Evaluating the impact of NBS on biodiversity: the EU Task Force

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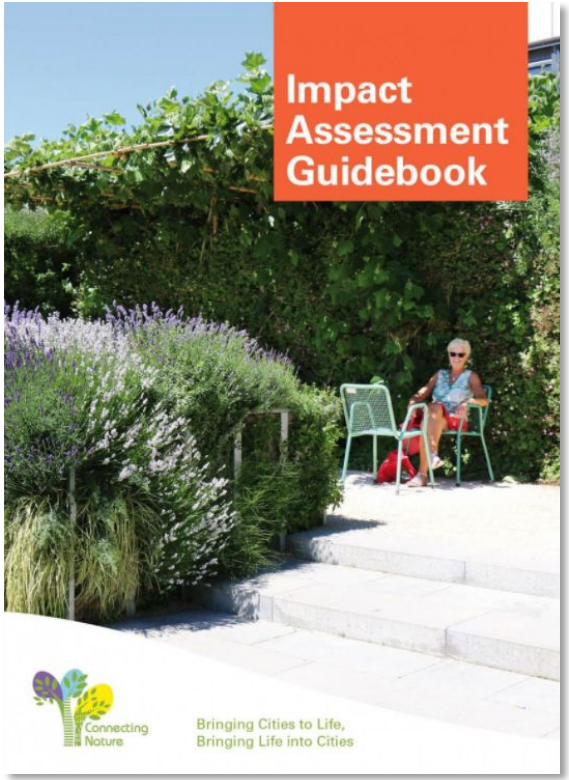
CN Impact Assessment

- Co-production
- Cities: Genk, Glasgow, Poznań
- Environment: Economic: Social: Process



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Environmental Indicators

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Environmental Indicators

- Challenge of such a huge topic
- Broad spectrum – need to be applicable across contexts/scales
- Juxtaposition of evolving best practice in scientific literature and available resources/expertise in cities
- Cover a diversity of potential environmental benefits relevant to societal challenges

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Environmental Indicators

- Focused literature review
- Analysis of NBS interventions presented in the CN database
- Analysis of other EU projects on NBS
- Comprehensive list (n = 93)

Table 1. Full list of Environmental Indicators for Nature-based solutions

1. Carbon storage OR Carbon sequestration in vegetation/soil
2. Carbon sequestration rate by tree species
3. Air temperature change
4. CO2 emissions reduced
5. Energy savings
6. Climate resilience strategy
7. Albedo
8. Rainfall storage/absorption capacity of NBS
9. Flood peak reduction/delay
10. Reduction of drought risk
11. Increase groundwater availability
12. Groundwater quality
13. Water exploitation index
14. Drinking water (surface/ground)
15. Water quality
16. Increase evapotranspiration
17. Air Temperature – Energy demand
18. Reduction of stormwater treated in public sewerage system (economic benefit)
19. Inundation risk for critical urban infrastructures (probability-economic)
20. Flood damage (economic)
21. Water consumption
22. Increase greywater and rainwater reuse
23. Public green space distribution
24. Recreational value of blue-green spaces
25. Cultural value of blue-green spaces
26. Community accessibility
27. Connectivity of urban green and blue spaces (structural and functional)
28. Ecological connectivity (general)
29. Supporting/increasing biodiversity conservation
30. Increase in pollinators (habitat)
31. Increase in pollinators (abundance of pollinators)
32. Urban forest pattern
33. Urban tree health
34. Number of native species
35. Species diversity
36. Species under nature conservation designation
37. Introductions
38. Mapping ecosystem services and spatial-temporal biodiversity legacies
39. Ecological connectivity (Ecological connectivity Index)
40. Fragmentation
41. Accessibility of greenspaces
42. Land-use change and greenspace configuration
43. Ratio of open spaces to built form
44. Reclamation of contaminated land
45. Citizen access to public transport
46. Quality of public transport
47. Access to vehicle sharing
48. Access to public amenities
49. Length of bike route network
50. Land devoted to roads
51. Road density
52. Leapfrog development index
53. Linearity development index
54. Area for pedestrians
55. Green space area
56. Blue space area
57. Population density
58. Local food production
59. Cultivated crops
60. Urban sprawl
61. Intensity of land use
62. Land-use intensity
63. Landuse mix
64. Brownfield use
65. Annual amount of pollutants captured by vegetation
66. Air quality change
67. Share of emissions (air pollutants) captured/sequestered by vegetation
68. Pollutant fluxes per m2 per year
69. Value of air pollution reduction
70. Total monetary value of urban forests
71. Atmospheric pollutant flux
72. NOx emissions
73. Fine particulate matter emissions
74. Air quality index
75. Noise mitigation by vegetation
76. Increase portion of sky visible from the ground
77. Index of habitat types
78. Targeted habitats
79. Proportion of landscape not in intensive management
80. Reduction in pesticide use
81. Soil sealing
82. O2 production by vegetation
83. Light levels at night
84. Noise pollution reduction
85. Change in ecosystem service provision
86. Temperature increase/wind shelter
87. Use of organic fertilizers
88. Tree shade for local heat change
89. community garden area per capita and in a defined distance
90. community garden area per child capita and in a defined distance
91. % of protected areas (ecologically and/or culturally sensitive)
92. % of buildings with NBS adaptation
93. Habitats restored

