

Green infrastructure and Health

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UNIVERSITÀ
DEGLI STUDI
DI PADOVA

70TH AIPH ANNUAL CONGRESS

Padova, Italy
17th – 22nd September



AIPH

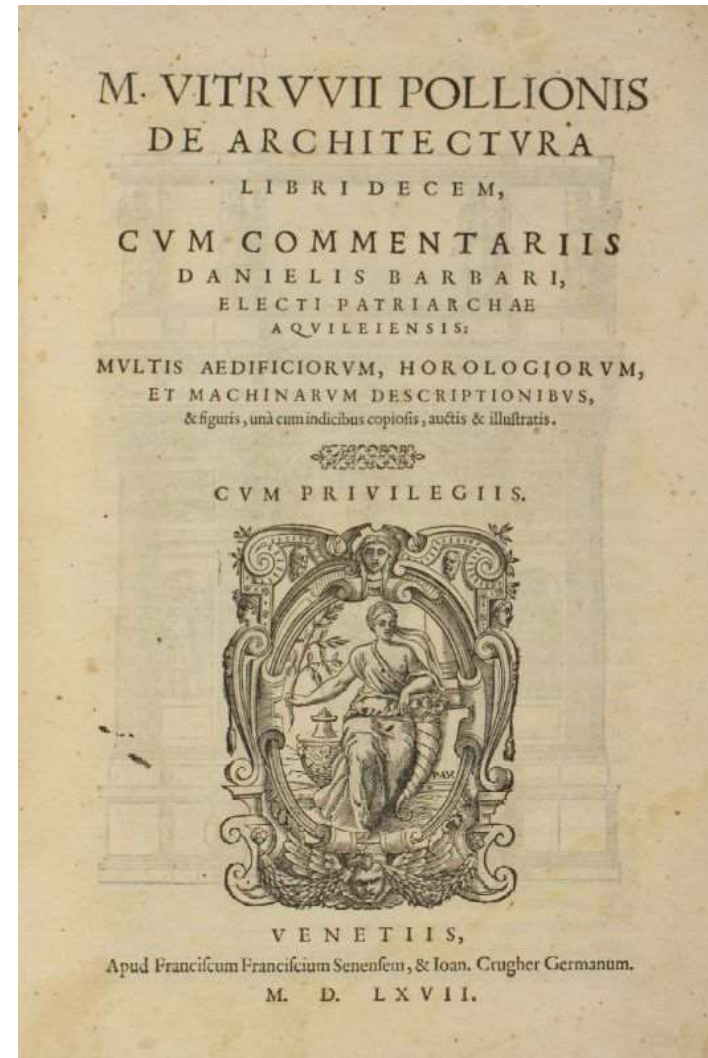


The role of green spaces as a tonic to urban society is certainly not a new concept

Classical theorists on city space and architectural and urban design ventured firm connections between green space and the health of citizens

‘Walking in the open air is very healthy, particularly for the eyes, since the refined and rarefied air that comes from green things, finding its way in because of physical exercise ... leaves the sight keen and the image distinct’ as well as ‘sucking the humours from the frame’

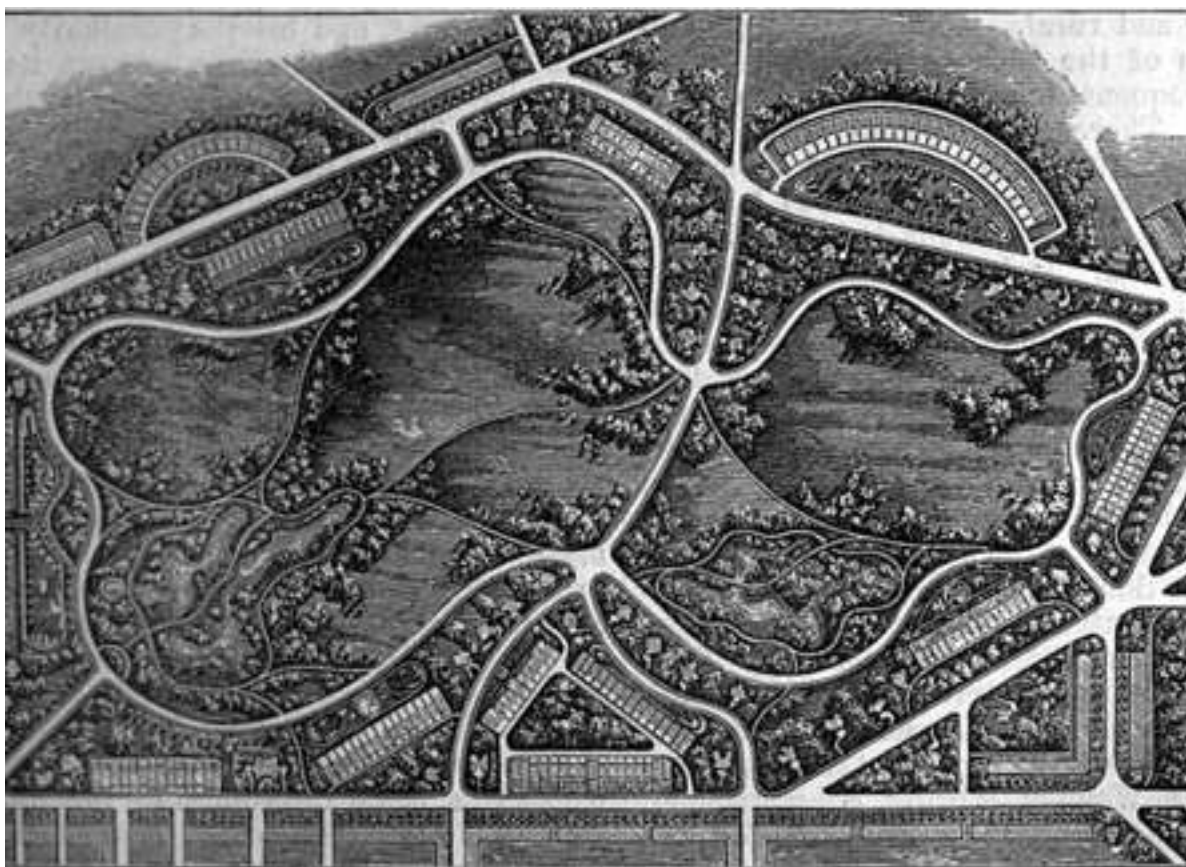
**Vitruvius (70 BC- 15 BC)
De Architectura**



More recently in the industrial revolution cities where squalor and filth characterised living conditions Urban parks emerged as a new important element in the urban context. The medical community believed these conditions created miasmas (obnoxious gases) that were the source of all diseases. Urban parks were perceived to provide oxygenised oases that offered protection against miasmas. They were viewed by government entities as contributing to reducing societal costs associated with pauperism and lost labour productivity, while individuals viewed parks as offering a defence against disease contagion and epidemics.



Urban parks were, therefore, first developed in the 19th Century to benefit health, reduce disease, crime and social unrest as well as providing 'green lungs' for the city.

