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Green infrastructure offers many ecosystem-service benefits in densely populated areas, finds Amsterdam study

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A new study models ecosystem services at a local level to support urban planning in Amsterdam, the Netherlands. The researchers assess how ecosystem services might change in the city as green infrastructure (GI) — natural and semi-natural features such as parks and green roofs — is developed. By identifying the key factors that generate value for residents, the approach could help planners optimise green infrastructure and communicate its importance to decision-makers, investors and residents.

GI across soil, vegetation and water (with the latter sometimes called 'blue infrastructure') provides people with valuable ecosystem services. Such structures can mitigate pollution and extreme weather — trees, for example, absorb carbon dioxide, provide shade and soak up heavy rain — as well as providing recreation opportunities and causing property values to increase. However, tools are needed to assess how best to incorporate GI into urban development, say the researchers behind an Amsterdam-based study. As the city's 850 000-strong population will increase by a projected 70 000 by 2025, the necessary development of 'grey' infrastructure (built-up and paved areas) will compete for resources, making it increasingly important to justify the value and importance of GI, the researchers note.

To support planning and communication about GI, the study applies an approach called the Natural Capital Model to quantify and map the socioeconomic benefits of ecosystem services. Amsterdam is implementing its Green Quality Impulse *(KwaliteitsImpuls Groen)*[1] spatial plan to expand and improve the city's GI by the year 2025, in-line with goals to transition into a sustainable, climate-proof and socially attractive urban environment. The researchers apply the Natural Capital Model across three scenarios relevant under this plan, each capturing different potential levels of GI change, and compare the benefits to a reference scenario (which foresees no increase in green infrastructure).

The three scenarios are **'green neighbourhoods'** (which forecasts substantial increases in vegetation by converting parking spaces and creating green roofs); **'green network'** (which envisions strengthened ecological habitats and recreational trails for cycling and hiking, etc., chiefly by planting more trees); and **'urban parks'** (which plans existing parks enhanced with further vegetation and the creation of new parks).

Green infrastructure offers many ecosystem-service benefits in densely populated areas, finds Amsterdam study (continued)

To develop these scenarios, the researchers consulted the local authority about planned changes and worked with an urban design firm to envision where GI would be located, considering the projected changes in residential infrastructure. Six types of benefits were then assessed for each scenario: air quality, physical activity, property value, urban cooling, urban health and water storage.

According to the model, the highest overall increase in ecosystem service benefits was found in the **green neighbourhoods** scenario, despite it having the lowest net expansion in vegetation cover (249 hectares (ha)) and woody vegetation. This was due to **green neighbourhoods'** initiatives typically located in densely populated, built-up areas, where more people can experience health and physical activity benefits. These benefits were valued at €22 million/year (€6 million from reduced mortality; €3 million from reduced health costs; and €13 million from reduced labour costs — due to factors such as reduced absenteeism, increased productivity, and fewer citizen visits to a general practitioner).

The **green network** scenario revealed the highest improvement in air quality (reducing levels of particulate matter (PM10) by 8 100 kilograms per year — by increasing pollution-retaining tree cover by 454 ha) and water storage (due to the capacity of vegetation to soak up rain, which reduced water treatment costs). This resulted in health and economic benefits worth €0.4 million and €1.1 million per year, respectively.

The **urban parks** scenario brought the greatest cooling benefits due to increased tree cover (258 ha), which reduced the urban heat island effect by 0.04°C. Overall, however, it produced relatively low increases in benefits.

Additional workshops revealed that urban planners were less interested in the economic value generated by GI than in socioeconomic wellbeing. However, as lack of awareness of such benefits can result in the conversion of urban nature into built infrastructure, the researchers note the necessity of an economic case for investing into GI.

The researchers were unable to estimate the costs of the GI modelled, but acknowledge that it can be most expensive to introduce GI in densely populated areas where there are small or no gardens, for example, which poses a trade-off in the scenario conferring the greatest benefits (**green neighbourhoods**). They also acknowledge that the model relies on simplification, for example by using just one indicator for air quality improvement (reduction in particulate matter) and not considering complexities such as the effect of street trees trapping pollution. Nevertheless, it provides a useful tool to assess the benefits of Amsterdam's Green Quality Impulse, they argue, providing detailed insights on how different strategies may influence ecosystem service delivery and allow planners to optimise and communicate ecosystem-service delivery through GI.

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Air pollution, Environment and health, Green Infrastructure, Urban environment

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1. Paulin *et al.* (2019) *Amsterdam's Green Infrastructure Valuing Nature's Contributions to People.* National Institute for Public Health and the Environment, Ministry of Health Welfare and Sport.