European Environment Agency
European Topic Centre on
Biological Diversity

Working paper N° D/2017

Review existing evidence and information on the implementation status of GI/Nature-Based initiatives (NBI) in the Member States

Sandra Naumann, McKenna Davis and Keighley McFarland

October 2017

The European Topic Centre on Biological Diversity (ETC/BD) is a consortium of twelve organisations under a Framework Partnership Agreement with the European Environment Agency for the period 2014-2018
AOPK-CR Ecologic ILE-SAS ISPRA JNCC MNHN NATURALIS SC-NAT SLU S4E UBA WENR

Authors' affiliation:

Sandra Naumann, Ecologic Institute (DE)
McKenna Davis, Ecologic Institute (DE)
Keighley McFarland, Ecologic Institute (DE)

EEA project manager:

Gorm Dige, European Environment Agency (DK)

ETC/BD production support:

Muriel Vincent, Muséum national d'Histoire naturelle (FR)

Context:

The Topic Centre has prepared this Working paper in collaboration with the European Environment Agency (EEA) under its 2017 work programmes as a contribution to the EEA's work on Assessments of relevance to protected areas and Green Infrastructure.

Citation:

Please cite this report as
Naumann, S., Davis, M. and McFarland, K., 2017. Review existing evidence and information on the implementation status of GI/Nature-Based Initiatives (NBI) in the Member States. ETC/BD report to the EEA.

Disclaimer:

ETC/BD Working paper N° D/2017
European Topic Centre on Biological Diversity
c/o Muséum national d'Histoire naturelle
57 rue Cuvier
75231 Paris cedex, France
Phone: + 33 1 40 79 38 70
E-mail: etc.biodiversity@mnhn.fr
Website: http://bd.eionet.europa.eu

Contents

1 Aim and approach

This study aims to establish the current state of information and data availability regarding green infrastructure (GI), nature-based initiatives (NBI) and closely related concepts (such as ecosystem-based adaptation, nature-based solutions, etc) at the European level. Through a review of existing evidence, the study assesses the availability of information on: costs and benefits; financing, policy and governance mechanisms; planning, assessment and monitoring tools; case studies; drivers for implementation; sector-specific aspects; spatial information; use of ecosystem services (ES) in assessment; relevant platforms; and wider dissemination materials. The results highlight gaps and areas necessitating further investment and research. They further serve to inform the specifications of a subsequent project on NBI as well as the design of a foreseen questionnaire targeting EEA countries.

Scope and approach

A growing recognition of the value of ecosystem services and the wider socio-economic and socio-cultural benefits provided by natural systems has spurred a shift in planning and policy discourse, aiming to integrate these considerations into decision-making processes. Such multifunctional 'green' measures are subject to a wide array of labels depending on the context in which they are implemented and their specific aims.

While the umbrella terms 'nature-based solution' (NBS) and 'nature-based initiative' have been coined to better conceptualize this approach, they ultimately represent a family of interventions that seek to use the properties of nature to address a set of environmental and societal challenges. These approaches serve as an alternative to conventional methods of planning and development, which often deploy largely technological and "grey infrastructure" solutions, and can thereby deliver multiple ecological, economic, social and planning benefits in parallel. Given the relative newness of the terms NBS/NBI, however, this study acknowledges the diversity of related concepts and includes these in the review process (see Box 1.1).

Box 1.1 Selected definitions of NBI-related concepts

1. Ecosystem-based adaptation (EBA): The EU Adaptation Strategy recognises multiple benefits of ecosystem-based approaches to adaptation. Ecosystem-based adaptation is defined as "the use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people to adapt to the adverse effects of climate change." [CBD 2009] [1] (DG Climate Action)

2. Green Infrastructure (GI): Green Infrastructure is defined as a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services. It incorporates green spaces (or blue if aquatic ecosystems are concerned) and other physical features in terrestrial (including coastal) and marine areas. On land, GI is present in rural and urban settings.[2] (DG Environment)

3. Natural Water Retention Measures (NWRM): Natural Water Retention Measures are multi-functional measures that aim to protect 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. The main focus of applying NWRM is to enhance the retention capacity of aquifers, soil, and aquatic and water dependent ecosystems with a view to improve their status. The application of NWRM supports green infrastructure, improves the quantitative status of water bodies as such, and reduces the vulnerability to floods and droughts. It positively affects the

[1] http://ec.europa.eu/clima/policies/adaptation/index_en.htm
[2] http://ec.europa.eu/environment/nature/ecosystems/index_en.htm

chemical and ecological status of water bodies by restoring natural functioning of ecosystems and the services they provide. The restored ecosystems contribute both to climate change adaptation and mitigation. [3] (DG Environment)

4. Ecosystem-based Disaster Risk Reduction (ecoDRR): The European Commission promotes ecosystem-based approaches that contribute to the conservation, enhancement and restoration of biodiversity, ecosystems and ecosystems services in urban, rural, coastal and natural areas. These initiatives constitute a positive and cost-efficient way of supporting disaster risk reduction and adaptation to climate change, while often providing significant co-benefits in terms of climate change mitigation or human health, safety and well-being. [4] (DG Sanco)

5. Nature-Based Solutions (NBS): Nature-based solutions to societal challenges are solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. Such solutions bring more, and more diverse, nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions. [5] (DG Research & Innovation)

Utilising the above understandings and focusing in particular on the terms GI and NBI, this study followed a three-step methodological approach to gathering, assessing and presenting information on the available evidence base. Specifically, the following steps were implemented:

1. Identify available evidence and information on GI and NBI in EEA countries[6] through targeted desk-based research and web searches: The focus was to identify published reports, documents, factsheets, toolboxes, web platforms, and guidance documents, as well as synthesis materials summarising the outcomes of relevant research and implementation projects which have already finished or been running for at least 2 years. Materials largely excluded national, regional or local strategic documents/studies as well as scientific articles[7]. Additionally, a separate list was generated during the search process to note all recently started or planned research projects whose foreseen outputs can potentially contribute to the GI/NBI evidence base.

2. Conduct a systematic review of identified sources: All sources were systematically entered into an excel template to facilitate a streamlined analysis. Each source was assigned a number, and general information on the type of source, key terms used, title, citation, year, spatial scale and geographic coverage were entered as well as – where relevant - the related research project, website, and client. This information was complemented with more detailed information on the type and breadth of information provided. A particular focus was placed on the questions/answers and demand for more information raised by the participants of ETC-LUSP-meeting, held in October 2016. The categories explored include *inter alia* information on:

- Costs and benefits
- Financing mechanisms and investments
- Policy and governance mechanisms of GI/NBI
- Relevant planning, assessment and monitoring tools and guidelines

[3] http://ec.europa.eu/environment/water/adaptation/ecosystemstorage.htm
[4] http://ec.europa.eu/echo/sites/echo-site/files/1_en_document_travail_service_part1_v2.pdf
[5] https://ec.europa.eu/research/environment/index_en.cfm?pg=nature-based-solutions
[6] Results show that the majority of relevant report on GI and NBI were published in the last 10 years.
[7] Due to the breath of scientific studies published in the last 5 years on relevant topics and limited resources available for conducting this study, this type of publication was largely excluded from the review process. Exceptions include key peer reviewed articles published in the last 3 years which are a central element of EU discourse or which offer a substantial body of new evidence on the topic.

- Drivers for creating, maintaining or restoring GI and implementing NBI
- Case studies/Good practices at regional and national level
- Sector specific information on GI/NBI
- Spatial information/data on GI
- Use of ecosystem services in existing assessment concepts
- Relevant platforms and networks in place
- Wider dissemination and public awareness material
- Further relevant information

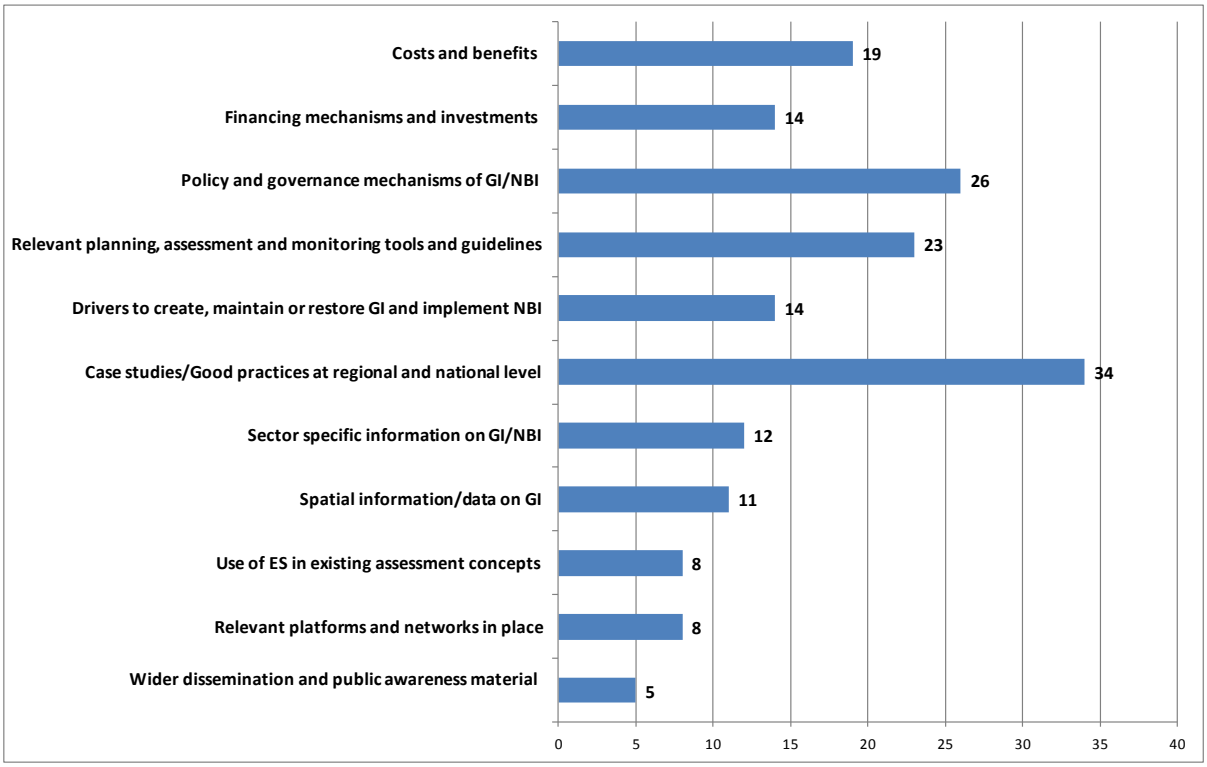
3. Assess information availability and identify gaps: On the basis of the entered information, each category was analysed across all relevant sources to identify the types of data/information available (i.e. content, parameters etc, including key references/sources), the spatial and geographic coverage, and areas in which evidence is currently missing (i.e. issues/parameters/countries which are not addressed or covered only to a limited extent, as well as resultant research needs). These findings as well as the list of recently started and planned projects of relevance (identified in Step 1) were compiled in this study.

Ultimately, these steps and the content of this study serve to avoid the duplication of current initiatives and provide an indication of areas and needs which can be addressed in upcoming GI/NBI research and targeted projects in order to add value to the evidence base.

2 Data availability and identified gaps

This chapter presents evidence emerging from the conducted review per topic area, following the outlined methodological approach. Statistics on the number and type of publications reviewed, the frequency of themes within each topic area, and availability of data by scale and geographic region are presented. Illustrative examples of some sources, highlighting the type of information available, are also outlined where deemed to have added value. Finally, all sources that include information on the respective topic areas are listed according to their assigned number for easy reference. (A full list of the 49 sources and their respective numbers is included in the References section.) While each of these topics is outlined in depth in the following subchapters, the figure 2.1Table 2.1 provides a first overview of the frequency of occurrence of each topic across all identified sources.

Figure 2.1 Number of sources which include information on each topic area



2.1 Costs and benefits

Type of information:

19 of 49 sources provide information on 'benefits and/or costs' for GI and NBI.

The majority of the reviewed sources focus solely on benefits (7, 8, 12, 13, 15, 18, 22, 24, 31, 34, 39, 47), with little inclusion of information relating to costs. Several studies provide more details on the type of benefits and ES delivered by GI, NBS and ecosystem-based approaches, but often remain at a general level without using specific case studies or quantitative and monetary figures. The contribution of NBI-related concepts to climate change adaptation and mitigation is commonly emphasised, focusing on urban as well as non-urban areas. The report *Nature-based solutions to climate change mitigation and adaptation in urban areas* (22), for example, lists the benefits and co-benefits of NBS in cities for adaptation/mitigation (in particular for flood mitigation, temperature reduction and air

purification), without quantitative figures. The report also summarises existing evidence on measured benefits of green roofs, green walls and parks for adaptation/mitigation as well as on contributions of urban NBS to health and social-environmental justice. In addition to outlining the benefits associated with climate change impacts, a number of sources also list biodiversity, socio-cultural and health benefits addressing current societal challenges (e.g. 7, 17, 24, 31).

While some studies refer to urban areas, other studies focus on specific ecosystems and types of measures, such as the *Report on Socio-Economic Benefits of Wetland Restoration in Central and Eastern Europe* (34), which examines and presents the socio-economic benefits of wetlands and wetland restoration in Central/Eastern Europe at the local and landscape levels[8]. The benefits included are: flood control, coastal protection, groundwater recharge, water purification, carbon sequestration, food and materials, wildlife habitats, recreation and cultural value.

All reviewed studies highlight the potential of GI, NBI and related concepts to deliver multiple benefits. The *BISE website* (39), for example, provides a link to a table[9] listing all GI functions and benefits in order to illustrate the multifunctionality of GI. The benefits are expressed in terms of the functions and services provided by ecosystems, which are the basis for GI. They include provisioning services such as food and water, regulating services such as flood and disease control, and cultural services such as spiritual, recreational, and cultural benefits. The table also provides an overview of units and examples for quantitative and monetary benefits for each of the listed services/functions.