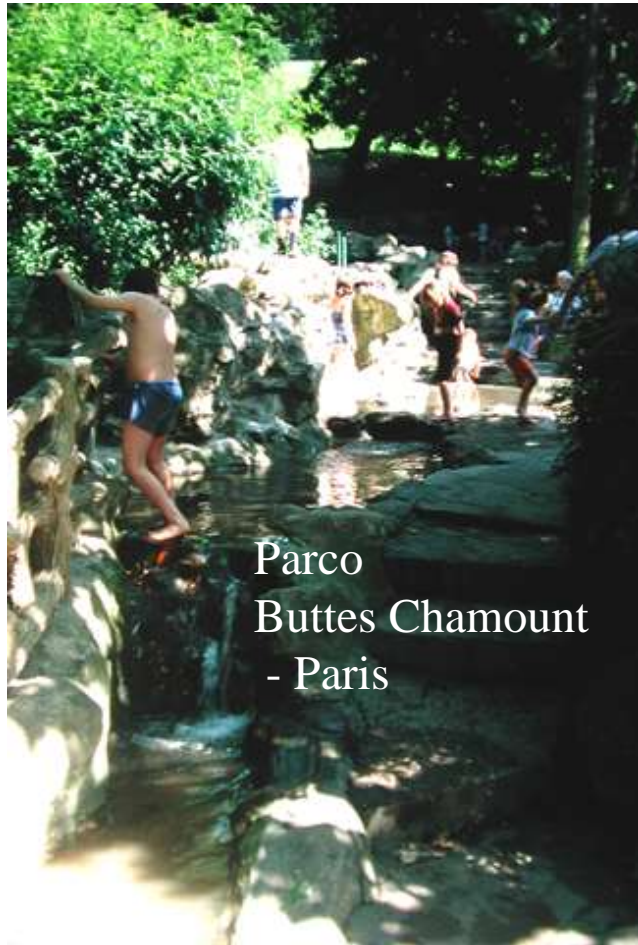


Birkenhead Park opened on 5 April 1847

A link, between the of the physical or biotic environment and the wellbeing of an urban citizenry that incorporated both literary-romantic ideas of nature and a developing professional medicine is also the basis of the diffusion of the Park Movement in many parts of the world.



19th century parks and urban greening is often still the most important part of the green infrastructure of today's cities



Parco
Buttes Chamount
- Paris



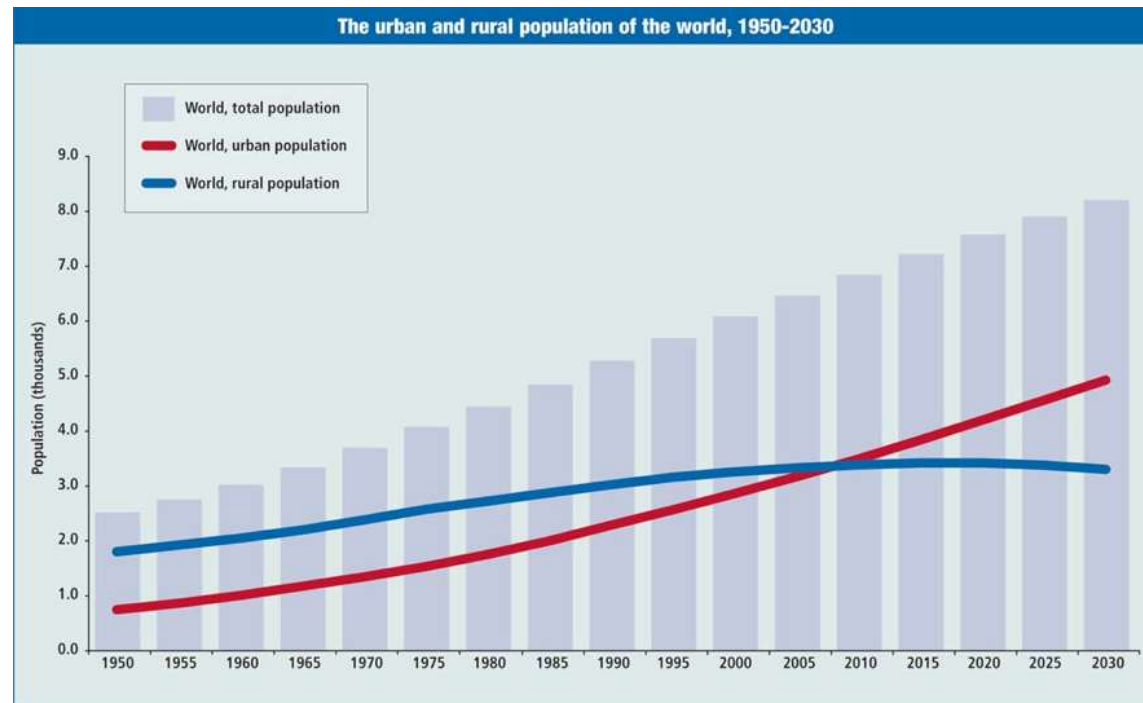
Central Park – New York City

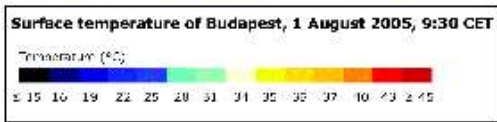
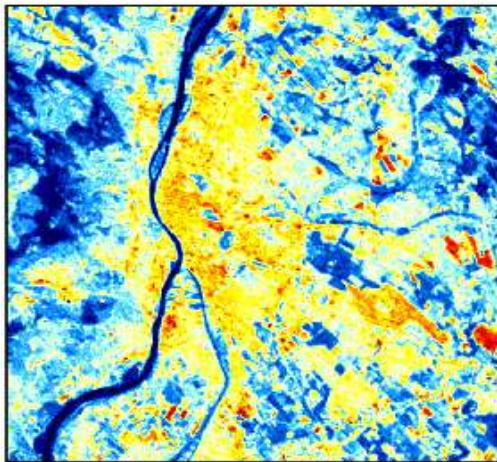
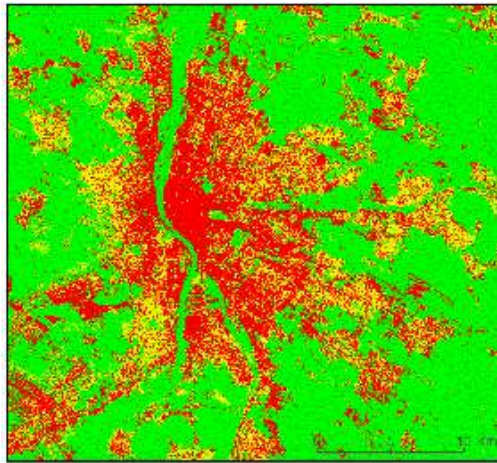


Parco del Valentino – Turin

Cities of today

Although cities and urban settlements cover less than 1% of the planet's surface, they are the nexus of human activity accommodating 54% of the population and 70–90% of economic activity. The percentage of the world's population living in urban areas is projected to increase from 54% in 2015 to 60% in 2030 and to 66% by 2050.





Urban growth resulted has caused many changes to the environment we live in:

Increase in air temperature (Urban Heat Island)

Air pollution

Increased stormwater run-off and flooding

Loss of water quality

Loss of natural areas and habitats

Habitat fragmentation

Loss of ecosystem resilience

Loss of opportunities for physical activity

Loss of contact with nature

Problems for human health and well-being

The role of green spaces in urban sustainability

The definition and the role of urban green spaces evolved rapidly in the last 20 years

Benefits and functions of
urban parks and trees

Ecosystem services

1850-1960

1965

2006

2012

Parks and urban greening

Urban forest

Green Infrastructure

Nature based solutions

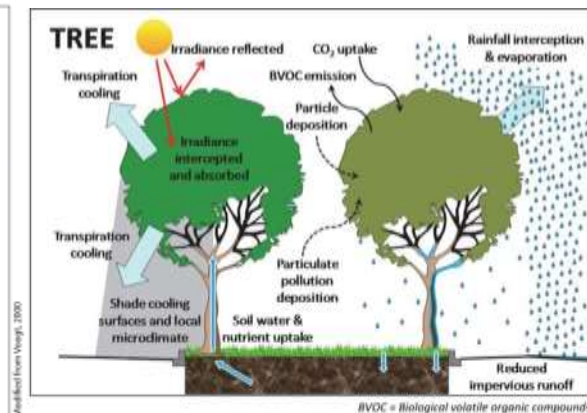
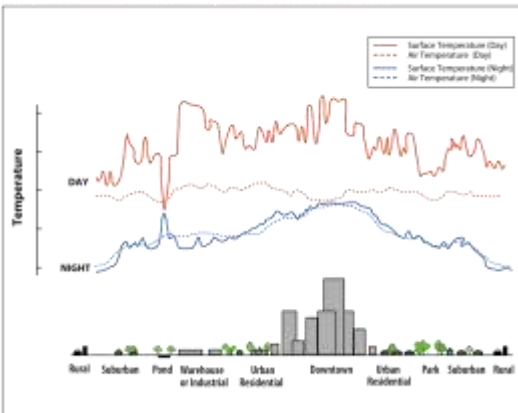


