



Sustainable Use of Land and Nature-Based Solutions Partnership

Better regulation to boost NBS at European, national and local level
(ACTION N6)

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(3 February 2020)

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1 Introduction

Nature Based Solutions (NBS) projects provide a valuable answer to environmental and societal challenges and contribute to increase urban resilience. NBS can be defined as solutions that are inspired and supported by nature, solutions that are cost-effective and provide simultaneous environmental, social and economic benefits. Such solutions bring more diverse nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource efficient and systemic interventions (EC 2015). Nevertheless, cities are still struggling to mainstream those solutions within their urban environment due to financial, knowledge and political barriers.

To boost NBS implementation within EU cities and to better assess and understand their potential effectiveness in relation with different societal challenges, the EU Commission included NBS as one of the main topics within the H2020 research innovation programme. As a result, demonstration projects showcasing various types of NBS implementation are currently taking place in several European cities. At the same time, within the Urban Agenda for the EU process, the Commission included *sustainable land use and nature-based solutions* as one of the priority themes to be tackled. The EU Urban Agenda was launched in May 2016 and represents a new multi-level working method promoting cooperation between Member States, cities, the European Commission and other stakeholders in order to stimulate growth, liveability and innovation in the cities of Europe and to identify and successfully tackle social challenges.

The partnership on sustainable land use and NBS started its work in June 2017 and is led and coordinated by the municipality of Bologna and the Ministry of economic development of Poland. The partnership also includes different services from the EU Commission (DG REGIO, DG ENV, DG RTD), eight European cities and metropolitan urban areas (Bologna, Antwerp, Cork, Lille, Águeda, Stavanger, Stuttgart and Zagreb), six national ministries (Poland, Cyprus, Lithuania, Luxembourg, Portugal and Slovenia), and other relevant stakeholders (European Investment Bank, Eurocities, ICLEI, etc.).

The partnership is addressing the topic of sustainable land use and NBS, focusing on funding opportunities and issues, further knowledge needed and current regulation gaps. Indeed, the Urban Agenda for the EU focuses specifically on three pillars of EU policymaking and implementation (as stated in the document of Pact of Amsterdam): better regulation, better funding and better knowledge.

The current document is one outcome of Action N°6 - Better regulation to boost NBS at European, national and local level, led by the municipality of Bologna and the University of Bologna. The main aim of this study is to analyse related EU policies and strategies for NBS, identify which are the most relevant and propose recommendations about these to the European Commission. In the first section, a brief overview of selected EU policies is provided, highlighting those which could play a role in fostering or hindering NBS uptake and implementation. The second section analyses the Floods Directive, EU Strategy for Adaptation to Climate Change and Strategic Environmental Assessment in more depth with a focus on their current NBS support and highlights gaps and opportunities for an improved NBS integration.

2 EU policy support for NBS: An overview

Evidence and awareness of the potential of NBS to provide environmental, social and economic benefits and support progress towards increased resilience and sustainability continues to grow. Consequently, NBS and related concepts such as ecosystem-based adaptation, green infrastructure, and natural water retention measures are being increasingly referred to and integrated in a range of sectoral policies from the local to EU level. The extent and manner in which these concepts are integrated has the potential to support or hinder wider NBS implementation across Member States. This potential has been explored in several research projects, such as NATURVATION (Davis et al. 2018) and CLEVER Cities (Knoblauch et al. 2019).

The table below builds on the findings of these reports and outlines the level of NBS support for 20 key EU environmental policies relevant for NBS and related concepts. Specifically, the table outlines policy instruments and measures relevant for the NBS context and the level of support for NBS. The level of support is defined as follows:

- (1) **Strong explicit support:** NBS or related terms are explicitly mentioned and strongly embedded throughout the framework, including in objectives, policy measure design and/or supported actions.
- (2) **Strong implicit support:** Strong framing of nature as a means to address (select) societal challenges, with multiple references to/support for elements of NBS or NBS intervention types; no explicit mentioning of NBS or related terms.
- (3) **Medium support:** NBS and related concepts are not a prominent feature, but deployment is supported through references to/support for individual NBS elements and interventions.
- (4) **Low support:** NBS are neither a prominent feature nor relevant for/mirrored in policy measure design and supported actions.

Out of the 20 analysed policies, 25% are found to provide strong explicit support for NBS and 10% strong implicit support. Strong explicit support for NBS is provided by, for example, the “Green Infrastructure Strategy”, which explicitly promotes the use of green and blue infrastructure solutions. The EU Biodiversity Strategy, as another example, identifies NBS as priority and thereby implicitly supports wider uptake and integration in Member State policies.

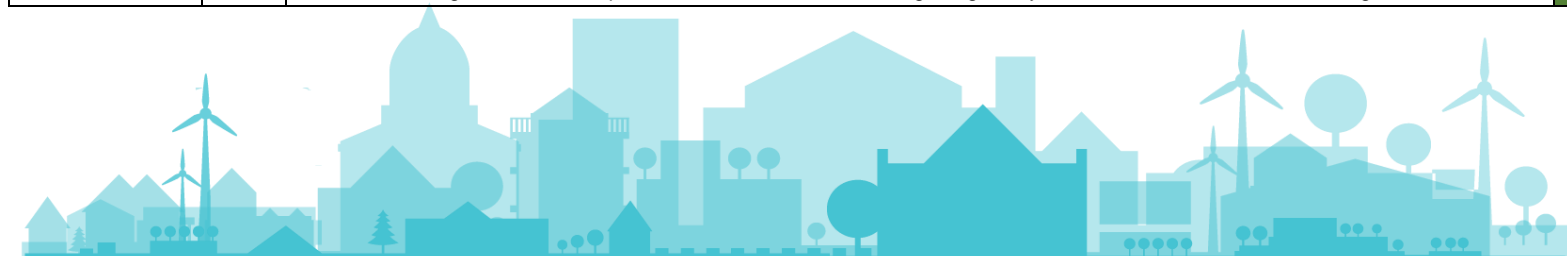
While some support for the NBS concept is evident in the EU policy framework, significant untapped opportunities to support NBS remain. Particularly beyond the more obvious environmental and climate policies, the integration of NBS into other sectoral policies such as health, transport or housing holds immense potential to benefit society. These gaps and the linked potential are further analysed and discussed in Chapter 3.

