Cutting Urban Forest Budgets is Costing More than Money

By Kit P. Jory Sr., ISA Municipal Specialist

What Would the Future Look Like with Fewer Trees?

Tree planting and maintenance costs can make up a substantial portion of tax-payer funded budgets. In order to reduce operational expenses, public agencies are decreasing funding for maintaining and replacing their urban forests. Time will prove that failing to maintain and replace tree canopies now may provide short-term budget relief, but the long-term costs and effects will be exponentially costlier and more damaging. Agencies that are justifying budget cuts to urban forest services, using the reasoning that they are being fiscally responsible today, are actually being fiscally and environmentally irresponsible for future generations. They are putting off needed tree maintenance and reforestation, surrendering stewardship, and abandoning responsibility for some of our greatest resources. The future with fewer trees looks dull, more expensive, and unhealthy, and eventually would lead to a world that is unable to sustain human and animal life.

Government agencies looking to reduce their operational budgets are targeting maintenance services as an area to save money, and urban forests are commonly included in these budget cuts (Vogt et al. 2015). In order to show the error in this strategy, it will be important to prove that regular tree maintenance is necessary to extend the life of trees and the benefits they provide. In addition to bringing attention to the impact that deferring tree maintenance and replanting will have on the environment and on future maintenance costs, this article seeks to provide ideas and sources to fund current and ongoing reforestation efforts.

Lack of preservation, before and after (Detroit, Michigan, U.S.).

Deferring tree maintenance and replanting to save money today will ultimately be counteractive to the goal agencies are trying to achieve. First, it is clear that increased tree pruning frequency preserves tree health, increases tree life-spans, and increases tree benefits. Second, when comparing the savings in tree pruning costs versus the reduction in tree value, it was found that the optimal pruning cycle is between four and five years (Vogt et al. 2015). Last, if we know that proper and regular tree maintenance prolongs the life cycle and benefits of a tree and is more cost-efficient when done on a regular cycle, then it is evident that delaying maintenance on trees will cause increased mortality and drive higher the future costs for maintenance and replanting. As reported by Vogt et al. (2015), "maintenance can be linked to tree success both at the beginning and the end of its life span. The costs of not maintaining trees early in life may translate to greater maintenance costs down the road…Tree pruning to remove high-risk limbs and removal of the entire tree can be considered a type of maintenance that purportedly can save money due to avoided litigation costs." Since the tree maintenance and reforestation that we put off doing today will have to be done at some point in the future, then it would be logical to assume that the same amount of maintenance will cost more when we account for the inflated costs of labor, equipment, and the demand for resources.

Failing to replant lost trees that are removed due to urban development and failing to plant trees to match increasing city hardscapes will cause a decrease in cool surfaces as well as the amount of vegetation available to dissipate solar heat and street-side shade trees available to naturally cool commercial buildings and residences. This decrease is directly contributing to increased localized temperatures. Cool surfaces absorb heat and solar radiation. Trees and greenspaces naturally cool the surrounding areas by providing shade, increasing humidity through transpiration, and releasing large amounts of oxygen. When cool surfaces are replaced with dark surfaces or surfaces such as buildings, parking lots, and roadways, the ability for heat and solar radiation to be absorbed is hindered. As a result, the immediate area experiences a rise in temperature otherwise known as the heat island effect (Akbari et al. 2001). While sufficient data isn't available to clearly identify the exact and specific causes of rising global temperature, there is enough data to identify heat islands as contributors within an urban environment. To counteract these rising temperatures and other negative effects of deforestation, aggressive tree replanting and prioritizing efforts to increase greenspaces should be made.

Tree canopy loss is also driving increased energy costs due to the demand for additional cooling. As temperatures rise, the need for energy consumption will also continue to rise. Using downtown Los Angeles as an example, minimum temperatures are about 4° Celsius (7° Fahrenheit) higher than they were in 1880, and maximum temperatures are about 2.5° Celsius (4.5° Fahrenheit) higher than they were in 1920. "Nationwide, the additional air-conditioning use caused by urban air temperature increase is responsible for five to ten percent of urban peak electrical demand, at a direct cost of several billion dollars annually" (Akbari et al. 2001). In relation to how this would affect the average home, studies show that for residents of New York City, "each tree could save 4.13 dollars every year…[and] planting about three trees per building could decrease the energy for heating and cooling by 50 to 90 dollars per dwelling unit per year" (Frigeri et al. 2017). In addition to the effect on energy consumption, tree canopy loss caused by deferring maintenance creates a negative impact through the resources needed for removal as well as any hazard or risk costs that may need to be mitigated. The impact is additionally exacerbated by the costs of replanting the tree and maintaining it until it reaches the maturity level where it can again contribute the level of benefits the previous tree provided. We are losing global tree canopy at an alarming rate; agencies cannot afford to forego budgeting for reforestation.

