NATURVATION
cities – nature – innovation

THE ECONOMIC VALUE OF NATURE-BASED SOLUTIONS IN EUROPEAN CITIES

KEY POINTS

- **The value of 168 nature-based solutions in European cities is 1.6 billion USD**
- **Nature-based solutions can deliver excellent return on investment**
- **The economic value of nature-based solutions by hectare is greater than GDP per capita**
- **Nature-based solutions are essential to sustainability and climate efforts, in the context of the Green New Deal and the Convention on Biodiversity.**

THE NATURVATION PROJECT

NATure-based URban innoVATION is a 4-year project involving 14 institutions across Europe in the fields of urban development, geography, innovation studies and economics. We are creating a step-change in how we understand and use nature-based solutions for sustainable urbanisation.

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Why this study?

Cities and regional governments are making critical contributions to sustainability and climate change, and are key sites of achieving the aims of the Convention on Biodiversity and the Green New Deal. This study demonstrates the economic value of nature-based solutions throughout Europe, in order to raise awareness among decision makers and practitioners about their value, and to demonstrate the potential of urban actions.

What were the results?

The study analysed a set of nature-based solutions in Europe, based on data from the Urban Nature Atlas.

Urban nature in European cities delivers high value

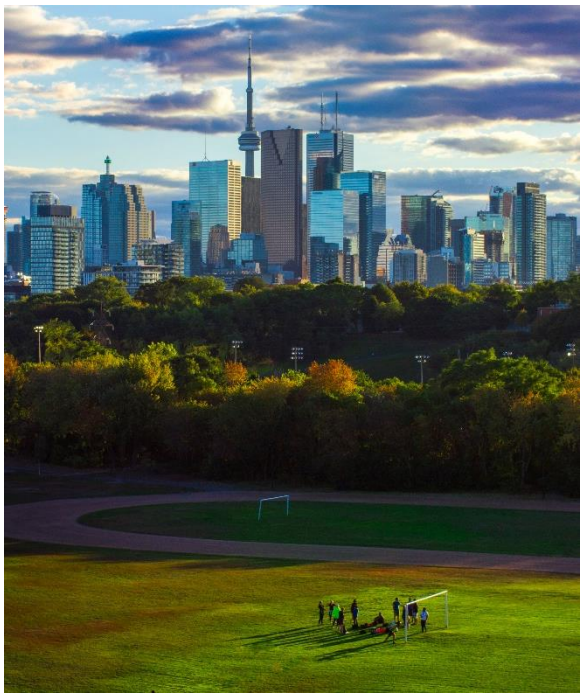
The study estimated economic value of 168 nature-based solutions in various cities in Europe.

Total value: 1.52 billion USD per year

Individual city interventions have significant value

Average value per intervention: 9.1 million USD per year

Median value per intervention: 4.2 million USD per year



The value per intervention ranges from 153,877 USD per year, in the Forest Protection Curtain in Iaşi, Romania, to 113.6 million USD per year in the Protection and development of the Schwanheimer Düne, Frankfurt am Main, Germany.

Value by hectare is greater than GDP per capita

Average value per hectare: 83,203 USD per year

Median value per hectare: 28,103 USD per year

The average value per year by hectare is twice the average GDP per capita in the European Union of 40,937 USD (OECD statistics). These results are well within the range of values reported in studies that survey people on the economic value they attach to goods and services (Bockarjova et al., 2017).

Nature-based solutions can deliver excellent return on investment

For 60 cases, which were considered fundamental interventions, we were able to compare the estimated total economic benefit to the respective capital investment cost. Because these economic benefits are delivered to urban population but are not related to monetary flows, this provides an indication of the social return on investment per project.

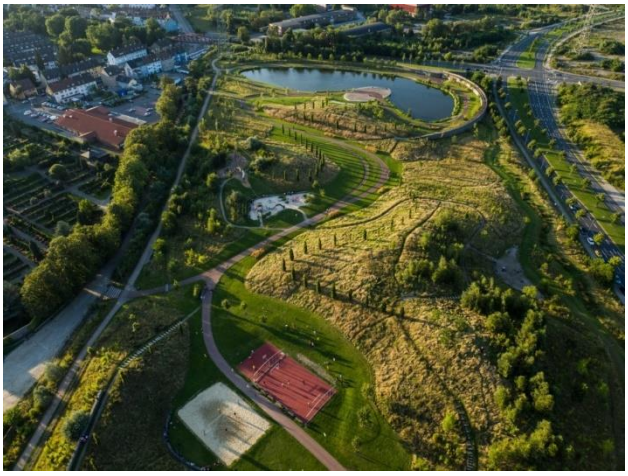
- 25 nature-based solutions recouped investment costs within one year, the other 13 interventions – within five years, and benefits continued in subsequent years.
- 11 nature-based solutions needed a longer periods before benefits caught up to investment costs.