URBAN AGENDA FOR THE EU



SUSTAINABLE USE OF
LAND & NATURE-BASED SOLUTIONS

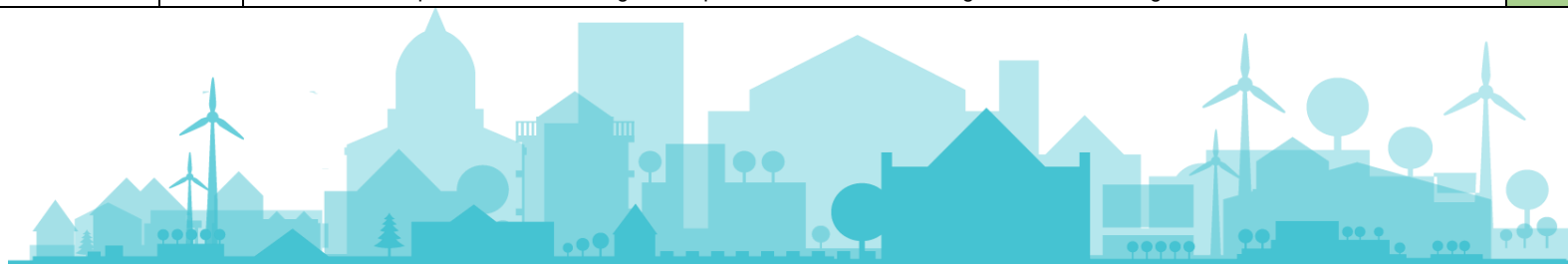
Policy	Year	NBS-relevant instruments and measures	Level of NBS support
Biodiversity /Nature			
Habitats Directive	1992	Supports the protection, creation, restoration and sustainable management of habitats as part of Natura 2000, providing benefits to species, habitats and society (e.g. preserving a community's natural heritage, creating green recreational areas). Instruments include the designation of protected areas (Sites of Community Importance and Special Areas of Conservation) and Natura 2000 management plans.	3
Birds Directive	1979/ 2009	Supports the conservation of all naturally occurring wild bird species in the territory of the Member States by employing measures to preserve, maintain and re-establish a sufficient diversity and area of habitats and biotopes for these species. Instruments include: creation of protected areas and biotopes (such as Special Protection Areas for particularly threatened bird species and all migratory birds); upkeep and management in accordance with the ecological needs of habitats inside and outside the protected zones; re-establishment of destroyed biotopes. Particular attention is paid to wetland protection.	3
Biodiversity Strategy to 2020	2011	Aims to halt the loss of biodiversity and maintain and restore ecosystem services for the benefit of nature and society. Six targets address the main drivers of biodiversity loss and aim to reduce key pressures on nature and ecosystem services in the EU and beyond, including: Target 2 (Better protection and restoration of ecosystems and the services, and greater use of green infrastructure), Target 1 (The full implementation of the EU nature legislation) and Target 3 (More sustainable agriculture and forestry). The targets are accompanied by a set of time-bound actions to ensure their full realisation, including: <ul style="list-style-type: none"> • Target 1, Action 1: Complete the establishment of the Natura 2000 Network and ensure good management. Ensure adequate financing of Natura 2000 sites. • Target 2, Action 6: Set priorities to restore and promote the use of green infrastructure. • Target 3, Action 8: Enhance direct payments for environmental public goods in the EU CAP to reward the delivery of environmental public goods that go beyond cross-compliance (e.g. ecological set-aside, Natura 2000) • Target 3, Action 12: Integrate biodiversity measures in forest management plans (e.g. ecosystem-based measures to increase the resilience of forests against fires as part of forest fire prevention schemes). • Target 4, Action 14: Eliminate adverse impacts on fish stocks, species, habitats and ecosystems by e.g. preserving vulnerable marine ecosystems and financial incentives for marine protected areas (including Natura 2000 areas). 	2
An Action Plan for nature, people and the economy	2017	Aims to support the application of the Nature Directives and ensures their coherence with broader socio-economic objectives, thereby accelerating progress towards halting and reversing the loss of biodiversity and ecosystem services. It sets out a work programme with four priority areas, 15 concrete actions and over 100 individual measures, including: <ul style="list-style-type: none"> • Priority A: Improving guidance and knowledge and ensuring better coherence with broader socio-economic objectives. Action 1. Update, develop and actively promote guidance on site permitting procedures, species protection and management and for specific sectors as well as on integrating ecosystem services into decision-making. 	1



		<ul style="list-style-type: none"> Priority B: Building political ownership and strengthening compliance. Action 4. Complete the Natura 2000 Network, especially filling gaps for the marine environment, and put in place the necessary conservation measures for all sites. Priority C: Strengthening investment in Natura 2000 and improving synergies with EU funding instruments. Action 8. Strengthen investments in nature. Action 10: Increase awareness of Cohesion Policy Funding opportunities and improve synergies (e.g. the Commission launched a partnership under the Urban Agenda for the EU on Sustainable Land use and NBS and promotes biodiversity and NBS in other partnerships (e.g. on Climate adaptation, Circular economy, Air quality). Action 12. Provide guidance to support the deployment of green infrastructure for better connectivity of Natura 2000 areas; support NBS projects through EU research and innovation policy and Horizon 2020 funds. 	
Green Infrastructure Strategy	2013	Aims to improve information, strengthen the knowledge base, promote innovation, and improve access to finance surrounding GI. The Strategy is implemented within the context of existing legislation, policy instruments and funding mechanisms. Developing GI is seen as a key step towards the success of the EU 2020 Biodiversity Strategy and to all 6 Targets, particularly Targets 1-4.	1
Environment as an overarching issue			
7th Union Environment Action (EAP) Programme to 2020	2013	<p>Guides European environmental policy towards 2020 and sets a long-term direction and a vision until 2050 (to live within the planet's ecological limits and in the healthy environment where biodiversity is protected, valued and restored). Relevant instruments are:</p> <p>Thematic priority objective 1 to protect, conserve and enhance the Union's natural capital:</p> <ul style="list-style-type: none"> Maritime spatial planning and integrated coastal management can play an effective role in coordinating sustainable use of marine waters and coastal zones when applying the ecosystem-based approach to the management of different sectoral activities in those areas. Ecosystem-based approaches to climate change mitigation and adaptation which also benefit biodiversity and the provision of other ecosystem services. In combination with the full implementation of the Nature Directives, further enhance natural capital and increase ecosystem resilience to offer cost-effective options for climate change mitigation and adaptation and disaster risk management. Mapping and assessment of ecosystems and their services for data availability, and the 'no net loss' initiative (2015) will contribute to maintaining the stock of natural capital at a variety of scales. <p>Thematic priority objective 3 to safeguard citizens from environment-related pressures and risks to health and wellbeing:</p> <ul style="list-style-type: none"> Measures to enhance ecological and climate resilience, such as ecosystem restoration and green infrastructure, can have important socio-economic benefits, including for public health. <p>Enabling framework priority objective 7 to improve environmental integration and policy coherence:</p> <ul style="list-style-type: none"> Incorporating green infrastructure into related plans and programmes can help overcome fragmentation of habitats and preserve or restore ecological connectivity, enhance ecosystem resilience and thereby ensure the continued provision of ecosystem services, including carbon sequestration, and climate adaptation, while providing healthier environments and recreational spaces for people to enjoy. <p>Meeting local, regional and global challenges priority objective 8 to enhance the sustainability of the Union's cities:</p> <ul style="list-style-type: none"> Biodiversity conservation through actions such as the reintroduction of nature into the urban environment and urban landscaping is increasingly evident. 	3
European Green Deal	2019	Outlines a commitment to tackling climate and environmental-related challenges and aims to make Europe climate-neutral, protecting the EU's natural capital and improving human well-being, including the following actions:	1