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Shortlisting

- Scored based on FRC value filters (relevance to exemplar; relevance to case studies; geographical scale; KPIs/policy relevance; SDG goals).
- Selection of highest scoring indicators adjusting for similarity and overall diversity.
- Shortlist indicators of most relevance to FRCs (n = 33)

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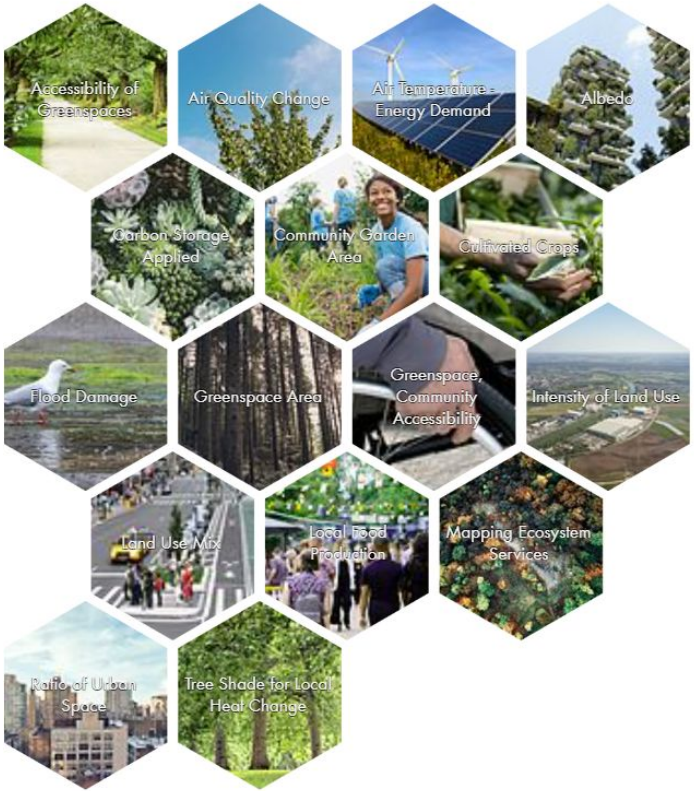
Co-production sense check:

- Workshop with cities
- Core indicators (n=17)
- Feature indicators (n=16)