Only a minor share of sources present the full range and an analysis of costs and benefits associated with specific interventions/case studies (3, 17, 27, 29, 30, 40). Alternatively, as in the case of *Green Infrastructure Implementation and Efficiency* (27), some studies present the costs, benefits and cost-effectiveness of specific GI elements[10]. Within the case studies, the level of detail varies from short summarising text on costs and benefits to detailed lists of all associated costs and benefits.

The *CEEweb Green Infrastructure Knowledge Platform* (3) contains several external studies that provide full cost and benefits assessments for selected case studies; these can be found under e.g. the tab 'Business'. Examples include a study from eftec and CRESR (2013)[11], detailing the Gross and Net Benefits of Property Investment, Net Business Investment Benefits, Net Economic Benefits of Visitor Spending, Impacts on Employment, amongst other aspects, along with a study from the Nature Conservancy (2013)[12] that provides information on costs and investments and the resulting benefits.

The study *Supporting the Implementation of Green Infrastructure* (35) developed a baseline estimating the current EU funding levels for GI under the existing GI policy and funding structures in

[8] Eg Building blue-geen infrastructure and restoration projects in SK, EE, LT, RO, HU, SI, PL, DE, DK, SE, BG

[9] http://ec.europa.eu/environment/nature/ecosystems/docs/Table%201%20GI.pdf, adapted by the European Commission based on source 34 (http://ec.europa.eu/environment/nature/ecosystems/studies.htm#implementation)

[10] Core areas, Restoration zones, Sustainable use/Ecosystem Service Zones, Green urban and peri-urban areas, Natural connectivity features, Artificial connectivity features

[11] Eftec (2013): Green Infrastructure's contribution to economic growth: a review A Final Report for Defra and Natural England. URL: http://www4.shu.ac.uk/research/cresr/sites/shu.ac.uk/files/green-infrastructures-contribution-growth.pdf; case studies: Glasgow Green, Glasgow, Scotland; Canalside Development in City Centre, Birmingham, England; Philadelphia Land Care Programme, Pennsylvania, USA; Cheonggyecheon Stream, Seoul, Korea, The Highline Linear Park, New York City, USA.

[12] The Nature Conservancy (2013): Case Studies evaluated by participating companies for creation of the White Paper "The Case for Green Infrastructure."URL: https://www.nature.org/about-us/working-with-companies/case-studies-for-green-infrastructure.pdf?redirect=https-301, Business cases from USA, Canada, Colombia, Vietnam, Germany and

order to compare and contrast the expected costs and benefits of having an EU level Green Infrastructure[13] to a situation without such a network. Building on this baseline, the project team conducted a first-phase assessment of the costs and benefits of a potential TEN-G versus continuing the current GI policy and funding structures.[14] As part of this study, seven sectoral factsheets (9)[15] were prepared, with each including a small section on costs and benefits in relation to GI as well as some overall illustrative case studies.

Example(s):

Box 2.1 Case study of GI protecting ecosystem functions and promoting ES

UK National Forest project

The National Forest project was conceived in 1987 to create a large, new forest for the nation in lowland Britain that would demonstrate multi-purpose forestry and improve an area damaged by past mineral workings. Its aims were economic regeneration from the restoration of mining sites and the support of future agriculture through rural diversification. Commercial forestry was blended with additional benefits including economic regeneration, landscape and ecological enhancement, rural diversification and community engagement, and creation of a new recreational and tourism resource. The Forest area spans 518 km², representing an increase from 6% to nearly 19% since 1990 with 19,000 hectares of new and existing woodlands, hedgerows, meadows, heathlands and wetlands. The project targeted nine priority species: otters, bats, adder, bluebell, black poplar, rudder darter dragonfly, water vole, redstart and barn owl. Several ESSs are promoted, such as carbon sequestration, recreational services and timber and forestry products.

Table 3: Estimated Costs of Project (Naumann *et al.*, 2011a)

One off costs	Project management and administration	€11,357,206
	Land management and restoration works	€18,907,908
	Other/unspecified	€4,220,828
	Total	**€34,485,943**
Recurrent costs	Land Management, buildings and maintenance	€2,669,136
	Other Equipment	€39,400
	Project Management and administration	€1,491,418
	Research and Monitoring	€47,378
	Total	**€4,247,332**
OVERALL TOTAL COSTS		**€38,733,275**

Much of land converted to woodland had been former mining areas with few development opportunities so by regenerating the area the project has brought significant opportunities for economic development rather than lost them. A report by eftec (Dickie & Thomson, 2010) suggested that opportunity costs are likely to be negative.

Benefits of Project (Naumann *et al.*, 2011a)

The project created 6,229 hectares of new woodland, planted 7,800,000 trees and increased woodland cover by 207%. The value of timber production from 1991-2100 is estimated to be €11 million. In addition it created or returned to management 1,750 hectares of other habitats. The benefits due to biodiversity improvement in terms of habitats created is estimated at €56 million (based on habitats of high biodiversity value being worth £300 per hectare and habitats of low biodiversity value being worth £30 per hectare). The benefits due to landscape enhancement were estimated at €57 million, whilst benefits gained from regeneration of the land is estimated at €57 million. The total carbon sequestered to date is estimated to be 66,000 tonnes which it is estimated to be worth €209 million (based on the value of £50 per tonne of CO_2). The project created 86 km of new cycle ways as well as 45 new sports and recreation facilities and 20 new tourism attractions. It has 8,686,500 visitors a day and 84% of the local population are satisfied by landscape improvements. The value of recreational use is estimated at €628 million which includes the tourism value of €321 million. The project created or safeguarded 333 forest-related jobs, created five forest-related business activities. In total the benefits were estimated at €1,005 million (£909 million).

[13] The term EU-level Green Infrastructure" - formerly referred to as TEN-G - builds on "GI projects of European interest" as described in the action 12 of the Action Plan for nature, people and the economy (2017) http://ec.europa.eu/environment/nature/legislation/fitness_check/action_plan/index_en.htm

[14] The study shows that "Whilst the assessment process is high level and subject to a number of uncertainties, the findings indicate that a TEN-G has the potential to provide greater benefits per € invested than the current GI policy implementation and funding allocation (as described under the baseline scenario)" (34, p.153)

[15] Sectors/issues covered: climate change adaptation, transport, health, water, energy, rural abandonment and finance

Evaluation and Monitoring

Eftec (Dickie & Thomson, 2010) was commissioned to assess the costs and benefits of the UK National Forest project over the period 1990 to 2100. The total benefits came to €1,005 million whilst costs, including the grants, came to €210 million (£188 million). This means the benefits exceeded the costs by €795 million (£721 million) with a cost ratio of 4.8 to 1. The benefits were also found to exceed costs by a factor of 2.6 to 1 over the 1990 to 2010 time period.

Figures in sterling are from the original eftec report. Figures in euros are from Naumann et al. *(2011a)*

Sources: 14: p19; 27

Scale and geographic coverage of information:

Cost and benefit assessments are often conducted at the local, regional or ecosystem levels. Case studies are, for example, available from several European countries (in particular from the UK) as well as from the USA, Canada, Korea, Colombia and Vietnam.

Gaps:

One of the major data gaps is the availability of complete cost and benefit assessments, often resulting from their difficulty. Such assessments are often time and resource intensive and a transfer of the values and results between case studies, ecosystems or regions is often difficult or not possible. A more frequent use of assessment tools in planning and monitoring (see e.g. Multiple benefits toolbox (47))[16] is needed.

Moreover, cost-benefit assessments at a larger scale (e.g. landscape or even at the national level) could be of interest to guide decision-making processes and attract investments. The MAES-process taking place at the European Member State level could be one source to feed into such a process.

Sources: 3, 7, 8, 12, 13, 15, 17, 18, 22, 24, 27, 29, 30, 31, 34, 35, 39, 40, 47

2.2 Financing mechanisms and investments

Type of information:

14 of 49 analysed sources include information on 'GI financing mechanisms and investments'. Relevant sources provide both overviews of existing financing mechanisms, investment models, and funding sources that can be used, as well as present case studies of approaches that have been used for financing. More specifically, extensive information is available on existing EU funding programmes (see examples below) in relation to the implementation, monitoring, planning, and maintenance of GI/NBI-related concepts. Specific programmes were highlighted, such as:

- LIFE
- European Bank for Reconstruction and Development (EBRD)
- the European Investment Bank (EIB)
- Operational Programmes
- Natural Capital Financing Facility (NCFF)
- Regional and Structural Funds (ERDF incl. Urban Innovative Actions, Cohesion Funds, Interreg, the European Social Fund (ESF)),

[16] A methodology was developed for the robust evaluation of the multiple functionalities of Blue-Green infrastructure which demonstrates the relative significance of benefits in context specific locations.

- European Maritime and Fisheries Fund
- Common Agricultural Policy
- Horizon 2020
- URBACT
- European Economic Area (EEA) grants
- JPI Urban Europe

One source provides an overview the types of GI projects that are financed through EU programmes (35). This report estimates that investments in GI projects from EU public funds would amount to approximately €6,397 million during the 2014-2020 programming period (35, p. 8). It further outlines that 78% of all GI funding is estimated to target conservation of green areas, 12% targets restoration, and connectivity issues, and that the sustainable use of green zones, and green urban and peri-urban areas receive approximately 1%, 4% and 4% of investment respectively (35, p. 8)

The aforementioned study (35) also includes an analysis of the potential of supporting the implementation and financing of an EU GI network, finding that a TEN-G network would be more cost-efficient than GI investments through existing EU funding mechanisms.

Case study analyses within the respective resources also provide information on funding opportunities at the national and regional levels as well as examples of traditional and innovative private funding and public-private-partnerships for some MS (e.g. France, the United Kingdom, Estonia, Austria, Slovakia, the Netherlands, Spain, and Romania). These range from loans, grants, stakeholder partnerships, and credit-enhancement mechanisms (e.g. credit guarantees) to innovative measures, such as crowd-funding (1, 46). The types of ecosystems and sectors covered in the case studies include wetlands, urban areas (green facades, drainage, regeneration, creation of urban green areas, etc.), agriculture and multifunctional farming, aquaculture and fisheries, mountains/forests, and marine/coastal ecosystems. In the case studies, examples of funding for transboundary connectivity projects are also included. Additional information is planned to be included for each MS on financing in relation to GI within the BISE website's GI factsheets (9).

The reviewed sources also outline principles of risk management for GI investments (1). The risk and benefits of GI projects are often not well-understood by investors, but credit-enhancement mechanisms can be used to minimize or redistribute risks that otherwise cause projects to be unattractive to investors. As credit enhancement for GI projects is currently underused, potential remains to expand their application. Credit enhancement mechanisms mitigate or redistribute risks for investors, e.g. a loan guarantee (i.e. a loan which does not need to be paid back if an exploratory phase of a project is unsuccessful) or risk-sharing arrangements. The presence of trustworthy partners with solid credit, such as the World Bank, can also serve to create comfort among investors and reduce barriers to their involvement in GI projects (1).

Some of the resources looked into barriers and challenges for GI investments. The EEA (46) investigated barriers for municipalities for financing climate adaptation measures including GI and NBI, while another study (1) also looked at barriers to investing in GI. Identified barriers include e.g. lack of knowledge of GI options, their benefits, and financing options, as well as lack of staff capacity to research and apply for funding. A third source (7) highlights the current challenges presented by the structure of municipal revenues for investing in NBS and GI, including constitutional and fiscal restrictions. It concludes by outlining potential solutions to enable greater investments in multifunctional urban NBS.

Scale and geographic coverage of information:

Most of the available information on financing and investments targets the EU level. Information on the national, regional, and local levels is available for some case studies in descriptive examples. Nine of eleven sources covered the EU level (1, 3, 4, 16, 18, 19, 30, 35, 46). Case studies at the regional, local, or site levels in MS were covered in 5 of the sources (3, 25, 29, 30, 46), including Romania, Italy, Germany, Austria, France, the UK, Estonia, the Netherlands, Spain, Slovakia, Sweden, Denmark, and Belgium.

Example(s):

Box 2.2 Overview of GI funding opportunities on the *CEEWeb Green Infrastructure Knowledge Hub*

The *CEEWeb GI Knowledge Hub* (3) includes an extensive guide to EU level funding opportunities for GI projects. The guide covers LIFE, Operational Programmes, Structural and Cohesion Funds (ERDF, Cohesion Funds, INTERREG, and the European Social Fund), the European Maritime and Fisheries Fund, the Common Agricultural Policy, Horizon 2020, and the Natural Capital Financing Facility. For each funding opportunity, a basic description of the funding programme is provided, with a link to the relevant website and/or an explanatory document. For some of the programmes, more detailed information is available, e.g. what sub-programmes of the ERDF can be applicable to GI projects. The platform also includes reports on case studies of innovative financing for GI projects at MS level or involving the private sector, focusing on Central and Eastern Europe.

Source: 3

Box 2.3 Financing urban adaptation to climate change

This report is an overview of financing for urban adaptation to climate change. It introduces financing options, explores barriers and risks faced by municipalities for investing in climate adaptation, and presents 11 case studies from across Europe. Of these case studies, 9 (Hamburg, Bilbao, Ghent, Amsterdam, Paris, Malmö, Bologna, Bratislava, and Copenhagen) include GI and NBI measures. It explains the financing options used in each case study, the types of measures implemented, and gives a description of the results. Case studies covered a variety of adaptation-related sectors and measures, including greening urban areas, flood protection, storm water management and drainage, urban gardening, and green roofs. The report extracts lessons learned from the case studies to provide guidance for municipalities looking for information about adaptation financing.

Source: 46

Gaps:

Most of the identified resources did not go into detail about the funding opportunities available, or provide guidelines on applying for funding, how to design projects so they qualify for funding, etc. When financing options were mentioned in the reviewed documents and websites, it was usually on a case study basis containing indicative but not comprehensive information, or covering only superficial information (e.g. simply mentioning that the LIFE programme could fund GI projects) (see e.g. 46). Information on relevant funding streams that are not currently utilised to their full potential

for GI or NBI-related interventions is largely lacking, particularly regarding means to increase this utilisation in the future.