		<ul style="list-style-type: none"> Adopting a new, more ambitious EU strategy on adaptation to climate change. Work on climate adaptation should continue to influence public and private investments, including on NBS. It will be important to ensure that across the EU, investors, insurers, businesses, cities and citizens are able to access data and to develop instruments to integrate climate change into their risk management practices" Strengthening 'a sustainable 'blue economy' to alleviate the multiple demands on land resources and tackle climate change, emphasizing aquatic and marine resources and NBS, including healthy and resilient seas and oceans Developing the Biodiversity Strategy for 2030 to halt the loss of biodiversity by protecting and restoring ecosystems and biodiversity, including proposals to green European cities and increase biodiversity in urban spaces. Mobilising research and fostering innovation: <ul style="list-style-type: none"> At least 35% of the budget of Horizon Europe will fund new solutions for climate, which are relevant for the Green Deal. Four 'Green Deal Missions' will help deliver large-scale changes in e.g. climate change adaptation, oceans, cities and soil. The Horizon Europe programme will involve local communities in working towards a more sustainable future, in initiatives that seek to combine societal pull and technology push. 	
Water			
Water Framework Directive (WFD)	2000	Aims to achieve good ecological and chemical status of surface waters, and good quantitative and chemical status for groundwater. Recognizes the value of NWRM and supports implementation through the river basin management plans (RBMPs) and the accompanying programme of measures (PoM). Restorative NWRMs are particularly relevant for the PoM: e.g. restoring and recreating wetlands for water resource protection, natural bank stabilisation and re-meandering, the restoration of lakes, or floodplain restoration. NWRM are seen as GI applied to the water sector, as an alternative to grey infrastructure (Article 4.7) to achieve and maintain healthy water ecosystems and offer multiple benefits. In the agriculture sector, agricultural soil moisture conservation practices can be linked to agricultural NWRM.	3
A Blueprint to Safeguard Europe's Water Resources	2012	Outlines actions to better implement current water legislation, integrate water policy objectives into other policy areas, and fill gaps regarding e.g. water quantity and efficiency. It aims to ensure that a sufficient quantity of good quality water is available for meeting people's needs, the economy and the environment. Relevant actions include: maximisation of the use of NWRM (achieved through the CIS Guidance on NWRM), greening of CAP pillar I (ecological focus areas), and Structural & Cohesion Funds & EIB loans.	3
Floods Directive	2007	Establishes a framework for the assessment and management of flood risks, and aims at reducing adverse consequences of floods for human health, the environment, cultural heritage and economic activities. Floodplains are considered to be natural retention areas, with a preliminary flood risk assessment (Article 4.2) applied to assess potential risks. The flood risk management plans (Article 7) take into account the characteristics of the particular river basin or sub-basin, including the promotion of sustainable land use practices and improvement of water retention.	3
Agriculture			
Common Agricultural Policy (CAP)	2014-2020	The latest CAP reform (2014-2020) acknowledges the importance of ecosystem services for food production and the environment and this supports green and blue infrastructure features: "greening" requirements, particularly Ecological Focus Areas (EFA) and permanent grassland, and cross-compliance mechanism under the first pillar, as well as agri-environment-climate measures under the second pillar. They deliver benefits for biodiversity, soil, water, air and climate and wider ecosystem services.	3
Adaptation and mitigation			
Climate Change Adaptation Strategy	2013	One of the three key objectives of the EU Adaptation Strategy focuses on 'climate-proofing' action at EU level by promoting adaptation in key vulnerable sectors such as agriculture, fisheries and cohesion policy and ensuring that Europe's infrastructure is made more resilient to the impacts of climate change. Its implementation is based on eight actions, including:	2



		<ul style="list-style-type: none"> Action 2: A climate-action sub-programme was created under the 2014-2020 LIFE funding programme for the environment and targets the priority vulnerable areas aiming to increase their resilience. Action 6: Guidance on how to further integrate adaptation into the CAP, the Cohesion Policy and the Common Fishery Policy has been prepared. It facilitates managing authorities and other stakeholders involved in programme design, development and implementation during the 2014-2020 budget period. Action 7: Guidance was planned for authorities and decision makers, civil society, private business and conservation practitioners to ensure the full mobilisation of ecosystem-based approaches to adaptation for more resilient infrastructure. 	
Paris Agreement	2015	Countries have submitted comprehensive national climate action plans (nationally determined contributions, NDCs) as a contribution to the objectives of the agreement. These are, however, not enough to reach the agreed temperature objectives. It recognises the role of non-Party stakeholders in addressing climate change, including cities, other subnational authorities, civil society, the private sector and others (role of cities, regions and local authorities). They are invited to build resilience and decrease vulnerability to the adverse effects of climate change.	4
Urban and regional development			
Urban Agenda for the EU (i.e. Pact of Amsterdam)	2016	Strives to involve Urban Authorities in achieving Better Regulation, Better Funding and Better Knowledge with the aim to deliver on its strategic objectives; offers a new form of multilevel and multi-stakeholder cooperation to strengthen the urban dimension in EU policy. NBS and GI are priority themes of the Urban Agenda for the EU and are foreseen in the Working Programme as follows: <ul style="list-style-type: none"> 7. Climate adaptation (including green infrastructure solutions) focuses on: vulnerability assessments, climate resilience and risk management (including the social dimension of climate adaptation strategies). 9. Sustainable use of land and nature-based solutions focuses on urban sprawl, development of brownfields and renaturing/ greening urban areas. 	1
Sustainable Use of Land and Nature-Based Solutions Partnership. Action Plan	2018	Aims "to ensure the efficient and sustainable use of land and other natural resources to help create compact, liveable and inclusive European cities". It is underpinned by two objectives: 1) to promote the liveable compactness city model and 2) to mainstream and promote NBS as a tool to build sustainable, resilient and liveable urban spaces. The Partnership acknowledges the close relationship between sustainable land use and NBS, focusing on the sustainable use of land and nature a solution to current societal challenges. It promotes compact city development, reducing urban sprawl and minimising land-take using e.g. NBS. It foresees specific NBSs actions including, for example, Indicators of Land Take, Better Regulation to Boost NBS at EU and Local Level, Better Financing on NBS, or Awareness Raising on NBS and Urban Sprawl.	1
Cohesion and growth			
Europe 2020 Strategy	2010	Emphasises smart, sustainable and inclusive growth to improve Europe's competitiveness and productivity and underpin a sustainable social market economy. Sustainable growth – promoting a more resource efficient, greener and more competitive economy – is one of the three mutually reinforcing priorities that offers a vision of Europe's social market economy, which considers including green technologies as a means of ensuring resource efficiency and sustainable growth.	4
Circular Economy Action Plan	2015	Aims to help stimulate Europe's transition towards a circular economy, boost global competitiveness, foster sustainable economic growth and generate new jobs. It establishes a concrete and ambitious programme of action, with measures covering production and consumption to waste management and the market for secondary raw materials and a revised legislative proposal on waste. The proposed actions will contribute to "closing the loop" of product lifecycles through greater recycling and re-use to benefit the environment and economy.	4