The total cost of these 60 nature-based solutions was 5.46 billion USD. Individual project costs ranged from 110,000 USD to 2.75 billion USD. The average project cost was 94.14 million USD, or 47.5 million USD if the most expensive project was excluded. Costs that were not directly related to the realization of the nature-based solutions, and maintenance costs, were not included.

Examples of nature-based solutions and their economic and social value

Restoration of urban parks

Improve environmental conditions and accessibility for recreation and biodiversity, and extend urban nature networks in the city.



Restoration of Krupp in Essen, Germany

Investment	6.771 million USD
Economic value	44.503 million USD per year
Social return	6.63 USD per year per dollar invested

Other cities pursuing urban park restoration

El Patriarca Park, Cordoba, Spain

Riemer Park, München, Germany

Zapaden Park, Sofia, Bulgaria

Regeneration of urban rivers and canals

Improve water quality, increase recreational potential, and regulate flooding.

Lambro river city regeneration project, Milan, Italy

Investment	4.2 million USD
Economic value	11 million USD per year
Social return	2.66 USD per year for each dollar invested

Other cities pursuing regeneration of urban rivers and canals

Le Lez River, Montpellier, France

Flood channel, Wuppertal, Germany

Magra and Vara rivers, Genova, Italy

Urban reforestation

Reduce carbon dioxide, regulate the climate, improve urban water and air quality, and increase recreation.

Climate adaptation for humid forests in Münster, Germany

Investment	3.63 million USD
Economic value	9.1 million USD per year
Social return	2.49 USD per year for each dollar invested

Other cities pursuing urban reforestation

Afforestation in the Aarhus, Denmark

Reforestation of Malaga's Green Belt, Spain

Peri-urban forests and wetlands

Urban recreation and flood control.

Haukaas Marshlands, Bergen, Norway

Investment 1.65 million USD

Economic value 4.1 million USD per year

Social return 2.48 USD per year for each dollar invested

Other cities with peri-urban forests and wetlands

Wigan Flashes wetland restoration, Manchester, UK

Wetland expansion at Potteric Carr, Doncaster, UK

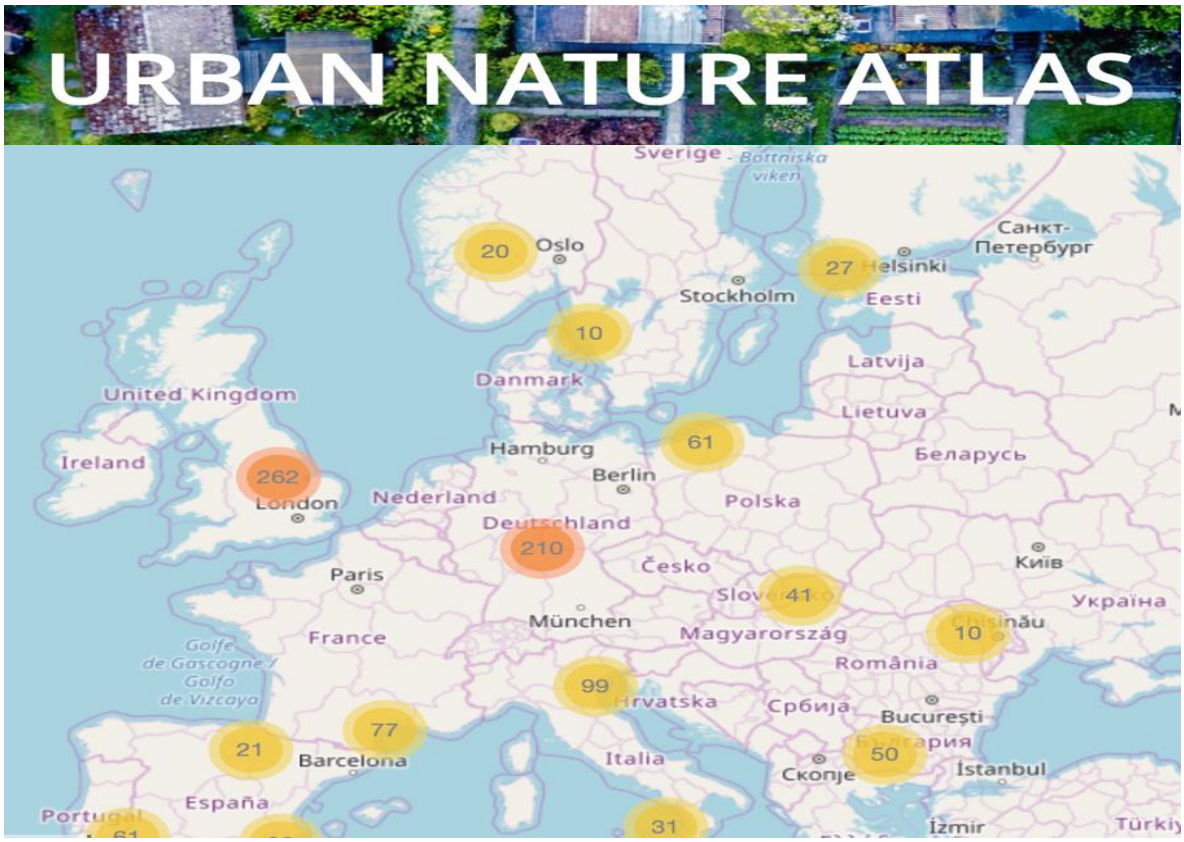
Ciobarciu wetland restoration, Iaşi, Romania

How were these values calculated?

