The Importance of Trees in Urban Transport Infrastructure

Kathleen Wolf, Ph.D.
Research Social Scientist

University of Washington (Seattle)
School of Environmental and Forest Sciences

Australia Arboriculture 2017 Conference
Canberra - 2 May 2017
trees & transport :: better partnering?
canopy of a city = multiple services & benefits
economic value of street trees

urban forestry and urban greening
# Yard & Street Trees

<table>
<thead>
<tr>
<th>Value</th>
<th>Increase</th>
<th>Condition</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2%</td>
<td>mature yard trees (greater than 9-inch dbh)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3%</td>
<td>larger street trees (up to 100’ away)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3-5%</td>
<td>trees in front yard landscaping</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6-9%</td>
<td>good tree cover in a neighborhood</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10-15%</td>
<td>mature trees in high-income neighborhoods</td>
<td></td>
</tr>
</tbody>
</table>

*multiple studies: Green Cities: Good Health > Local Economics*
Local Government Benefits

*Civic Investment – Public Goods*
*like schools, emergency response, roads*

- Street trees average positive effect on house values
- Added up across Portland, Oregon yields a total value of $1.35 billion
- Potentially increasing annual property tax revenues $15.3 million

Donovan & Butry. 2010. *Landscape and Urban Planning*
economic value of trees in retail districts

urban forestry and urban greening
Trees & Retail Environments Research

Trees & Shopper Environments Research

• Research Questions •
  trees and visual quality?
  trees and consumer behavior?
  trees and product pricing?

• Methods:
  mail out/in surveys
  national or local sample
  residents/nearby city residents

partners: U of Washington, NGOs, business organizations
funded by USDA Forest Service
Image Categories (sorted by ratings)

Scale: 1=not at all, 5=like very much, 26 images

Pocket Parks
mean 3.72
(highest)

Full Canopy
mean 3.63
Enclosed Sidewalk 3.32

Intermittent Trees 2.78
No Trees
mean 1.65
(lowest)
(high - 3.72)
1. Place Perceptions
   • Place Character
   • Interaction with Merchants
   • Quality of Products

2. Patronage Behavior
   • travel time, travel distance
   • duration & frequency of visits
   • willingness to pay for parking

3. Product Pricing
   • higher willingness to pay for all types of goods
   • higher in districts with trees – 9-12%
social science of consumer behavior

‘atmospherics’
human health & wellness benefits

urban forestry and urban greening
‘metro nature’
extensive evidence about human wellness & ‘nearby nature’
evidence about human wellness & ‘nearby nature’
Public Health & Wellness Determinants
Green Cities: Good Health
www.greenhealth.washington.edu

Sponsors:
USDA Forest Service, U&CF Program
University of Washington
NGO partners

thanks!
to U of WA students:
Katrina Flora
Mary Ann Rozance
Sarah Krueger

research review & summaries
Local Economics

Trees in cities are not grown and managed for products that can be bought and sold on markets, but they do provide many intangible services and functions! This article serves two purposes. First, it introduces valuation methods that are used to convert intangible benefits to dollar sums. Then, it shows how nonmarket valuations can support local decision-making.

Fast Facts

- The presence of larger trees in yards and as street trees can add from 3% to 15% to home values throughout neighborhoods.
- Averaging the market effect of street trees on all house values across Portland, Oregon yields a total value of $1.35 billion, potentially increasing annual property tax revenues $15.3 million.
- A study found 7% higher rental rates for commercial offices having high quality landscapes.
- Shoppers claim that they will spend 9% to 12% more for goods and services in central business districts having high quality tree canopy.
- Shoppers indicate that they will travel greater distance and a longer time to visit a district having high quality trees, and spend more time there once they arrive.
Urban Forests and Newborns
the natural environment may affect pregnancy outcomes . . .