Environmental Assessment			
Environmental Impact Assessment Directive (EIA)	2012	An environmental impact assessment report requires the developer to provide information on measures envisaged in order to avoid, prevent or reduce and, if possible, offset likely significant adverse effects on the environment, as well as provide a description of the reasonable alternatives (for example in terms of project design, technology, location, size and scale) and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects. These requirements encourage more environmentally-friendly solutions.	3
Strategic Environmental Assessment Directive (SEA)	2001	The criteria to determine whether a project/plan/policy will negatively impact the environment would all favour greener solutions over traditional/grey infrastructure. By requiring all applicants (contractors and planners) to review 'reasonable alternatives' can encourage more natural or environmentally-friendly solutions to economic/social development.	3
Procurement			
EU Green Public Procurement (GPP)	2014	The use of the voluntary EU GPP criteria for public space maintenance has the potential to considerably reduce environmental impacts from public space maintenance and can help stimulate demand for more sustainable goods and services (e.g. eco-innovations). As it requires the inclusion of clear and verifiable environmental criteria for products and services in the public procurement process, it has the potential to accelerate the single market for environmentally sound goods and services and increase the availability of green alternatives.	3



3 Snapshots of selected EU policies and their support for NBS

This chapter focuses on three EU policies and identifies how they have integrated the NBS concept directly or indirectly into their legislative text, as well as the remaining gaps and future potential for further NBS support. The partnership has specifically chosen the **Floods Directive**, the **Climate Adaptation Strategy**, and the **Strategic Environmental Assessment Directive** for the analysis.

The EU Floods Directive was selected in light of drastic increases in the threat of flooding and its prioritisation as a key risk for many EU cities. While cities do not always have clear competencies in terms of flood reduction policies and strategies, most European countries are taking action to build NBS (in the form of water retention measures) to mitigate and reduce flood risks. Further integration of such concepts in the current Flood Directive could support cities in making progress towards better protection, a reduction of future damages and increased urban resilience. Climate Adaptation strategies and Strategic Environmental Assessments (SEA) can have a great impact on local policies since they are developed and integrated by municipalities that have direct competencies in this matter. Local climate adaptation plans are developed, implemented and monitored at city level. SEAs have great impact at the local level since they assess and provide further recommendations for urban plans and tools.

For each policy, the following issues are addressed:

- aim of the policy and its link to NBS, including also the current support of NBS and specific instruments/measures;
- gaps and opportunities for strengthened NBS support, and
- conclusions for better integration of NBS.

As underlined by the partnership and the subsequent analysis, each of these instruments has the potential for further improvement in order to more fully integrate and support NBS and the ecosystem services approach.

3.1 Floods Directive

Floods are one of the most common and most dangerous natural hazards affecting societies. The risks and likely impacts of flooding are increasing in Europe and beyond. This is due to multiple factors, including the modification of water bodies' natural courses; the transformation of natural surfaces into hard, impervious surfaces or agricultural areas, which have a higher run-off rate; increases in population density, floodplain development and land-use change; and climate change (Trémolet et al. 2019). While there is a long tradition for constructing engineered flood control infrastructure such as levees, retention basins, straightening or transversal barriers (EC 2018a), there is an increasing interest to invest in nature-based solutions (NBS), that can reduce the frequency and/or intensity of flood, provide more resilient responses and multiple benefits and improve risk management, compared to investing in conventional methods alone (Trémolet et al. 2019). NBS such as green-blue infrastructures, for example in urban spaces, offer several co-benefits besides flood risk reduction, such as water savings, energy savings due to less cooling usage, air quality improvement and carbon sequestration. Traditionally, these co-benefits were not included in decision making processes for flood risk management (Alves et al. 2019). The recent Water Fitness Check (2019)¹ of the Water Framework Directive, Groundwater Directive, Environmental Quality Standards Directive and Floods Directive identified that nature-based solutions “offer multiple benefits in many cases, thus offering potential for all the affected legislation and policies to be implemented more efficiently”, suggesting that NBS will be considered more regularly in the future.

Aim of the policy and linkages to NBS

In 2007, the EU Floods Directive (2007/60/EC, *hereafter called FD*)² was established to provide a framework for the assessment and management of flood risks, aiming at the reduction of the adverse consequences for human health, the environment, cultural heritage and economic activity associated with floods in the Community (Art.1). The FD requires the EU Member States to produce, building upon their flood risk and flood hazard maps, catchment-based *Flood Risk Management Plans* (FRMP), which consider the portfolio of flood risk management measures (prevention, protection and preparedness) and are harmonised with the WFD River Basin Management Plans. FRMPs should take into account the characteristics of the particular catchment area and include the promotion of *sustainable land use practices*, improvement of water retention as well as the controlled flooding of certain areas in the case of a flood event. (Art.7). The FD does not specify what kind of water retention measures are preferable. However, in practice most *natural water retention measures* (NWRM) as well as *natural flood management* (NFM) can be also considered types of NBS. The box below provides the definition of NWRM.