Concept introduced to
upgrade the urban green
spaces network to a
coherent planning entity

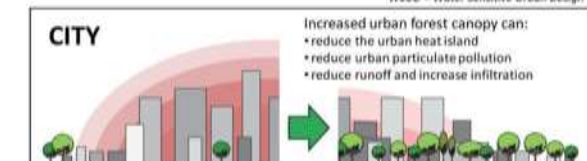
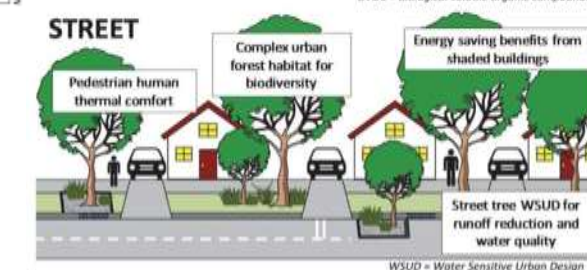
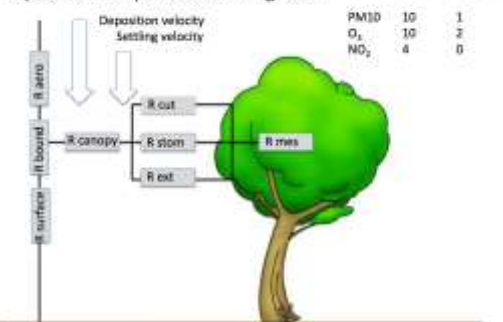


Green infrastructure ecosystem services

Figure 2: Variations of Surface and Atmospheric Temperatures



Deposition of particles and gases



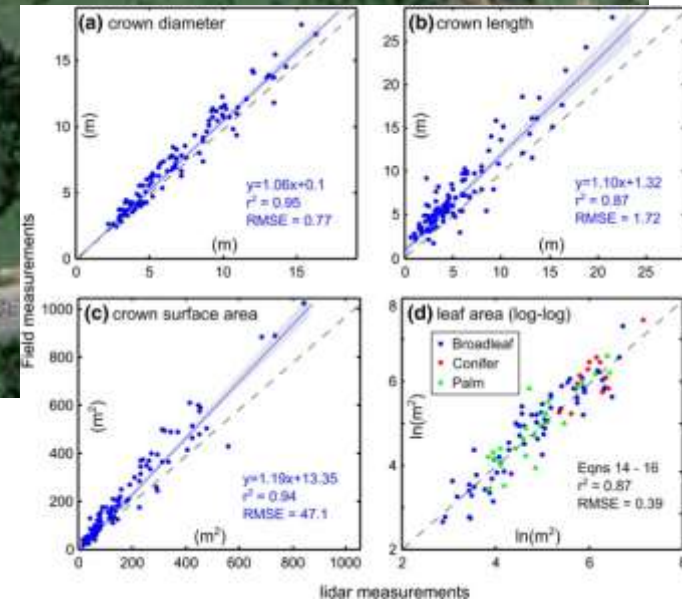
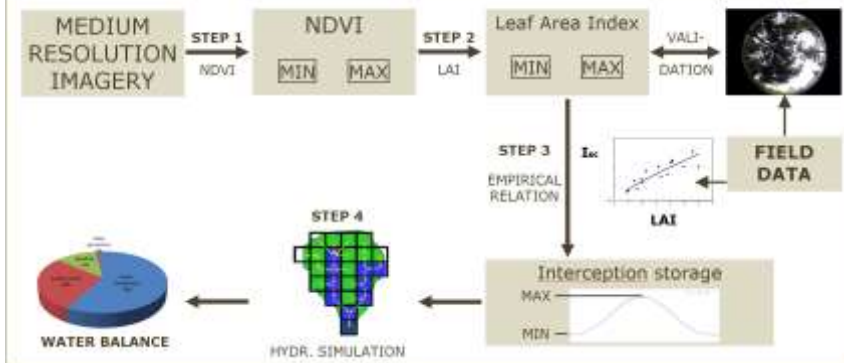
i-Tree Tools for Assessing and Managing Community Forests

Until recently research in urban forestry has primarily studied environmental services directly related to the presence of trees and vegetation.

Green infrastructure ecosystem services



EO BASED PARAMETERISATION of URBAN VEGETATION



They are more directly analyzed with quantitative methods, and models were developed based on measurable parameters such as canopy cover or leaf area.

Benefits for human health and well being

More recently urban forestry and urban planning researchers realized that they were likely missing a less understood but equally important part of the picture. Citizen's health and well being.



Benefits for human health and well being



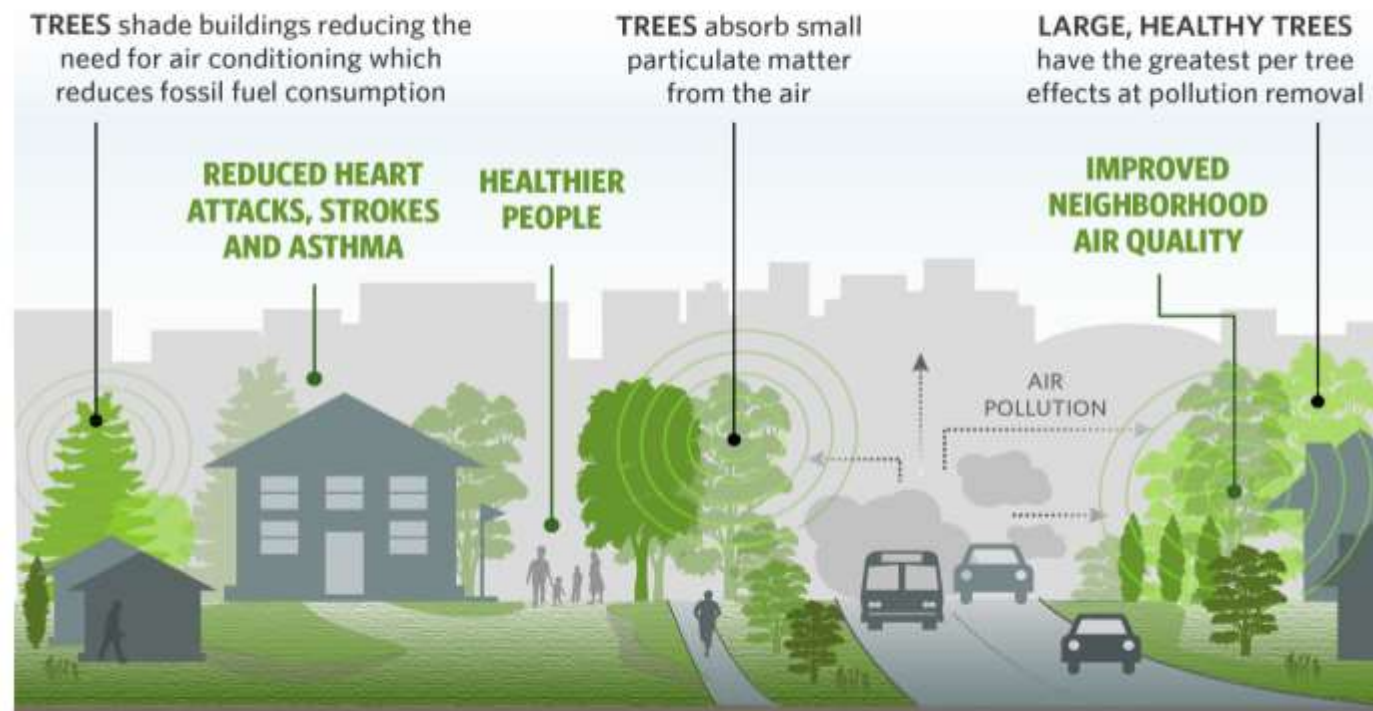
Definition of Health (WHO)