10% increase in tree-canopy cover within 50m of a house
= lower number of low weight births
(1.42 per 1000 births)

Donovan et al., Health & Place 2011;
Hystad et al., Env Health Perspectives 2014
Trees & Crime Reduction

- trees in the public right of way are associated with lower crime rates
  - smaller, view-obstructing trees are associated with increased crime
  - larger trees are associated with reduced crime

Donovan & Prestemon. 2012. *Environment and Behavior*
10% increase in tree canopy
~ 12% decrease in crime

Air quality :: strategic planting

Pugh et al. 2012. Environmental Science and Technology
combatting obesity
moderate activity recommended

walkable communities
Green Streets for Walkability

evidence of lower frustration and higher meditation when moving into the greener streets

Aspinall et al. 2013. The Urban Brain: Analysing Outdoor Physical Activity with Mobile EEG. British Journal of Sports Medicine
20 adults with major depression walk in a park setting and an urban setting

- 50-minute walks one week apart
- before-after testing:
  - Mood: Positive and Negative Affect (PANAS)
  - Cognition: Backward Digit Span (BDS)

Cognitive and affective improvements after walking in a nature setting

Berman et al. 2012. Journal of Affective Disorders
Local Economics

Trees in cities are not grown and managed for products that can be bought and sold on markets, but they do provide many intangible services and functions! This article serves two purposes. First, it introduces valuation methods that are used to convert intangible benefits to dollar sums. Then, it shows how nonmarket valuations can support local decision-making.

Fast Facts

- The presence of larger trees in yards and as street trees can add from 3% to 15% to home values throughout neighborhoods.
- Averaging the market effect of street trees on all house values across Portland, Oregon yields a total value of $1.35 billion, potentially increasing annual property tax revenues $15.3 million.
- A study found 7% higher rental rates for commercial offices having high quality landscapes.
- Shoppers claim that they will spend 9% to 12% more for goods and services in central business districts having high quality tree canopy.
- Shoppers indicate that they will travel greater distance and a longer time to visit a district having high quality trees, and spend more time there once they arrive.
economic value opportunities

urban forestry and urban greening
‘metro nature’
Nearby nature experiences are important across the entire life cycle, from cradle to grave.

**INFANTS**

**BIRTH WEIGHT**

Potential Economic Value: **$15.9M savings on annual healthcare costs.**

Birth weight influences long-term childhood health and development, and has been linked to some adult diseases. Low birth weight is associated with both short- and long-term health care costs, such as longer hospital stays and increased illness. Pregnant women that have more tree canopy and green space near their homes generally have better health outcomes with healthier birth weights.

**IMMUNE FUNCTION**

**Economic Implication:** Stronger immune system leads to reduced illness and chronic disease across a lifetime.

We must be more aware of our early months of life, the body and mind are growing and developing at an astonishing rate. The "nature hypothesis" suggests that early contact with outdoor environments stimulates the development of a healthy immune system.

**FAMILY DYNAMICS**

**Economic Implication:** Improved family dynamics, perhaps reducing mental health treatment and counseling services.

An infant's parents and siblings adopt their lives after a baby arrives, and the changes can bring on stress and anxiety. Nature views and walks help reduce these conditions and improve interactions between people within the household.

**ADHD**

**Potential Economic Value:** $13.6 increase in medication savings per year.

ADHD is a common disorder that affects children and adults. It can lead to difficulties in concentration, behavior, and relationships.

**FUTURE FINANCIAL SUCCESS**

**Potential Economic Value:** $13.6 increase in annual income.

School performance affects both short-term self-esteem and long-term success. Having green views from classrooms and common spaces in schools can improve students' capacity to direct attention and feel less stressed. Green high school campus landscapes are linked to higher graduation rates.

**CHILDREN & TEENS**

**OVERALL HEALTH AND WELL-BEING**

**Economic Impact:** Increased physical activity, reduced asthma or leading cause of emergency department visits, hospitalizations, and missed school days, and reduced risk of adult skin conditions.

Recreational time in a child's surroundings can contribute to both immediate and ongoing health impacts. Nature is a positive influence, playing in nature helps children develop social, physical, and intellectual skills that improve both health and later life achievement. Green spaces near the air our children and teens breathe give them space for moderate to vigorous activity, and help them from too much screen exposure.

**DEPRESSION AND STRESS**

**Economic Implication:** Reduces frustration, mental distress and depression disorders, and improves body image, self-esteem, and life satisfaction.

Busy, highly scheduled lifestyles take their toll. Nature experiences reduce stress. Nearly 4 million adults experience depression each year in the U.S. and associated, behavioral, and nonspecific symptoms are a leading cause of disability. Nature experiences can support people who need fresh air and health benefits in the short term to improve mental health and function. Improved mental health and function reduces disease treatment costs, and improve overall productivity.