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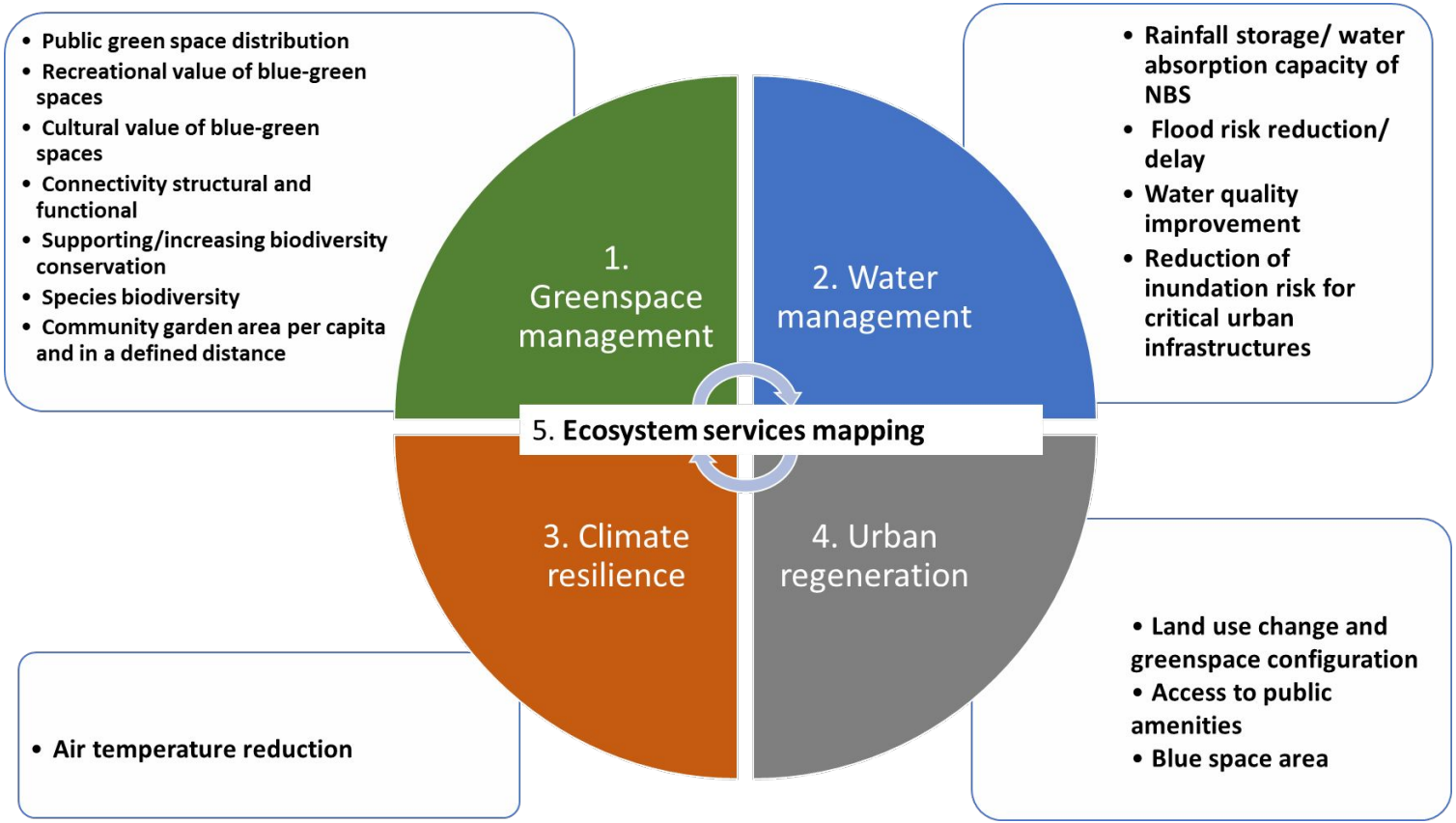
Environmental Impact Indicators



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Environmental Impact Indicator Reviews

Air Pollution:

Examples of use of low-cost monitoring methodologies to promote community participation include:

- Wearable sensors for monitoring PM levels in London Underground stations (Zhang et al. 2017);
- Crowd sourced air quality monitoring programmes (Thompson 2016);
- Personal ozone monitoring (Cao and Thompson 2016);
- Use of smartphones to collect air quality data (Pereira et al. 2018);
- Use of low-cost sensors to cover new pollutants and new areas (Commodore et al. 2017);
- Toolboxes of monitoring systems to support citizen science (Barzyk et al 2016);
- Nitrogen dioxide passive diffusion tubes for ambient measurement (Kirby et al. 2000).

Such studies have demonstrated that low-cost sensors can make a valuable contribution to understanding and awareness-raising in relation to air pollution exposure (Jerrett et al. 2017).

Biological monitoring of air quality using plant/lichen growth patterns in relation to the presence of air pollutants has also been used as a mechanism for assessing air quality (Matos et al. 2019, Limo et al. 2018), including for promoting a participatory approach (Nali and Lorenzi 2007).

For the measurement of the pollutants directly absorbed or intercepted by the vegetation, methods adopted have focused on the physical removal and analysis of samples of vegetation, or the 'washing' of material from foliage (Dzierzanowski et al. 2011; Weerakkody et al. 2017). For air pollution deposition sampling over known time periods, vegetation is washed at the beginning of the study to establish a baseline (Weerakkody et al. 2018). Once samples are obtained, standard laboratory analytical methods and/or scanning electron microscopy are used to identify accumulation rates (Weerakkody et al. 2017).

