



Greenery has more positive effects on our living environment than just health and well-being benefits. It also facilitates water management and promotes biodiversity in built-up areas. And it can help to reduce the effects of noise pollution. Greenery also helps to raise the property value of homes and office buildings. This document provides general information on the benefits of greenery, and complements the detailed fact sheets on how greenery can improve health and well-being in residential, work, education and healthcare contexts.

What does greenery do?

- ▶ Greenery in urban areas reduces the required drainage capacity of sewage systems, as green areas enable the absorption of most of the precipitation by the soil and a small part of the precipitation captured evaporates from the surface of the greenery.
- ▶ The judicious planting of green areas (green roofs, recessed parks and gardens, wadis) offers even more storage capacity at times of peak rainfall.
- ▶ Greenery situated close to homes increases their property value.

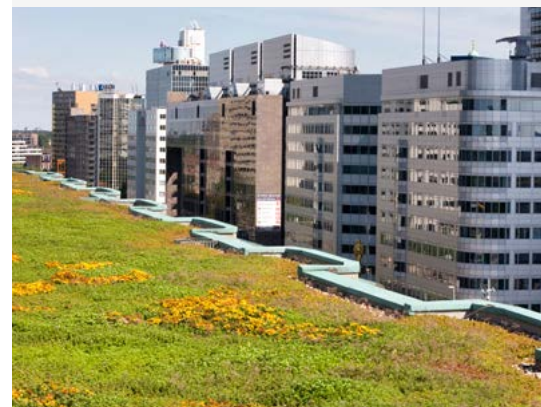


Applications

- ▶ Green roofs and walls
- ▶ Courtyards and rooftop gardens
- ▶ Indoor plants in the living environment
- ▶ Indoor plants in offices, schools and healthcare institutions
- ▶ Plants, shrubs and trees around buildings and in public parks and gardens
- ▶ Use of planters
- ▶ Wadis and recessed green areas in gardens and parks
- ▶ Open flower and garden beds, insect hotels
- ▶ The value of the vegetation in Rembrandtpark (approx. €33 million) that would be lost if residential towers were built there, amounts to twice the value the towers themselves would have.⁵
- ▶ There are many more facts, figures and examples available on the benefits of vegetation. Consult the specific documents on greenery in residential, work, education and healthcare contexts (see last page), or see the references cited in this document.

Proven successes

- ▶ The presence of greenery in the immediate vicinity of houses increases their value by 4-15%, depending on local conditions.²
- ▶ Reserving 10% of urban areas for varied greenery provides an excellent habitat for butterflies and bees.³
- ▶ Based on the gains made in water management, property values, carbon capture, air quality and energy saving, the 116,000 street trees in The Hague represent an annual value to society of € 22 million.⁴
- ▶ Greenery supports and contributes to biodiversity in urban areas.
- ▶ Greenery can contribute to reducing the amount of noise pollution experienced by residents.
- ▶ Its many positive effects make greenery an essential part of the solution to the many challenges faced by today's cities.¹



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Water management

In 2014, the Royal Netherlands Meteorological Institute (KNMI) drew up four potential climate change scenarios for the Netherlands. All four show a significant increase in precipitation intensity and the frequency of heavy rains, while the current climate already causes significant problems as a result of overflowing drains, flooded streets and cellars, etc. Hence, the Dutch Association of Insurers expects a significant increase in damage caused by extreme weather. In addition to material damage, these types of water emergencies can also cause injuries and even deaths, especially in inclined areas (e.g. South Limburg) where small streams of water can quickly become torrents. Expanding green zones in built-up areas improves water management and reduces the adverse effects of peak rainfall.