Natural Water Retention Measures (NWRM) are multi-functional measures that aim to protect and manage water resources and address water-related challenges by restoring or maintaining ecosystems as well as natural features and characteristics of water bodies using natural means and processes. Their main focus is to enhance, as well as preserve, the water retention capacity of aquifers, soil, and ecosystems with a view to improving their status. NWRM have the potential to provide multiple benefits, including the reduction of risk of floods and droughts, water quality improvement, groundwater recharge and habitat improvement. The application of NWRM supports green infrastructure, improves or preserves the quantitative status of surface water and groundwater bodies and can positively affect the chemical and ecological status of water bodies by restoring or enhancing natural functioning of ecosystems and the services they provide. The preserved or

¹ https://ec.europa.eu/environment/water/fitness_check_of_the_eu_water_legislation/index_en.htm

² eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32007L0060&from=en

restored ecosystems can contribute both to climate change adaptation and mitigation. (Source: <http://nwrn.eu/concept/3857>)

NFM includes measures that “alter, restore or use landscape features to manage flood risk”; NWRM include (1) interception (retaining water in and on plants), (2) increased plant transpiration, (3) improved soil infiltration, (4) ponds and wetlands, and (5) reconnecting the floodplain. Also, floodplain and wetland restoration, re-allocation of dykes or re-meandering can be considered a NBS that mitigates water-related risks. These measures have the potential to reduce extreme flow discharge and thus help to level out extreme events. Positive effects can include a beneficial impact on ecological issues (i.e., nutrition retention), agriculture (irrigation) or tourism) (Hartmann et al., 2019:4). NWRM present a form of NBS, therefore NBS is used as reference term in the following.

Gaps and opportunities for strengthened NBS support

NBS can be used (as sustainable land use practices) within natural, rural and urban areas to mitigate and prevent catchment flood risks. Some specific NBS measures for flood risk management include (Trémolet S. et al. 2019, nwrn.eu):

- Ponds (detention & retention) and basins
- Afforestation/reforestation
- Wetlands restoration/conservation
- Riparian zone restoration/riparian buffers
- Reconnecting rivers to floodplains
- Flood bypasses
- Urban forest parks, green roofs and rain gardens
- Sustainable urban drainage systems
- Buffer strips and hedges, no/low tillage agricultural practices

As mentioned above, NBS aspects are implicitly mentioned by the Floods Directive and can be addressed at many scales in order to implement appropriate NBS within FRMPs. Public authorities, being responsible for the preparation of FRMP, can decide in what way they want to implement NBS. The Navarra region successfully demonstrates how NBS can be fostered in FRMPs (see box below).

Navarra region: Riparian restoration to reduce flood risk

The Navarra region (Spain) is highly impacted by flooding. In order to efficiently to reduce the risk and effects of flooding the government of Navarra has developed Flood Risk Management Plans with the integration of NBS in 2011. More specifically, actions were included that are based on the protection and restoration of rivers with a focus on the protection of riverbeds and banks, the establishment of preferential river territory, reconnecting rivers to floodplains and gradual regulations in the area with a return period of 500 years. The implementation of these actions was made possible by a public funds and the European Regional Development Fund (ERDF) through the Operational Cooperation Program Territorial Spain - France - Andorra (POCTEFA 2014-2020). (Source: Trémolet et al. 2019)

Several public authorities at local and regional level have made use of this opportunity and implemented NBS (e.g. relocating dykes, using floodplain forests) to cope with floods in a sustainable way, but they still represent only a small percentage of authorities. Only a limited number of FRMPs use green infrastructure as flood protection measures (ECA 2018, Schwarz et al. 2018). The low uptake of NBS to mitigate flood risk are determined by different factors such as traditions, insufficient awareness of the benefits, felt lack of experience to scale solutions up, lacking capacity to manage

or carry our NBS projects, limited financial resources or the lack of evidence of the effectiveness and long-term impacts of NBS as compared to structural measures (EC 2018a). Solutions to overcome these challenges entail **catchment scale monitoring experiments engagement, models and decision support tools** are needed to provide a robust evidence-based evaluation of NBS to meet policy needs of environmental Directives and underpin catchment science (Wilkinson et al. 2017). This includes real world studies, which show how to integrate incorporate such measures into FRMPs and their likely impact on downstream urban flood risk. Such studies are needed to encourage further uptake by decision makers and land managers such as farmers (Collentine and Futter 2018). Furthermore, there is a need to thoroughly **analyse costs and benefits and potential trade-offs of NBS**, which vary depending on the location of the measure (e.g., altitude, land use). While data on costs and benefits can support the selection of appropriate measures, data on possible trade-offs (such as reduced crop yield and therewith income foregone) can inform payments for **agri-environmental climate schemes financed through the Rural Development Programmes** under the Common Agricultural Policy/European Agricultural Fund for Rural Development. According to Rouillard and Berglund (2017) there is a missed opportunity in most Rural Development Programmes RDPs to promote Natural Water Retention Measures [...], which can act as effective remedial measures. There is also evidence from research that it is less costly to pay farmers to temporarily flood their land upstream, than it is to pay for urban damage downstream (Collentine and Futter 2018).

The FRMPs should also include an assessment of the potential co-benefits generated from the implementation of NBS in urban and peri-urban areas (e.g. socio-economic benefit from the recreational aspect, climate change mitigation, habitat for native species, etc.) and consider these as an added value in the cost benefit analysis.

Fostering NBS requires also to **address policy and stakeholder issues** (problems, needs and necessary resources) **at many scales** in order to build appropriate NBS within sustainable catchment water management plans (Wilkinson et al. 2017). In addition, ancillary benefits of NWRM/NBS such as their compatibility of different purposes, and the cumulative effects still need to be researched in more depth (Hartmann et al., 2019).

The selection of NBS might be supported by spatial analysis considering factors such as ecosystem capacity (i.e. infiltration capacity), flood hazard (i.e. change in inundation height) and the distribution of green infrastructure (NBS/NWRM) which can help to **identify priority areas for the establishment or restoration of green infrastructure elements** (EEA 2018).

Further challenges in using NBS for flood risk management include the limited availability of space, land ownership (in particular if land is owned privately), absence of land registry to identify land owners and housing legislation (EC 2018a, ECA 2018), which often require **regulatory measures at the regional and/or national level**. The **combination of engineered solutions and NBS** for optimal flood protection, as documented by Browder, et. al. (2019) can offer further opportunities for strengthened NBS support. River flood management can be supported through restored river floodplains, wetlands, flood bypasses that can diminish the need for high embankments, sluice gates and pump stations (Trémolet et al. 2019: 64). These findings are also supported by Alves et al. (2019) who reveal that a mix of green, blue and grey infrastructures is likely to result in the best flood management strategy as these three alternatives tend to complement each other. Grey infrastructure has good performance at reducing the risk of flooding, whilst green infrastructure brings in multiple additional benefits that grey infrastructure cannot offer.

