Green Infrastructure and **Public Health**

What is Green Infrastructure?

Green Infrastructure "is a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services. It incorporates green spaces (or blue if aquatic ecosystems are concerned) and other physical features in terrestrial (including coastal) and marine areas. On land, GI is present in rural and urban settings." Linked together, these strategically planned networks of green elements are able to provide multiple benefits in the form of supporting a green economy, improving quality of life, protecting biodiversity and enhancing the ability of ecosystems to deliver services such as disaster risk reduction, water purification, air quality, space for recreation and climate change mitigation and adaption.

The European Green Infrastructure Strategy

The Green Infrastructure Strategy proposed by the European Commission, promotes the development of Green Infrastructure across the EU delivering economic, social and ecological benefits and contributing to sustainable growth. It guides the implementation of Green Infrastructure at EU, regional, national and local levels. A main feature of the Green Infrastructure Strategy is its integration into relevant policies through: ecosystem-based adaptation into climate change policies; nature-based solutions into research and innovation policies; natural water retention measures into water policies; and through its focus on delivering multiple ecosystem services and their underlying factor - a rich biodiversity - into nature policies. The Natura 2000 network in particular plays a major role in protecting many of the core areas with healthy ecosystems.

The 2012 Science for Environment Policy in-depth report on the Multi-functionality of Green Infrastructure has a strong focus on public health benefits of Green Infrastructure. Recent reports on Nature Based Solutions stress the importance of urban green infrastructure for urban health and wellbeing. At the time of writing, a new report is also under preparation under the Health and Social Benefits of Nature and Biodiversity Protection project.

As Green Infrastructure can make a significant contribution to many sectors and EU policy objectives, Green Infrastructure is being integrated into many funding streams including Structural Funds (the European Regional Development Fund (ERDF); European Social Fund (ESF)), the Cohesion Fund (CF), the European Maritime and Fisheries Fund (EMFF), the European Agricultural Fund for Rural Development (EAFRD), LIFE+ and Horizon 2020 project funds and the Natural Capital Financing Facility (NCFF) of the European Investment Bank (EIB).

Links between Public Health and Green Infrastructure

The World Health Organization defines human health not simply in terms of lack of illness or disease, but as 'a state of complete physical, mental and social wellbeing'. The Science for Environment Policy In-depth Report on The Multi-functionality of Green Infrastructure draws a conceptual framework linking Green Infrastructure, ecosystems and human health. It distinguishes eight types of Green Infrastructure that have an impact on eight ecosystem functions and services (air purification; climate and radiation regulation; water purification; soil and nutrient cycling; habitat provision; waste decomposition; aesthetic and spiritual; noise pollution control) and six aspects of ecosystem health (air quality; soil structure; energy and material cycling; water quality; habitat and species diversity; ecosystem resilience). Together these interact with four socio-economic health factors (income and employment; education and lifestyle; living and working conditions; access to services and housing), four community health aspects (sense of community identity; community empowerment; social capital; culture), six aspects of physical health (cardiovascular; endocrine functions and immunity; nervous system; respiratory; digestive; bone tissue) and four

aspects of psychological health (relaxation from stress; positive emotions; attention capacity; cognitive capacity). It is a complex system and many of the interactions are two-way. Some of the most important links are as follows:

- Green Infrastructure helps to regulate air quality by removing contaminants through filtration, decomposition and assimilation;
- Improved noise abatement, trees and shelter belts provide sound screening from traffic noise for human settlements;
- Urban Green Infrastructure helps to regulate the urban heat island effect thereby reducing heat stress;
- Green Infrastructure areas encourage physical activity, which is linked to many aspects of physical and mental health;
- Opportunities for contact with nature offer stress reduction, which is linked to many aspects of physical and mental health; and
- Attractive, Green Infrastructure particularly in cities promotes social cohesion and reduces social inequalities; in turn leading to reduced public health issues linked with inequality (such as diet related health concerns).