How greenery works

- ▶ Vegetation reduces the amount of rainwater that needs to be discharged. In this way less capacity for sewage systems is required. Some rain is 'retained' on the surfaces of foliage, stems and branches (this is called interception) and evaporates again once the rain has stopped. Non-sealed ground beneath vegetation contributes to this effect, trapping more rain than hard surfaces and allowing more water to evaporate. In forests broad-leaved trees can intercept around 5-20% of the annual precipitation in this manner, and conifers up to 50%. A further 5-34% of precipitation infiltrated into the soil can evaporate from the trees and vegetation (and in part directly from the ground). Vegetation in green urban areas can also approach these figures.¹
- ▶ In vegetated areas water freely infiltrates the soil, replenishing the soil water and ultimately the groundwater supply. Some of this water is later absorbed by the vegetation and part of it will evaporate again. This means that less water needs to be discharged than with hard surfaces, and the process is slower too (reducing peak intensity). Infiltration speed depends on the soil type and can reach speeds of over 50mm/h in areas with effective drainage (coarse sand). Greenery promotes infiltration, as vegetated areas with extensive root systems absorb water much more effectively than bare soil.²
- ▶ Green roofs help to reduce peak intensity by retaining some of the rainfall and delaying the flow of the remainder. Intensive green roofs, i.e. rooftop gardens with a substrate of more than 15 cm) are most effective and can retain 50-80% of rainfall, allowing it to evaporate later.³
- ▶ In blue-green vegetation systems an enhanced rain water storage under the vegetation is realised. These systems are increasingly applied on blue-green roofs and when laying out growing areas for trees, green strips, etc. in urban and hard-surfaced areas. The rainwater is stored in hollow spaces directly under the rooting area and from there it is immediately available for the vegetation by natural capillary ascent.⁵ The water supply in these systems can be measured and controlled, enabling smart control on the basis of weather forecasts. (www.dakakker.nl, www.metropolder.com, smart-flow-control-nl.pdf (optigruen.nl)). In this way run-off reductions of 70-97% are achieved, compared with 12% for conventional green roofs.⁵
- ▶ Thanks to the stored rainwater, these blue-green vegetation systems on the basis of capillary irrigation on top of roofs supplied growing plants with water for many weeks during extended dry periods. As a result, the actual plant evaporation approached the reference plant evaporation defined by the Royal Netherlands Meteorological Institute (KNMI) (KNMI - Evaporation in the Netherlands). This contributes to the cooling effect of the vegetation.⁹
- ▶ In industrial estates greenery may also be used for organic filtration of wastewater via helophyte filters. For proper filtration water must be collected in a separate water buffer during precipitation peaks.
- ▶ In cities green shores and helophyte filters can be used to improve water quality. Vertical helophyte filters can be used for organic purification of household wastewater to remove contaminants such as nitrogen, phosphate and heavy metals. This requires 2.5 to 5 m² of helophyte filter per PE (population equivalent). Examples of this application can be found in various urban districts (Drielanden in Groningen, Aardehuizen in Olst and the Erasmus Canal in Amsterdam).⁴
- ▶ Greenery can play a key role in integrated water solutions for districts. A good example of this is the Zuidbroek district in Apeldoorn. The water that falls on roofs is channelled into gardens. From the gardens it flows onto the street and from the street into a broad green strip known as a wadi. When the wadi is full, the water is fed to an overflow.

Recommendations

- ▶ Increasing the ratio of vegetated areas to hard-surfaced/built-up areas reduces the amount of water that needs to be discharged. Green roofs also contribute to this.
- ▶ In blue-green vegetation systems for city trees, in green strips and on roofs an improved rainwater storage under the vegetation is realised. This increases the water storage capacity and the supply of water to trees and vegetation, improving the quality of ecosystem services (e.g. cooling) they provide.⁷
- ▶ Introducing plants to wadis improves infiltration, contributes to biodiversity, renders them suitable as ecological transition areas and improves the perceived value of a neighbourhood's green areas.
- ▶ Plants in and around wadis must be able to withstand temporary (and sometimes extremely) high water levels as well as dry periods; planting trees at the wadi's edge (instead of inside it) provides more scope.
- ▶ Planted gardens as opposed to tiled gardens also significantly help to limit run-off during heavy rains.⁶
- ▶ More information is available in the Urban Greenery and Water Management fact sheet (<http://e depot.wur.nl/460541>).

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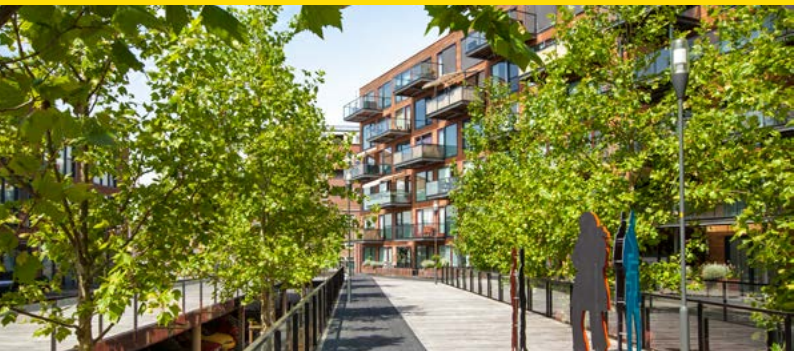
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Property prices and attractiveness

Greenery makes an area more appealing and notably plays a role in attracting middle to high income earners to urban areas.



Recommendations

- ▶ Some investments in local greenery pay themselves back through increased property prices, or, in the case of public sector investments, through higher tax revenue (taxes on the basis of the Valuation of Immovable Property Act).
- ▶ An attractive living and working environment is a key factor for large international businesses in deciding where to open a new site. Greenery adds to the attractiveness of these environments.