Conclusions

NBS (referred to as “Natural water retention measures”) present an essential element of sustainable flood risk management plans, which are hydrologically sound, economically feasible, ecologically acceptable, publically supported and should also meet local perceptions of floods and risks. NBS and sustainable flood risk management plans seek recognition and legitimacy (Gutman 2019), which are key for their implementation and large scale. NBS should be consequently introduced in all FRMPs (under the Floods Directive) as well as all River Basin Management Plans and Programmes of Measures (under the Water Framework Directive) as these plans must be harmonized. The multiple benefits (environmental and climate related) and co-benefits (socio-economic) derived from NBS need to be considered in the planning and decision-making process of selecting measures and their combination with engineered solutions.

3.2 Climate adaptation strategy

An increasing number of challenges associated with climate change are threatening European society, including rising temperatures, heat waves and urban heat islands, flooding, and droughts (Fritz 2017). Traditional approaches to reduce associated risks have relied on conventional engineering, which often does not tackle the root causes of risk and can actually increase societal vulnerabilities in the long-term (Depietri and McPhearson 2017). Nature-based solutions, on the other hand, have emerged as a sustainable solution to simultaneously mitigate natural hazard risks and boost societal resilience (Mysiak et al. 2018a). This approach to climate change adaptation harnesses the services provided by ecosystems as a cost-effective approach to deliver not only climate adaptation objectives, but also wider societal benefits (e.g. to human health, local economy, biodiversity conservation).

Aim of the policy and linkages to NBS

The use of nature in the context of achieving adaptation objectives was first included in the EU White Paper on Adaptation³, describing the crucial role of green infrastructure (GI) in the provision of social and economic benefits to support adaptation under extreme climatic conditions. The EU Adaptation Strategy⁴ was then adopted in 2013 to enhance the preparedness and capacity of Europe to respond to foreseen climate impacts at the local, regional, national and EU levels by scaling up climate-resilience. As with the White Paper, the Strategy explicitly encourages GI implementation and the application of ecosystem-based adaptation approaches as part of a coordinated European approach to climate adaptation (Mysiak et al. 2018b). Specifically, the Adaptation Strategy focuses on three key objectives; these and their linkages to NBS are:

1. **Promote action by Member States**, encouraging and supporting the adoption of comprehensive adaptation strategies, building of adaptation capacities and taking action. The aim to encourage projects with demonstration and transferability potential, as well as green infrastructure and ecosystem-based approaches to adaptation is explicitly outlined.
2. **'Climate-proofing' at EU level** by promoting adaptation in key vulnerable sectors (e.g. agriculture, fisheries and cohesion policy) to ensure that Europe's infrastructure is made more resilient. This also includes encouraging insurance against natural disasters, drawing attention to the idea of using ecosystems to buffer against weather extremes and reduce

³ <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52009DC0147&from=EN>

⁴ <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52013DC0216>

the impact of disturbances on real estate and built infrastructure (e.g. coastal ecosystems as a barrier to storm surges, permeable surfaces to protect against flooding and urban trees to mitigate heat waves) (Andersson et al. 2017). Referring to the insurance value offered by ecosystems can “reflect the avoided socioeconomic and wellbeing costs associated with weather related disasters, and insurance itself as the maintenance of ecosystem services provided by social-ecological systems despite variability, disturbance and management uncertainty” (Andersson et al. 2017: 53).

3. **Support more informed decision-making** by addressing gaps in knowledge about adaptation and further developing the European climate adaptation platform ‘Climate-ADAPT’. Improving access to information on the costs, benefits, necessary conditions and successful case studies of GI and ecosystem-based approaches can only support uptake in the long-run for such approaches through increased buy-in and confidence in NBS effectiveness for adaptation.

While the Strategy only explicitly mentions one type of NBS (i.e. ‘sustainable water management’), it **encourages the use of ecosystem-based approaches to adaptation and deployment of green infrastructure** more broadly (Davis et al. 2018) and highlights their multiple values as “win-win, low cost and no-regret adaptation options” (p. 5). Concrete examples of NBS to reduce societal vulnerability and improve climate-resilience include: parks, green spaces and waterways designed to regulate local temperatures and air and water flows, floodplains to buffer the impacts of flood events, or green roofs and facades to reduce building temperatures (EC 2019; Kabisch et al. 2017). Green infrastructure along coastlines could further help protect against erosion and flooding, provide water retention services to mitigate floods or seasonal water scarcity, and reduce societal exposure to landslides, flooding, storms and wave surges (EC 2013).

The Strategy also includes eight concrete actions, which support the three overarching objectives (discussed in more detail below). Action 7 is the only action to explicitly provide support for adaptation measures, aiming to “ensure more resilient infrastructure”. Specifically, this action foresees the provisioning of guidance for authorities and decision makers, civil society, private business and conservation practitioners on how to **fully mobilise ecosystem-based approaches to adaptation**. Action 1 **encourages MS to adopt Adaptation Strategies and action plans**, which can serve as a key instrument for integrating NBS and supporting wider uptake on the regional and local levels.

Gaps and opportunities for strengthened NBS support

Beyond its explicit support through Action 7, a number of the Strategy’s remaining Actions provide further opportunities for fostering NBS to fill existing gaps. These are described below, emerging out of grey and scientific literature as well as the Commission’s ‘Evaluation of the EU Strategy on adaptation to climate change’ (EC 2018b) and ‘Guidance on a strategic framework for further supporting the deployment of EU-level green and blue infrastructure (EC 2019).

Action 1 can be strengthened to **require all MS to design, implement and monitor a national adaptation strategy** and translate these into action plans or National Adaptation Plans that are ready for implementation, instead of only ‘encouraging’ the MS to pursue such actions. It is critical that these respond to local vulnerabilities and needs, involve relevant actors to ensure successful implementation across levels, ensure full exploration and use of nature based solutions, and guarantee sustained political and financial support for maintenance and monitoring through EU and national funding (CAN 2018; Mysiak 2018b). It is important to note, however, that making NBS obligatory through national legislation runs the risk that the municipalities in charge of implementing

such measures would not have the staff or financial resources to fulfil the requirements. Knoblauch et al. (2019) instead encourages the provisioning of incentives in national (adaptation) strategies to increase implementation.