Information on investments (both specific examples and more general investment models) is presented only in relation to specific case study examples, rather than providing a more overarching review of e.g. investment models or types of investment which could be relevant for fostering an increased uptake of GI and NBI-related interventions. Though an estimate of EU public funding for GI exists, an overview of the overall state of investments (covering national, regional, local, and private financing) and potential investment types in GI would be useful areas for further research. The existing information is also difficult to compare across cases, as costs and benefits are not consistently quantified (35).

In addition, challenges and barriers related to GI financing were not covered in depth in the literature, with the exception of barriers for municipalities, and could be investigated more in the future.

Sources: 1, 3, 4, 7, 9, 16, 18, 19, 25, 29, 30, 35, 40, 49

2.3 Policy and governance mechanisms

Type of information:

26 of 49 sources include information on 'Policy and governance mechanisms', covering a diverse range of topics. The majority of reviewed sources focus broadly on the topic of GI, green areas or NBS and address this chapter's thematic only as one of many sub-topics. However, three dedicated sources were also identified, including the GreenSurge publications on *Innovative governance of urban green spaces - Learning from 18 innovative examples across Europe* (2) and *The Governance of Urban Green Spaces in Selected EU-Cities* (26), as well as the (draft) report on *Policy Instruments for Ecosystem-based Management in Europe* (38). All of these dedicated publications utilise case studies to acquire 'real world' information on governance arrangements. More specifics regarding the contents of these publications are outlined below, clustered with other identified sources according to thematic topic.

The largest group of studies identify and describe EU (14, 15, 18, 27, 29, 35, 37, 49) or national and regional/city level policies (9, 12, 28, 29, 38, 39, 45) and their relation to GI, or related concepts. Focuses areas of the sources containing information on the EU level are on the TEN-G network (35), policies relating to GI more broadly (14, 15, 27, 29, 37) and the GI Strategy specifically (18, 27). Of the eight studies containing information on the EU-policy context, five were authored by the EC or EEA. National focus was given to policies across all MS within the GI Country Factsheet in BISE (9), and to specific MS within e.g. the *Green Infrastructure and Territorial Cohesion* report (EEA, 12). Other reports look at enabling policy frameworks at the international level (49), the GI policy context in Germany (29), or focus instead on policy related to ecosystem-based management on a national (38) or city level, e.g. Nairobi (45). A series of 'City Portraits' also look at the urban and regional planning characteristics in 20 cities (28). Six sources include cross-sectoral considerations, such as policy coherency and linkages (7, 12, 18, 27, 28, 29). Two studies provide policy-related recommendations, such as for new urban green policies and an agenda for future action, targeting city authorities, national governments and the European Commission (44) and for integrating ecosystem-based approaches into existing sectoral policies (29).

The thematic of actors/stakeholders and their participation and roles within planning, policy-making, and governance processes are explored in nine sources (2, 7, 26, 28, 29, 30, 35, 40, 48). Specifically, questions such as "How do governments deal with questions surrounding participation in their green

space policies and related practices?" and "Who is involved with green space policies and initiates which projects?" are explored in one GreenSurge publication (2), while aspects such as "How do governments deal with questions surrounding participation in their green space policies and related practices?" and "Who are involved with green space policies and who initiates what projects?" are addressed in a second (26). Types of actors as well as a typology of their potential roles in green space governance processes[17] are outlined in four sources (26, 29, 30, 40). One source also showcases examples of and lessons learned from multi-stakeholder partnerships, private sector leadership, and citizen engagement, which have supported the development or implementation of NBS in urban areas (7).

Innovation is explored within the context of e.g. (co-)governance arrangements and government practices in five sources (2, 7, 21, 26, 28). Specifically, contents include:

- Instruments for co-governance (e.g. participatory budgeting, public-private partnerships, community-led management of green spaces, E-tools for facilitating citizen involvement, and neighbourhood planning approach) (2, 26),
- Innovative approaches in relation to urban GI planning (e.g. in relation to implementation, actors and collaboration, strategy approach, etc.) (21), and
- Experiences with innovative governance practices (i.e. how 'traditional' government-driven steering of green space planning and management compares to emerging forms of governance with a greater role for non-governmental actors in different cities) (28).

In light of fostering successful GI integration into policies and planning processes, six sources outline potential challenges within governance processes and GI planning, as well as lessons learned and factors for success in overcoming these (2, 7, 21, 26, 28). Supporting and hindering factors influencing participation, for example, are clustered into three major categories: institutional framework, local authorities' approach and civil society's approach (26). Furthermore, advanced strategies and approaches for urban green infrastructure planning (21) and mainstreaming nature-based solutions in urban governance/planning as well as factors of success are outlined in two sources. Concrete planning instruments, tools and approaches to support planning and decision-making processes are also raised (28, 30, 38).

Several further considerations are also explored in individual studies, regarding e.g. institutional set-up (38), transferability (21), sustainability indicators focusing on urban water environments (8), and sector-specific policy considerations focusing on wetland restoration policy and its relation to GI (34).

A range of case studies and examples examining the above topics are included in twelve sources (2, 3, 7, 8, 9, 21, 26, 28, 29, 30, 37, 38, 40, 45).

[17] i.e. (1) Consultation on plans, which involves public authorities setting up a citizen-consultation process in relation to certain issues, plans or developments; (2) Strategic involvement in decision-making, which involves public authorities delegating some of their decision-making power to non-government actors, while maintaining final decision-making powers; (3) Co-operative forms of management, which involves government actors inviting non-government stakeholders to share rights and duties or facilitating projects initiated by non-government stakeholders; (4) Informal spontaneous attempts to influence policies or green space practices, where nongovernment stakeholders spontaneously and autonomously express their opinion or organise civic movements; (5) Informal green space management activities, where initiatives concerning green space management emerge in a bottom-up way without significant government involvement. (26, p. 60)

Example(s):

Box 2.4 Nature-Based Solutions to Climate Change Adaptation in Urban Areas

This book contains five chapters looking at 'Policy, Governance and Planning Implications for Nature-Based Solutions'. Insights on mainstreaming NBS for climate change adaptation in urban governance and planning comprise one chapter, including the presentation of an integrated framework illustrating potential mainstreaming measures and strategies at different levels of governance and its application in urban planning practice (with a focus on NBS). Case studies from Germany and Portugal illustrate the text, underlining four key principles for successful mainstreaming. A further chapter looks at partnerships for NBS in urban areas, again showcasing successful examples of multi-stakeholder partnerships, private sector leadership, and citizen engagement.

Source: 7

Scale and geographic coverage of information:

The majority of studies focus on either the EU or MS-level policy frameworks, or target specific cities as case studies. The *BISE website* (39) and its GI-factsheets were developed for all 28 MS (9), whereas other sources concentrated on specific MS[18]. Three of the studies focusing on the national level include non-EU countries (8, 38, 45), i.e. Liechtenstein, Switzerland, Albania, Croatia, Serbia, Belarus, Indonesia, and Russia. Other studies focus on specific EU cities[19] (2, 3, 21, 26, 28, 29, 37), or a mix of global and EU cities[20] (8).

Gaps:

Gaps are less related to data and evidence, but rather linked to the development and use of effective decision-making tools and monitoring systems in GI planning. More far-reaching gaps and challenges for advanced and efficient green space planning include provision of legal support through clear mandates and binding instruments, challenges and opportunities of inter- and transdisciplinary urban GI planning, improvement of social inclusion and citizens involvement and appropriate resources for better urban GI planning.

Sources: 2, 3, 5, 7, 8, 9, 12, 14, 15, 18, 21, 26, 27, 28, 29, 30, 34, 35, 37, 38, 39, 40, 44, 45, 48, 49

2.4 Relevant planning, assessment and monitoring tools and guidelines

Type of information:

23 of 49 sources covered GI planning, assessment, and monitoring tools and guidelines. The most commonly included topics among the sources are indicators and guidelines for monitoring and

[18] e.g. Belgium, Denmark, Germany, Estonia, Ireland, France, Hungary, Netherlands, Austria (12); Sweden, Finland, Czech Republic, France, Hungary, Germany, Spain, Poland (38); Germany (29)

[19] i.e. Arhus, DK; Helsinki, FI; Malmö, SE; Bristol and Edinburgh, UK; Ljubljana, SI; Lodz, PL; Oradea, RO; Poznan, PL; Szeged, HU; Amsterdam and Utrecht, NL; Berlin and Halle an der Saale, DE; Linz, AT; Bari and Milano, IT; Barcelona, ES; Lisboa and Almada, PT (21, 26, 28); Kamen, Karlsruhe and Saarland, DE; Vienna, AT (29); Berlin (DE), Ourense (ES), Aaruhus (DK), Lisbon (PT), Malmö (SE), Utrecht (NL), London (UK),Basel (CH), Budapest (HU), Galati (RO), Heerlen (NL), Maribor (SI), Osijek (HR), Padua (IT), Rzeszow (PL), Salford (UK), Santiago de Compostela (ES), Vilnius (LI) (37)

[20] i.e. Warsaw, PL; Hradec Kralove, CZ; Gaziantep, Turkey; Sheffield, UK

evaluating GI (6, 10, 11, 12, 13, 14, 17, 22, 31,36, 43, 44), and guidelines for stakeholder involvement in GI projects (3, 4, 20, 36, 37, 43).

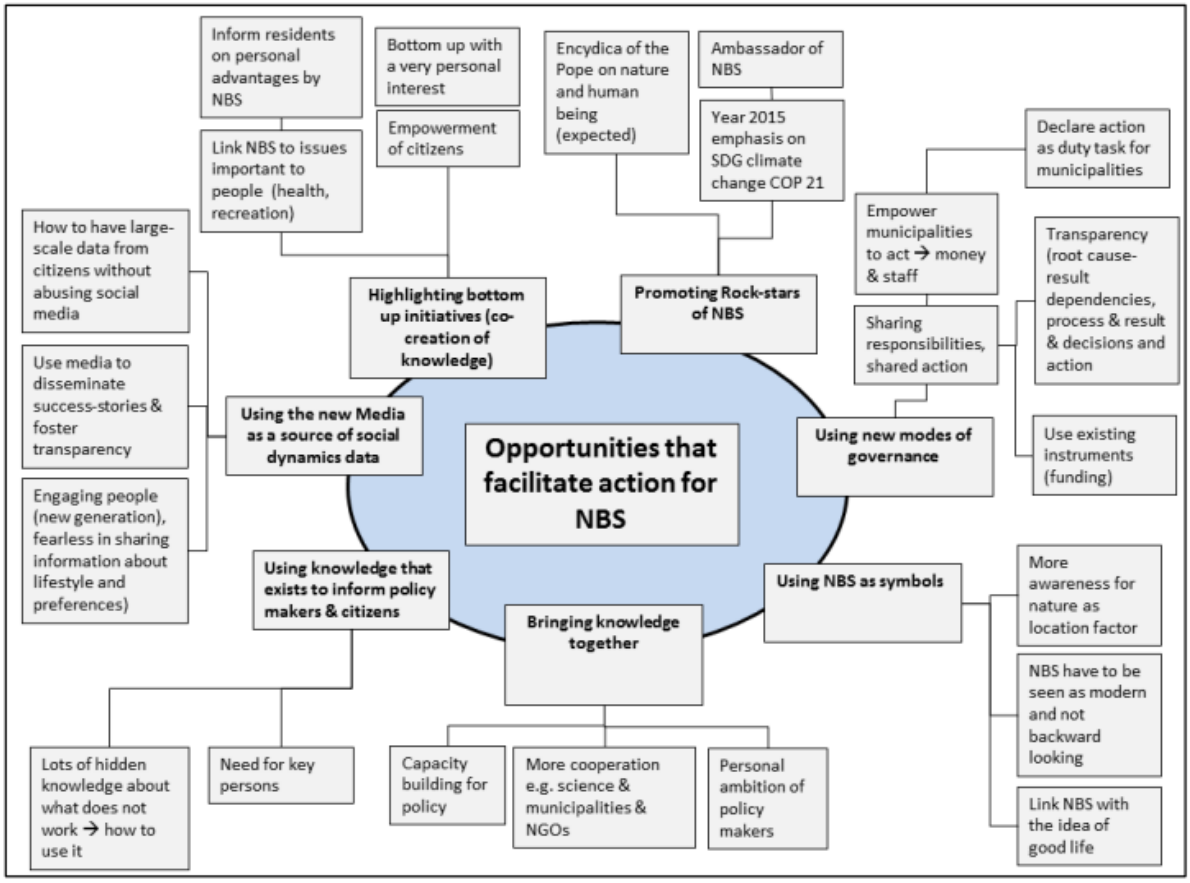
Urban GI planning and evaluation was explicitly targeted by seven sources (5, 12, 26, 31, 33, 36, 37, 47). One of these, the *Blue-Green Cities Multiple Benefits Toolbox* (47) serves as a means to identify, evaluate and monetise the multiple benefits of GI in context specific locations.

Five sources included information on maps and mapping tools for GI planning, monitoring, and evaluation (10, 12, 13, 14, 43). The 2014 EEA report *Spatial analysis of green infrastructure in Europe* (13), for example, provides EU-wide maps and data on potential GI areas. Provision of EU-wide data that can be directly applied is not the focus of most of the sources, however; instead, the sources provide methodologies and/or information on tools for using spatial data for GI planning, monitoring, and evaluation. The sources include illustrative case studies to explain the methodologies' use. Both urban level and landscape level mapping are covered in the sources.

The design of GI was the focus of two sources (4, 43). The *Green Infrastructure Training Manual for Trainers* (4) is a practical guide with instructions for activities on teaching GI design and implementation. The *GIFT-T Project Manual* (43) Provides tools for GI design related to vision building and interactive design of GI.

Two sources isolated success factors for GI planning (22, 42). For example, Kabisch et al. (2016) (22) isolated the following success factor clusters for NBS planning:

Figure 2.2 Success factors for nature-based solutions planning (22)



Two sources provided overviews of examples of GI elements (4, 33). One source analysed trends in GI planning (5), and one source provided guidelines for managing conflicts of interests in GI projects (e.g. between conservation and regional development interests) (3).

