GREENERY: MORE THAN BEAUTY AND HEALTH

The positive effects of greenery in urban environments

Version 3

Greenery in our living environment benefits more than just our health and well-being. It also facilitates water management and promotes biodiversity in built-up areas, and can help reduce the effects of noise pollution. Greenery also helps to raise the property value of homes and offices. 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?

Groen in de stad vermindert de benodigde afvoercapaciteit van het riool, doordat in groengebieden de neerslag (grotendeels) in de bodem weg kan zakken en doordat een klein deel van de opgevangen neerslag weer verdampt vanaf het oppervlak van het groen.

› The judicious planting of green areas (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.

› 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]

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.

PROVEN SUCCESSES

› The presence of greenery in the immediate vicinity of houses in creases their value by 4-15%, depending on local conditions.[2]

› Reserving 10% of urban areas for varied greenery provides plenty of habitat for butterflies and bees.[3]

› Based on the gains made in the field of 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]

› 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 information on Residential, Work, Education and Healthcare environments (see last page), or see the references cited in this document.

Sources:

1 FAO (2016), Forestry Paper 178.

2 J.C.A.M. Bervaes & J. Vreke (2004), De invloed van groen en water op de transactieprijzen van woningen. Alterra-rapport 959. WUR-Alterra, Wageningen.

3 M. Hoffman (2010), Biodiversiteit in tuin en plantsoen. Uitgave PPH, Boskoop.

4 Buck Consultants International (2016), Waardestelling groen in Den Haag.

5 E. Bos & T. Vogelzang (2018), Groei versus groen. Drie casestudy's over de waarde van het stadsgroen in Amsterdam [Growth versus greenery. Three case studies on the value of urban greenery in Amsterdam]. Rapport 344 Wageningen Economic Research.

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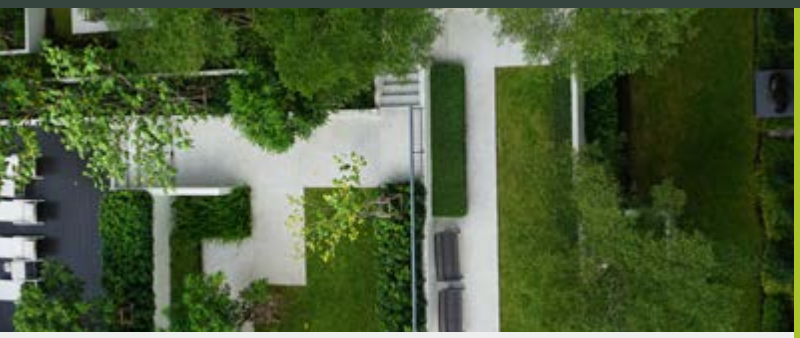

HOW GREENERY WORKS

› Vegetation reduces the amount of rainwater that needs to be processed. 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 aids in this regard, trapping more rain than a hard surface 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 can evaporate from the ground. Vegetation in urban areas can also approach these figures.[1]

› In vegetated areas, water is free to infiltrate the soil, replenishing the groundwater and ultimately the underground water supply. Some of this water is absorbed later by the vegetation, and some of it will evaporate. This means that less water needs to be channelled away than from surfaced areas, and the process is also slower (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 (especially on large buildings, such as factories, hospitals and large office complexes) help reduce peak intensity by retaining some of the rainfall, and delaying the flow of the remainder. Extensive green roofs (i.e. with a substrate of at least 15 cm) achieve the greatest effect, and can retain 50-80% of rainfall, allowing it to evaporate later.[3]

› Plants can sometimes also be used on industrial sites for the organic filtering of wastewater via helophyte filters, an application that also serves to reduce peak intensity.

› In cities, green shores and helophyte filters can be used to improve water quality. Vertical helophyte filters are effective in organically purifying household wastewater of contaminants such as nitrogen, phosphate and heavy metals. This requires 2.5 to 5 m^2 of helophyte filter per IE (inhabitant equivalent). Examples of this application are in use in various 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 local communities. A good example of this is the Zuidbroek district of Apeldoorn. The water that falls on roofs is channelled into gardens. From the gardens it flows to the street, and from the street into a broad green space known as a wadi. Only when the wadi is completely full is the water fed to an overflow.