Costs & benefits of Green Infrastructure in relation to Public Health

The benefits of Green Infrastructure encompass physical, psychological / emotional and socio-economic benefits and can be identified at both the individual and community level. The presence of Green Infrastructure features increases time spent outdoors (independent of age, sex, marital and socio-economic status), which in turn affects physical and mental health. Access to walkable green streets and spaces has been associated with, e.g., increased longevity, reduced blood pressure and body mass index, reduced risk of a stroke, cardiovascular disease and obesity. Active contact with nature has been found to significantly reduce blood pressure, while participating in activities in green settings improves the functioning of children with attention deficit disorder. Green spaces that are visible from home reduce residents' mental fatigue and depression. Natural features and open spaces also play an important role in social cohesion at the community level. For example, Green Infrastructure has been found to increase the likelihood of informal interactions and help promote a sense of community spirit. It may also reduce crime rates. Finally, nature can have cultural and aesthetic value which, in turn, can improve the sense of wellbeing and health.

In England, the benefits of urban greenspaces for physical and mental health have been estimated at EUR 2-3 billion in averted health costs (ENV, 2012 and references therein). All the health issues above are linked to employability and sick leave. For the Netherlands, KPMG has estimated a gain of hundreds of millions of EUR per year by greening neighbourhoods. Reducing sick leave by only 1% would save billions of EUR.

The benefits of Green Infrastructure must be weighed up against the social and economic costs, including 'lost opportunity' costs. Additionally, unintended consequences of Green Infrastructure must be taken into account, such as the health risk of biting arthropods (e.g., ticks, mosquitoes) potentially carrying diseases (e.g., Lyme, West Nile Virus) allergic reactions to, e.g., pollen, and the spread of invasive species or pathogens. Weighing-up such "ecosystem disservices" against the reported positive effects indicates that Green Infrastructure brings multiple benefits at comparatively little cost. Moreover, with Green Infrastructure improvement / restoration, the respective ecosystems generally become less vulnerable against the risk of invasive alien species spreading. Green Infrastructure measures can therefore contribute to the prevention of invasive species.

Good practices in Public Health & Green Infrastructure

Urban cooling (Lleida, Catalonia, Spain)

Climate change comes with an increase in temperature and frequency of heat waves. Absorption of heat by dark surfaces in urban areas can significantly increase the temperature (the 'urban heat island' effect). Excessive heat presents a range of health risks, including potentially fatal heat stroke. Scientists monitored the behaviour of a green façade in Lleida (Catalonia, Spain), to test its ability to mitigate the "urban heat island" effect through shading and evapotranspiration. Results revealed a significant shading effect which peaked in July and August as the leaves reached maximum size. The surface temperature of the wall in an area that was unshaded by vegetation was on average 5.5ºC higher than in partially covered areas. The difference was higher in August and September, with a maximum of 15.2ºC.

Green Infrastructure and **Public Health**

Green care

In the 1980s, Roger Ulrich showed that patients recovering from cholecystectomy (gall bladder surgery) fared better if they had a view of trees from their hospital bed than a view of a brick wall, inspiring a 'green care movement'. 'Green Care' is a range of activities that promotes physical and mental health and well-being through contact with nature. It utilises farms, gardens and other outdoor spaces as a therapeutic intervention for vulnerable adults and children. Green care includes care farming, therapeutic horticulture, animal assisted therapy, facilitated green exercise interventions, ecotherapy, wilderness therapy and other nature-based approaches. A special case of green care is the use of 'dementia gardens'.