The tools and guidelines in the resources are primarily aimed at planners and policymakers involved in designing and implementing GI.

Example(s):

Box 2.5 5th MAES report on 'Informing strategic green infrastructure and restoration planning through mapping and assessment methods based on spatial and technical data' (draft report, May 2017)

The 5th MAES report, currently in draft stage, outlines examples of mapping and assessments of ecosystems and their services, with the goal of supporting strategic planning and restoration of GI in Europe. It will collect available knowledge, data, and tools and addresses the linkages between different geographical scales. The report focuses not only on the structural-spatial dimension of GI, but also the functional dimension, i.e. the quality and condition of GI components, ecosystems, and ecosystem services. It gives an overview of datasets, methods and tools available for GI assessment at urban and landscape levels for Europe. It looks into how existing methods and datasets can support GI planning and in which situations specific tools are most useful. The report will also investigate specific assessment questions related to GI, such as assessing GI's contribution to forest protection and threats to forest GI, the impact of climate change on connectivity, or urban GI patterns. The report includes a number of illustrative case studies with spatial assessments and maps.

Source: 10

Scale and geographic coverage of information:

The majority of sources focus on the EU and local levels. Two sources also include national and regional levels (3, 18). The strong focus on the local level is not surprising given the topic of planning, as most planning takes place at this scale and is most relevant for sources targeting planning officials. Both urban areas/urban planning and rural areas/regional planning are included in the resources. The majority of the case studies tend to focus on urban GI than GI in rural areas. The literature includes a high number of case studies, especially at the local/city level, which are spread throughout the EU.

Gaps:

As planning is usually in the jurisdiction of the local or regional levels, the development of planning tools at a national level would not be particularly useful; this explains why most tools target the local level. However, more research could be done to develop national level tools for monitoring and assessment. In addition, impact assessments of existing tools could be carried out to determine if they are presented in a format that is useful to stakeholders, and develop recommendations for how to translate existing information into formats and media that meets the needs of the targeted stakeholders.

Sources: 2, 3, 4, 5, 6, 10, 11, 12, 13, 14, 17, 20, 22, 26, 31, 33, 36, 37, 39, 42, 43, 44, 47

2.5 Case studies/Good practices

34 of 49 examined sources include information on 'NBI /GI case studies', making it the most frequently covered issue within the reviewed sources. The focus of the included case studies varies depending on the objectives of the respective projects, studies or platforms for which the case studies have been prepared. A large amount of case studies and good practice databases aim to present the diversity of GI, NBI and related concepts at a practical level and discuss issues linked to implementation in European and non-European countries (e.g. 7, 9, 11, 23, 29, 30, 31, 42, 40, 41, 44,). In this context, local/regional case studies are often described in terms of:

- **General information**: name of initiative, duration, location, responsible authority, objectives and aims, challenges (e.g. related to climate change) addressed;
- **Governance and Financing**: initiating and involved stakeholders, beneficiaries, funding sources, polices/strategies involved;
- **Implementatio**n: measures implemented, challenges and barriers faced, solutions identified to overcome barriers, total project costs;
- **Outcomes**: results, impact and benefits, outreach; and
- **Contact details** for obtaining further information.

The level of detail varies significantly across the different sources depending on many factors, such as whether the case studies have been prepared solely based on desk-based literature searches, or if they integrate more in-depth information obtained in interviews, on-site visits, own data collection and/or analysis, etc. In addition to including project databases (e.g. 9, 11, 23, 29, 30, 40, 42, 40), some reviewed sources include in-depth cases studies seeking to gather deeper insights on specific topics. The GreenSurge project, for example, has developed a large body of case studies to present insights on innovative governance of urban green spaces, urban policy planning and GI implementation (2, 5, 22) and conducted in-depth analysis in up to 18 cities in Europe (see examples). Other in-depth case studies focus on drivers for implementing GI and ecosystem-based approaches, associated costs and benefits, as well as barriers to implementation and solutions to overcomes those (e.g. 30, 31, 40, 44).

Given the variance in purpose for the case studies, there are also differences in content. The reviewed sources include cases which address (innovative) governance, citizen engagement in urban GI planning (2, 5, 10, 11, 21, 37), climate change adaptation and mitigation (e.g. 6[21], 7, 11[22], 23, 29, 42 45, 46, 38, 40), GI policy measures (7, 9, 12[23], 28, 38[24]), the landscape level and connectivity issues (10[25], 12[26] 16[27], 19), different societal challenges (6, 37) and restoration of ecosystems (6[28], 18[29], 34[30]). Limited focus is placed on transboundary case studies (16) and purely financing aspects (46).

[21] USA, Japan, UK, Ecuador, Rwanda, Costa Rica, Jordan, Spain, Guatemala
[22] 101 case studies covering 17 EU countries (13 ecosystem-based mitigation, 49 ecosystem-based adaption, 39 adaptation in nature conservation); most from UK, DE and NL
[23] Provides examples of GI policy measures from EU countries: BE, DK, DE, EE, IE, FR, HU, NL, AT, UK
[24] Analyses policy instruments for EBM on a national level in 8 EU countries (SE, FI, CZ, FR, HU, DE, ES, PL), 2 EEA member countries (Liechtenstein & Switzerland), and 3 cooperating countries (Albania, Croatia, Serbia).
[25] Connectivity, riparian corridors, impact of climate change, forests, wetland case study in Italy, analysis of Austrian green space network, etc.
[26] from Romania (flood plain/wetland restoration)
[27] Case studies on GI in transnational protected areas in FI, NO, Russia (green belt, river/fisheries) and DE, NL (river, wetlands)
[28] Restoration in USA: wetlands and forest landscape in Rwanda and land restoration in Jordan

Examples:

Box 2.6 GREENKEYS@YOUR CITY – A guide for urban green Quality – City folder

Within the GreenKeys project, 12 GreenKeys City profiles were developed and a number of complementing case study reports for the following cities: Budapest (HU), Bydgoszcz (PL), Dresden (DE), Giulianova (IT), Halandri (GR), Kotel (BG), Leipzig (DE), Nova Gorica (SI), Sanok (PL), Sofia (BG), Volos (GR) and Xanthi (GR). The case study reports include information about:

- Key overarching data (location, population, size, current green situation, etc.);
- Process of formulating an Urban Green Space Strategy, describing the challenges faced and the approaches adopted for strategy building, strategy vision, mission and goals; it also lists the important tasks and actions undertaken to support the strategy building process, together with the lessons learnt and good practices available for use; and
- Summary of Pilot Projects implemented within the GreenKeys project (short description of each project, key data, objectives and goals for improvement, challenges and problems, actions undertaken, maintenance concept, good practices and lessons learnt).

Source: 44

Box 2.7 Advanced Urban Green Infrastructure Planning and Implementation

In total, 14 case studies from 10 cities were studied in-depth, including in Milan, Berlin, Edinburgh, Helsinki, Lisbon, Almada, Aarhus, Szeged, Ljubljana and Malmö. The report outlines the employed innovative strategies and approaches for urban GI planning in each of the 14 cases according to the following themes: urban GI principles (green-grey integration, connectivity, multifunctionality, and social inclusion) and selected important policy challenges that can be addressed by urban GI planning (biodiversity protection, climate change adaptation, promotion of the green economy, and social cohesion). In addition, the cases were compared to one another in order to identify advanced or innovative elements, factors of success, limitations and potentials for improvements in urban GI planning and implementation.

Source: 21

Scale and geographic coverage of information:

While case studies are available at all scales within the reviewed sources, the majority focus on local, regional or city initiatives. In some cases, national initiatives are presented, such as in the *GI country fiches in BISE* (9) as well as for cases studies outside of Europe (6, 23, 38, 42, 45).

Within Europe, case studies are available for almost all EU countries. In addition, case studies (focusing on NBS and ecosystem-based approaches) also cover countries and areas beyond Europe,

[29] Rivers, marine/coastal, urban (green facade), flood protection/wetlands, urban regeneration and drainage, restoration, connectivity (green belt), agriculture and water),
[30] -Wetland Restoration in Central and Eastern Europe: SK, EE, RO, DK, SE, DE, LT, PL, LV, SI, HU, BG

such as in the USA, Japan, UK, Ecuador, Rwanda, Costa Rica, Jordan, Spain, Guatemala (10) and Belarus, Indonesia, Russia, Switzerland (45).

Gaps:

No real gaps can be identified given the large variety and amount of case studies at different scales and which address several relevant issues. However, the lack of a centralised platform/mechanism that presents the available case studies in a logical way hinders their easy accessibility and ability to be used by wider groups. Further gaps may emerge with the identification of new topics that are relevant for GI and NBI, for which no in-depth studies will have been conducted. Moreover, more research could be conducted on transboundary cases, which seem to have hardly been documented to date.

Sources: 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 16, 18, 19, 21, 23, 25, 27, 28, 29, 30, 31, 33, 34, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 48

2.6 Drivers for creating, maintaining or restoring GI and NBI

Type of information:

13 of 49 sources include information on the drivers for creating, maintaining, or restoring GI and NBI, covering a variety of perspectives. Five publications look at how societal and socio-environmental challenges drive GI and NBI creation (6, 8, 23, 31, 45). Societal challenges identified as drivers in these sources include: Water security/management, Food security, Health, Disaster risk, Climate change mitigation, adaptation, resilience, Biodiversity protection, Recreation, Coastal resilience, Urban regeneration, Air quality, Participatory governance, Social justice/cohesion and Job creation and economic development.

Specifically, climate-related drivers (adaptation and mitigation) are the main focus of four of the publications (8, 23, 31, 45). One example is the EKLIPSE report *"An Impact Evaluation Framework to Support Planning and Evaluation of Nature-based Solutions Projects"* (31), which investigates 10 challenges related to urban climate resilience to which NBS respond. It offers a framework to evaluate the effectiveness of NBS in responding to these drivers.

Five publications investigate the enabling factors that play into GI and NBI-related implementation (e.g. ecosystem-based approaches) as drivers, and also examine barriers (5, 22, 23, 30, 40). The 2015 report by Davies et al. (5) provides insight into the mechanisms that ensure or hinder the implementation of GI projects. A range of barriers are identified, such as: political support, availability of (matching) funding, institutional structures and capacities at city level, responsibilities and cooperation across spatial scales, and monitoring and evaluation. It also provides a synthesis of implementation styles with their unique barriers and supporting factors across different parts of Europe (5). Kazmierczak and Carter (2010) also identify driving factors for the successful implementation of GI projects (23), i.e.: Regulations and policy at the local level, Access to and quality of data and information, Cross-departmental collaboration, Public engagement, Policy framework at higher levels (national and regional), Collaboration with external stakeholders, Access to funding, Learning from others (networking, research projects), Need for urban development or regeneration, Existence of a strong sustainability movement, Public awareness and Current green space resources.

Some resources also look at the drivers for specific stakeholder groups for creating, maintaining, or restoring GI. Two explore drivers for business and private investors (3, 35), and four look at drivers

relevant to policymakers (3, 30, 38, 40). Resources that look at drivers for policymakers also elaborate the drivers for the creation of GI policy.

Example(s):

Box 2.8 Design, implementation and cost elements of Green Infrastructure projects

A thorough overview is provided of drivers for the implementation of GI. The report presents policies at the EU level that influence and support GI, giving an overview of objectives, implementation examples, and related EU policies. It also explains the role of spatial planning at regional and local level and action plans and strategies at national level. Beyond policy drivers, the publication also delves into the role of regional and local needs in driving GI, and investigates how private and social interests drive and influence GI implementation. The report finally presents experience from practice from six case studies in Estonia, the Netherlands, Spain, France, Austria and Slovakia, and the UK. The study also looks at general barriers and enabling factors that support or hinder GI implementation.

Source: 30

Scale and geographical coverage of information:

The sources cover all levels, including local/regional, national, and EU. The geographic coverage is also broad, spanning across the EU. Transboundary areas and non-EU states are also covered (e.g. Russia, Switzerland) (45). Regarding policy, one source (38) looks specifically at policy drivers on a national level, while two others (3, 30) cover a range of levels, spanning from EU to local.

Gaps:

Overviews of what drivers exist for the creation, maintenance, and restoration of GI is well covered in the literature. Gaps exist in the understanding of options and opportunities to improve the framework conditions that enable or hinder GI and NBI implementation. As pointed out in one source (30), the interaction of (policy) drivers between levels is important in determining contextual drivers, barriers, and enabling factors for GI and NBI creation. More research is needed to better understand these interactions, and to investigate options for improving policy coherence at various levels, to create a more enabling policy environment.

Sources: 3, 5, 6, 8, 10, 18, 22, 23, 30, 31, 35, 38, 40, 45

2.7 Sector specific information on GI/NBI

Type of information:

12 of 49 sources have a sector-specific focus regarding GI, NBI or related concepts. While two sources conduct a review of what types of GI interventions (30) or ecosystem-based approaches (40) are being implemented across sectors, the remaining sources all focus on one or more specific sectors or ecosystems and relevant considerations for GI or nature-based solutions. Water is most commonly addressed (3, 7, 10, 14, 18, 35, 48), followed by coastal/marine information (14, 16, 18). Other sector-specific considerations were identified for construction (3, 7, 35), agriculture (3, 18), urban and spatial planning (3, 7, 18, 48), health (3, 35), forests (10, 14), business / industry (3, 35), climate (3, 35), energy (35), finance (35), transport (35), and mountains (14). Thematic factsheets have also been created, focusing on GI in relation to the abandonment of rural areas and job creation (35).

