The Costs of Managing an Urban Forest[1]

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Urban forests comprise all of the vegetation in and around urban and residential lands. Urban forests include both private and public lands (Ecobedo et al. 2011). Humans derive many benefits from urban forests. These benefits are referred to as ecosystem services. Urban forests improve human health, environmental quality, and even local economies by increasing property values and aesthetics in communities. Urban forests also help control stormwater, reduce air pollution and energy costs, and offset carbon dioxide emissions (http://edis.ifas.ufl.edu/fr347). Urban forests, however, do present some associated costs of their own, or "ecosystem disservices," so we need to manage for and mitigate their occasional detrimental effects (Table 1) (Escobedo et al. 2011; Lyytimäki et al. 2008). Understanding these costs is just as important as determining the benefits of an urban forest. An accurate assessment of an urban forest's costs can assist decision makers to better understand the role the forest plays in improving the well-being of the community (http://edis.ifas.ufl.edu/fr358). Identifying how funding is used can also help communities minimize costs and increase benefits. This fact sheet will review some of the types of costs associated with urban forests and present typical financial costs associated with urban forest management in the city of Gainesville, Florida.

Examples of Economic and Financial Costs

Urban trees require homeowners and communities to invest in personnel, equipment, gasoline, and other tree maintenance necessities. According to a national study from the 1980s, the size of the city had no relation to the percentage of the budget allocated to tree care, but the region in which the city was located did (Kielbaso et al. 1988). In 1986, the United States' national mean annual expenditure was $10.62 per public tree (i.e. approximately $20 in 2007 using the Consumer Price Index) and approximately 0.5 percent of the total municipal budget was allocated for tree care. Thirty percent of the total tree care budget was allocated to pruning, 28 percent to removal and disposal, and 14 percent to plantings. Larger cities devoted more to administrative expenses than did smaller cities. For example, urban forest management expenditures in Modesto, California (population 183,000), which has a temperate, Mediterranean climate, represented 2 percent of the city's total operating budget (McPherson et al. 1999). Total annual costs for urban forest maintenance cannot be predicted based on population alone since those costs vary according to many other variables such as weather conditions and local policies and objectives. But, in the Orlando, Florida area, approximately 8 hours per year on average are spent by homeowners on leaf blowing, hedge trimming, and tree pruning with a chainsaw (Horn et al. 2015).

In 2007 it cost $1,559,932 to care for Gainesville's public urban forests or approximately $10.57 per public tree (assuming approximately 3 million trees larger than 1 inch in diameter). National estimates for tree costs range from $12.87 to $65 per tree (McPherson et al. 2005). Table 2 presents some typical costs associated with management of public urban forests in the city of Gainesville, Florida.

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Annual cost information was acquired from on-site interviews, e-mail and written correspondence, and phone calls with the city arborist, Gainesville Regional Utilities (GRU), the Public Works Department, and the city claims adjustor. A more recent study by Timilsina et al. (2014) found that urban forests in Gainesville can generate on average 2 metric tons per hectare per year of wood waste from tree pruning and removal activities alone.

According to Escobedo et al. (2011), additional costs include the emission of carbon dioxide and other pollutants as a result of maintenance activities using fossil-fuel-burning equipment (Table 3). In Orlando, Florida, a homeowner can emit on average 5.4, 7.6 and 11.8 kg of C per hectare per year on leaf blowing, hedge trimming and tree pruning activities, respectively (Horn et al. 2015). Other costs include the disadvantages to people from having trees on their property. Trees generate litter, falling fruit and pollen which can aggravate allergies and accumulate on vehicles and other property (http://edis.ifas.ufl.edu/fr268); trees provide habitat for undesirable species of wildlife and insects; they can damage buildings and infrastructure in windstorms and through natural growth (Wyman et al. 2012); and proper tree maintenance and tree removal can be both costly and time consuming for property owners (Escobedo et al. 2009). In general, unmaintained trees growing in vacant and natural forested areas incur very few if any of these costs.

When accounting for all the costs associated with urban forests, one needs also to consider the environmental costs of urban forest management (Tables 1 and 3). Although these costs are rarely assigned a monetary value, they need to be accounted for when considering all of the benefits and costs associated with urban forest management (Escobedo et al. 2011). In homes or communities with well-managed urban forests, the fact that a tree is present in the community generally means that its "benefits (i.e. ecosystem services)" have been determined to exceed its "costs (i.e. ecosystem disservices)." Trees typically will be removed when costs have exceeded their benefits.