› Research is currently being carried out into green roofs that have their own water supply system, which could store even more rain.[5]

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 through overflowing drains, flooded streets and cellars, etc. The Dutch Association of Insurers therefore 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 death, especially in inclined areas (e.g. South Limburg) where small streams of water can quickly become a torrent. Expanding green zones in built-up areas improves water management and reduces the adverse effects of peak rainfall.

RECOMMENDATIONS

› Increasing the ratio of vegetated areas to surfaced/built-up areas reduces the amount of water requiring processing. Green roofs contribute in this regard.

› Deep-rooted plants (trees and bushes) facilitate the penetration of water into deeper substrates. Variation in vegetative ground covers (trees in combination with shrubs and undergrowth) are most effective, and also serve to prevent compaction and erosion.

› 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 both temporary (and sometimes extremely) high water levels and also dry periods; planting trees at the wadi's edge (instead of inside it) provides more scope.

› Planted 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://edepot.wur.nl/460541)

Sources:

1 A.J.M. Gerrits (2010), The role of interception in the hydrological cycle. Proefschrift TU Delft.

2 W.H. Green & G.A. Ampt (1911), Studies on soil physics. The Journal of Agricultural Science 4(1):1-24.

3 K.L. Getter & D.B. Rowe (2006), The role of extensive green roofs in sustainable development. HortScience 41(5):1276-1285.

4 Aquarama (2011), Rietland bvba wil rietveldsysteem op een hoger plan tillen. Aquarama nummer 51, Dossier Waterzuivering & Hergebruik.

5 www.projectsmartroof.nl.

6 www.operatiesteenbreek.nl

Compilation: Wageningen University & Research: Dr J.A. Hiemstra, Dr S. de Vries and J.H. Spijker

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PROPERTY PRICES AND ATTRACTIVENESS

Greenery makes an area more appealing, and plays a role in attracting particularly mid-to-high income earners to urban areas.

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]

› The greenery in The Hague increases the value of all the city's residential properties by approx. €1.9 billion, an average of approx. €7,500 per property, and increases 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 attractiveness of the environment is not crucial, but it is becoming an increasingly important criterion for knowledge-intensive businesses.[3,4]

› Crime in green neighbourhoods is lower, and residents feel safer than in areas without local greenery.[4]

ADVANTAGES

› Some investments in local greenery pay for themselves through increased property values, or – in the case of public-sector investments – through higher tax revenue (Valuation of Immovable Property Act, notional rental value).

› 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.

Sources:

1 J.C.A.M. Bervaes & J. Vreke (2004), De invloed van groen en water op de transactieprijzen van woningen. Alterra-rapport 959. WUR-Alterra, Wageningen.

2 Buck Consultants International (2016), Waardestelling groen in Den Haag.

3 E.M. Jókövi & J. Luttik (2003), Rood en groen. Het combineren van verstedelijking en natuur in de praktijk. Wageningen.

4 M.K. Wolfe & J. Mennis (2012), Does vegetation encourage or suppress urban crime? Evidence from Philadelphia, PA. Landscape and Urban Planning 108(2-4):112-122.

Compilation: Wageningen University & Research: dr.ir. J.A. Hiemstra, dr. S. de Vries en ir. J.H. Spijker

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BIODIVERSITY

'Biodiversity' refers to the variety of living organisms. A wide range of different types of vegetation 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 source of food for birds and other animals. Pollinators (and pollination) therefore constitute an important link in ecosystems, making them essential to biodiversity. Many city residents value the presence of nature, which they express by putting up nestboxes and bee hotels, and feeding birds in the winter time.