Action 3 aims to introduce adaptation in the Covenant of Mayors framework. Although cities' consideration of climate-related green infrastructure has successfully been promoted to through e.g. its inclusion in the Urban Adaptation Support Tool⁵ (UAST), RE&E (2017) highlight the need to **explicitly extend the framework to promote cities' consideration of nature-based solutions**. Furthermore, as the main tool for building local adaptation strategies, steps 3 and 4 of the UAST should be linked with the results of relevant European projects.

Action 4 strives to address knowledge gaps through research and provides an opportunity for **increased pilot studies and building the evidence base on effectiveness, long-term costs and benefits, design**, etc. This is critical as significant gaps still exist regarding NBS effectiveness and impact towards adaptation, not least to understand ecological characteristics that could mitigate the effects of extreme events and climate change. "Sound ecological knowledge is the first building block for understanding how to design NBS to meet different needs... An ecologically suitable NBS will only deliver expected solutions if it is sufficiently sized and adequately located" (Andersson et al. 2017: 55).). There is a need to develop coordinated monitoring indicators across MS to measure progress and better understand and value the co-benefits of NBS in adaptation and disaster risk reduction (EC 2018b).

Action 5 highlights the ambition of the Climate-Adapt portal to be a 'one-stop shop for adaptation information in Europe". This site has the opportunity to not only feature case studies from around Europe, but could **strengthen links to similar concepts and platforms** from other sectors (such as natural water retention measures on WISE, green infrastructure on BISE, forest restoration on FISE, etc). Climate-Adapt **should serve as a decision-making support tool** by linking to valuable resources for diverse stakeholder groups, such as cost-benefit assessment methods and tools, indicators for monitoring impact, integrated climate and socio-economic scenarios for medium to long-term adaptation planning, and innovative financing models and tools to support decision-making (Sgobbi and Faivre 2017).

Action 6 aims to climate-proof other EU sectoral policies, such as the Common Agricultural Policy, Cohesion Policy and Common Fisheries Policy. Enormous scope remains to further **align sectoral planning instruments with the green infrastructure strategy and mainstream ecosystem-based approaches** as tools for climate mitigation and adaptation, disaster risk reduction, economic growth, agriculture, water management and environmental protection at various scales (FEEM 2018).

Finally, Action 8 sets out to promote products and services by insurance and finance markets. The importance of maintaining biodiversity and resilient ecosystems to buffer climate change induced weather extremes is increasingly viewed in the context of insurance value (Andersson et al. 2017). While aspects such as the continued **ability to avoid socioeconomic and well-being costs** in variable environmental conditions are increasingly being explored within the context of NBS and insurance against climate change, Andersson et al. argues that "this field has yet to recognise the need for making the NBS themselves survive over time" (2017: 53). Work under this action and the Strategy more broadly has the opportunity to provide increased evidence, case studies and arguments to underline increased ecosystem restoration and maintenance within the frame of being

⁵ <https://climate-adapt.eea.europa.eu/knowledge/tools/urban-ast/step-0-0>

a sound insurance investment. This buy-in will also be critical for increasing much needed private sector engagement.

Conclusions

Despite both climate adaptation and nature-based solutions being widely advocated, there has not yet been a systematic implementation or mainstreaming for sustainable urban development and increased climate-resilience. An answer requires the use of more standardized indicators across MS to monitor and assess the effectiveness of different green infrastructure regarding climate adaptation. More robust data could in turn also increase the investment case for key nature-based solutions in order to persuade more mainstream investments and wider sectoral support (IEEP 2019). While the EU Adaptation Strategy has already made noteworthy contributions to addressing these gaps, significant rooms remains to strengthen requirements and accompanying support for MS (e.g. in the form of guidance for authorities and decision-makers, civil society, private businesses and conservation practitioners), foster wider cross-sectoral integration and uptake and generate critical knowledge to fill remaining gaps. Finally, the links between policy and science should be extended and strengthened within the climate adaptation strategy. Its review should take into account the wealth of knowledge and data emerging from H2020-funded NBS-focused projects.

3.3 Strategic Environmental Assessment

Climate change has increasingly detrimental effects across multiple European economic sectors, such as agriculture, fisheries and transport as well as causing increasing destruction of entire environmental systems and biodiversity as a whole (EEA 2017; EEA 2018). Land use and land change in urban and peri-urban areas remain among the most discussed issues at planning level. The application of Strategic Environmental Assessments (SEA) has the potential to address these negative impacts by enabling strategic thinking for the integration of environmental factors into decision-making processes, supporting the transition towards environmentally sustainable economic growth in Europe (Noble and Nwanekezie 2017). In order to effectively integrate nature into policies, plans and programs, nature-based solutions are apparent to replace grey designs (Kabisch et al. 2016). Nature-based solutions can have a wide range of co-benefits that have the potential to assist in navigating a plethora of environmental issues, as well as increase resilience and enable a sustainable use of resources (Wendling et al. 2018). They can guide and inform sustainable use, planning and management of natural resources, as well as related decision-making processes, making them a valuable asset to SEAs. However, as is the case for multiple concepts, such as green infrastructure and ecosystem services (GRETA 2019), Strategic Environmental Assessment and nature-based solutions (NBS) have until now not been widely connected. Applying nature-based solutions within the SEA context has the potential to close gaps between economic ambition and sustainable long-term environmental goals in knowledge-based decision making.

Aim of the policy and linkages to NBS

The EU Directive for Environmental Impact Assessment (EIA) from 1985 first put in place the concept of environmental assessments on a European scale, with the aim to assess public and private projects with significant negative effects on the environment (e.g. airports) throughout Europe. The development of environmental assessment requirements for local, regional and national plans and programs is based on this initial legislative framework, but has since consciously transitioned away from the EIA approach, due to the understanding that SEA's roles and benefits can be of multilateral

nature in comparison to project-based assessments (Noble and Nwanekezie 2017). As such, the EU SEA Directive entered into force in 2001, requiring authorities to undertake an environmental assessment of public sector plans and programmes with likely effects on the environment.

The objective of SEA Directive is to provide a high level of protection for the environment. This is to be achieved by increasing the integration of environmental considerations in the preparation and adoption of plans and programmes, with a view to promoting sustainable development. Specifically, the Directive ensures that an environmental assessment be carried out for certain plans and programmes which are likely to have significant effects on the environment. It sets out standard procedures for undertaking such strategic-level environmental assessments.