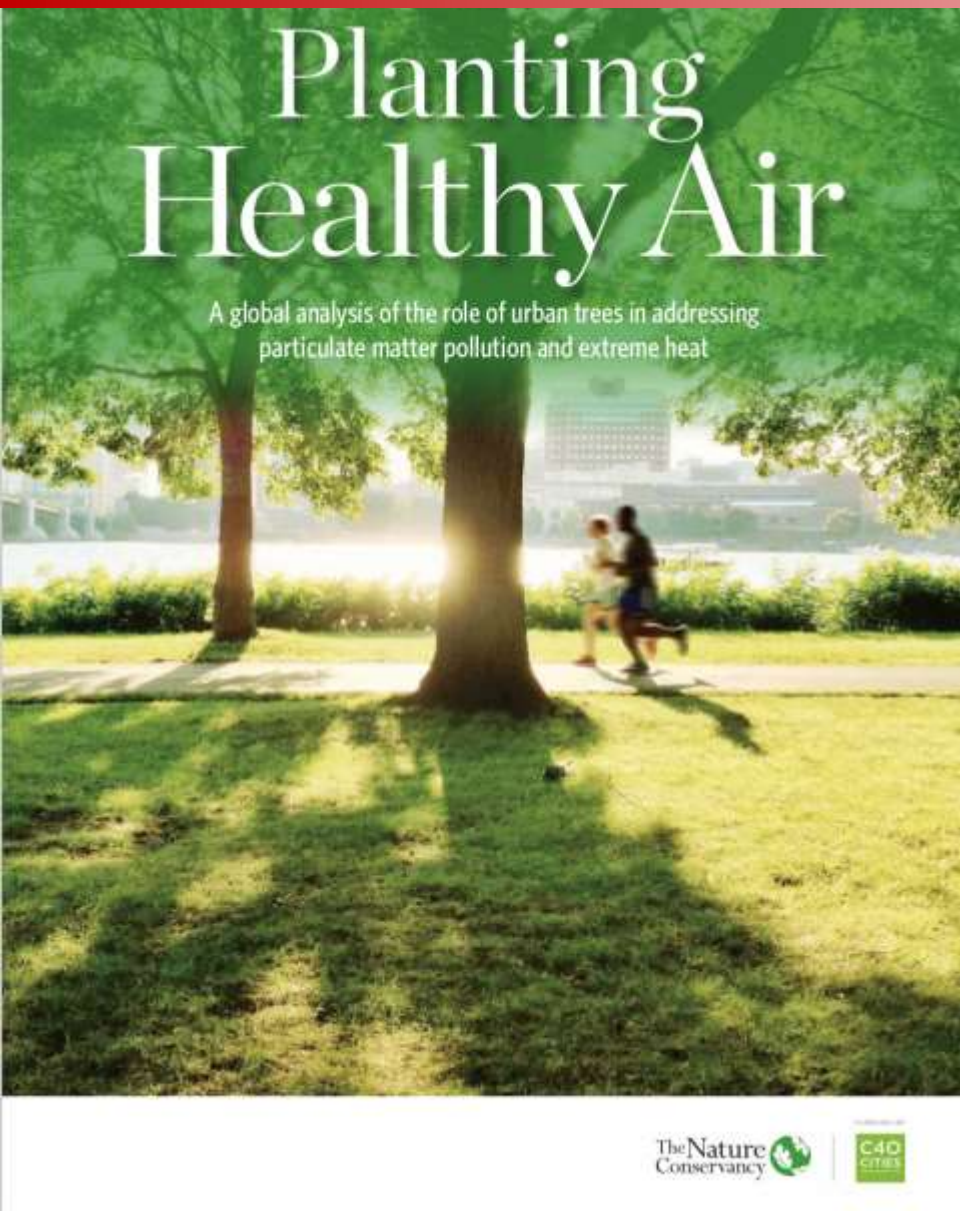


The effects on human health and well-being not only are essential for the quality of life in urban areas, but can also have a significant economic impact, considering the possible savings in healthcare expenditure

Benefits for human health and well being

- **Effects on human health directly related to changes to the physical environment**





Map 4. The forest cover (%) in cities globally in 2010.

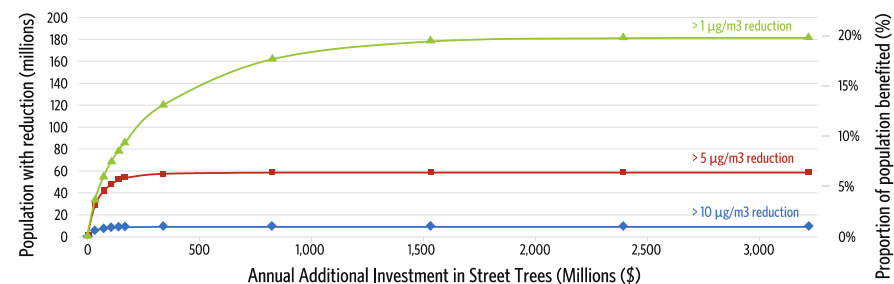


Figure 15. The global potential for street trees to benefit urban dwellers with reduced PM concentrations, given different annual investments in tree planting and maintenance. Results shown are for our Medium scenario of the effectiveness of trees in removing PM. Note that the curves for 5 and 10 $\mu\text{g}/\text{m}^3$ flatten out at high investment levels because there are relatively few cities (principally the most polluted) where street tree planting can remove more than this amount of pollution. Once investment in street tree planting has fully occurred in these cities, additional investment in tree planting won't increase the number of people receiving a reduction of more than 5 $\mu\text{g}/\text{m}^3$, but will continue to increase the number of people receiving more modest reductions of 1 $\mu\text{g}/\text{m}^3$.