Participatory process: Participatory processes represent a key part of air quality monitoring as they are directly linked to assessing exposure, raising awareness, and behaviour change. Air quality analysis can be linked to local schools/universities through the use of microsensors, and biological indicators. Automated sampling and analysis equipment offer less opportunity for such participation with participation limited to observing and/or processing the data produced. Several studies revealed the success of incorporating remote sensing and citizen's perception of green space and especially their role for air quality improvement (Chen et al., 2018; Schöpfer et al., 2005).

Data availability: Many ground-based measurement approaches generate new data, or it is possible to use existing city-wide air quality monitoring station data if available. Baseline data prior to intervention is not always necessary as it may be possible to measure air quality across the nature-based solution (from pollution source to leeward side) to get a measure of air quality change. If comparison to a previous green or grey space is required, establishing baseline data prior to installation can be of benefit. Alternatively, a control space without a nature-based solution but with a high likelihood to be experiencing the same air pollution levels as the nature-based solution site could also be used for comparative purposes. Remote sensing data is widely available free of charge (see Cost section above for examples). According to Vatseva et al. (2016), recently available Sentinel-2A (S2A) multispectral satellite imagery are provided free of charge in the frame of European Copernicus Earth observation program, and the target minimum mapping unit presents a five-fold improvement compared to Urban Atlas, i.e. 500 m^2 as well as more frequent and timely data updates compared to Urban Atlas.

Geographical scale: Implementation scale can be very different depending on indicator metrics used. Direct sampling tends to be focused on a component or site scale. Spatial modelling can be

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Accessibility: Environmental Impact Indicators

https://connectingnature.eu/nature-based-solution-evaluation-indicators-environmental-indicators-review

https://co-impact.app/

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Evaluating the Impact of Nature-based Solutions: A Handbook for Practitioners

- European Commission Handbook
- Leads: Laura Wendling (UNaLab) & Adina Dimitru (Connecting Nature)

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Evaluating the Impact of Nature-based Solutions: A Handbook for Practitioners

- Nature4Cities
- NATURVATION
- THINK NATURE
- Connecting Nature
- Grow Green
- UNaLAB
- URBAN GreenUP
- Clever Cities
- ProGIReg
- EDICITNET
- UrbiNat
- Clearing House
- ReGreen
- NAIAD
- Operandum
- PHUSICOS
- ReConect
- MAES
- Enroute

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Evaluating the Impact of Nature-based Solutions: 11 Thematic Areas

- Climate Resilience
- Water Management
- Natural and Climate Hazards
- Green Space Management
- Biodiversity
- Enhancement Place Regeneration
- Knowledge and Social Capacity Building for Sustainable Urban Transformation
- Participatory Planning and Governance
- Social Justice and Social Cohesion
- Health and Wellbeing
- New Economic Opportunities and Green Jobs

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Evaluating the Impact of Nature-based Solutions: Reviews

Proposed Indicator:	Biodiversity
Description and justification	
Definition	
Strengths and weaknesses	
Measurement procedure and tool	
Scale of measurement	
Data source	
Required data	
Data input type	
Data collection frequency	
Level of expertise required	
Synergies with other indicators	
Connection with SDGs	
Opportunities for participatory data collection	
Additional information	
References	

- Holistic review
- Combining approaches of projects
- 73 core indicators
- 381 additional indicators

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Evaluating the Impact of Nature-based Solutions: Biodiversity

Limited number of contributing NBS projects (7/19)

- Connecting Nature
- ReConect
- UNaLab
- PHUSICOS
- proGIreg
- Nature4Cities
- URBAN GreenUP

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Evaluating the Impact of Nature-based Solutions: Biodiversity

Limited number of contributing NBS projects (7/19)

- Connecting Nature **[Urban]**
- ReConect **[Hydro-meteorological risk]**
- UnaLab **[Urban]**
- PHUSICOS **[Hydro-meteorological risk]**
- proGIreg **[Urban]**
- Nature4Cities **[Urban]**
- URBAN GreenUP **[Urban]**
- **Gaps** (marine, wetland, forestry, etc)

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EC TF3 Workstream 4:
NBS and biodiversity

Ambitions

- Review Handbook NBS and biodiversity metrics
- Supplement with greater depth/breadth of NBS approaches
- Create updated resource for dissemination
- Ensure accessibility for practitioners