Often, several sectors or ecosystems are included within a single source, within a given thematic. Forests, mountains, water/rural areas and coasts are, for example, explored within the context of mitigating the impacts of weather and climate change-related natural hazards (i.e. carbon sequestration, landslides, and floods) (14). Here, information is included on the hazard potential across Europe, the (ecosystem capacity) potential for a GI network to mitigate exposure. Similarly, the 2016 report *Supporting the Implementation of Green Infrastructure* (35) also presents an overview of standards for green infrastructure for different sectors. For each sector, information is provided on:

- Major findings/conclusions on the extent GI is included today and the possible steps forward
- Representative examples of standards on performance, procedure and methodology
- The extent GI is integrated in standards and the potential, with a focus on the potential
- Recommendations on the way forward for the sector

In the final section, major cross-sector recommendations are also outlined, which are considered as more general and not specific to a single sector. Finally, the *BISE website* also includes sector-specific considerations within its country pages on 'GI-related developments in the European Union' (9). While not all MS have fully completed pages, the structure accommodates information on 'mainstreaming green infrastructure' in the areas of agriculture, urban policy, spatial planning, flood protection / disaster risk reduction, and transport / energy infrastructure, as well as on finance considerations.

While the above sources provide quite detailed theme-specific information, the remaining sources largely only include a general introduction on the potential benefits and relevance of GI to the respective sector, which is sometimes expressed in terms of costs and benefits (e.g. 7, 35). The *CEEweb platform* (3) additionally includes informational videos and illustrative case studies from across Europe, as well as a list of further resources that may be consulted to obtain more information.

Additionally, an array of relevant sources, documents and data on various sectors and aspects can be found on the BISE website (39) within the GI library.

Example(s):

Box 2.9 Supporting the Implementation of Green Infrastructure

Six sector factsheets and four topic factsheets were produced to provide GI-relevant information in the areas of finance, industry, transport, energy, public health, water as on the relation of GI to the construction of buildings, abandonment of rural areas, job creation, and climate adaptation. The factsheets are aimed to serve sector actors as well as policy-makers and contain information about the aims of the EC GI Strategy and actions as well as indications on costs and benefits of investing in GI for the specific sector/topic and good practice examples.

Source: 35

Scale and geographical coverage of information:

All of the sources have an EU-wide focus, with one (16) extending to include a case study on fisheries in transboundary protected area in Finland/Russia. While some present evidence at a European scale (e.g. 14), the majority of the information presented stems from or is restricted to local case studies across MS.

Gaps:

Although aspects such as costs and benefits of GI/NBI-related interventions are largely context specific, it would nevertheless be of value to increase the evidence base in this regard across sectors. Furthermore, there was no information identified regarding potential future markets and therewith the delivery of benefits per sector. Increasing this evidence base could support increased buy-in amongst these sectors, and a shift to decision-making processes and investments having a longer-term orientation. Specific recommendations to strengthen existing sectoral mechanisms towards the implementation and support for NBI/GI are also lacking.

Sources: 3, 7, 9, 10, 14, 16, 18, 30, 35, 39, 40, 48

2.8 Spatial information/data

Type of information:

12 of 49 examined sources include 'spatial information or data' on GI. The type of spatial information available in the reviewed sources covers a broad range of scales. Maps cover both current and potential GI. Some specifically cover GI, and others cover elements that belong to GI, such as High Nature Value (HNV) Farmland. At the EU level, spatial data is available on:

- GI networks, projects and components
- Ecosystem services
- Functional linkages between urban green space and climate change mitigation and adaptation
- Potential GI networks based on ecosystem capacity to mitigate various climate change related risks
- Distribution of High Nature Value (HNV) farmland

Resources also cover a number of tools for policymakers and planners, with three introducing tools for planning and mapping GI/NBI (10, 12, 13). The purpose of these are to e.g. identify high-impact areas for habitat reconnection or map GI networks or ecosystem services. Five resources contain tools and information for performing spatial monitoring and assessment of GI and NBI (8, 10, 12, 24, 31, 46). For example, the 5th MAES report (currently in draft phase) presents an overview of available datasets, methods, and tools for assessing and monitoring GI, and evaluates which would be useful in certain planning situations (10). The Multiple Benefits Toolbox, another example, delivers a tool for planners to perform spatial identifications where benefits of GI elements accrue (47).

Specific resources exist on spatial information and tools for GI/NBI in urban areas (8, 24), as well as with a focus on climate mitigation and adaptation (14, 23, 24).

The table below details the types of information and tools available in the sources.

Table 2.1 Number of sources per topic related to spatial information

Topic addressed	Sources
Maps of (potential) GI	3, 13, 14, 28
Maps of ecosystem services	3, 10
Planning and mapping tools for planners and policymakers	10, 12, 13

Spatial monitoring and assessment tools and information	8, 10, 12, 24, 31, 47
Spatial tools focusing on GI/NBI for climate mitigation and adaptation	14, 23, 24
Spatial information/tools on urban GI/NBI	8, 24, 47
Information on national and local action, projects, resources on GI/NBI in spatial planning	32, 39

Scale and geographic coverage of information:

Tools exist for the EU, national, regional, urban, and combined levels.

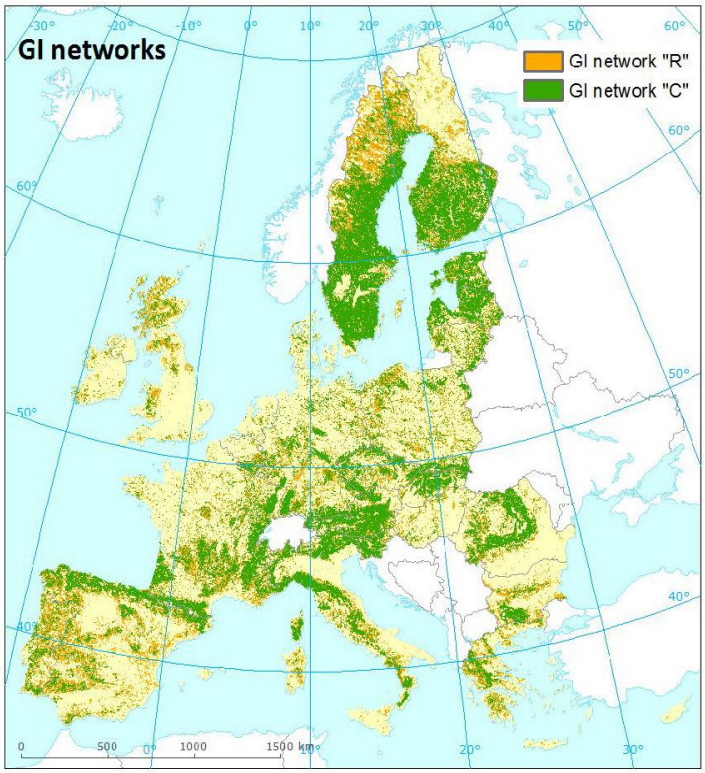
Spatial data at the national, regional, city, or site level are available within case studies, focusing on specific areas. Several case studies in the literature include spatial information and maps. EU cities, regions, and countries covered in the literature include Warsaw (PL); Hradec Kralove (CZ); Gaziantep, Turkey; Sheffield (UK); NL; Stuttgart (DE); Slovakia; Faenza (IT); Dorset (UK); Berlin (DE); Augustenborg in Malmö (SE); North West England (UK); and the London Borough of Sutton (UK). The scale of the spatial information depends on the scale of the case study – some are at regional level, some are at city level, and some are at site level. In the resources covered, there is no clear bias towards a specific geographic level; all levels are covered in the sources.

Example(s):

Box 2.10 Spatial analysis of green infrastructure in Europe

This EEA technical report (2014) presents a methodology for identifying priority areas for GI conservation and restoration. The method is intended for use by policymakers and planners at MS and local levels. The methodology consists of two components: an assessment and mapping of 8 key ecosystem services (filtration of air pollutants by vegetation, erosion protection, water flow regulation, coastal protection, pollination, maintenance of soil structure and quality, water purification, carbon storage and sequestration), and an identification of key habitats for biota (large forest-bound animals in this case) and analysis of their connectivity. The methodology was tested using the EU as a case study. The result is a map of potential GI areas in the EU, showing priority areas both for conservation and for restoration (see map below). According to the spatial model, areas in the conservation network ("C") should be given priority, as they are key for ensuring ecological connectivity and intact ecosystem functions. Restoration areas ("R") can provide additional ecosystem services with additional protection or restoration. Both the map in itself as well as the methodology can be useful tools to help decision makers identify areas to target for inclusion in GI networks.

Map of GI conservation network ("C") and restoration network ("R")



Source: no. 13, p. 12

Since key habitats are defined based on large forest-bound animals, the analysis may be skewed towards these species and neglect areas that are more important for other types of species, such as birds dependent on agricultural habitats. Application of the model using different categories of species is an area for further research. The authors also note that "priority" areas were defined as those that deliver multiple ecosystem services and habitat connectivity; further research could test different or more refined parameters to determine whether the priorities chosen in the study are adequate for identifying potential GI areas. (Source: 13)

Gaps:

The available spatial information on GI has a geographic coverage that spans the entire EU. Tools are available that cover landscape, regional, city, and site levels. Areas for further research would be spatial information that more completely covers transboundary areas and GI on the outer borders of the EU.

Another gap is in the translation of existing spatial information into formats and media used by planners, policymakers, and other target groups. The resources covered both spatial data (e.g. maps) as well as tools which stakeholders can apply to generate spatial data for new cases. More research could be invested into the needs of stakeholders and the most appropriate media to use to deliver existing information to them effectively.

Sources: 3, 8, 10, 12, 13, 14, 23, 24, 28, 31, 39, 47

2.9 Use of ecosystem services in existing assessment concepts

Type of information:

8 of 49 sources include information on the 'use of ES in existing assessment concepts', each with a different focus. Several studies take account of ES in assessing the impact of GI/NBI, focusing on the

supply side of delivery and including different types of services (10, 14, 31, 33, 43). One study (14) only explores only the ES relating to disaster risk reduction that are provided by GI, while a second publication (31) includes this aspect, but also adopts a wider perspective and encourages a shift from the assessment and valuation of ES to a wider assessment of the "co-benefits (and costs) of NBS through the lends of co-production of ES" (p. 2). The resultant *EKLIPSE 'NBS Impact Assessment Framework'* outlines 10 societal challenges[31] and, for each, outlines a description of the challenge, a list of potential NBS actions and their respective impacts, examples of indicators to measure impacts and methods to assess the indicators, as well as potential success and limiting factors and a small case study example. "Challenge 4: Green space management", for example, includes the potential actions and impacts outlined in Table 2.2 and presents the potential indicators outlined in Table 2.3Table 2.3 to measure these. This publication additionally includes one chapter entitled: 'Application Guide for the Assessment of the Effectiveness of NBS Projects'.

Table 2.2 Potential green space management actions and expected impacts

Potential actions	Expected Impacts
• Inventories, hierarchizing and representation of green and blue spaces (e.g. Mapping and Spatial Planning) (Buijs et al., 2016; Davies et al., 2015; Hansen et al., 2015; Martos et al., 2016).	• Clear accounts of existing, restored, modified and new NBS (Buijs et al., 2016; Buizer et al., 2015; Elands et al., 2015).
• Set clear and measurable quality and quantity requirements for existing and new NBS (Mazza et al., 2011; Pinho et al., 2016).	• Increase of quality and quantity of green and blue existing, restored and new NBS (Gómez-Baggethun and Barton, 2013).
• Make use of innovative, interdisciplinary planning methods for green space co-design and co-implementation, including development of innovative social models for long-term positive management (e.g. Citizen Engagement for Health) (Derkzen et al., 2015; Fernandez et al., 2015).	• Increased stakeholder awareness and knowledge about NBS and ecosystem services, as well as citizen participation in the management of NBS (Filibeck et al., 2016; Hansen et al., 2015; Mell et al., 2013).
• Create, enlarge, fit out, connect and improve green and blue infrastructure by implementing NBS projects (Kazmierczak and Carter, 2014; Landscape Institute, 2009; Madureira et al., 2011).	• Improve the connectivity and functionality of green and blue infrastructures (Brown et al., 2015; Niemelä, 2014).
• Conserve, improve and maintain existing NBS areas in respect to biodiversity (Elands et al., 2015; Elmqvist et al., 2015).	• Increase achievement of biodiversity targets (Elands et al., 2015; Elmqvist et al., 2015).

Table 2.3 Examples of green space indicators and their applicability at different scales

Indicators	Measurement scale				
	mesoscale			microscale	
	Region	Metropolitan	Urban	Street	Building
• Distribution of public green space – total surface or per capita (Badiu et al., 2016; Gómez-Baggethun and Barton, 2013; La Rosa et al., 2016).	•	•	•		
• Recreational (number of visitors, number of recreational activities) or cultural (number of cultural events, people involved, children in educational activities) value (Kabisch and Haase, 2014).	•	•	•	•	
• Accessibility (measured as distance or time) of urban green spaces for population (Tamosiunas et al., 2014).	•	•	•	•	
• Changes in the pattern of structural and functional connectivity (Iojă et al., 2014).	•	•	•		
• Species richness and composition in respect to indigenous vegetation and local/national biodiversity targets (Cohen et al., 2012; Krasny et al., 2013).	•	•	•	•	•

[31] i.e. (1) Contribution to climate resilience; (2) Water management; (3) Coastal resilience; (4) Green space management; (5) Air quality; (6) Urban regeneration; (7) Participatory planning and governance; (8) Social justice and cohesion; (9) Public health and well-being; (10) Potential for economic opportunities and green jobs Pollination and biological control were not included as they are usually provided by organisms an

A third study (33) outlines the functional links between specific urban GI elements and ecosystem services. Included in the assessment are: provisioning services (food, raw material, fresh water), regulating services[32] (local climate and air quality regulation, carbon sequestration and storage, moderation of extreme events, waste-water treatment), habitat/supporting services (habitats for species), and cultural services (recreation and mental/physical health; tourism; aesthetic appreciation and inspiration for culture, art, and design; spiritual experience and sense of place). Regarding data availability, the study highlights that:

> "…not all ESS are equally well represented in terms of empirical or model-based knowledge about their performance. The performance of the … elements very much depends on the specific configuration and the spatial context … Nevertheless, the knowledge about the effects of some … elements is considerable, for example for green roofs and green walls and of more classical elements … like forests and parks. Particularly green roofs provide a number of ESS, ranging from air temperature regulation and respective cost savings for heating and cooling up to rainwater infiltration and habitat provision" (p. 57).

