This article was published in the May/ June 2015 issue of "The Buckeye Arborist"

Benefits and Costs of Trees

By Shirley Vaughn

The value of trees cannot be taken for granted. Trees provide shade, but also offer unique benefits such as enhancing aesthetic value, making us cooler, absorbing pollutants, and improving the economic and social climate of a community. The benefits trees provide are not "free". Trees have costs associated with their planting and maintenance, along with management challenges such as growing trees in urban areas.

When considering the benefits a tree provides, one must acknowledge the cost of owning that tree and caring for it during its lifetime. Some of the costs associated with growing trees in urban areas include purchasing, planting and establishing the tree, and irrigating it when necessary. Throughout the tree's lifetime, it also requires pruning, mulching, plant health care, debris clean up, and risk management, which all cost money and take time. Whether a tree is located beside a home, next to city hall, in a park or along a street, that tree requires routine maintenance.

When trees in urban areas are not properly planted, maintained, and managed, they can become liabilities. In some situations, the maintenance required may exceed the benefits that the tree is producing. Understanding the benefits and costs of urban trees helps the arborist make informed decisions about planting, pruning, and removal. By reducing the risk associated with trees and improving tree health, arborists can play a critical role in enhancing the quality of life in a community.

Aesthetic, Environmental, Economic, and Social Benefits

Environmental tree benefits include improvements in air quality, the sequestration of carbon, reductions in stormwater runoff and erosion, and energy conservation. Trees emit oxygen during photosynthesis and collect and filter airborne particulate pollutants, which are stored on leaves. This reduction in particulate matter cleanses the air we breathe. Also, trees absorb carbon dioxide during photosynthesis. Some of this CO2 is stored as the woody tree biomass while some of the CO2 is stored as carbon-based tissue. This process, called carbon sequestration, can be an effective way to minimize excess carbon in the atmosphere. A tree only stores carbon during its lifetime. Thus, when it dies or is removed, some of the carbon is returned to the atmosphere through burning or normal decomposition processes.

- Trees decrease energy consumption and moderate local climates by providing shade and acting as windbreaks.
- Trees act as mini-reservoirs, helping to slow and reduce the amount of stormwater runoff that reaches storm drains, rivers, and lakes. 100 mature tree crowns intercept ~100,000 gallons of rainfall per year (U.S. Forest Service 2003).

- Trees help reduce noise levels, cleanse atmospheric pollutants, produce oxygen, and absorb carbon dioxide.
- Trees can reduce street-level air pollution by up to 60% (Coder 1996). Lovasi (2008) suggested that children who live on tree-lined streets have lower rates of asthma.
- Trees stabilize soil and provide a habitat for wildlife.

Stormwater runoff is a problem in some urban areas. Trees can help decrease stormwater management costs through their mere presence in a landscape. Leaves and branches intercept rainfall and slow some of the rain as it passes through the tree's canopy. Because of trees, the amount of throughfall reaching the ground is lessened, which slows erosion and decreases the volume of runoff entering storm and combined sewer systems. Tree roots also hold the soil in place and further reduce erosion. In addition to reducing the volume of stormwater runoff, trees also help purify stormwater runoff.

The contribution of the urban trees towards conserving energy is reflected in their ability to shade structures and surfaces, reduce electricity use for air conditioning in summer, and divert wind in the winter, which reduces energy consumption. Trees located near and around buildings can significantly reduce heating and cooling costs. Climate and the location of the trees in relation to buildings can affect the amount of energy used. Trees with leafy canopies located on the south and west sides of buildings typically contribute the most to reducing air conditioning demands. During winter and in cooler climates, deciduous trees allow sunlight to pass through to warm buildings. Strategically placed trees can also serve as windbreaks, which is especially beneficial in colder climates.

- Tree-lined streets are safer; traffic speeds and the amount of stress drivers feel are reduced, which likely reduces road rage/ aggressive driving (Wolf 1998a, Kuo and Sullivan 2001b).
- Chicago apartment buildings with medium amounts of greenery had 42% fewer crimes than those without any trees (Kuo and Sullivan 2001a).
- Chicago apartment buildings with high levels of greenery had 52% fewer crimes than those without any trees (Kuo and Sullivan 2001a).
- Employees who see nature from their desks experience 23% less sick time and report greater job satisfaction than those who do not (Wolf 1998a). Hospital patients recovering from surgery who had a view of a grove of trees through their windows required fewer pain relievers, experienced fewer complications, and left the hospital sooner than similar patients who had a view of a brick wall (Ulrich 1984, 1986).
- When surrounded by trees, physical signs of personal stress, such as muscle tension and pulse rate, were measurably reduced within 3–4 minutes (Ulrich 1991)

Trees provide important habitats for the numerous bird, insect, and animal species in urban areas.