Benefits for human health and well being



- Promoting changes in lifestyle (Physical activity)

Benefits for human health and well being



- Reduce stress (Restorative environments)



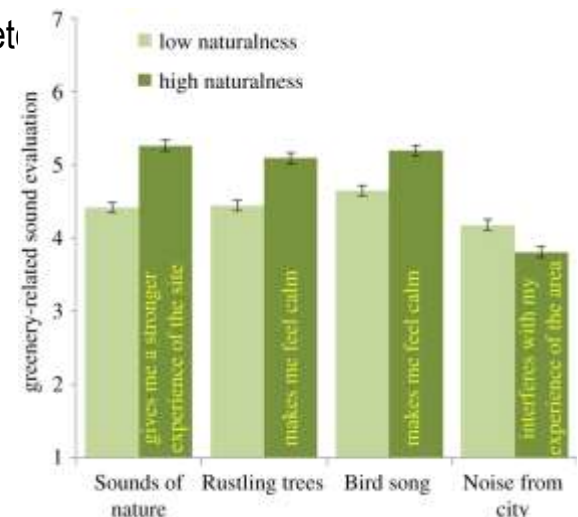
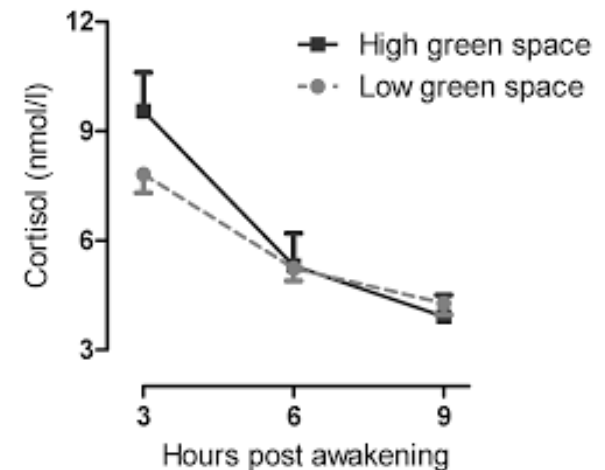
Benefits for human health and well being

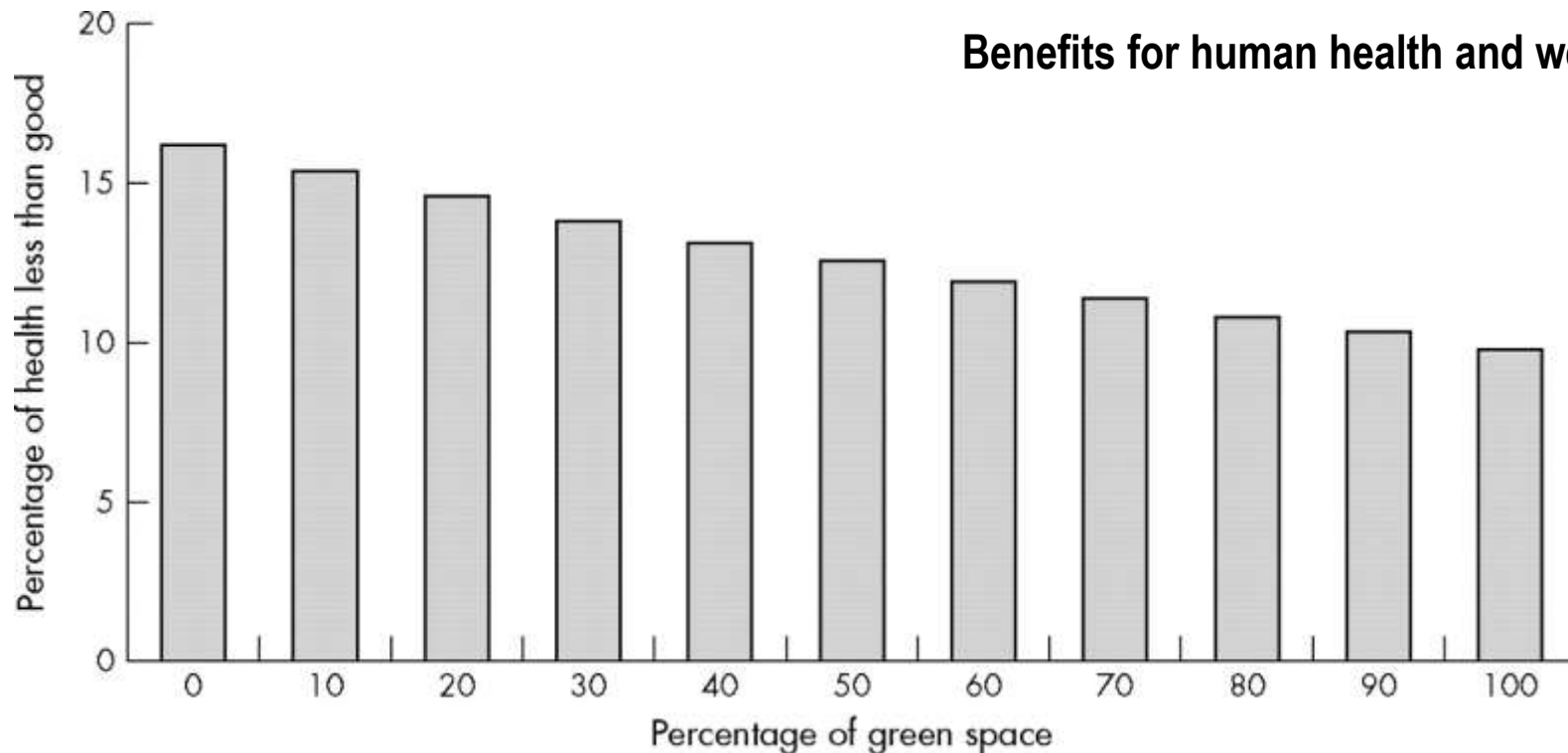
- Address specific health problems
 - Hospital gardens
 - Therapeutic gardens
 - Therapeutic horticulture



Benefits for human health and well being

- Epidemiological studies
 - Self reported health and well being
 - Data from physicians and health care databases
- Experimental studies
 - In controlled environment
 - In situ
 - self reported
 - Based on physiological parameters (cortisol levels, blood pressure etc)
- Survey studies
 - Studies on self-regulation of mood





Green space, urbanity, and health: how strong is the relation?

Jolanda Maas, Robert A Verheij, Peter P Groenewegen, Sierp de Vries, Peter Spreeuwenberg

J Epidemiol Community Health 2006;**60**:587-592. doi: 10.1136/jech.2005.043125

- A growing set of epidemiological studies provide evidence on the positive relationship between well-being, health and green space.



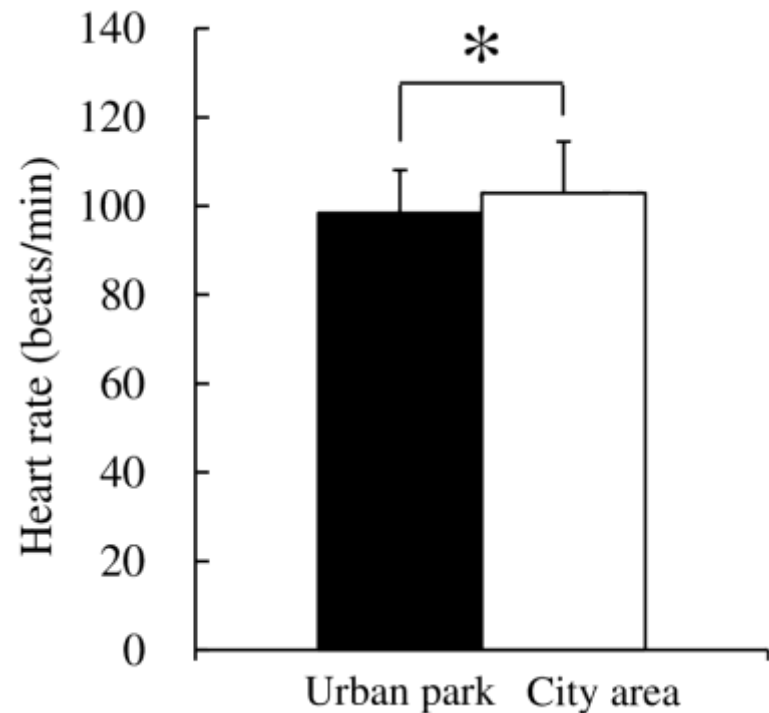
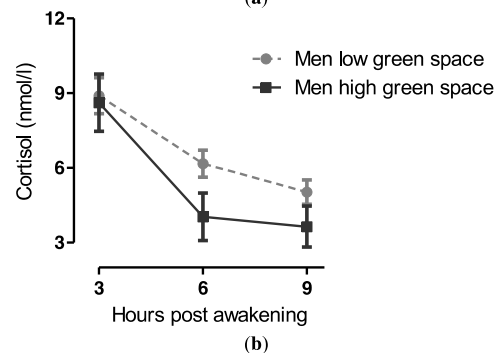
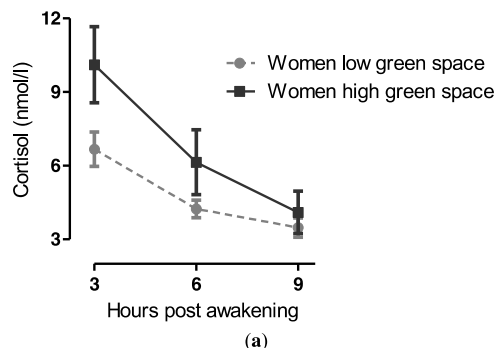
Benefits for human health and well being