Finally, the *GIFT-T! toolbox* (43) cites the Millennium Ecosystem Assessment categories from 2005, namely provisioning, regulating and cultural ES, and provides information on several related tools. The 'Ecosystem Services Performance Mapping'[33] tool is outlined as an approach to use in planning processes to come to a shared vision, as well as a GIS method[34] for mapping the types of GI in a study area, the ES that they perform, and the need for services.

In addition to focusing on the supply side of ES, two of the aforementioned studies also look at the demand side of ES in relation to GI/NBI (14, 43). Specifically, the first report (14) considers the demands of population and infrastructure for protection by GI, and produced an additional series of maps for that purpose at the NUTS 2 level. By coupling ES with their demand side, the study is able to identify areas where these services (and thus the GI to provide them) are needed most. The second source (43) does not provide data on ES demand, but rather provides a vague description of the variance in needs and preferences by stakeholders depending on their interest and values.

Information regarding the inclusion of ES in policies and related national processes is outlined in two sources. One identifies the MAES-related developments across the MS (9), while the other examines ecosystem-based management in national strategies (sectoral, general environmental, specific ecosystems) (38).

Example:

Box 2.11 A typology of urban green spaces, eco-system provisioning services and demands

As a product of the GreenSurge project, this report introduces the methodological approach to conducting an 'urban green space elements inventory' and applies this on the European and Urban Learning Lab scales. In total, 44 elements are identified and grouped into eight broad categories. The results include empirical evidence for the (1) inventory of green space elements (including information on the functional links between urban green space elements and ecosystem services, and assessments of selected urban green space elements for European and Urban Learning Lab cities), as well as (2) assessment of urban green space demand for the two scale levels. To conclude, the report highlights the key findings and data gaps/limitations about ecosystem provisioning by urban green space.

Source: 33

[32] Pollination and biological control were not included as they are usually provided by organisms and not particular GI elements, and erosion prevention and maintenance of soil fertility were excluded as no link was found.

[33] http://www.gift-t.eu/manual/mapping-tools/es-performance-mapping

[34] http://www.gift-t.eu/manual/mapping-tools/gi-mapping

Scale and geographic coverage of information:

The identified sources either focus on MS-level processes of assessing ES (MAES process), or present methodological assessment frameworks and approaches which can be applied across the EU (down to the 'GI element' scale). While the methods are applicable in a variety of contexts, however, it should be noted that limitations are outlined in some of the studies regarding the availability of data and thus the ability to link certain GI elements to their provisioning of ES, as well as to identify 'demands' in some areas on local scales.

Gaps:

Although considerable attention has been directed towards assessing the environmental impacts of GI and NBI (in particular NBS), greater attention needs to be paid to both exploring and explaining the interlinkages between environmental, economic and social impacts within and across current societal challenges. This requires not only employing an interdisciplinary and transdisciplinary approach and using a range of indicators and qualitative, quantitative and mixed-methods, but also a shift from a purely environmental focus towards a better consideration of all socio-cultural ES as well as biodiversity, which goes partly beyond the classical ecosystem service concept. Another dimension comes with dependence of ES delivery (by GI and NBI) on the local context, which still presents a major challenge in current assessment and the transfer of assessment results/values across case studies ecosystems and countries.

Sources: 9, 10, 14, 31, 33, 38, 39, 43

2.10 Relevant platforms and networks in place

Type of information:

Only 4 of 49 sources provide information on 'relevant platforms and networks in place', whereas an additional 5 sources are relevant platforms themselves. The information providers include the *CEEweb website* (3), which is also a platform itself, and the *Green Infrastructure: Training manual for trainers* (4), a report on *Supporting the Implementation of Green Infrastructure* (35), and *Taking stock on ecosystem-based initiatives in the European Commission* (49). The first source provides information and links to the LinkedIn community entitled 'European Green Infrastructure Practitioners' Network and Learning Alliance (3), while the second provides links to relevant platforms (e.g. CEEweb) and sources of further information (4). The third source dedicates a chapter to 'increasing GI visibility for selected platforms' (35), which analyses the effectiveness of several platforms (see example below for full list) regarding their current approach and future potential for increasing GI visibility and provides recommendations for each of these platforms regarding the visibility and consideration of GI. Finally, the EC stocktaking document (49) introduces existing relevant platforms (NWRM, Climate-ADAPT and BISE) and outlines ambitions for what was then a new knowledge platform on NBS, i.e. *Oppla*.

Additional platforms which are of themselves of relevance and which were covered in the review include *CEEweb* (3), *Oppla* (41), *BISE* (39), *ThinkNature* (32), and the *Panorama Platform* for ecosystem-based initiatives (42).

Example(s):

Box 2.12 Supporting the Implementation of Green Infrastructure (35)

This DG Environment-funded report highlights approaches for increasing GI visibility for selected platforms, i.e. BISE, NWRM/WISE, Climate-ADAPT, Sustainable Cities Platform, International Council of Landscape Architecture Schools, World Green Building Council, Green Roof Association, and the European Council of Spatial Planners. It also includes a series of recommendations to support BISE in becoming a GI information hub, GI becoming common vocabulary across platforms, GI relevant information being available to the end-users of the various platforms, strong connections across platforms, and finally to support machine-to-machine communication in the longer-term.

Source: 35

Scale and geographic coverage of information:

While three of the identified platforms are predominantly European in coverage (3, 32, 39), the remaining two include examples and case studies from all over the world that have applied an ecosystem-based approach (42) or NBS (41).

Gaps:

Very limited information is provided overall in the reviewed sources regarding relevant platforms, and particularly relevant networks. One main gap identified is the lack of visibility of GI and NBI-related topics on existing platforms, as well as a lack of coordination between one another. Topics requiring more research would include e.g. a comparative analysis looking at the types of end-users of the respective platforms and the information sought, as compares to that which is currently provided. Potential for integration between the main European thematic platforms, including clarification of terms and interlinkages would be a further area for work; ideas for approaches in this regard can be found in *Supporting the Implementation of Green Infrastructure* (35).

Almost no information was identified on relevant networks. This could be due to the often country or local/regional-focus of relevant networks, but further investigation could be done here as to existing networks, potential linkages and synergies which could be drawn between them, and potential for EU-wide networks supporting such aspects as exchange and support regarding capacity and skills building, dissemination of available knowledge, etc.

Sources: 3, 4, 32, 35, 39, 41, 42, 49

2.11 Wider dissemination and public awareness material

Type of information:

Only 4 of 49 sources include 'wider dissemination and public awareness material'.

The *CEEweb Green Infrastructure Knowledge Hub* (3) is a platform that includes a variety of resources targeting a wide swath of stakeholders. These resources include public awareness material in forms such as online videos, a Pinterest board with infographics and explanatory images, brochures, and online courses. The resources explain what GI is, what functions it can fulfill, and what benefits it bring, and also introduce case studies of GI. The platform also includes resources for community engagement, such as case studies for inspiration and reports targeted at local actors involved in GI projects, i.a. businesses and universities.

The brochure *Building a Green Infrastructure for Europe* (18) was created by the European Commission to raise awareness about GI, its benefits, and the political framework for GI among the general public. It also contains a number of case studies to illustrate examples of GI from across Europe, and explains the link between GI and Natura 2000.

The *GIFT-T project toolbox* (43) contains material for 'informing and inspiring' stakeholders and the public about GI. It provides an example from Antwerp: an image with a vision of a landscape with multiple GI elements is presented, and processes are detailed in which the image has been used to support GI planning and stakeholder engagement. The toolbox also includes a video of a case study on the business benefits of biodiversity, as well as a series of icon-images for ecosystem services provided by GI.

Figure 2.3 Examples of ES icon-images from GIFT-T toolbox

The *GreenKeys toolbox* (44) features an e-learning module to raise awareness about the value of green spaces and the benefits of good urban green space management. The Module is primarily targeted at professional, urban based, planners who are seeking further information on the added value and benefits that urban green spaces can bring to the development of the urban environment. As such, it does not target the general public, but is still aimed at dissemination and awareness-raising among planners as key stakeholders.

Scale and geographic coverage of information:

The resources provide information on the local and landscape level all the way up to the European level. However, due to the relatively small number of resources, the local and landscape level examples are limited to specific case studies. Case studies profiled in the resources include Pumlumon catchment area and Glasgow (UK); Gran Canaria seagrass meadows (ES); Antwerp, Schelde basin, and Hoge Kempen national park (BE); Ekostaden Augustenborg (SE) Vosges Mountains (FR); Amsterdam (NL); Nicosia (CY); Harku (EE); Lodz and Warsaw (PL); as well as the transboundary projects European Green Belt, Alpine-Carpathian Corridor, and a Greek-Bulgarian wildlife corridor for bears. Slovakia is covered with a national level case study (3).

Gaps:

Public awareness-raising material currently covers the EU scale, but awareness-raising material for the local and landscape levels is patchy and only available for a handful of specific case studies. More awareness raising material could be developed to cover different ecosystem types, GI, features, and specific sites.

More resources could also be developed translating the benefits of GI for key stakeholder groups. The currently available resources are useful for informing and working with the general public, policymakers, and planners. Additional material could specifically target other stakeholder groups

who could help support GI implementation and acceptance, such as (environmental) engineers, educators and schools, civil society and environmental organisations, etc.

Sources: 3, 18, 43, 44

2.12 Ongoing and upcoming research activities

A number of recently started and planned projects and initiatives are foreseen to provide further information on the areas addressed throughout this chapter, and contribute to closing the outlined gaps. While the exact outputs can of course not yet be determined, available descriptions of the projects and websites have been consulted to provide a first indication of potentially relevant products.

The large majority of identified projects in this category are funded through either the Horizon 2020 (H2020) programme of DG REGIO or BiodivERsA. Specifically, seven H2020 calls for tender were funded in the 2015-2017 period focusing on NBS and related concepts: *demonstrating innovative nature-based solutions in cities* (URBAN GreenUp, GrowGreen, UNALAB, ConnectingNature), *new governance, business, financing models and economic impact assessment tools for sustainable cities with nature-based solutions* (urban re-naturing) (Naturvation, Nature4Cities), and *operationalising the insurance value of ecosystems* (NAIAD) (see Table 2.4 for details). Further relevant calls are expected to be published in 2018/2019.

Table 2.4 Recently started H2020 GI/NBI-related projects

Project/ Initiative	Duration	Aims and potential outputs to advance the GI/NBI knowledge base
Naturvation	2016-2020	Naturvation[35] ('NATURe-based urban innoVATION') assesses what NBS can achieve in cities, examine how innovation is taking place, and work with communities and stakeholders to develop the knowledge and tools required to realise the potential of nature-based solutions for meeting urban sustainability goals. A special focus is on the assessment and development of innovative financing and governance mechanisms.
GrowGreen	2017-2022	GrowGreen[36] ('Green Cities for Climate and Water Resilience, Sustainable Economic Growth, Healthy Citizens and Environments') aims to help cities create high-quality green spaces at the heart of local communities. It will demonstrate how 'greening' can help manage the risks of climate change, improve health outcomes and ensure protection and improvement for the natural environment, while they continue to develop and grow. Residents in different cities will be supported to transform their area into an exemplar green neighbourhood to support local wildlife, reduce flood risk and achieve the wide range of leisure and health benefits that green spaces provide.
UNaLab	2017-2022	UNaLab[37] ('Urban Nature Labs') will develop, via co-creation with stakeholders and implementation of 'living lab' demonstration areas, a robust evidence base and European framework of innovative, replicable, and locally-attuned NBS to enhance the climate and water resilience of cities.
URBAN GreenUP	2017-2022	Urban GreenUP[38] ('New Strategy for Re-naturing Cities through Nature-Based Solutions') aims at obtaining a tailored methodology to support the co-

[35] http://naturvation.eu/
[36] http://cordis.europa.eu/project/rcn/210514_en.html
[37] http://cordis.europa.eu/project/rcn/210510_en.html
[38] https://www.urbangreenup.eu/

		development of Renaturing Urban and to assist in the implementation of NBS in an effective way. A large scale and fully replicable demonstration action of NBS accompanied by innovative business models will provide evidences about the benefits of NBS contributing to the creation of new market opportunities for European companies.
Nature4Cities	2016-2020	Nature4Cities[39] aims at developing complementary and interactive modules to engage urban stakeholders in a collective-learning process about re-naturing cities, develop and circulate new business, financial and governance models for NBS projects, as well as provide tools for the impact assessment, valorisation and follow-up of NBS projects. Results can feed into this framework contract particularly with regards to: integrated analytical frameworks which integrate decision making processes and implementation models particularly GI in urban contexts, based on urban metabolism, ES and life cycle assessment; NBS performance and environmental impact assessments and socio-economic assessments of NBS projects. Operational demonstration in cities will also provide valuable information on both existing NBSs deployments and scenario master plans for NBS implementation.
Connecting Nature	2017-2022	ConnectingNature[40] ('COproductioN with NaturE for City Transitioning, INnovation and Governance') will co-develop the policy and practices necessary to scale up urban resilience, innovation and governance via NBS. It will provide the reference framework for a new generation of urban NBS processes and empower transitioning ambassadors who will globalise this approach through a strategy targeting multiplier cities.
NAIAD	2016-2019	NAIAD ('Nature Insurance value: Assessment and Demonstration') aims to operationalise the insurance value of ecosystems to reduce the human and economic cost of risks associated with water (floods and drought) by developing and testing - with key insurers and municipalities - the concepts, tools, applications and instruments (business models) necessary for its mainstreaming. We will do this in detail for 8 demonstration sites throughout Europe and develop tools and methods applicable and transferable across all of Europe.

