URBAN & FORESTRY URBAN GREENING

A comparison of municipal forest benefits and costs in Modesto and Santa Monica, California, USA*

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Abstract: This paper presents a comparison of the structure, function, and value of street and park tree populations in two California cities. Trees provided net annual benefits valued at $ 2.2 million in Modesto and $ 805,732 in Santa Monica. Benefit-cost ratios were 1.85:1 and 1.52:1 in Modesto and Santa Monica, respectively. Residents received $ 1.85 and $ 1.52 in annual benefits for every $ 1 invested in management. Aesthetic and other benefits accounted for 50% to 80% of total annual benefits, while expenditures for pruning accounted for about 50% of total annual costs. Although these results were similar, benefits and costs were distributed quite differently in each city. Variations in tree sizes and growth rates, foliation characteristics, prices, residential property values, and climate were chiefly responsible for different benefits and costs calculated on a per tree basis.

Key words: Urban forest valuation, economic analysis, natural resource economics

Introduction

Cities need to grow to maintain vigorous local economies, but their ability to grow is influenced by environmental constraints and competition with other regions in terms of quality of life. Research quantifying the benefits of healthy municipal urban forests is showing that trees can mitigate impacts of development on air quality, climate, energy for heating and cooling buildings, and stormwater runoff. Healthy street trees increase real estate values, provide neighborhoods with a sense of place, and foster psychological well-being (Dwyer et al. 1992). Street and park trees are associated with other intangible benefits such as increased community attractiveness and recreational opportunities that make cities more enjoyable places to work and play.

The motivation for this study is to provide cities with a comprehensive accounting of municipal forest benefits and associated management costs. We build upon previous benefit-cost analyses in Chicago, IL and Modesto, CA (McPherson et al. 1997, 1999a) that were applied to:

- assess the adequacy of management programs and justify their funding,
- provide baseline information for the evaluation of program cost-efficiency,
- highlight the relevance of the urban forest to local quality of life,
- develop alternative funding sources through electric utilities, air quality districts, federal or state agencies, legislative initiatives, or local assessment fees.

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1618-8667/02/01/2-61 $ 15.00/0

This paper compares the structure, function, and value of municipal urban forests in Modesto and Santa Monica, CA.

Operational Definitions of Structure, Function, and Value

The 'structure' of an urban forest is defined as the species composition and spatial array of vegetation in relation to other objects such as buildings (Rowntree 1984). Urban forest structure reflects historic interactions between a host of cultural and ecological factors (Sanders 1984). Ecological measures of the structure of street and park tree populations include species and age diversity, stocking level, health, and importance value (Barbour et al. 1980; McPherson & Rowntree 1989).

The term urban forest 'function' refers in general to the services that urban forests provide such as pollution removal, temperature modification, and property value increase (Rowntree 1986). Tree location and type (i.e., structure) influence function. For instance, a tree located south of a building can increase heating costs, but the same tree west of the building will reduce cooling costs and provide substantial net energy benefits. We measure function in terms of resource units (RU) – kilograms of pollutant uptake, kilowatt-hours of electricity savings for cooling, etc.

'Value' refers to the benefits and costs society derives from the urban forest. Tyrvainen (2001) reviewed different approaches to determine the value of urban forest benefits. Hedonic pricing relies on differences in housing prices to reflect the value of nearby greenspace. Contingent valuation is based on surveys that ask what people are willing to pay for greenspace. Average willingness to pay is multiplied by the total number of consumers to estimate greenspace value. The travel-cost method uses the costs of travel as a proxy for the price that people are willing to pay for recreational benefits of greenspace. Each of these methods have their advantages and limitations (Tyravinen 2001). However, these approaches have not been applied to street and park tree populations because they do not isolate the benefits of individual trees within forest stands.

Several methods have been developed to value benefits from individual trees. The most common approach calculates asset value, the current worth of previous investments, using the cost of replacing trees. Prices for individual trees are summed to calculate the total asset value for all street and park trees. This method is also called the depreciated cost approach because the tree's replacement cost is depreciated to account for the difference in benefits that would result from a new tree compared to the existing tree. The cost of replacing a tree may be more or less than what people are willing to pay for the existing tree. Because this approach is cost-based it does designate prices for individual benefits produced by the existing tree population.

External benefit valuation quantifies specific impacts of trees on the urban environment, such as climate modification and air pollutant removal (McPherson 1992). Benefits are priced through alternative costs of environmental control that reflect people's willingness to pay for air pollution control or stormwater runoff reduction. Energy savings for heating and cooling are calculated directly using marginal prices for electricity and natural gas. This approach excludes non-environmental values such as aesthetics, recreation, environmental education, stress reduction, and spiritual renewal. Also, it requires large amounts of data for numerical modeling, and these models simplify the complex interactions between trees and the surrounding urban environment.

Performance Variables for Structure, Function, and Value

Performance variables provide a standard metric to measure and compare urban forest structure, function, and value across cities. These indicators should address factors that are most important to efficient management of street and park trees. Also, they should be based on information that is widely available through standard tree inventories, surveys of municipal services, modeling algorithms and output, and other sources. To facilitate comparisons across cities in this study, findings are presented on a per tree basis. As knowledge grows with future research, more definitive sets of performance variables will be identified.

Study Sites

The cities of Modesto and Santa Monica were chosen for this study because of their extensive tree inventories and detailed information on tree program expenditures. Their tree programs are not typical of most U.S. cities, but rather examples to emulate. Modesto, California (latitude: 37°38′10″ N, longitude: 121°11′10″ W) is located in the Central Valley and has a population of 182,260 within the 9,065 ha city limits. The City of Santa Monica (latitude: 34°02′00″ N, longitude: 118°29′00″ W), is located along the Pacific Ocean and adjacent to the City of Los Angeles. A population of 92,578 reside in the 2,176 ha city. The average elevation of both cities is about 10 m. For purposes of comparison, the trees and climate in Santa Monica are similar to coastal Mediterranean cities such as Lisbon, Valencia, and Naples, while conditions in Modesto more closely resemble those of inland cities like Madrid and Florence.