- Large epidemiological studies found a positive correlation between the quantity of urban green space and the perception of general health.
- Other studies, based on physician assessed morbidity, or data from public health databases confirm the previously established relation between green space and self-reported general indicators of physical and mental health.
- Studies are showing that the availability of green spaces and nature may also lead to people spending a greater amount of time outdoors and being more physically active.
- Users of green spaces reported better general perceived health, higher levels of activity and the ability to relax faster.
- Indeed there is evidence of the importance of the quality of outdoor spaces on neighbourhood walking and physical activity.
- Evidence of the association between levels of physical activity and proximity of green areas in the neighbourhood have been provided

Benefits for human health and well being

Contact with nature has been shown to reduce both psychological indicators of stress as well as its physical markers, for example, cortisol level, heart rate, and blood pressure.

Figure 2. (a) Differences in mean cortisol slope in women living in high *versus* low green space areas. (b) Differences in mean cortisol slope in men living in high *versus* low green space areas.



Benefits for human health and well being

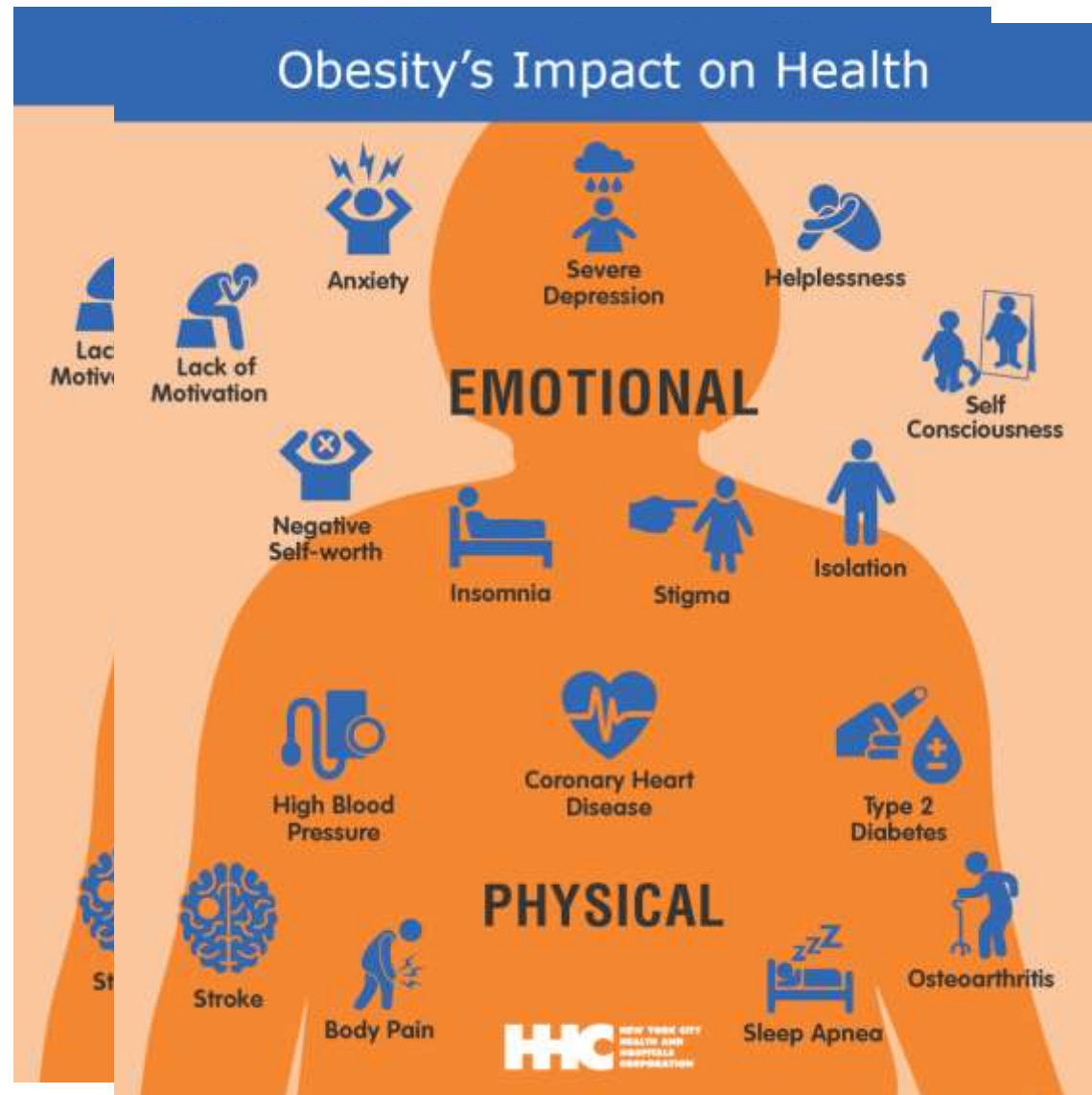


Studies have shown that performing activities in green settings can reduce children's Attention Deficit-Hyperactivity Disorder symptoms. ADHD is one the most common behavioral disorder among children. The symptoms of ADHD overlap with the symptoms of mental fatigue (e.g., distractability, irritability) caused by sustained and depleted directed attention. When parents were asked about the “aftereffects” of green outdoor activity on their children's ADHD symptoms, it was found that green



EFFECTS ON PHYSICAL HEALTH

One postulated mechanism by which green space influences physical health is through its effect on physical activity levels. Modification of the built environment to provide green space offers opportunities for beneficial 'green exercise' such as walking.



EFFECTS ON PSYCHOLOGICAL HEALTH

Physical and social features of the environment may also affect behaviour. The provision and access to green space also positively affects reported stress and quality of life.

The urban environment requires greater directed attention that can cause attention fatigue, and the natural environment provides the opportunity to recover from this fatigue with resultant cognitive improvements. In current research, the concept of *restorative environments* offers an interesting perspective for understanding the beneficial effects of contact with nature in human life.



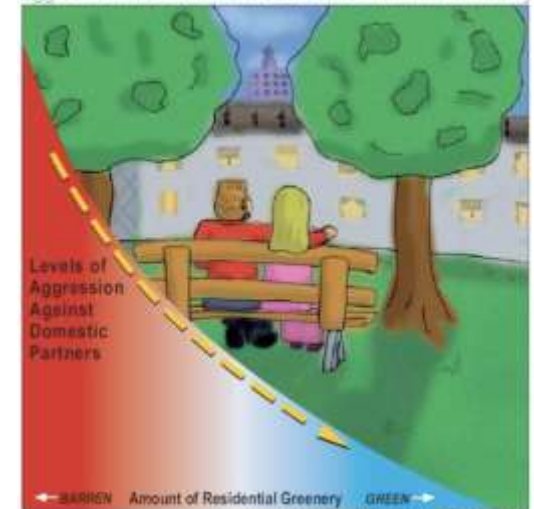
EFFECTS ON SOCIAL HEALTH

- Finally, recent studies also suggest that staying in touch with nature has a positive influence on cognitive, behavioural, and emotional development, interpersonal relations, and promoting positive social behaviour and altruism in children and adults.
- Strong evidence to suggest that green infrastructure, especially in the form of community gardens, is able to improve a community's social cohesion and capital, and some emerging evidence to suggest that it may reduce criminal, violent and aggressive behaviour, leading to safer communities.