Nr.	Indicator	Units	Class	Applicability to NBS		
				Type 1	Type 2	Type 3
RECOMMENDED						
9.1 9.1.1	Structural connectivity of urban green and blue spaces	Various	O	●		●
9.1 9.1.2	Functional connectivity of urban green and blue spaces	Various	O	●	●	●
9.2	Number of native species	Number	O	●	●	●
9.3	Number of non-native species introduced	Number	O	●	●	●
9.3.1	Number of invasive alien species	Number	O	●	●	●
9.4	Species diversity within a defined area	Number	O	●	●	●
9.5	Number of species within a defined area	Number	O	●	●	●

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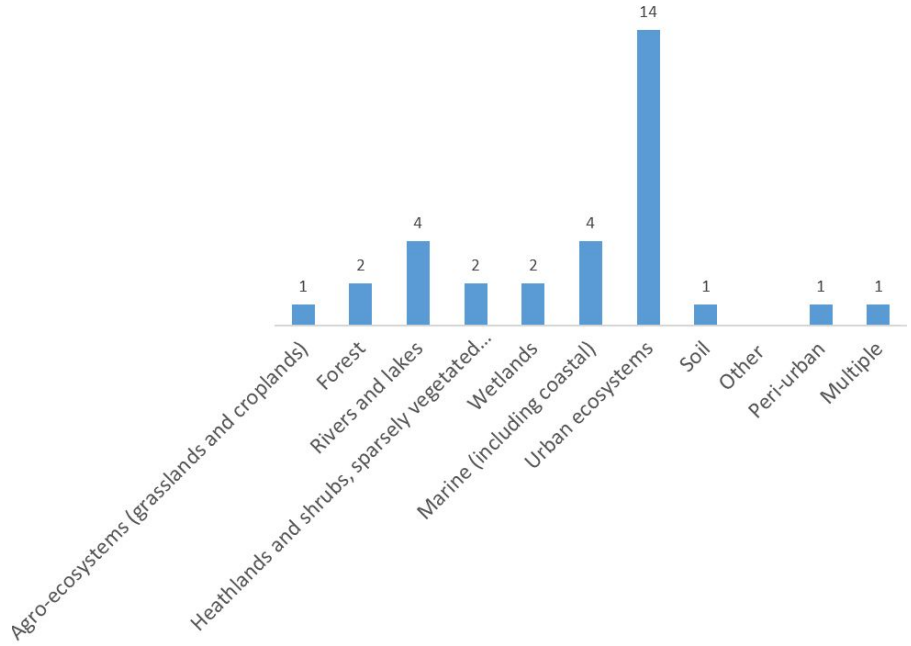
EC TF3 Workstream 4: NBS and biodiversity

- Biodivercities
- Connecting Nature
- DRYvER
- EuropaBON
- INTERLACE
- MaCoBioS
- MULTISOURCE
- NICE
- OPERANDUM
- PHUSICOS
- PONDERFUL
- proGIreg
- RECONECT
- REGREEN
- UNaLab
- URBAN GreenUP

16+ projects

Project themes



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EC TF3 Workstream 4: NBS and biodiversity

- Agro-ecosystems (grasslands and croplands):
- Wetlands + Amphibians
- Forest
- Marine & Coastal
- Rivers and Lakes
- Urban ecosystems
- Heathland and shrubs (sparsely vegetated land)
- Soil
- Peri-urban + Ecological corridors
- Pollinators/Invertebrates
- Natural Hazard Risk & Biodiversity
- Ecological restoration
- Ecosystem services

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EC TF3 Workstream 4: NBS and biodiversity

Recommended							
	Indicators						
Theme	9.1.1 Structure connectivity of urban green and blue spaces	9.1.2 Functional connectivity of urban green and blue spaces	9.2 Number of native species	9.3 Number of non-native species introduced	9.3.1. Number of invasive alien species	9.4 Species diversity within a defined area	9.5 No. of species within a defined area
Urban	X	X	X	X	X	X	X
Marine			X	X	X	X	X
Wetland			X	X	X	X	X
Agroecosystems			X	X	X	X	X
Rivers and Lakes			X	X	X	X	X
Heathlands and shrubs			X	X	X	X	X
Soils			X	X	X	X	X
Per-urban	X	X	X	X	X	X	X
Ecological corridors	X	X					
Pollinators/Invertebrates			X			X	X
Ecological restoration			X	X	X	X	X

- Easy to use mini-handbook
- Target date Oct 2022
- Currently standardising existing reviews
- Network Nature: https://networknature.eu/task-force-2-integrated-assessment-framework
- Get involved…

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Thanks for listening

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