Trees provide many social and cultural benefits that are often overlooked or taken for granted. Some of these include how trees affect property values, their social impact on communities, and how they can improve people's overall health. As you will see below, while sometimes hard to quantify, some of the most valuable features of trees are these ancillary benefits; when trees decline, these benefits are lost as well. A scientific method for quantifying the actual dollar value of trees is to utilize the i-Tree valuation tool, which can be found at www.itreetools.org. While the degree to which people value trees appears to vary based on these different factors, the general consensus on how trees impact property values is overwhelmingly positive.

Metropolitan area after 500 trees removed (Hanoi, Vietnam).

Throughout the urban forest, different tree species can affect property values in various ways, such as whether they are street trees, park trees, or natural forests. While some street trees have presented negative impacts on property values due to the actual amount spent on maintenance or infrastructure conflicts, risk-related costs, and costs associated with poor maintenance management (Vogt et al. 2015), overall, trees have been shown to significantly improve property values. Greenspaces near properties can provide an estimated "increase of up to five percent in property value" (Frigeri et al. 2017). On average, each tree was found to increase property value by 51 dollars for aesthetics, 26 dollars for tree shade benefit, 11 dollars for storm water runoff prevention, 7 dollars for air quality benefit, and 3 dollars for carbon reduction (Song et al. 2018). Heimbuch (2016) reports that "5.82 dollars in benefits is returned for every 1 dollar spent on trees." However, the presence of declining trees was found to reduce aesthetic value and in most cases impacted property values negatively. A common denominator of trees that had declined prematurely was that they had been neglected or were subjected to either a lack of maintenance or improper maintenance. The aesthetic value of trees is largely influenced by the psychological relationship people have with them, measurable and quantifiable through the benefit-cost ratio (BCR). Song et al. (2018), in 22 of 26 papers studied, showed that the BCR of trees outweighed the costs of maintaining the trees, even when aesthetics was the only category of value considered.

After aesthetics, benefits received by a tree's micro-environment (the area immediately around the tree) held high values when applied towards property valuation. Some of these micro-environment benefits included shade provision, protection from the wind, mitigation of storm water runoff, and the reduction of carbon. Reductions in energy cost benefits are separate from the environmental value trees bring in the way of shade and wind protection and the creation of wind fields (Nowak 2000).

Further benefits of tree shade include the protection and life extension of paved surfaces, the cooling of parked cars, and the provision of partial shade for other species of vegetation to grow in. The benefits of tree shade and wind protection are often overlooked, but they have significant value in many geographical areas.

Trees capture rain water, reducing the amount of needed infrastructure for drainage systems as storm water runoff is reduced in urban neighborhoods (Frigeri et al. 2017). Trees provide permeable surfaces immediately around their planting spaces. These permeable surfaces allow for the trees to take up rainwater through their root system, increasing air humidity and reducing air temperature immediately around the tree (Nowak 2000). This hydrological process also improves soil quality, increases the presence of nutrients that improve ground water quality, and helps to maintain natural land features and topography by preventing land erosion. Greenspaces provided by street trees, park trees, and other urban vegetation contribute to the resupply of ground water. In contrast, the surrounding asphalt and concrete surfaces contribute to street flooding. While water interception volume and benefits have been tracked by numeric models (Song et al. 2018), more data collection and tracking are needed to quantify the cost savings that could be obtained by reducing the need for additional drainage infrastructure. Once quantified, these savings could be realized as a financial benefit to maintaining and growing urban forests.

