

Why Do We Need Trees? Let's Talk About Ecosystem Services

By Kathleen L. Wolf



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Many cities are installing green infrastructure to manage storm water. With careful design, such facilities can provide co-benefits of health and livability.

In these challenging economic times, arborists and urban foresters who work with clients in both the public and private sectors must often explain why money should be spent on trees. Sharing scientific evidence is one way to build the case for investment in city trees and the urban forest.

In recent years, a surge of research results tells why trees are necessary in our communities. Some of the benefits evidence comes from the direct study of one's local community. Other evidence comes from studies that have been conducted in situations similar to one's own place, generating highly likely outcomes that translate to similar conditions.

How do we talk about this scientific wealth? How do we move from reciting specific scientific facts to sharing a bigger story about urban forest benefits? How do we help connect this important knowledge to everyday needs and issues in communities?

What's the big idea?

A concept that is gaining greater public attention is *ecosystem services*. The term describes the full scope of nature's contributions to human health and welfare. Ecosystem services are defined as those conditions and processes by which natural ecosystems sustain and fulfill human life.

Economists have used the concept of ecosystem services (ES) for decades, but it really gained momentum in the 1990s after a key paper was published in the journal *Nature* (Costanza et al. 1997). The article defined ES and tackled the ambitious goal of providing an economic estimate of service value, suggesting that all services across the planet tallied up to an average of USD \$33 trillion per year.

The Millennium Ecosystem Assessment (MEA) of 2005 firmly established the ES concept in discussions of natural capital and sustainability. The report outlined a services classification that has since become widely used in scientific and popular communications. The classification identifies four main ES types (further divided into 30 sub-categories): 1) provisioning (e.g., food, raw materials, medicine, water supplies), 2) regulating (e.g., climate, water, soil retention, flood retention), 3) supporting (e.g., soil formation, nutrient cycling, decomposition), and 4) cultural (e.g., science and education, artistic, spiritual).

The MEA encouraged a fundamental shift in how natural systems and resources are defined and valued by human society. Natural assets, such as forests, agricultural lands, shorelines, and seas, have been the sources of essential and economically valuable goods and services throughout

human history. Products such as timber, grains, and fish are readily bought and sold in markets. ES also includes natural systems' benefits that have economic consequences, but setting their values is more difficult. Examples include flood protection, pollinator activity, natural filtering of potable water, and climate stability. Generally, ecosystem services arise from broad systems of ecological components, processes, and functions, but the term specifically signifies aspects of ecosystems that are valued by people.

Where do we find ecosystem services?

To date, most ES assessments have been done in wildland, working forests, or rural areas. Many ES studies assume that services are generated beyond the city and are then 'delivered' to urban residents. Yet recent research in urban forestry and urban ecology has yielded important insights about the functions of natural systems that are in the city. Services can be provided by a single parcel or may be estimated across an entire city, such as a canopy assessment.

Scientists have identified the benefits provided by urban trees and forests for decades, including environmental, social, and economic benefits. Such benefits are definitely included in the realm of ecosystem services (Thomas and Gellar *in press*). Incorporating urban forestry benefits into the broader scope of ES offers advantages as there is ever greater national to local support for ES policy, and the ES concept is all-encompassing, encouraging integration of urban forestry with green infrastructure, stormwater management, public health, and other multi-partner resource management systems.

Urban nature provides many regulating and supporting services. Trees are major contributors and their services list is long. Trees modify local microclimate to improve living conditions, including changes in solar radiation, wind speed, air temperature, relative humidity, and re-radiation from paved areas. Urban greening also improves air quality, as plant foliage enables beneficial gaseous exchange and intercepts polluting particles. Urban vegetation positively affects water quantity and quality, as the pervious soils of planted areas allow infiltration of precipitation, reducing runoff and increasing groundwater recharge. Soils and vegetation can also retain water pollutants, thus improving water quality by mitigating nonpoint source pollution. Climate and energy effects are additional benefits. Strategically placed trees within residential areas can reduce heat gain, thus reducing household energy consumption. Scaling up, areas of substantial tree canopy across a city can produce an oasis effect in hot climates, contributing to mitigation of the urban heat island effect, perhaps a more immediate threat in some cities than climate change.