Green Streets, Not Mean Streets In an inner city neighborhood, the greener the residence, the lower the crime rate.



Aggression and Violence are Reduced with Nature Nearby



EFFECTS ON PUBLIC SPENDING

Table 6. The economic health value of contact with nature in the UK. This table was sourced and adapted from Mourato et al. (2010).

| Type of Green Space | Change in Green Space | Tentative Annual Value (per person) |
|-------------------------------------------------------|--------------------------------------|-------------------------------------|
| Having a view over green space from your house | No view to any view | £135-£452 |
| Use of own garden | Less than weekly to weekly or more | £171-£575 |
| Use of non-countryside green space | Less than monthly to monthly or more | £112-£377 |
| Local freshwater, wetland, and flood plain land cover | +1% within 1km of the home | £20-£68 |
| Local enclosed farmland land cover | +1% within 1km of the home | £4-£12 |
| Local broad-leaved/mixed woodland land cover | +1% within 1km of the home | £8-£27 |

Table 8. Total estimated savings in healthcare costs in the Netherlands increased green space levels per annum. This table was sourced and adapted from KMPG (2012).

| Disease | Number of Fewer Patients | Estimated Savings in healthcare costs (€) |
|---------------------------------------|--------------------------|-------------------------------------------|
| Gastro-intestinal tract infections | 1,770 | 1,031,841 |
| Migraine | 7,587 | 480,374 |
| Diabetes | 2,529 | 2,820,041 |
| Asthma and COPD (+ respiratory tract) | 27,820 | 11,548,806 |
| Neck and back complaints | 24,026 | 4,231,571 |
| Depression and Anxiety | 20,232 | 43,984,118 |
| Coronary heart disease | 506 | 1,340,682 |
| Total | 84,470 | 65,437,433 |

Annual ealthcare saving with a 10% increase in urban green spaces in the netherlands

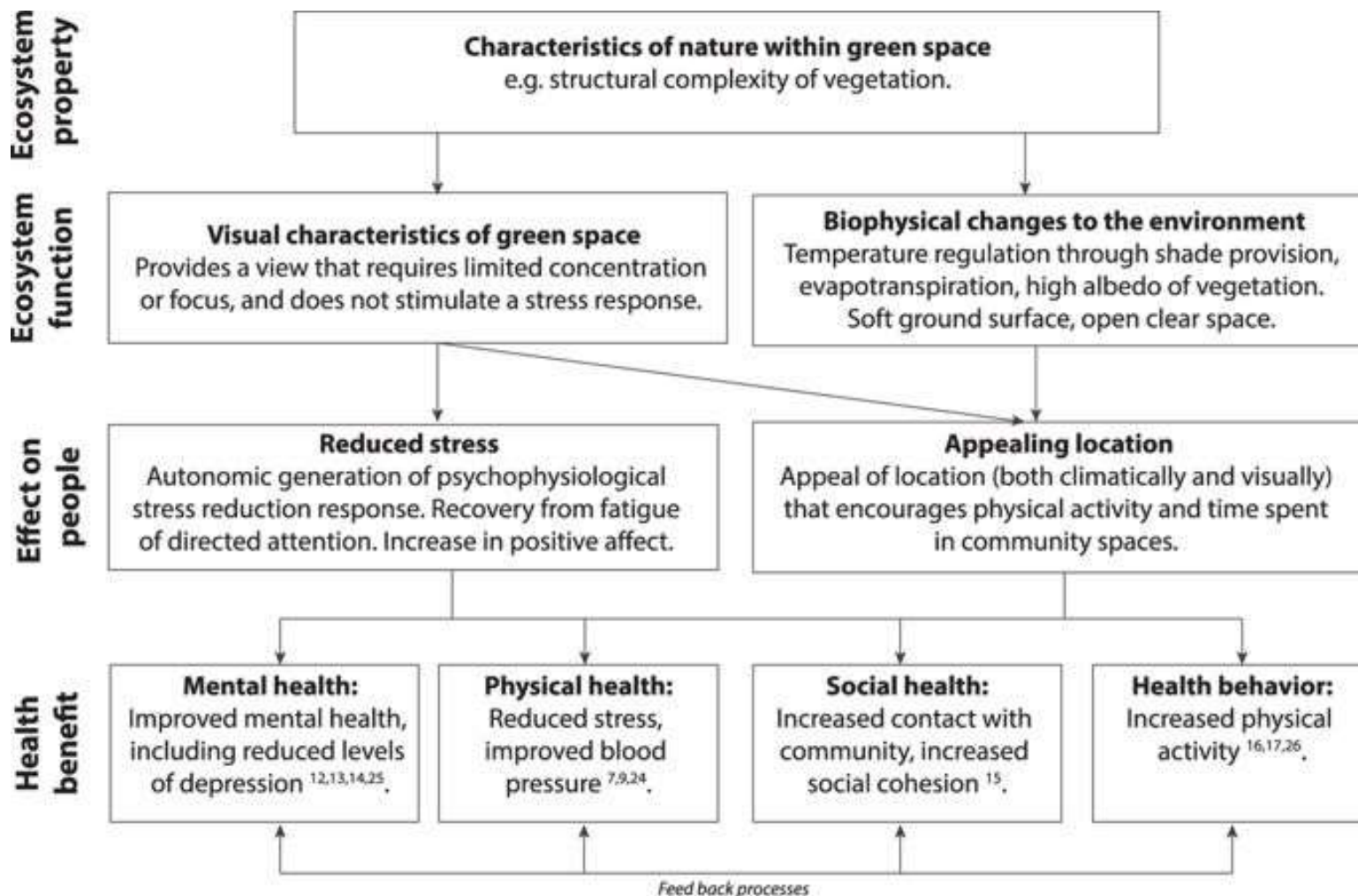
- There is some international evidence that indicates the potential, substantial economic health value of green infrastructure.

Bowen, K. J. and Parry, M. (2015) The evidence base for linkages between green infrastructure, public health and economic benefit, Paper prepared for the project Assessing the Economic Value of Green Infrastructure.



- Studies on self-regulation of mood complement epidemiological and experimental studies by emphasising the active role of individuals in the use and choice of green settings.

EFFECTS ON PSYCHOLOGICAL HEALTH





- The presence itself of green space is unlikely to explain the public health benefits suggested and the relationship is likely to be complex and influenced by multiple factors including attributes of the environment and the individual. Environmental influences have been identified that appear to affect the use of green space and therefore leisure-time physical activity in these areas. These include characteristics of the green space such as its features, condition, accessibility and safety.
- Identifying these features is very important for planning and design purposes

Benefits for human health and well being

- Studies conducted in our Department, address the issue of whether urban residents' evaluations of urban and peri-urban natural settings and the positive outcomes deriving from contact with such settings vary as a function of their biodiversity and naturalness
- The field and laboratory studies assessed benefits and subjective well-being reported by urban residents visiting four different typologies of green spaces.