Trees hold additional value to the community around them such as their social impact. Social impact is measured primarily by the safety value trees bring, their contribution to unifying communities, and how they provide privacy for property owners. Safety value can be described as a combination of multiple factors such as the effect roadside trees have on safer driving, how greenspaces result in lower criminal activity, or how well maintained trees and lawns encourage community policing (Dandy 2010). Green communities that are well-landscaped and maintained promote participation in events that connect people and provide a feeling of well-being. In contrast to encouraging people to connect in communities, those same neighborhood trees provide a physical and psychological barrier between homeowners and the public that offers a certain level of privacy. This privacy not only deters crimes of opportunity from would-be criminals who happen upon a dark, empty house by simply driving by it, but they also provide a sense of security and solitary for a homeowner when they are home. Studies show that trees and greenspaces that provide this privacy benefit more prevalently are also found to be in neighborhoods and communities that are reported as more desirable living locations. As such, there appears to be a strong correlation to this privacy benefit between homeownership and social status. While voluntary support for tree programs was found to be highest among the most affluent residents, "individual characteristics such as race, gender, and residence were not statistically significant factors in explaining attitudes towards urban forestry" (Dandy 2010). The social impact of trees is clear and is one of the motivating factors behind many authorities that award tree planting grants with stipulations that trees be planted in distressed neighborhoods or in areas with higher poverty rates.

Removals caused by failure to identify pests due to maintenance neglect (Stockton, California, U.S.).

Many health benefits have been reported to be provided by trees and greenspaces. These benefits include restorative value to overall well-being, physical health, and recovery from mental fatigue. Dandy (2010) reports that multiple studies show greenspaces provide rest and relaxation, stimulate the positive feelings needed for mental recovery, and contribute other beneficial factors that lead to good health. Greenspaces that are safe, maintained, and provide a variety of vegetation along walking trails provide the environment for people to interact with nature and perform regular exercise, which leads to healthy living. At hospitals, rooms with views of trees and greenspaces were found to improve the recovery of patients and decrease the costs for medications (Frigeri et al. 2017). Even across different cultures, there appears to be a connection between greenspaces and the restorative benefits they provide. People overwhelmingly appreciate the emotional and psychological benefits that greenspaces provide. Frigeri et al. (2017) reported data from studies that show how trees and greenspaces have a profound effect on stress reduction. These studies include a poll where individuals could choose the best prescription for anxiety out of several choices, including a walk in the forest, reading a book, taking medicine, and others. In this study, respondents overwhelming chose a walk in the forest as the best method to reduce stress. It is clear there is sufficient data to show that trees and greenspaces provide multiple health benefits for physical, mental, and spiritual improvement and general well-being. Some additional health-related benefits trees contribute are bio-diversity, recreation and tourism, and noise reduction (Song et al. 2018). Priority should be placed on providing proper care and maintenance to ensure these benefits continue.

The most important interaction that trees have with the environment is the relationship they have with air quality. This relationship is dependent on the balance between the ability of healthy trees to remove pollutants from the air while at the same time not having so many pollutants in the air that the trees are irreparably damaged. Through photosynthesis, a tree absorbs carbon-based pollutants from the air and water through roots, bark surface, and leaves. The right amount of carbon in the air allows trees to complete this process effectively as they continue to grow, but an overabundance of pollutants can cause decreased tree health and even mortality. Because of their size, trees can store large amounts of carbon; amounts vary by species. This carbon storage provides its own financial benefit, measured separately from the benefits of carbon reduction and its effect on air pollution. Net carbon storage created by tree maintenance activities was tracked in several studies and found to create an average positive annual benefit, even after factoring in carbon emissions from tree decomposition (Song et al. 2018). The ability for trees to remove carbon pollutants and store them is a tremendous benefit that trees provide. However, this relationship can be a dangerous cycle when out of balance. As tree canopies decline, less air pollutants are removed, overwhelming the remaining trees' ability to process the particulates. The trees ability to improve air quality is diminished, allowing more pollutants to travel throughout the atmosphere to be taken up by other trees and vegetation. The cycle continues, less trees…more pollutants…more tree damage…more pollutants…tree mortality…more pollutants, ad infinitum, until appropriate action is taken to stop this unsustainable cycle. The overall result of agencies deferring maintenance and failing to replant trees is deforestation and tree canopy loss, and the biggest consequence is an increase in air pollution.