The ESPON project “Green Infrastructure: Enhancing biodiversity and ecosystem services for territorial development” (GRETA) identified linkages between green infrastructure and the SEA Directive. While nature-based solutions are not directly mentioned within the Directive, they are implied as a benchmark for the sustainable alternatives to planning that are required under Article 5 (GRETA 2019):

Article 5: “d) a description of the reasonable alternatives studied by the developer, which are relevant to the project and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the project on the environment;”

In general, the SEA Directive is limited to requiring the undertaking of an assessment and determination of alternatives, but does not explicitly introduce sustainable solutions such as NBS or require their application in favour of grey solutions. Nevertheless, the criteria to determine environmental impact clearly favours greener solutions. Though NBS were not explicitly mentioned in the SEA Directive’s text, one of the main takeaways is that the criteria to determine whether a project, plan or policy will negatively impact the environment would ultimately always favour greener solutions over traditional ‘grey’ infrastructure. Requiring all applicants to review ‘reasonable alternatives’ (Article 5) can be viewed as implicitly encouraging more natural or environmentally-friendly solutions, encouraging contractors and planners to maximise win-win solutions to meet development needs while retaining ecological status. Without the enhanced knowledge basis that SEA requires, NBS would perhaps not be discovered as solutions to begin with. Thus, even though NBS are not actively considered for SEA, indirect influence and the potential for enhancing linkages is high, as discussed below.

Gaps and opportunities for strengthened NBS support

The nature of the SEA Directive requires an integrated assessment of plans and programs and their effect on the environment, **linking to the general EU environmental legislative framework**. The Water Framework Directive, for example, established the key procedural requirement of river basin management plans, thus the link between WFD and SEA Directive require SEA application during River Basin Management Plan preparation (Carter and Howe 2006). Thus, as the SEA Directive supports the implementation of numerous EU Directives and Strategies (i.e. Nitrates, Waste, Noise, and Flood Risk) that have various indirect and direct links with NBS, there remains potential for strengthening these linkages in the future.

SEA would benefit from an **integrated analysis of co-benefits for nature-based solutions**, ranging from cultural ecosystem services such as recreational opportunities to climate mitigation, as these can be considered as the strongest motivations for promoting NBS (Geneletti et al. 2016). If the SEA Directive were not only to ensure integration of environmental assessments across policies, plans

and strategies, but to explicitly **rank opportunities for nature-based solutions above alternative solutions** on the basis of higher co-benefits across determining factors (i.e. human health, biodiversity, material assets (SEA Directive, Article 3)), this would have a great effect across the European legislative framework.

The final Action plan of the Partnership on Sustainable Use of Land and Nature-based Solutions has addressed that a reference to 'land take' is missing in SEAs. This creates an incentive for policies and programmes to overlook the negative territorial and environmental impacts. The missing consideration of land take could prove a valuable entry point for NBS.

The Directive is intended to contribute to the integration of environmental considerations in the preparation and adoption of plans and programmes (including at the local level) and to promote sustainable development. For nature-based solutions to be effectively considered for SEA, it needs to be ensured that **practitioners and policy makers that apply SEA be sufficiently guided** in terms of NBS definition, good practice examples and how to include it in processes (Honrado et al. 2013). The additional effort to consider NBS as well as the aim to keep costs low may hinder practitioners to include diverse green solutions in their assessment.

The GRETA project (2019) has developed a full approach for determining entry points for the **consideration of green infrastructure and ecosystem services concept and approach in the SEA process from the screening stage to evaluation and monitoring**. It proposes that the inclusion of green infrastructure in SEA, as a form of NBS, could foster the development of a green infrastructure framework at the national level to be integrated in a plethora of planning processes.

Conclusions

The SEA Directive does not yet directly include NBS. One could argue that the instrument of SEA does, however, intrinsically support NBS by thoroughly vetting the 'grey' strategies, policies and programs that are less conscious of the environment. Furthermore, the Directive's link to climate change policies, energy and transport policies, European Funds, and environmental policies proves high potential that if NBS were to be favoured by SEA, then it would translate directly to a wide European policy network. The SEA Directive additionally requires the consideration of alternative planning scenarios, which is where NBS could serve as a benchmark for sustainable development. Further studies are needed to provide a better understanding of more concrete integration of NBS within the SEA Directive.

4 Concluding remarks

In recent years, the concept of NBS has gained increasing political interest from the local to the EU and global levels. An analysis of the European environmental and climate legislative framework identified that 35% of the analysed policies either explicitly or implicitly strongly support NBS. The potential for integrating NBS into the remaining policies as well as wider sectoral legislation is high and carries with it the potential to also increase the scale and scope of benefits NBS can provide.

Research conducted as part of this study has identified that European-level policies use different terms for NBS, such as natural water retention measures, ecosystem-based adaptation or management, and green infrastructure. A coherent approach for systematic implementation or mainstreaming NBS into policies would prove beneficial.

In order to further explore the potential of NBS on the European scale, policy implementation at local and national level needs to be improved. Strengthening support of NBS in the local implementation of the *Floods Directive* could entail catchment scale monitoring experiments engagement as well as models and decision support tools. The identification of priority areas for the establishment or restoration of NBS could make their application more appealing.

An additional opportunity for greater NBS support in the area of adaptation is for national *Climate Adaptation Strategy and National Adaptation Plans* to ensure the full exploration, use and monitoring of NBS and guarantee sustained political and financial support for their maintenance and monitoring. The use of more standardized indicators across MS to monitor and assess the effectiveness of different green infrastructure regarding adaptation is required to allow for robust NBS consideration, planning and implementation. Furthermore, the links between policy and science should be extended and strengthened within the climate adaptation strategy, with the Strateg's review taking into account wealth of knowledge and data emerging from H2020-funded NBS-focused projects.

In terms of *Strategic Environmental Assessment*, practitioners and policy makers require clear guidance and good practice examples for NBS inclusion. Implementing NBS as a baseline for sustainable scenarios would motivate local and national application. Further studies are needed to provide a better understanding of more concrete integration of NBS within the SEA Directive.

Overall, policies need to systematically consider implementation effects beyond their primary objective (e.g. flood protection), taking account of the multiple additional socio-economic and socio-cultural benefits which can be delivered by NBS. Targeted guidance for Member States on how to integrate NBS in policy implementation (including good practice and experiences from different countries), as well as a streamlining of terms and definitions could prove helpful. Thus, while there remain significant gaps to be addressed in order for NBS to meet its full potential, the opportunities for increased integration and support are plentiful and hold the potential to offer a wealth of societal, economic and environmental benefits and support the achievement of a range of sectoral policy targets.

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