Urban agriculture also generates provisioning services. Most agriculture still occurs in more rural lands. Public interest in local foods and improved nutrition in underserved communities supports creation of urban orchards and community gardens in neighborhoods. Surrounding landscapes are needed to harbor the pollinators needed for productive urban farms and gardens.

To your good health!

Cultural ecosystem services are described as opportunities for education, recreation, or spiritual experiences. Fewer studies have addressed the extent or value of cultural services. Yet millions of urban residents experience a much broader range of nature-based benefits that can be interpreted as ES but are not currently recognized as such. The cultural services category is particularly important in urban settings; the extent and economic value of these services may be equal or exceed other services!

Nearly 40 years of research across the social sciences points to the importance of having trees and nature in cities to address basic human needs, improve livability, and enhance quality of life. Nature provides beauty and aesthetics in built environments, but is also profoundly important to human health and well-being.

The Green Cities: Good Health website (www.greenhealth.washington.edu) is a catalog of research about social, economic, and cultural benefits. More than 2,200 peer-reviewed publications have been collected and sorted into topical themes (Table 1). Each theme is presented as an essay summarizing up to 300 articles. The U.S. Environmental Protection Agency recently provided another web-based resource for the research evidence about nature and human well-being, the Eco-Health Relationship Browser (www.epa.gov). Both tools are portals to research and are intended for use by urban greening professionals, local leaders, and concerned citizens.

Both projects provide evidence as to why planning and management of urban forests, and urban greening more generally, are important to improve social capital and provide better human habitat. The evidence addresses the range of social scales, from individual response to person-to-person interactions, to neighborhoods, to organizations, to various types of communities. The studies document how nature contributes to human performance and functioning



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Desk workers benefit from having views of nature. A study found that workers without views of nature reported more illness and those with views reported frustration less and higher overall job satisfaction.

Table 1. Green cities: Good health literature review themes.

| Benefit theme | Description |
|------------------------------|--|
| Community economics | Valuation methods are used to convert intangible benefits to dollar sums. Nonmarket valuations can support local decision-making regarding the urban forest. |
| Social strengths | People interact while spending time in city parks, gardens, and open spaces. These social dynamics can help build social capital, even resilience. |
| Culture and equity | There is some variability in how people respond to nature based on ethnic background, and there are inequalities in the distribution of nature across cities. |
| Active living | Obesity is a major public health issue. The presence and character of green spaces in a neighborhood affects residents' rates of physical activity. |
| Crime and fear | Law enforcement officials may regard vegetation as a contributor to social disorder and crime. Community activity for greenspace and vacant lots generates the social connections that may reduce crime. |
| Safe streets | City streets are thoroughfares for motor vehicles and can also serve as public spaces. A quality streetscape may be safer, as vegetation and mixed-use transportation effects crash rates. |
| Place attachment and meaning | Place attachment and meaning are person-to-place bonds that evolve through emotion and cognition of a specific place and/or features of a place. |
| Wellness and physiology | Scientific measures of stress response (such as heart rate and blood pressure) can improve quickly when one views nature, leading to better long-term health. |
| Healing and therapy | Gardens and restorative settings are becoming standard features in health treatment and recovery settings. The experience of nature promotes healing. |
| Mental health and function | Our busy lives make many demands on our ability to pay attention and process information. Brief respites in natural settings help one to recover the ability to concentrate and focus. |
| Work and learning | Little attention is given to how one's environment affects the places where we spend many hours each day. Green offices and classrooms appear to boost work productivity and education performance. |
| Reduced risk | The built environment concentrates certain conditions that can affect one's health. Urban vegetation can reduce the health risks of excessive noise, heat, and other stressors. |
| Lifecycle and gender | There are a few differences in the human response to nature, with some based on a person's age and/or whether the person is male or female. |

in everyday life, as well as within the institutions and social systems that are the underpinnings of vibrant cities.

