the NbS implementation to date has been led by or substantially funded through the public sector, but for significant upscaling, the skills and finance of the private sector could be transformational.
3. Building awareness and partnering across different sectors of government for which NbS are especially relevant e.g. building on experience of restoration of mining areas in Germany or coastal rehabilitation in the Netherlands. A key barrier to wider NbS adoption is the lack of holistic/integrated thinking between government sectors.

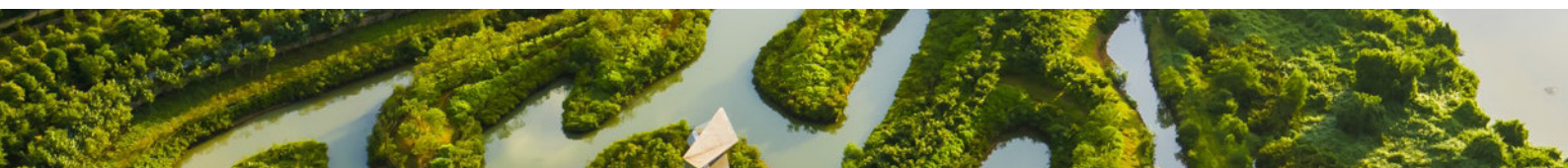
59 IUCN online Self-assessment tool at <https://nbs-sat.iucn.org/>

4. Many of the case studies from China as well as some from Europe have shown the benefit of large-scale NbS at a landscape, or city scale. These large scale NbS projects deserve special attention in terms of their approaches and impacts. A review of lessons from largescale NbS as well as their governance and finance mechanism could help to stimulate additional projects of this size in both the EU and China.
5. Data that clearly demonstrates the impact of NbS projects on the economy, human health and the environment are essential to promoting the uptake of NbS by governments and the private sector. NbS can have a range of positive impacts improved water quality, reduction in the intensity of flooding, reduction in airborne pollution and particles and carbon sequestration. The more these benefits can be quantified along with the costs of implementing NbS projects, the more decision-makers in government and the private sector can be convinced of the benefits of NbS. An international database of costs and benefits of NbS projects would support communication to decision-makers.
6. Monitoring and evaluation of the impact of nature-based solutions is necessary to ensure that policy makers have confidence in interventions and provides a basis for future decisions that favour nature-based solutions over other alternatives. Arrangements for monitoring and evaluation should be decided at the outset of projects and programmes to ensure that critical lessons from the initiation and development phase are not lost as these can be instrumental to future users. This should lead to a stronger understanding of the potential for nature-based solutions and help to mobilise support for their wider deployment.

Nature-based solutions: Lessons from European and Chinese case studies

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