Greening school grounds

The International School "Grounds Alliance" is a global network of organisations working to enrich and green children's learning and play through improving the way school grounds are designed and used. The well-being of children and the ecological diversity of their learning landscapes are intrinsically linked. A survey of UK schools that have improved their school grounds demonstrates the benefits: 85% said that healthy active play had increased; 65% observed improved attitudes to learning; 73% said behaviour had improved; 64% reported reduced bullying; 84% reported improved social interaction. In Berlin, Germany, an increase in playground violence led to a radical transformation from asphalt yards to green natural playgrounds. The reported impact has been extraordinary with violence more or less disappearing and teachers reporting children are happier in class as well as outdoors. Greener school grounds thus can promote more active, more environmentally-conscious and more balanced school children; qualities which will also improve their health status once they move into adolescence.


Greener school grounds


air quality

Challenges and opportunities

The health system in Europe is challenged by ever-increasing costs due to, inter alia, the ageing of the population. Costs for society of, e.g., dementia, obesity, cancer and cardiovascular disease are increasing rapidly. Dementia is a very expensive disease and is expected to have an increase in prevalence of 90% between 2013 and 2050. The total cost of illness of dementia disorders in EU27 in 2008 was estimated to EUR 160 billion, of which 56% were costs of informal care.

Green Infrastructure promotes healthy lifestyles, healthy lifestyles lead to active and healthy ageing, which in turn reduces health costs and improves quality of life of patients and their formal and informal caregivers. Other opportunities are: greening schoolyards to fight child obesity and diabetes, greening business parks to improve employee health and wellbeing, greening cities for multifaceted benefits. This fits perfectly to the EU health-in-all-policies approach and the EU health policy theme 'Investing in Health': as well as being a value in itself, health is a precondition for economic prosperity.

Europe needs smart investments in public health as it relates to Green Infrastructure:

- Investing in people's health, particularly through health-promotion programmes; these can be directly linked with some Green Infrastructure measures (e.g. urban cycling paths).
- Connecting green spaces in urban areas to encourage physical activity in daily life.
- Spending smarter but not necessarily more in sustainable health systems; Green Infrastructure solutions sometimes offer a more cost-effective solution than conventional measures.

References

ENV, 2012. Science for environment policy. In-depth report on the multi-functionality of Green Infrastructure, March 2012. Available from: http://ec.europa.eu/environment/nature/ecosystems/docs/Green_Infrastructure.pdf

European Union Directorate-General for Research and Innovation Climate Action, Environment, Resource Efficiency and Raw Materials, 2015. Towards an EU Research and Innovation policy agenda for Nature-Based Solutions & Re-Naturing Cities; Final Report of the Horizon 2020 Expert Group on Nature-Based Solutions and Re-Naturing Cities. doi: 10.2777/479582

KPMG(2012). Report Groen gezond en productief. The Economics of Ecosystems & Biodiversity (TEEB NL) http://www.kpmg.com/NL/nl/IssuesAndInsights/ArticlesPublications/Documents/PDF/Sustainability/Groen-gezond-en-productief.pdf (in Dutch)

Sempik, J., Hine, R. and Wilcox, D. eds. (2010). Green Care: A Conceptual Framework, A Report of the Working Group on the Health Benefits of Green Care, COST Action 866, Green Care in Agriculture, Loughborough: Centre for Child and Family Research, Loughborough University.

Tzoulas, K., Korpela, K., Venn, S. et al. (2007) Promoting ecosystem and human health in urban areas using Green Infrastructure: A literature review. Landscape & Urban Planning 81:167-178.

Ulrich, R. S. (1984). 'View through a window may influence recovery from surgery'. Science, 224, 420-421.

Whear, R., Coon, J. T., Bethel, A., Abbott, R., Stein, K., & Garside, R. (2014). What is the impact of using outdoor spaces such as gardens on the physical and mental well-being of those with dementia? A systematic review of quantitative and qualitative evidence. Journal of the American Medical Directors Association, 15(10), 697-705.

Contract details: EC DG ENV, ENV.B.2/SER/2014/0012 "Supporting the implementation of the European Green Infrastructure Strategy"

Presented by: Trinomics, Alterra, Arcadis, Regional Environment Centre, Risk & Policy Analysis, Stella Consulting.