Under the 2015-2016 BiodivERsA Theme 2 call on "*Understanding and managing biodiversity dynamics in land-, river- and seascapes (habitat connectivity, green and blue infrastructures, and naturing cities) to improve ecosystem functioning and delivery of ecosystem services*"[41], 26 projects were funded, of which the following are estimated to be of particular importance to the areas covered in this review[42]:

- **BIOVEINS** - Connectivity of green and blue infrastructures: living veins for biodiverse and healthy cities
- **CROSSLINK** - Understanding cross-habitat linkages between blue and green infrastructure to optimize management of biodiversity, ecosystem services and multiple human uses.
- **ENABLE** - Enabling green-blue infrastructure in complex social-ecological regions - system solutions to wicked problems.
- **FUNGREEN**- Functional connectivity and green infrastructure.
- **GREENFUTUREFOREST** - Scenarios for a sustainable future forest green infrastructure.

[39] https://www.nature4cities.eu/
[40] http://www.connectingnature.eu/
[41] http://www.biodiversa.org/922
[42] Full descriptions of all projects are available at https://www.era-learn.eu/network-information/networks/biodiversa3/biodiversa3-joint-call-2015.

- **IMAGINE** - Integrative Management of Green Infrastructures Multifunctionality, Ecosystem integrity and Ecosystem Services: From assessment to regulation in socio-ecological systems.
- **OSCAR** - Optimising the configuration of woody riparian buffer strips along rivers to enhance biodiversity and ecosystem services.
- **URBANGAÏA** - Managing urban Biodiversity and Green Infrastructure to increase city resilience.

INTERREG has also recently launched several projects of relevance, including:

- **PERFECT**[43] - Planning for Environment and Resource efficiency in European Cities and Towns: aims to identify and analyse good practice in the use of GI to deliver a number of benefits, influence and improve the way that new projects and policies are developed and used by fully engaging people who make decisions on them on the socio-economic benefits of GI; and increase the professional capacity of key people in the public and private sectors in delivering new projects.
- **Green&Blue Futures**[44]: aims to develop a strategic framework for managing Europe's nature sites, parks, open space, woodlands and waterways in a more cost-effective way that can be promoted throughout Northwest Europe. These assets are often managed by local authorities or other public agencies, and there is increasing pressure on public sector funds so involvement of the social economy in resource management by not-for-profit organisations can only help. Such an approach involves local stakeholders as well as delivering social outcomes like employment for disadvantaged groups.
- **BEGIN**[45] - Blue Green Infrastructures through Social Innovation: aims to demonstrate at target sites how cities can improve climate resilience with Blue Green Infrastructure involving stakeholders in a value-based decision- making process to overcome its current implementation barriers.
- **TRANSGREEN**[46] - Integrated transport and GI planning in the Danube-Carpathian region for the benefit of people and nature: aims to contribute to safer and environmentally-friendly road and rail networks in mountainous regions of the Danube Basin with a special focus on the Carpathian Mountains by improving planning frameworks and developing concrete environmentally-friendly and safe road and rail transport solutions taking into account elements of GI, in particular ecological corridors.

Finally, the ESPON-funded **GRETA project** on "Green Infrastructure: Enhancing biodiversity and ecosystem services for territorial development" is expected to deliver relevant data and information. The project began in August 2017 and considers the role of scale, connectivity, accessibility, multifunctionality and complexity of GI as a mechanism for enhancing ES provision for territorial development. The project proposes a novel approach to analyse the geographical distribution patterns of GI and ES at regional and local level: the combination of a top-down approach (using N2000 areas as backbone for GI) and completing the GI network with a bottom-up approach based on good ES service supply and condition. The spatial assessment of GI is completed by a series of case studies exemplifying different territorial, governmental and planning situations and challenges.

[43] https://www.interregeurope.eu/perfect/
[44] http://greenandbluefutures.eu/
[45] http://northsearegion.eu/begin/
[46] http://www.interreg-danube.eu/approved-projects/transgreen

3 Conclusions and future actions

3.1 Overall data availability and gaps on GI, NBI and related concepts

The most comprehensively covered topics are case studies/good practices, relevant planning, assessment and monitoring tools and guidelines, policy and governance mechanisms of GI/NBI and cost and benefits, while only limited information and evidence is available within the 49 sources on sector-specific, spatial data, use of ES in assessments and wider dissemination material. A short summary of the main gaps for each of the topics and how these topics/activities are linked to the EU Biodiversity Strategy and its targets[47] is presented in Table 3.1 below. The strongest linkages exist with Target 2, i.e. "By 2020, ecosystems and their services are maintained and enhanced by establishing green infrastructure and restoring at least 15 % of degraded ecosystems." In particular, linkages are evident with the following specific actions:

- Action 5: "Member States, with the assistance of the Commission, will map and assess the state of ecosystems and their services in their national territory by 2014, assess the economic value of such services, and promote the integration of these values into accounting and reporting systems at EU and national level by 2020."
- Action 6a: "By 2014, MS, with the assistance of the Commission, will develop a strategic framework to set priorities for ecosystem restoration at sub-national, national and EU level."
- Action 6b: "The Commission will develop a GI Strategy by 2012 to promote the deployment of green infrastructure in the EU in urban and rural areas, including through incentives to encourage up-front investments in GI projects and maintenance of ecosystem services, for examples through better targeted use of EU funding streams and Public Private Partnerships."

[47] http://biodiversity.europa.eu/mtr/biodiversity-strategy-plan; http://ec.europa.eu/environment/nature/biodiversity/strategy/target1/index_en.htm

Table 3.1 Summary of gaps identified per topic

Topic addressed	Gaps and required activities	Link to EU Biodiversity Strategy
Costs and benefits	One major gap concerns the availability of complete costs and benefits assessments. A more frequent use of assessment tools in planning and monitoring in urban and wider GI/NBI planning would be required. Moreover, cost-benefit assessment at a larger scale (i.e. landscape or even national) could be of interest to guide decision-making processes and attract investments. The MAES-process at the Member State level could be one source to feed into such a process.	Direct Link to Target 2 (Action 6b) through improved information on costs and (in particular) benefits on GI and related delivery of ecosystem services feeding into project and policy development. Indirect link to Target 2 (Action 5) through the assessment of benefits (incl. ES) delivered by GI/NBI.
Financing mechanisms and investments	Most of the resources do not provide much detail about the funding opportunities available, or provide guidelines on applying for funding, how to design projects so they qualify for funding, etc. There is only little information on relevant funding streams that are not currently utilised to their full potential for GI or NBI-related interventions or which are which will become more important in the near future (such as e.g. private financing). Information on investments is presented only in relation to specific case study examples, rather than providing a more overarching review of e.g. investment models or types of investment which could be relevant for fostering an increased uptake of GI and NBI-related interventions. In addition, challenges and barriers related to GI financing were not covered in depth in the literature, with the exception of barriers for municipalities, and could be investigated more in the future.	Direct Link to Target 2 (Action 6b) by providing evidence on current EU budget spending for GI and better access to knowledge about potential sources for MS. Indirect link to Target 3 (Action 8a): "The Commission will propose that CAP direct payments will reward the delivery of environmental public goods that go beyond cross-compliance" and (Action 9a): "The Commission and MS will integrate quantified biodiversity targets into Rural Development strategies and programmes, tailoring action to regional and local needs." and Target 1 (Action 2): "Make sure Natura 2000 sites get sufficient funding" through available evidence on current EU budget spending for GI/NBI (incl. also nature protection areas/Natura 2000).
Policy and governance mechanisms of GI/NBI	Gaps are less related to data and evidence, but rather linked to the development and use of effective decision-making tools and monitoring systems in GI planning. More far-reaching gaps and challenges for advanced and efficient green space planning include the provisioning of legal support through clear mandates and binding instruments, challenges and opportunities of inter- and transdisciplinary urban GI planning, improvement of social inclusion and citizens involvement and appropriate resources for better urban GI planning.	Direct link to Target 2 (Action 6a and 6b) by informing Member States about policy instruments and decision-making tools to foster the planning and deployment of GI/NBI and related concepts.
Relevant planning, assessment and monitoring tools and guidelines	To support overarching planning and measures progress and achievements, appropriate planning and monitoring tools at local as well as national level need to be implemented. In addition, impact assessments of existing tools could be carried out to determine if they are presented in a format that is useful to stakeholders, and develop recommendations for any	Direct link to Target 2 (Action 5, 6a and 6b) through improved knowledge and availability of methods and tools to asses and monitor the a) delivery of benefits and ES; and b) the impact of GI/NBI on environmental social

	necessary further steps to translate existing information into formats and media that is easily usable by target stakeholders.	and economic objectives and c) to support current planning processes.
Drivers for creating, maintaining or restoring GI and implementing NBI	An overview of what drivers exist for the creation, maintenance, and restoration of GI is well covered in the literature. Gaps exist in the understanding of options and opportunities to improve the framework conditions that enable or hinder GI and NBI implementation. More research is needed to better understand the interactions of drivers between different levels, and to investigate options for improving policy coherence at various levels, to create a more enabling policy environment.	Direct link to Target 2 (Action 6a and 6b) through improved knowledge and evidence and driving forces and suggestions for an optimal framework for the deployment of GI/NBI and related concepts.
Case studies/Good practices at regional and national level	No real gaps can be identified given the large variety and amount of case studies at different scales and which address several relevant issues. The lack of a platform/mechanism that presents this variety of case studies in a logical way hampers the accessibility and use of this information and data towards a wider groups of relevant users. Moreover, more research could be conducted on transboundary cases, which are hardly documented to date.	Direct link to Target 2 (Action 6b) through improved knowledge and evidence on the variety of GI/NBI and related projects that can be implemented at the local/regional/national levels across Europe.
Sector specific information on GI/NBI	More details on the costs and benefits of GI/NBI-related interventions for each sector would be of value to increase the evidence base. No information identified regarding potential future markets and the potential delivery of benefits per sector. Increasing this evidence base could support increased buy-in amongst these sectors, and a shift to decision-making processes and investments having a longer-term orientation. Specific recommendations to strengthen existing sectoral mechanisms towards the implementation and support for NBI/GI are also lacking.	Direct link to Target 2 (Action 6b) by providing evidence on the linkages between GI/NBI and related initiatives and on the benefits sectors can derive from such projects to foster a mainstreaming process of GI/NBI across sectors (and related policies), and therewith support a larger uptake.
Spatial information/data on GI	Tools are available that cover landscape, regional, city, and site levels, but further research would be needed on spatial information that more completely covers transboundary areas and GI on the outer borders of the EU. Moreover, the translation of existing spatial information into formats and media used by planners, policymakers, and other target groups (which addresses their needs) is largely lacking. More research could be invested into the needs of stakeholders and the most appropriate media to use to deliver existing information to them effectively.	Direct link to Target 2 (Action 5, 6b) by providing data to inform a) the mapping and assessment of ES and spatial distribution (with regards to GI) and b) the assessment of the functionality and status of GI as part of monitoring processes and support future planning processes.
Use of ecosystem services in existing assessment concepts	While substantial attention has been directed towards assessing the environmental impacts of GI and NBI-related concepts (in particular NBS), greater attention needs to be paid to both exploring and explaining the interlinkages between environmental, economic and social impacts within and across current societal challenges. This requires not only employing an interdisciplinary and transdisciplinary approach and using a range of indicators and qualitative, quantitative and mixed methods, but also a shift from a purely environmental focus towards a better consideration of all socio-cultural ES as well as biodiversity, which goes partly beyond the ES concept. Another dimension comes with dependence of ES delivery (by GI and NBI) on the	Direct link to Target 2 (Action 5) by providing knowledge on the current use of ES in GI/NBI and related assessments, feeding into the respective EU/national processes. Direct link to Target 2 (Action 7a): "In collaboration with the Member States, the Commission will develop a methodology for assessing the impact of EU funded

	local context, which still presents a major challenge in current assessment and the transfer of assessment results/values across case studies ecosystems and countries.	projects, plans and programmes on biodiversity by 2014." by providing information of current methods/assessments used.
Relevant platforms and networks in place	Very limited information was provided overall in the reviewed sources regarding relevant platforms, and particularly relevant networks. One main gap identified is the lack of visibility of GI and NBI-related topics on existing platforms, as well as a lack of coordination between one another. Potential for integration between the main European thematic platforms, including clarification of terms and interlinkages would be a further area for work. Further investigation could be also done on existing networks, potential linkages and synergies which could be drawn between them, and potential for EU-wide networks supporting such aspects as exchange and support regarding capacity and skills building, dissemination of available knowledge, etc.	Direct link to Target 2 (Action 6b) by providing a variety of evidence, reports and dissemination material that has the potential to support the deployment and mainstreaming of GI/NBI and related concepts.
Wider dissemination and public awareness material	Public awareness-raising material currently covers the EU scale, but awareness-raising material for the local and landscape levels is patchy and only available for a handful of specific case studies. More awareness-raising material could be developed to cover different ecosystem types, GI, features, and specific sites. More resources could also be developed translating the benefits of GI for key stakeholder groups. The currently available resources are useful for informing and working with the general public, policymakers, and planners. Additional material could specifically target other stakeholder groups who could help support GI implementation and acceptance, such as (environmental) engineers, educators and schools, civil society and environmental organisations, etc.	Direct link to Target 2 (Action 6b) by providing a variety of evidence, reports and dissemination material that aims to support the deployment and mainstreaming of GI/NBI and related concepts. Indirect link to Target 1 (Action 3): "Raise awareness of Natura 2000, get citizens involved and improve the enforcement of the nature directives" by providing Natura 2000-specific information (as a core part of the EU GI network and outlining its role in this network).

3.2 Open data needs for successfully implementing GI projects of European interest

In light of the upcoming TEN-G and its planned funding of EU-level GI projects, several data needs can be identified which need to be addressed in order to successfully achieve its envisioned objectives. For example, the operationalisation of the selection criteria for potential GI projects (currently under discussion by the European Commission) require diverse data and information inputs.