Increase Benefits, Reduce Costs

Communities and homeowners can increase the benefits of the urban forest and decrease the costs listed in this fact sheet by following a few clear guidelines for proper management and care:

- Determine and prioritize long-term objectives and a desired future condition for your urban forest (plan for future windstorms, droughts, fires, and decreasing budgets; See http://edis.ifas.ufl.edu/fr176);
- The less maintenance a tree requires, the lower its financial and environmental costs (use low-maintenance, drought-resistant trees, and reduce gas or diesel use);
- Trees in harsh urban sites will incur greater financial and environmental costs than established trees growing in natural areas;
- Longer-lived trees will reduce costs and delay removal for a longer period of time;
- Preserving existing forested areas and groups of trees that are large and well-established should take precedence over planting new trees whenever possible (established forests need less maintenance and create fewer environmental costs);
- Assess tree condition and identify and deal with hazard trees appropriately (remove hazardous trees in poor condition during building development activities);
- Understand your community's attitudes and perceptions towards urban forests;
- Seek public input during the development of management goals and objectives; and
- Plant the right tree in the right place.

Conclusion

Understanding both benefits (often referred to as ecosystem services) and costs (often referred to as ecosystem disservices) is needed when managing and planning for an urban forest (Lyytimäki et al. 2008, Escobedo et al. 2011). Seeking public input to determine the perceived costs and benefits of trees will prevent many future problems and allow others to be handled proactively and with an improvement in public understanding and appreciation of the urban forest (Wyman et al. 2012). Each management decision has its potential drawbacks or trade-offs; for instance, deciding to increase tree densities for wind resistance and carbon offsetting may also increase the likelihood of complaints about wildfire hazard or undesirable wildlife and insects. Preserving low-maintenance, publicly acceptable, larger trees in good condition provides the clearest benefits to communities, but widespread investment of resources to manage and maintain the entire urban forest will also benefit residents. In Gainesville, as in other communities in Florida, an accurate assessment of the costs of the urban forest and careful management to reduce those costs will enhance the forest's benefits to the community.

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Table 1. Types and Examples of Common Costs and Ecosystem Disservices Associated with Urban Forest Management. Source: Escobedo and others 2011.

Types of Costs	Examples
Economic and Financial	Pruning, planting, replacement, and removal of trees; emergency transplants; pest and disease management; and irrigation Damage to urban infrastructure (telephone and electricity cables, sidewalks, roads, private property) Increased humidity (decreased human comfort) Higher property taxes when trees increase home values Foregone real estate revenue Blocked sunlight—increased energy use Green waste—storm debris, falling trees, branches, litter
Social Nuisances	Allergenic plant structures (particularly pollen) Habitat for disease vectors (mosquitoes, ticks) Undesirable wildlife Obscured views, foregone opportunities (gardening, sports), and unattractiveness Crime, risks, and hazards to humans from trees Increased wildfire risk
Environmental Pollution	Reduced water quantity, quality; increased consumption Increased use of fertilizers Increased energy consumption due to maintenance Increased air pollution emissions from tree management and maintenance activities Volatile Organic Compounds and other emissions from plants that can indirectly create smog Displacement of native species and ecosystems by establishment of urban forests

Table 2. Annual financial costs of management activities for the city of Gainesville Florida's public urban forest based on 2007 estimates.

Expenditure Item	Cost[1]
Total municipal budget for entire city	$92,183,600
Planting (public and private through outreach program)	$695,470
Pruning	$240,270
Pest and disease control	$626
Establishment and irrigation	$37,540
Stump removal and disposal	$134,700[3]
Repair infrastructure damage	$285,000[4,5]
Litigation and settlements due to tree-related claims	$5,000[2]
Storm/litter clean-up	$73,550
Inspection/answer service requests	$31,090
Program administration	$40,640
Outreach and grants	$16,040

From: [1]M. Niederhofer, Interview, November 27, 2007, [2]C. Luster, Interview, November 28, 2007, [3]S. Joplin, Interview, November 28, 2007.[4]J. Sparks, Interview, November 28, 2007. [5]M. Gaines, Interview, December 10, 2007.

Table 3. Carbon Emissions from Common Tree Maintenance Equipment.

Equipment	Carbon emissions
Chainsaws of less than 4 horsepower	1.5 kg /hour
Chainsaws of greater than 4 horsepower	3.2 kg /hour
Aerial lift trucks	3.2 kg /hour
Chippers/grinders	5.4 kg /hour
U.S. Environmental Protection Agency, 1991.	