Economic tree benefits include increased residential and business property values, attractive business districts, increased rental rates for apartments and offices, and energy savings for buildings as well as surfaces, such as pavements. Research has found that properties with well-positioned and maintained trees command a higher appraisal and sales value than similar properties without trees. Tree-lined

streets and commercial districts attract more businesses and consumers. Also, when these areas are surrounded by trees, shoppers tend to stay longer and pay more for goods and services.

The social benefits of trees have been researched for many years, with findings showing that the presence of trees help people relax, heal, and learn. The calming effect of nearby trees and urban greening can significantly reduce workplace stress levels and fatigue, calm traffic, and even decrease the recovery time needed after surgery. Trees can also reduce crime. Apartment buildings with high levels of greenspace have lower crime rates than nearby apartments without trees. Natural settings also have been linked to behavioral and learning improvements in children.

- Trees increase residential property values by an average of 7% when present in the yard or neighborhood. Commercial property rental rates were 7% higher when trees were on the property (Wolf 2007).
- Trees moderate temperatures in the summer and winter, saving on heating and cooling expenses (North Carolina State Univ. 2012, Heisler 1986).
- On average, consumers will pay about 11% more for goods in landscaped areas, with this figure being as high as 50% for convenience goods (Wolf 1998b, Wolf 1999, and Wolf 2003).
- Consumers also feel that the quality of the products is better in business districts having trees than those considered barren (Wolf 1998b).
- The quality of landscaping along the routes leading to the business district had a positive influence on consumers' perceptions of the area (Wolf 2000).

Benefit Value and Appraised Value

i-Tree was developed by the U.S.D.A Forest Service and its public and private partners to estimate the value of the economic and environmental benefits trees provide. i-Tree is public domain software or free software which should be used to convey the value of the benefits provided by trees. i-Tree is not a substitute for tree appraisal systems such as the "Trunk Formula Method," which was developed by the Council of Tree and Landscape Appraisers to estimate tree replacement value.

References

Coder, K.D. 1996. "Identified Benefits of Community Trees and Forests." University of Georgia Cooperative Extension Service, Forest Resources Publication FOR96-39.

Heisler, G.M. 1986. "Energy Savings with Trees." J. Arbor 12(5):113–125. Prepared by Ryan Bell and Jennie Wheeler.

Kuo, F., and W. Sullivan. 2001a. "Environment and Crime in the Inner City: Does Vegetation Reduce Crime?" Environment and Behavior 33(3): 343–367.

———. 2001b. "Aggression and Violence in the Inner City - Effects of Environment via Mental Fatigue." Environment and Behavior 33(4): 543–571.

Lovasi, G.S., J.W. Quinn, K. M. Neckerman, M. S. Perzanowski, and A. Rundle. 2008. “Children living in areas with more street trees have lower prevalence of asthma.” J. Epidemiol Community Health 62:647–9.

North Carolina State University. 2012. “Americans are Planting Trees of Strength.” http://www.treesofstrength.org/benefits.htm. Accessed May 12, 2012.

Ulrich, R. 1984. “View through Window May Influence Recovery from Surgery.” Science 224(4647): 420–421.

Ulrich, R. 1986. “Human Responses to Vegetation and Landscapes.” Landscape and Urban Planning 13:29–44.

Ulrich R.S., R.F. Simmons, B.D. Losito, E. Fiority, M.A. Miles and M. Zeison. 1991. “Stress Recovery During Exposure to Natural and Urban Environments.” J. Envir Psych 11(3): 201-230.

U.S. Forest Service. 2003 “Benefits of Urban Trees. Urban and Community Forestry: Improving Our Quality of Life.” Forestry Report R8-FR 71.

Wolf, K.L. 1998a. “Urban Nature Benefits: Psycho-Social Dimensions of People and Plants.” University of Washington, College of Forest Resources Factsheet. 1(November).

———. 1998b. “Trees in Business Districts: Positive Effects on Consumer Behavior!” University of Washington College of Forest Resources Factsheet. 30(November).

———. 1999. “Grow for the Gold.” TreeLink Washington DNR Community Forestry Program. 14(spring).

———. 2000. “Community Image: Roadside Settings and Public Perceptions.” University of Washington College of Forest Resources Factsheet. 32(August).

———. 2003. “Public Response to the Urban Forest in Inner-City Business Districts.” J. Arbor 29(3):117–126.

———. 2007. “City Trees and Property Values.” Arborist News (August):34-36.