Planning, Management, and Partnerships

Insightful individuals have long recognized the benefits provided by having nearby trees and nature. Science supports those intuitions and expands understanding. Ecosystem services is a concept that directly connects benefits knowledge to the needs and values of people, and can be one more set of messages about why a community or client should invest in trees and greening.

The big idea of ES is starting to move into planning and management efforts. Good plans don't happen unless there is broad community support. ES evidence can be used to reach out to local groups and decision makers to show how nature-based solutions can augment or even supplant social programs that are expensive. Partnerships with public health, medical, education, law enforcement,

and other professionals can be pursued to further fine tune, through design and monitoring, how nature can be integrated with social service delivery systems.

Also, urban greening professionals can align with the leadership of other professional groups. The cultural ES of urban greening address some of the most urgent issues of contemporary society, such as education quality, public health costs, therapy for emotional and physical disabilities (such as those experienced by veterans returning from deployment), and mental functioning of the growing elderly population. While the experience of nature is not a panacea for the ills of society, extensive psychosocial research suggests that natural settings enable a positive response, better functioning, and healing.

Economic values are estimated after benefits are measured. Economists have developed a variety of techniques to generate dollar values based on either nature services provided or the reduced costs of substituted systems (such as fewer stormwater drains and pipes). Some ecologists

are wary of valuation, arguing that those things that are not readily monetized will drop out of public attention (such as rare species that are not food sources). Yet if thoughtfully assessed, economic value can position urban natural resources on par with other capital investments in local government budgeting decisions. i-Tree tools offer economic valuation of some environmental ES.

Work is now underway to provide values for public health and other urban cultural services. The first step is to identify a unit of benefit, such as reduced obesity (using parks not drugs), healing (such as reduced time in a hospital after surgery when having a view of trees), or better mental health (such as horticultural therapy outcomes). The potential cost savings or substitution can be estimated. Values are then scaled up across whole populations, such as a treatment group or a city. The approaches are similar to health and epidemiology economics.

The ES concept is one way to understand and bundle up all of the possible functions and benefits provided by any particular landscape or natural system. Any urban parcel can be multitasking, providing co-benefits (Beatley 2010). A green infrastructure installation for stormwater management can be designed to also serve as an outdoor classroom for a nearby school. A green roof that is installed to reduce energy consumption of a hospital building can be designed to provide a restorative setting for stressed patients and staff. A street tree planting project can be coordinated with a walkable community program to encourage connected, safe routes for recommended daily moderate activity. In this way future landscape and urban forest plans can be installed and managed in a deliberate way to deliver the most services for the most people.

The opportunities are endless. Arborists and urban foresters can support such programs with the scientific evidence of ES and professional expertise. Ongoing assessments of ecosystem services will provide the data to underpin land use policy and planning, helping communities to create better quality of life and improved human well-being.

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Literature Cited

- Beatley, T. 2010. *Biophilic cities: Integrating nature into urban design and planning*. Island Press, Washington D.C.
- Costanza, R., R. D'Arge, R.S. de Groot, S. Farber, M. Grasso, B. Hannon, K. Limburg, S. Naeem, R.V.



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When considering the walkability of sidewalks for their school-aged children, parents indicated that sidewalks with a wide buffer with trees was the safest. Other research has found that kids who walk or bike to school are able to concentrate better for up to four hours.

- O'Neill, J. Paruelo, R.G. Raskin, P. Sutton, and M. van den Belt. 1997. The value of the world's ecosystem services and natural capital. *Nature* 387(6630):253–260.
- Millennium Ecosystem Assessment. 2005. *Ecosystems and Human Well-Being: Synthesis*. Island Press, Washington, D.C. 137 pp.
- Thomas, K., and L. Geller. *in press*. *Ecosystem Services of Urban Forests: Summary of a Workshop*. The National Academies Press, Washington D.C. 91 pp.



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