Research Paper

Go greener, feel better? The positive effects of biodiversity on the well-being of individuals visiting urban and peri-urban green areas

Giuseppe Carrus^{a,*}, Massimiliano Scopelliti^b, Raffaele Laforteza^c, Giuseppe Colangelo^c, Francesco Ferrini^d, Fabio Salbitano^e, Mariagrazia Agrimi^f, Luigi Portoghesi^f, Paolo Semenzato^g, Giovanni Sanesi^c

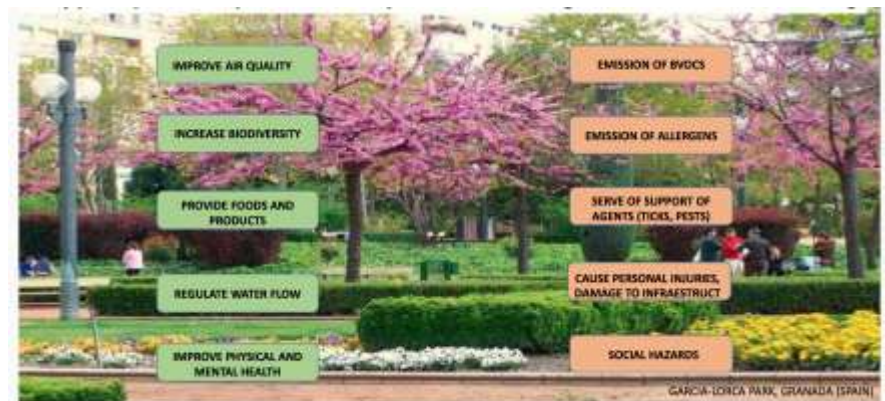
Human health and well being disservices

- Environmental
 - VOC emissions
 - Allergenic pollen
 - Hazard trees and root systems
- Planning and maintenance
- Neglect, lack of security and safety etc.

BREATHING IN THE MEDITERRANEAN PARKS: AN INITIATIVE TO ASSESS GI ECOSYSTEM DISSERVICES IN MEDITERRANEAN CITIES



Paloma Cariñanos, Manuel Casares-Porcel, Paolo Semenzato, Pedro Calaza-Martínez, María Beatrice Andreucci, Cristina Branquinho, Teresa Mexia, Andreia Anjos, Paula Gonçalves, Otilia Correia, Filipa Grilo, Margarida Santos-Reis, Nezha Acil, Elena Paoletti, Elisa Carrari, Artur Gonçalves, José Castro, Anna Chiesura, Pietro Massimiliano Bianco, Marzia Mirabile, Silvia Brini, Enrico Castro.



- Although some existing parks and urban forests have been the subject of renewal, many others have fallen into decline and it is the responsibility of public administrations to ensure that the potential for health improvement envisaged by 19th° and 20° century planners is not lost.

- Many of the health benefits of urban green spaces are directly linked to vegetation and particularly trees
- Bad tree maintenance can undermine their ecosystem services provision



- Maintenance influences perception of green spaces.
- Neglected and badly maintained green spaces

are perceived as inaccessible or/and unsafe and lose their potential benefits for physical and mental health



- Maintenance influences costs and benefits of the green infrastructure

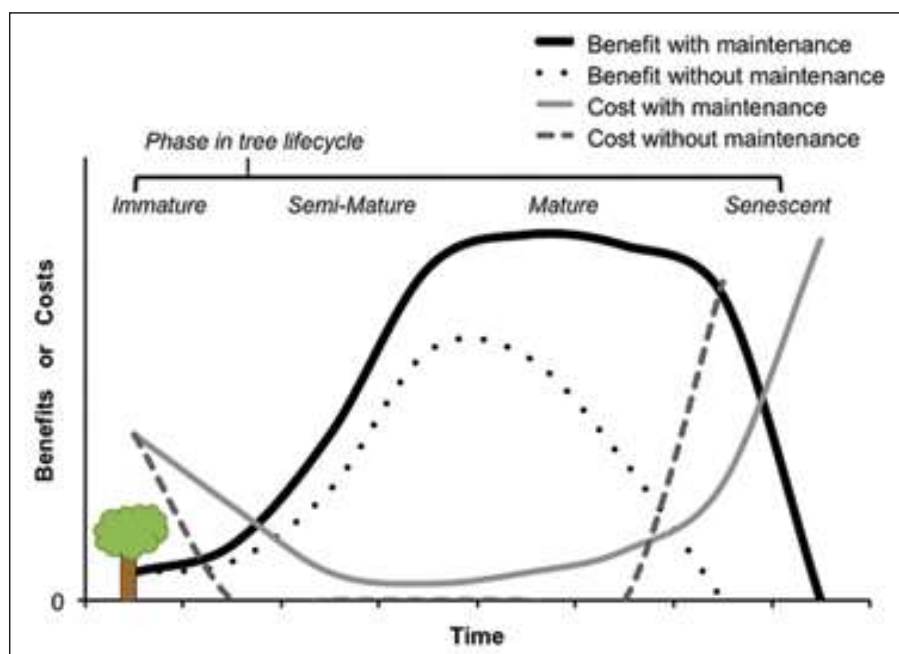


Figure 1. Theoretical costs and benefit profiles over the lifetime of an individual tree, with (solid lines) and without (dashed lines) adequate maintenance. Benefits are maximized during the mature phase of a tree and decline rapidly through senescence, while costs show an inverse pattern.

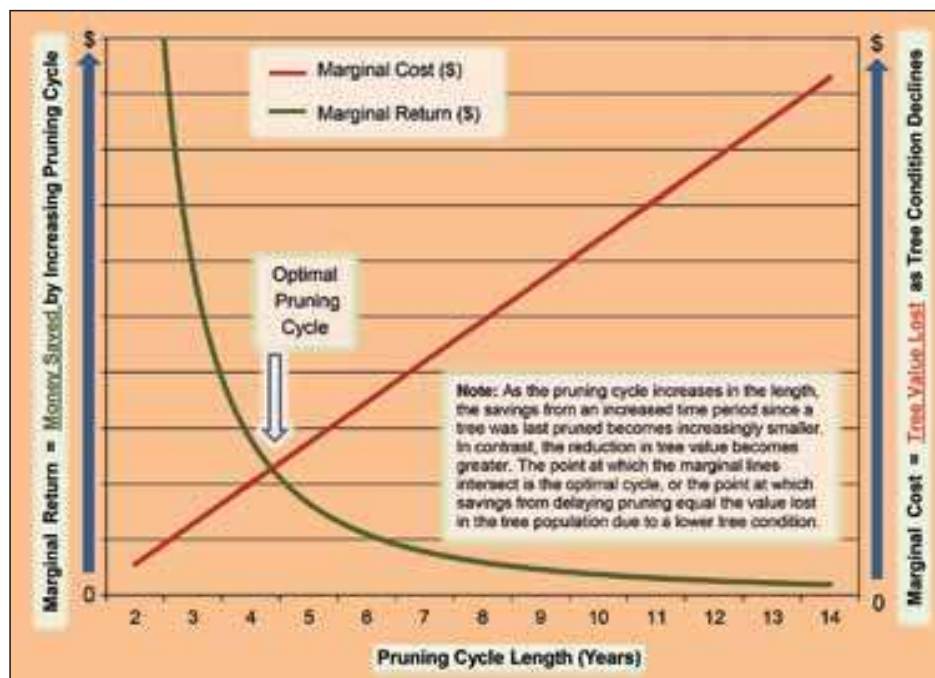


Figure 3. Marginal cost (loss of tree value) and marginal return (savings in pruning costs) for pruning cycle lengths used to determine an optimal pruning cycle at the point that marginal lines intersect (adapted from Miller and Sylvester 1981).

Research suggest that a Green Infrastructure may have a considerable potential for improving the health of urban residents. This assertion is based on the speculation that environmentally induced changes in physiological, emotional and cognitive processes may induce, or mediate, changes in well-being and health

Although more studies are needed to objectively quantify health benefits from Green Infrastructure. It appears that There is no greater good that could be done for health promotion than the protection of the GI on which all humans depend.





Thank you
for your attention



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