A great number of measurable and ancillary benefits are at risk when considering the consequences of deforestation and tree canopy loss due to deferring maintenance. It is apparent that the reduction of trees and greenspaces is having a negative impact on a vast number of diverse benefits as discussed above. While the ability to quantify some of these benefits financially is noted in U.S. dollars, it is also clear that there is a much larger psychological impact that needs to be considered.

In addition to the problem of deferring maintenance and allowing trees to fail due to improper care, agencies are also not replanting lost trees. Many property owners are taking it upon themselves to replant lost trees, and while this is beneficial, the overall net benefits are being reduced because of the species of trees that are being replaced. Mature large-leaf shade trees provide the greatest benefit to improving air quality. As these urban trees are failing, property owners are replacing them with smaller, ornamental trees that they consider to create less of a hardship on them (Nowak 2000). Since the costs of replacement and maintenance is being assumed by the property owner, they are selecting smaller tree species that are easier to maintain, provide fewer conflicts with infrastructure, and provide less tree litter. The greatest benefits can be found in the increases in property value, social impact, and health benefits that these smaller trees provide. To effectively counteract air pollution, tree planting should consist of, among other things, trees that are more tolerant to pollutants, larger evergreen trees with larger tree canopies, and trees that require lower maintenance (Oswalt 2018). This is not meant to contradict the message that 'planting trees is good.' It is simply apparent that certain trees will produce a greater impact on combatting air pollution than others. However, any tree planting effort will bring value by increasing some level of the benefits detailed above.

McPherson and Simpson (1999) clearly articulate the impact that trees have in reducing air pollution by pointing out that urban forests are responsible for decreasing large amounts of carbon dioxide (CO_2), removing pollutants from the air, and lowering air temperatures. These studies report that there are effective models that prove urban forests, when properly planned and managed, will provide significant impacts on removing and preventing air pollution on a local level. Sustaining just one large healthy tree provides enough oxygen to support four people for an entire day. What is done on a local level repetitively will result in changes on a global level. Deforestation is having a devastating effect globally on the quality of air. To put it simply, "Tropical deforestation and associated land conversion generate more than 30 percent of global greenhouse gas emissions...We have already lost 50 percent of the worlds intact forests, and 20 million hectares of forestland continues to be destroyed every year" (Bettelheim 2016). The downward trajectory of the cycle that we are headed on is clear. Continuing the practice of deferring tree maintenance and allowing trees to fail without being replaced is not an acceptable answer. If legitimate steps are going to be taken to curb air pollution, then a collaborated and aggressive tree replanting effort needs to be initiated on a global level right now.

The current practice of deferring tree maintenance to trim budgets is clearly not an acceptable strategy. Local urban forests are in decline and many agencies are not mitigating tree decline or tree loss with a long-term replanting plan; and this fails to account for increasing populations. An aggressive plan should be in place to ensure that urban forest growth will mirror population growth. Failing to maintain these trees now will be problematic for future stakeholders, not just on budgets that will be forced to fund the reforestation that will be needed to recover tree canopy loss, but on the many negative consequences that will come from the permanent loss of all benefits that these trees produce. Communities should invest in the reforestation of local urban forests, as the data shows that increasing local tree canopy provides many direct and indirect local benefits. It is clear that deforestation is a factor of climate change, the burning of fossil fuels is a contributor to global air pollution, and trees and other vegetation are the greatest tools to reduce temperatures and remove air pollutants.

