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Value, Benefits, and Costs of Urban Trees

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Introduction

The U.S. population has grown increasingly urban each decade, from 28 percent in 1910 to 80 percent in 2000 (U.S. Census Bureau, 2002). In the Chesapeake watershed alone, residential development is predicted to consume 800,000 acres between 2003 and 2030, nearly 90 percent of it replacing farmland (Boesch and Greer, 2003). As urban communities grow larger and faster than ever before, natural resource management in these areas becomes crucial for achieving sustainable development and maintaining and enhancing the quality of life and the environment.

The Value of Trees in an Urban/Community Forest

Ecological Services

Trees provide ecological services that include 1) reduced air pollution, 2) storm-water control, 3) carbon storage, 4) improved water quality, and 5) reduced energy consumption.

Trees reduce air pollution by trapping particulate matter in their leafy canopies and by absorbing noxious pollution into their leaves. The particulate matter is eventually washed away with rain. Absorbed pollutants are incorporated into the soil after leaf fall where they are broken down by microbes. These actions reduce human health problems related to air pollution. Tree canopies also intercept large amounts of rain, reducing the amount of runoff that is discharged into streams and rivers and extending the time that a watershed has to absorb rainfall. This reduces flooding and erosion.

As trees grow they accumulate biomass that absorbs carbon and nutrients, locking them into a biological cycle that keeps them out of the atmosphere and hydrosphere. The storage of carbon reduces the greenhouse effect that is linked to problems of global climate change. Absorbed nutrients stay out of water bodies where they would otherwise harm fish and other aquatic species.

In summer, trees ameliorate climate by transpiring water from their leaves, which has a cooling effect on the atmosphere. At night, when the earth radiates heat back into space, temperatures often drop to the cooling or dew point, when water vapor, some of which is produced by trees during the daytime, condenses. This releases latent heat back into the atmosphere. When groups of trees intercept sunlight and use it for photosynthesis, they shade roads, buildings, and other structures, and they help reduce energy consumption.

Social Benefits

Benefits to society are harder to quantify, but that does not mean they are less important than the ecological services that trees provide. Societal benefits include increased job satisfaction, faster recovery time for hospital patients, and improved child development. For example, hospital patients who have a view of trees out of their window recovered more quickly than patients who did not (Ulrich 1984). Similarly, employees who could look out their office windows and see trees and nature were happier at work (Miller 1997). Both of these have dollar values, like lower health-care costs and increased worker productivity, but it is harder to assign an exact dollar amount to them. Properly placed and maintained trees have even been shown to reduce crime (Kuo et al. 1998) and enhance

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cognitive development in children (Wells 2000).

Many outdoor recreation activities, such as picnicking, hiking, or even just sitting on a back porch are more enjoyable in and around trees. Trees provide homes and are an important component of habitat for many wildlife species. Observing wildlife in community nature parks is one of the fastest growing forms of outdoor recreation in the United States.

Aesthetic Value

The aesthetic value of landscape trees can be measured by determining how property values increase for yards that have trees in them. Property values can increase as much as 20 percent when trees are present on the land. The monetary value of an individual tree can be determined by an experienced appraiser. Tree appraisal considers a variety of factors such as the species, size, condition of the tree, and its location in a landscape. Such a monetary appraisal is often made when a court of law must determine how much money a homeowner is owed if someone vandalizes a tree on his or her property.

Large trees can increase property value up to 20 percent. Taking care of such trees is critical to realizing their values.

Photo credit; Brian Kane, Assistant Professor, University of Massachusettts, Amherst

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Cost/Benefit Worksheet

Complete this worksheet to determine the value and the annual benefit/cost of trees at a home or community property. The worksheet was developed by the authors as an educational tool for students.

Address of home or property _____

_____

Appraised value of property _____

_____

Potential contribution of trees to property value (multiply appraised value by 5% to 20%):

$_____ to _____

Annual Cost Benefit Analysis

Use the following table to calculate urban tree values. Columns D, E, F are mathematical operations to simplify calculations and are based on the formulas listed in the "Notes" section.

These equations are based on studies cited in the "References" section but may not be applicable to a particular community or household. They are only meant for demonstration purposes and more detailed models should be used for better value estimates. The USDA Forest Service uses the "UFORE" model, which is explained in the GTRs, listed in the "References." American Forests uses City Green® software to calculate tree values.

A	B	C	D	E	F	G	H	I
			Runoff, Pollution, & Carbon Savings					
Tree Number	DBH	DBH^2	Column b*-.247	Column c* .2173	Column d+e	Energy Savings (select from table)	Maintenance Costs*	Tree Value column F+G-H
Total Cost/Benefit								

*Annual maintenance costs are: $100 for small trees, $84 for medium trees, and $93 for large trees. The values are based on estimated costs divided by the number of years between maintenance activities. Costs will change, sometimes significantly, depending on a particular situation so these values should not be used except for the demonstration purposes of this exercise.

Energy Savings	Small (≤ 8 dbh) tree ≤ 20´ from building	Medium (9´´ - 20´´ dbh) tree ≤ 25´ from building	Large (≥ 21´´ dbh) tree ≤ 45´ from building
East side	$0.00	$3.00	$11.00
West side	$6.50	$16.00	$42.00
South side	$-4.00	$-7.50	$-8.50
North side	$0.00	$0.00	$0.00

Notes

The Benefit/Cost Analysis worksheet is based on the following equations:

1) Runoff reduction: $\$value = 0.0303*(DBH)^2 + 0.182*(DBH) + 2.29$

2) Pollution reduction: $\$value = 0.16*(DBH)^2 - 0.334*(DBH) + 2.57$

3) Carbon sequestration: $\$value = 0.027*(DBH)^2 - 0.095*(DBH) + 6.85$