HOW GREENERY WORKS

› Although the numbers in cities are relatively low, an international study indicates 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 and other insects.[3]

› Just 10% vegetation in urban areas can provide a good habitat for butterflies and bees, provided that the vegetation is varied and provides 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 is no more expensive, or even cheaper, than regular management.[5]

RECOMMENDATIONS

› Green roofs and façades can also be used to increase biodiversity, and also act effectively as links between different green areas.

› Different groups of organisms have different requirements.

› Van Rooij et al. have drawn up eco-profiles for pollinating insects such as wild bees, hoverflies and butterflies. Green zones must be no more than 100 metres apart.[4]

› More information is available in the Urban Greenery and Water Management fact sheet (http://edepot.wur.nl/460542)

Sources:

1 M.F.J. Aronson et al. (2014), A global analysis of the impacts of urbanization on bird and plant diversity reveals key anthropogenic drivers. Proceedings of the Royal Society B 281:20133330.

2 M. Hoffman (2010), Biodiversiteit in tuin en plantsoen. Uitgave PPH, Boskoop.

3 A. Salisbury, J. Armitage, H. Bostock, J. Perry, M. Tatchell & K. Thompson (2015), Enhancing gardens as habitats for flower-visiting aerial insects (pollinators): Should we plant native or exotic species? Journal of Applied Ecology 52:1156-1164.

4 S. van Rooij, A. Corment, W. Geertsema, M. Haag, P. Opdam, M. Reemer, R. Snep, J. Spijker, E. Steingröver & A. Stip (2016), Een bij-zonder kleurrijk landschap in Land van Wijk en Wouden. Handreiking 2.0 voor inrichting en beheer voor bestuivende insecten. Groene Cirkels Rapport nr. 5. WUR-Alterra, Wageningen.

5 A. de Jong, H. Korthof, A. Piepers & M. Rosaria 2018. Kosten en baten bijvriendelijk beheer. www.groenecirkels.nl

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NOISE

Plants and vegetation are crucial to the way noise and noise pollution from traffic and industry are perceived. Firstly, the sound made by trees and plants is generally considered to be quite pleasant, both directly (rustling) and indirectly (birds), and it can partially mask other noises. This fact, along with the higher quality of the living environment (due to the greenery) can serve to draw attention away from sources of noise pollution, making them less bothersome. Vegetation can then also 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 sound. Using vegetation as a sound barrier requires very dense planting, as even green noise barriers must be properly sealed.

HOW GREENERY WORKS

› City-dwellers who live near parks or other green spaces perceive the same level of noise pollution to be less bothersome than city-dwellers who do not have a park or other green space near where they live.[1]

› Green façades can help soundproof buildings.[2]

› Vegetation also has a positive effect simply by obstructing noise sources from view. Planting trees in the right size category helps.[3]

Sources:

1 A.M. Dzhambov & D.D. Dimitrova (2015), Green spaces and environmental noise perception. Urban Forestry & Urban Greening 14:1000-1008.

2 Z. Azkorra, G. Pérez, J. Coma, L.F. Cabeza, S. Bures, J.E. Álvaro, A. Erkoreka & M. Urrestarazu (2015), Evaluation of green walls as a passive acoustic insulation system for buildings. Applied Acoustics 89(March):46-56.

3 Factsheet – Soortentabel; http://edepot.wur.nl/460540

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FURTHER INFORMATION

This document is one of a series of five on the added value provided by greenery in our living environment.

The remaining documents take a closer look at Residential, Work, Education and Healthcare environments.

All the documents and large amounts of background information can be found through the Greenery and Well-being portal of www.groenkennisnet.nl

There are many real-life applications and studies that illustrate and demonstrate the added value of vegetation. Other useful sources of information include:

- https://www.groenkennisnet.nl/nl/groenkennisnet/portalen/leefomgeving/groen-en-welbevinden.htm
- https://ruimtelijke adaptatie.nl/hulpmiddelen/factsheets-groen/
- This also provides a table listing 120 tree species and their specific benefits as vegetation.
- www.degroenestad.nl
- www.royalfloraholland.com
- www.wur.nl

Specific questions on topics such as reference projects, research results, etc. can be sent directly to joop.spijker@wur.nl

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