This research relies on the argument that agencies are not replanting trees at an acceptable rate due to budget problems; here are just some of the multiple funding sources available for reforestation. Currently, there are multiple private funding agencies, as well as state and federal tree replanting grants, that are available to assist in tree planting. In California, for example, there are organizations such as ReLeaf and the state funded Cal Fire grant program that are potential funding sources. Federally, the USDA Forest Service offers assistance through grants and cooperative agreements for reforestation efforts. The international Tree Foundation and Green Earth Appeal both offer tree planting grant opportunities. Local environmental and community groups can be strategic partners in identifying program organization, volunteerism, and material donations to conduct regular tree replanting projects. Urban forests maintained by agencies can be utilized as a capitol asset. For example, Sacramento County's urban forest, consisting of six million trees, has an implied value of $28.7 million due to its ability to remove air pollutants (McPherson and Simpson 1999). Though the carbon credit offset program is in its beginning stages, it is plausible that in the very near future credits such as these could be traded or sold to an industry or even another city. A city such as Los Angeles, which due to infrastructure and development has limited tree planting locations, still has an obligation to offset carbon emissions (McPherson and Simpson 1999). Joint projects between agencies and industries can lead to reforestation efforts which would replace lost tree canopies, utilize large scale photosynthesis to store carbon, and generate funding to boost budgets to maintain and/or improve current tree maintenance programs (Bettelheim 2016). Vast areas of land are available to plant new trees, although finding appropriate planting locations in urban areas can be difficult (Nowak 2000). Some proactive agencies have formed reforestation plans, which include replanting all trees removed for any reason, with the costs offset by enterprise funds or land development permit fees. Agencies could also require that trees be replanted at a rate higher than the estimated tree mortality rate. Current average tree mortality rates range from 0.7 to 2.23 percent (Song et al. 2018). These are just a few resources to use in forming a replanting plan and some identified funding methods to at least partially offset the cost of reforestation.

Research suggests that agencies that are currently reducing their urban forest budgets will ultimately have to spend more money than originally budgeted and deal with considerable long-term negative consequences; and because agencies and communities will need to make up for years of deforestation and tree canopy loss, they will suffer the loss of many environmental and socioeconomic benefits and will have directly contributed to global air pollution. The result of deferring tree maintenance is clear: it will lead to tree canopy decline and eventually deforestation of urban areas. When considering this in its entirety, it should be obvious that the long-term effects of losing trees and failing to replant them will have dramatic effects on local and global environments. Public agencies have a responsibility to stop reducing budgets for urban forests, to stop deferring maintenance on street and park trees, and to stop allowing tree canopy loss to go unchecked by not engaging in replanting efforts. They have a responsibility to make financially conscientious decisions while considering the long-term consequences of their actions, to offset urban development by balancing hardscapes with sufficient trees and greenspaces to improve the local environment, and to be proactive in contributing to the global effort of reducing air pollution and ensuring our environment and planet are sustainable for human life. This can be accomplished by utilizing the multiple private, state, and federal funding resources available to fund efforts which would work to increase preservation, mitigate tree loss, and reinstate previously reduced maintenance services. This goal requires a commitment of resources to ensure that urban forest tree inventory records are periodically updated, that regular tree canopy assessments are completed, that the public is engaged with educational outreach aimed at improving community investment, that efforts to grow the tree canopy through tree planting are made, and that the product of all these activities is used to inform long-term Urban Forest Management Planning. To the local, state, and international agency decision makers that are reading this: what are you prepared to do to change the trajectory we are on to ensure these decisions won't cost more than the money that you are trying to save?

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Photos are courtesy of the author.

Plant I.D.

Did you correctly identify this tree from page 13?

Content sources: Missouri Botanical Garden, Monrovia, Royal Horticultural Society, and *Dirr's Encyclopedia of Trees and Shrubs*.

Davidia involucrata

An aesthetically pleasing, flowering tree, this aromatic plant is hardy when mature. It prefers light shade, but will tolerate sun and needs consistently moist soil. The tree should be watered regularly and pruned in winter. It has a pyramidal canopy in youth that loosens with age. It does not flower until 10 years of age and may not flower reliably/annually thereafter.

Botanical name:	*Davidia involucrata*
Common names:	Dove-tree, handkerchief tree, ghost tree
Mature size:	20 to 40 feet (6 to 12 m) height and width
Foliage:	Toothed, alternate, simple, 2 to 2.5 inches (5 to 6 cm) long, roughly 0.75 inches (2 cm) wide.
Fruit:	Flowers (late spring) are large, oval-rounded, showy white involucre bracts which subtend each flower cluster. The flowers are followed by round, greenish-brown, golf-ball-sized fruits on 2 to 3 inch (5 to 7.5 cm) stems. May not flower in colder climes.
Growth rate:	Moderate
Autumn color:	Bright green in summer but turning to warm pastels in autumn.
Geographic range:	Native to woodlands of central and southwestern China.
USDA Hardiness Zone:	6–8
Pests and diseases:	No serious insect or disease problems.