How greenery works

- ▶ Greenery in the form of parks and public gardens increases the value of residential properties by an average of 4-5%.¹
- ▶ Green areas in The Hague increase the total value of the city's residential properties by approx. €1.9 billion, i.e. an average of approx. €7,500 per property, and increase the city's property tax revenues by approx. €1.3 million per annum.²
- ▶ Greenery makes an area more attractive and encourages both individuals and businesses to move into the area. The green attractiveness of an area is not a decisive criterion, but it is becoming increasingly important for knowledge-intensive businesses.^{3,4}
- ▶ In green neighbourhoods crime rates are lower and residents feel safer than in areas without local greenery.⁴



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Biodiversity

Biodiversity refers to the variety of living organisms. A varied range of vegetation types in a city will ensure a high degree of biodiversity. The more varied the greenery, the more life it will attract. Large numbers of pollinating insects and various types of vegetation in turn provide a food source for birds and other animals. Therefore, pollinators (and pollination) constitute an important link in ecosystems, making them essential to biodiversity. Many residents value the presence of nature in their city, which they express by putting up nest boxes and bee hotels and by feeding birds in winter.



Recommendations

- ▶ Green roofs and façades can also be used to increase biodiversity, and act as effective links between different green areas.
- ▶ Different groups of organisms have different requirements.
- ▶ Ozinga et al. (2022) have drawn up eco-profiles for pollinating insects such as wild bees, hoverflies and butterflies. Green zones should not be more than 100 metres apart.⁴
- ▶ More information is available in the Urban Greenery and Water Management fact sheet (<http://edepot.wur.nl/460542>).

How greenery works

- ▶ Although the numbers are relatively low in cities, an international study showed that the majority of bird and plant species in cities are native species. As a result, urban greenery serves to enhance and protect biodiversity.¹
- ▶ A variety of plant species is a great way to encourage biodiversity in urban areas. Planting pollen and nectar bearing trees, shrubs and perennials is important to attract bees, butterflies and other insects. Birds and small mammals also do better in areas with plenty of diversity.²
- ▶ Non-native plants can be a valuable addition to native species in urban environments: they increase biodiversity and extend the blooming season, providing more food for pollinating insects.³
- ▶ Urban areas with 10% vegetation can provide a good habitat for butterflies and bees, provided that the vegetation is varied and offers sufficient food and shelter, and the areas are spread out through the city like a network.⁴
- ▶ Information about the costs and benefits of pollinator-friendly management has been compiled for green space managers. In many cases this type of management is no more expensive, or even cheaper, than regular management.⁵



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Noise

Greenery is crucial to the way noise and noise pollution from traffic and industry are perceived. Firstly, greenery can (slightly) limit direct exposure to sound waves by absorbing and dispersing sound waves.¹ Secondly, the sound made by trees and plants, both directly (rustling) and indirectly (birds), is generally considered to be quite pleasant and it can partially mask other noises. This fact, along with the higher quality of the (green) living environment, can serve to draw attention away from sources of noise pollution, making them less annoying. Hence, vegetation can reduce perceived levels of noise pollution. It usually has little to no effect on the actual volume of the noise; spaced-out plants normally create no audible drop in noise. Using vegetation as a noise barrier requires very dense planting, as even green noise barriers must be properly sealed.



Recommendations

The chief noise control measures in urban areas are noise barriers and measures directed at the source of the noise. The use of greenery can have a supplementary function:

- ▶ Green façades increase sound insulation of buildings.
- ▶ Green façades reduce reflection of noise, strongly decreasing the overall level of noise.
- ▶ Greenery contributes to reducing the amount of noise pollution experienced when the green structure obstructs noise sources from view.

How greenery works

- ▶ City dwellers who live near parks or other green spaces perceive the same level of noise pollution to be less annoying than those who do not have a park or other green space near their home.²
- ▶ Green façades can help to soundproof buildings.³
- ▶ Vegetation can also have a positive effect simply by obstructing noise sources from view. Also, a well-placed row of trees behind a noise barrier can enhance its effect¹, especially when trees in the right size category are planted.⁴
- ▶ Green roofs and façades help to reduce noise pollution by limiting the reflection of noise. A recent Australian study reported a significant drop in noise levels near green walls compared with bare reference walls. The magnitude of the effect depends on the type of noise and the surroundings, varying from a few dB to an exceptional -12 dB.



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Further information

This fact sheet is one of a series of five fact sheets on the added value of greenery in our living environment. The other fact sheets take a closer look at greenery in residential, work, education and healthcare contexts

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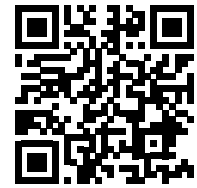
More information can be found on the websites of De Groene Stad, Groen Kennisnet and Wageningen UR:

- ▶ <https://www.wur.nl/nl/onderzoek-resultaten/onderzoeksprojecten-lnv/expertisegebieden/kennisonline/de-groene-agenda-2020-2023-valorisatie-van-groene-kennis-voor-een-klimaat-adaptieve-en-leefbare-stad.htm>
- ▶ www.degroenestad.nl
- ▶ groene-agenda.nl
- ▶ groenkennisnet.nl

Specific questions on reference projects, research results, etc., can be sent directly to info@degroenestad.nl.



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