Building on the gap analysis presented in this report, a first indication on potential support as well as open data needs can be made. In terms of operationalising the proposed selection criteria, the following three criteria can be supported by existing evidence:

Contribute to the goals of EU Nature legislation - build connectivity
The upcoming 5th MAES report (10) includes inter alia GI case studies in MS/regions addressing inter alia connectivity, riparian corridors and analysis of Austrian green space network. Case studies presented by Green Infrastructure in Transboundary Protected Areas (16) illustrate how conservation of ecosystems can contribute to landscape connectivity. A number of LIFE projects address connectivity and enhancing ecosystem functions (19) through the implementing GI. Moreover, the GreenSurge project (5) investigated trends in urban green space/GI, and use of GI concepts in urban planning such as multifunctionality, connectivity, integration and multi-scale.

Contribute to other environmental policies (and relevant sectors)
Studies including cross-sectoral considerations, such as policy coherency and linkages (7, 12, 18, 27, 28, 29), can support the development of relevant parameters supporting the measurement towards the contribution of GI projects to other environmental policies (and relevant sectors). Moreover, studies including policy-related recommendations, such as for new urban green policies and an agenda for future action, targeting city authorities, national governments and the European Commission (44) and focusing on the integration of ecosystem-based approaches into existing sectoral policies (29) can provide helpful insights.

Delivery of ecosystem services
Several studies exist that take account of ecosystem services n assessing the impact of GI/NBI and related concepts, focusing on the supply side of delivery and including different types of services (10, 14, 31, 33, 43) and to some extent the functional links between specific urban GI elements and ecosystem services (33). Moreover, tools exist such as the GIFT-T! Toolbox (43) which serves as 'Ecosystem Services Performance Mapping', an approach to use in planning processes to come to a shared vision, as well as a GIS method for mapping the types of GI in a study area, the ES that they perform, and the need for services. Moreover, the EKLIPSE 'NBS Impact Assessment Framework' (31) outlines 10 societal challenges and, for each, outlines a description of the challenge, a list of potential NBS actions and their respective impacts, examples of indicators to measure impacts and methods to assess the indicators, as well as potential success and limiting factors and a small case study example.

Open data needs remain in terms of the identification of potential GI areas. Results from mapping exercises (13) of GI networks as well as data from the Article 12 and 17 databases (on the conservation status of species and habitats) provide a first basis. However more data and assessments are needed to consider the (potential) delivery of benefits and ES of GI and NBI in the specific local or regional context. With regards to the contribution of GI Projects to other environmental policies, while indicators can be directly derived from the policy objectives, specific levels of contribution must be derived and defined to measure this progress. More research is also

needed to operationalise specific criteria, such as by e.g. ecological robustness/resilience as well as the functional and structural coherence of the Natura 2000 network.

3.3 Gaps and potential for new emerging topics and investigations

While extensive data and information is available on the various aspects covered in this study, important gaps remain. There is a need, for example, to better link and target user needs (demand) with the delivery of ecosystem services (supply) in order to design tailored GI/NBI interventions that meet wider user needs. Further research is needed on methodological approaches for such assessments, as well as on practical approaches to integrating such findings in planning processes and mainstreaming their consideration in decision-making processes. Other gaps exist in: applying cost and benefit analyses beyond the local scale as a means to attract investment and guide more landscape oriented decision-making processes; understanding options for improving framework conditions to foster GI at different scales; and means for supporting improved policy coherence between sectors and scales. Finally, no information was identified which looks at potential future markets and possibilities for increasing the delivery of benefits by sector.

In addition to these currently lacking aspects, several promising areas for the future pursuit and mainstreaming of GI/NBI and related concepts as an alternative to traditional grey solutions have been identified. The novelty and innovativeness underlying these topics warrant further research in order to increase the surrounding knowledge and evidence base. With the field of planning and participation, for example, several studies have highlighted new approaches to 'co-governance', which have yet to be extensively implemented or tested in e.g. 'urban living labs', giving increased room to non-governmental actors within steering-processes. Furthermore, following the approach of the EKLIPSE Impact Evaluation Framework (31), more research adopting a wider interpretation of the ES concept is needed, moving beyond the more restrictive Millennium ES approach. Such a framework should be utilised in the planning, as well as evaluation of interventions and contribute to the currently scattered evidence on costs and benefits. Novel sources of investment and funding have been identified as holding large potential for supporting increased implementation, but require additional investigation. In particular, innovative co-financing models, new partnerships and increased involvement of previously removed sectors (e.g. insurance) could be interesting.

A large new body of evidence on GI and in particular NBS can be expected from the currently running H2020, BiodivERsA and INTERREG projects as well as the new ESPON study on "Green Infrastructure: Enhancing biodiversity and ecosystem services for territorial development". These and other relevant projects should be closely monitored to allow them to feed into relevant policy processes at EU and national level(s) in a timely matter and also support the development of an EU-level green infrastructure.

References/List of sources

1 Aravamuthan, M., Ruete, M., Dominguez, C. (2015). Credit Enhancement for Green Projects: Promoting credit-enhanced financing from multilateral development banks for green infrastructure financing. IISD, Manitoba, Canada"

2 Arjen Buijs, Birgit Elands, Gilles Havik, Bianca Ambrose-Oji, Eva Gerőházi, Alexander van der Jagt, Thomas Mattijssen, Maja Steen Møller, Kati Vierikkor (2016). Innovative governance of urban green spaces - Learning from 18 innovative examples across Europe. GREEN SURGE Deliverable 6.2

3 CEEweb (n.d.) Green Infrastructure Knowledge Hub. Accessed 21.08.2017: http://www.ceeweb.org/work-areas/priority-areas/green-infrastructure/

4 Civic, K. and Siuta, M. (2014). Green Infrastructure – Training manual for trainers. ECNC, Tilburg, the Netherlands and CEEweb for Biodiversity, Budapest, Hungary. Copyright © 2014 ECNC and CEEweb"

5 Clive Davies, Rieke Hansen, Emily Rall, Stephan Pauleit, Raffaele Lafortezza, Yole De Bellis, Artur Santos, Ivan Tosics (2015). Green Infrastrcuture planning and implementation. REEN SURGE Deliverable 5.1

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

7 Kabisch, N; Korn, H; Stadler, J; Bonn, A. Nature-based solutions to cliamte change adaptation in urban areas: Linkagaes between science, policy and practice. Springer, 2017. Print.

8 Dawson RJ, Wyckmans A, Heidrich O, Köhler J, Dobson S and Feliu E (2014) Understanding Cities: Advances in integrated assessment of urban sustainability, Final Report of COST Action TU0902, Centre for Earth Systems Engineering Research (CESER), Newcastle, UK. ISBN 978-0-9928437-0-0

9 DG Environment and EEA (n.d.) GI-related developments in the European Union. Biodiversity Infromation System for Europe.

10 DG Environment, JRC, EEA, ETC-ULS (n.d.) Informing strategic green infrastructure and restoration planning through mapping and assessment methods based on spatial and technical data. 5th MAES Report

11 Doswald, N and Osti, M (2011). Ecosystem-based approaches to adaptation and mitigation – good practice examples and lessons learned in Europe. BfN-Skripten 306."

12 EEA (2011). Green infrastructure and territorial cohesion. The concept of green infrastructure and its integration into policies using monitoring systems.

13 EEA (2014) Spatial analysis of green infrastructure in Europe. EEA Technical report No 2/2014

14 EEA (2015). Exploring nature-based solutions — The role of green infrastructure in mitigating the impacts of weather- and climate change-related natural hazards. EEA Technical Report No. 12/2015.

15 EEA (2015). Green infrastructure: better living through nature-based solutions.

16 EUROPARC Federation (2015). Green Infrastructure in Transboundary Protected Areas - Factsheet: Conserving ecosystems, providing landscape connectivity

17 European Commission (2012). The multifunctionality of green infrastructure: Science for Environment In-depth Report. March 2012.

18 European Commission (2013). Building a green infrastructure for Europe. European Commission. DG Environment. Luxembourg: Publications Office of the European Union

19 European Union (2010). LIFE building up Europe's green infrastructure: Addressing connectivity and enhancing ecosystem functions.

20 GIFT-T! (2015). Developing green infrastructure business plans: The final WP4 report.

21 Hansen, Rieke; Rolf, Werner; Santos, Artur; Luz, Ana Catarina; Száraz, Luca; Tosics,Iván; Vierikko, K.; Rall, Emily; Davies, Clive; and Pauleit, Stephan (2016). Advanced approaches and strategies for UGI planning and implementation. GREEN SURGE Deliverable 5.2

22 Kabisch, N; Stadler, J; Korn, H; Bonn, A (2016). Nature-based solutions to climate change mitigation and adaptation in urban areas. BfN Skripten 446

23 Kazmierczak, A, and Carter, J (2010). Adaptation to climate change using green and blue infrastructure - A database of case studies. Green and blue space adaptation for urban areas and eco towns (GRaBS) project."

24 Klemen Eler, Špela Železnikar , Rozalija Cvejić, Marina Pintar, Dagmar Haase, Nadja Kabisch, Michael Strohbach, Matilda Annerstedt van den Bosch , Ingo Kowarik, Leonie K. Fischer (2016). Functional Linkages between Urban Green Infrastructure, Biodiversity and Human Well-Being. GreenSurge Deliverable 3.2

25 Lucius, I; Dan, R; Caratas, D; Mey, F; Steinert, J; Torkler, P (2011). Green Infrastructure: Sustainable Investments for the Benefit of Both People and Nature. SURF nature.

26 Marleen Buizer, Birgit Elands, Thomas Mattijssen, Alexander van der Jagt, Bianca Ambrose, Éva Gerőházi, Artur Santos, Maja Steen Møller (2015). The governance of urban green spaces in selected EU-cities. GreenSurge Deliverable 6.1

27 Mazza L., Bennett G., De Nocker L., Gantioler S., Losarcos L., Margerison C., Kaphengst T., McConville A., Rayment M., ten Brink P., Tucker G., van Diggelen R. 2011. Green Infrastructure Implementation and Efficiency. Final report for the European Commission, DG Environment on Contract ENV.B.2/SER/2010/0059. Institute for European Environmental Policy, Brussels and London.

28 Case studies-City portraits. Greensurge. http://greensurge.eu/products/case-studies/

29 Naumann, S; Davis, M; Goeller, B; Gradmann, A; Mederake, L; Stadler, J; Bockmühl, K (2015). Ökosystembasierte Ansätze zur Anpassung an den Klimawandel und zum Klimaschutz im deutschsprachigen Raum."

30 Naumann, S; Davis,M; Kaphengst, T; Pieterse, M; and Rayment, M (2011). Design, implementation and cost elements of Green Infrastructure projects. Final report to the European Commission, DG Environment, Contract no. 070307/2010/577182/ETU/F.1, Ecologic institute and GHK Consulting.

31 Raymond, C.M., Berry, P., Breil, M., Nita, M.R., Kabisch, N., de Bel, M., Enzi, V., Frantzeskaki, N., Geneletti, D., Cardinaletti, M., Lovinger, L., Basnou, C., Monteiro, A., Robrecht, H., Sgrigna, G., Munari, L. and Calfapietra, C. (2017). An Impact Evaluation Framework to Support Planning and Evaluation of Nature-based Solutions Projects. Report prepared by the EKLIPSE Expert Working

Group on Nature-based Solutions to Promote Climate Resilience in Urban Areas. Centre for Ecology & Hydrology, Wallingford, United Kingdom.

32 Think Nature platform. https://www.think-nature.eu/

33 Rozalija Cvejić, Klemen Eler, Marina Pintar, Špela Železnikar, Dagmar Haase, Nadja Kabisch, Michael Strohbach (2015). pology of urban green spaces, eco-system provisioning services and demands. GreenSurge Deliverable 3.1

34 Siuta, M. and Nedelciu, C.E. (2016). Report on Socio-Economic Benefits of Wetland Restoration in Central and Eastern Europe. A publication by CEEweb for Biodiversity, Budapest, Hungary"

35 Trinomics, Alterra, Acradis, RPA, Stella Consulting, REC (2016). Supporting the Implementation of Green Infrastructure. Final Report. DG Environment, European Commission

36 TURAS Project (2016). TURAS Toolbox.

37 URBACT (2016). Urban Green Labs - Promoting citizens engagement in in upgrading urban green spaces: Baseline Study.

38 Vallory et al. (2013). Policy Instruments for ecosystem-based management in Europe – examples from a few countries

39 The Biodiversity Information System for Europe (BISE). URL: http://biodiversity.europa.eu

40 Naumann, Sandra, Gerardo Anzaldua, Pam Berry, Sarah Burch, McKenna Davis, Ana Frelih-Larsen, Holger Gerdes and Michele Sanders (2011): Assessment of the potential of ecosystem-based approaches to climate change adaptation and mitigation in Europe. Final report to the European Commission, DG Environment, Contract no. 070307/2010/580412/SER/B2, Ecologic institute and Environmental Change Institute, Oxford University Centre for the Environment

41 OPPLA –Platform on ecosystem services, natural capital and nature-based solutions. URL: http://www.oppla.eu/

42 Panorama Platform: Supporting solutions for a healthy planet

43 GIFT-T! project manual (2015). URL: http://www.gift-t.eu/manual

44 GreenKeys Manual: GREENKEYS @ YOUR CITY – A GUIDE FOR URBAN GREEN QUALITY

45 Cowan, Carolin, Cordula Epple, Horst Korn, Rainer Schliep, Jutta Stadler (2010). Working with Nature to Tackle Climate Change: Report of the ENCA / BfN Workshop on “Developing ecosystem-based approaches to climate change – why, what and how”. Bundesamt für Naturschutz, Bonn."

46 EEA (2017). Financing Urban Adaptation to Climate Change. EEA Report No 2/2017.

47 Multiple benefits toolbox (2016). URL: http://www.bluegreencities.ac.uk/publications/multiple-benefit-toolbox.aspx

48 Sinnett, D; Smith, N; Burgess, S (2016). Handbook on Green Infrastructure: Planning, design and Implementation. Edward Elgar Publishing. Print.

49 European Commission (2016). Taking stock on ecosystem-based initiatives in the European Commission. Internal paper