Based in environmental economics methods, the valuation of urban nature is a rapidly expanding research area. When a site cannot be valued directly, an alternative approach is to apply existing estimates from another location, or value transfer. For example, the value of a lake used for recreational fishing in one city can be adjusted and applied to a lake with recreational fishing in another city. The study reviewed numerous valuation techniques that have been used to estimate the value of nature-based solutions. Variations within these techniques, such as methodology, income or price level, or type of nature, were then incorporated into a meta-function (or value transfer function) applied to specific cities. This was based on an existing meta-function that surveyed the extent to which individuals were willing to pay for urban nature (Bockarjova, Botzen and Koetse, 2020). The resulting estimates capture the total economic value of urban nature, based on direct and indirect value to individuals, as well as value that exists even when individuals are unlikely to use the site. This approach helps to adjust existing estimates of the value of urban nature by incorporating the local socio-economic context, including level of income and population density, and the type of nature-based solution and its size.

Which data sources were used?

The value transfer function described above was applied to a set of nature-based solutions in the Urban Nature Atlas, which includes 1,000 examples from across 100 European cities.



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Additional data employed in the study included the size of interventions, income levels, population density, and the dominant type of nature in urban projects. The methodology necessitated assigning the dominant type of nature even in examples where there were multiple types. In cases where there were multiple nature-based solutions in one landscape, a higher value was assigned.

The study only included examples from the Urban Nature Atlas where the size of interventions was comparable to the existing valuation studies used to calculate the value transfer function described above. This primarily meant that smaller nature interventions that were less than 22 hectares were excluded. The resulting set of useable examples included 168 nature-based solutions with a total area of 777,853 hectares. These examples covered a wide range of interventions, such as planting of street trees, beekeeping, green walls and roofs, community fruit and vegetable gardens, urban parks and forests, green urban squares, rain gardens, green corridors, revitalization of urban river banks, lakes and streams, vertical gardening, and neighborhood regeneration.

Conclusions

This study estimates the economic value of nature-based solutions recently implemented or underway throughout Europe, by developing and applying a new value transfer function. The results indicate that **nature-based solutions deliver high economic value to residents of European cities**, with a total value of 1.52 billion USD per year and an average value of 883,203 USD per hectare on an annual basis. Each hectare of nature, on average, delivers value that is twice the annual GDP per capita in European Union countries. Moreover, **many nature-based solutions are delivering excellent value for money**, with estimated yearly benefits surpassing total project costs. While an approximation, these estimated values demonstrate high collective appreciation of urban nature by the public, and a substantial monetary equivalent.

The study conveys a strong message to decision makers and practitioners involved in planning, creating, improving, and expanding natural infrastructure in urban areas, including municipalities, NGOs, businesses and entrepreneurs, and financial institutions. The study contributes to evidence that **nature-based solutions are essential to European and international efforts on sustainability and climate change**, particularly in the context of the Convention on Biodiversity and the Green New Deal.

Limitations and future research

This study has three main limitations that can be addressed by future research:

- Due to a lack of valuation estimates, the study was not able to estimate the value of small nature-based solutions under 22 hectares.
- Data limitations did not always allow for tailor-made value estimation of projects. For example, the study assigned the dominant type of nature to examples where there were multiple types, which means the resulting values should be viewed as indicative.
- Data limitation: the information about the extent of the intervention was not always clear, e.g. whether it was an intervention built on the empty ground, or only adding quality and extra functionality to an existing site. Although all NBS deliver a stream of economic benefits independent of the type of intervention, for the return on investment analysis we have selected only those NBS which are plausibly fundamental.
- The estimated values of nature-based solutions are based on willingness-to-pay, which is not exhaustive of all benefits of urban nature, measuring benefits that are of perceived value to urban residents.

References

Bockarjova, M., Botzen, W.J.W., Koetse, M.J. (2017) Briefing Note on Financial and Economic Values Database. Deliverable 1.2, H2020 NATURVATION project, May 2017.

Bockarjova, M., Botzen, W.J.W., Koetse, M.J. (2020) Economic Valuation of Green and Blue Nature in Cities: A Meta-Analysis. Ecological Economics, 169, 106-408. https://doi.org/10.1016/j.ecolecon.2019.106480 .