**CARDIOVASCULAR DISEASE**

**Potential Economic Value:** $13.6 increase in medication savings per year.

Cardiovascular disease is the leading cause of premature death in the U.S. People who show a reduced risk of CVD are less likely to have heart attacks and other health issues.

**CRIME & SAFETY**

**Potential Economic Value:** $13.6 increase in reduced costs of crime for victims and communities,

School performance affects both short-term self-esteem and long-term success. Having green views from classrooms and common spaces in schools can improve students' capacity to direct attention and feel less stressed. Green high school campus landscapes are linked to higher graduation rates.

**OLDER ADULTS**

**MOBILITY & QUALITY OF LIFE**

**Potential Economic Value:** $13.6 increase in quality of life.

One in three older adults falls each year, giving rise to falls and associated injuries. A majority of older care facilities are particularly unsuitable medical situations. Being in nature maintains personal mobility, leading to reduced falls and reduced need for medications. Further, those who are socially isolated are more likely to be unhealthy, so gardening and nature walking activities that promote social interaction support positive lifestyles and quality of life.

**HYPERTENSION**

**Potential Economic Value:** $13.6 increase in blood pressure.

Hypertension, or high blood pressure, is one of the five most common conditions impacting older adults. Views of nature, particularly forests and "forest bathing" (sensory walks in natural forest settings) decrease diastolic pressure.

**COGNITIVE DISORDERS**

**Potential Economic Value:** $13.6 increase in quality of life.

About one in five older adults experience mental and cognitive disorders, with age being the greatest risk factor. In 2010, about 11% of people aged 65 or older were affected with Alzheimer's disease. Those with dementia have three times as heavy hospital stays per year as other older adults. Encounters with nature improve symptoms related to cognitive disorders, such as agitation, depression, and reduced mobility.
## Summary Table

<table>
<thead>
<tr>
<th>Benefit (geographic scope)</th>
<th>Minimum ($)</th>
<th>Maximum ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newborn Health (U.S.)</td>
<td>5.3</td>
<td>5.3</td>
</tr>
<tr>
<td>Attention Deficit Hyperactivity Disorder (U.S.)</td>
<td>383.5</td>
<td>1,917.7</td>
</tr>
<tr>
<td>Schools (U.S.)</td>
<td>20.4</td>
<td>1,262.9</td>
</tr>
<tr>
<td>Crime (U.S.)</td>
<td>340.6</td>
<td>899.4</td>
</tr>
<tr>
<td>Cardiovascular Disease (U.K., U.S.)</td>
<td>1,220.0</td>
<td>1,220.0</td>
</tr>
<tr>
<td>Alzheimer’s Disease (U.S.)</td>
<td>724.6</td>
<td>1,449.2</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>2,694.4</strong></td>
<td><strong>6,754.5</strong></td>
</tr>
</tbody>
</table>

Valuation Strategies

Benefits Transfer approaches

• factor income
• avoided or replacement cost
• burden of illness
• hedonic pricing
• stated preference/contingent valuation
• revealed preference (e.g., travel cost)
• quality adjusted life years
• benefit/cost
Avoided Costs Potential?

transport innovations

- green streets
- complete streets
- environmental & human health
- co-design for co-benefits
credit: American Planning Association
stormwater management

source: City of Portland, Bureau of Environmental Services

Green Streets
green stormwater infrastructure tools & strategies

= mini parks?

source: Seattle Public Utilities
green infrastructure :: co-benefits
linked to active transport network
neighborhood social cohesion

environmental education & social learning
Complete Streets are streets for everyone. They are designed and operated to enable safe access for all users, including pedestrians, bicyclists, motorists and transit riders of all ages and abilities. Complete Streets make it easy to cross the street, walk to shops, and bicycle to work.

source: Smart Growth America
multi-modal transport

source: www.good.is
Complete Streets = Trees
Summary :: trees & transport

- economic benefits :: property value & retail behavior
- nearby nature = disease prevention & health promotion, also economic value
- Green Cities: Good Health web site
- trees in transport systems innovations :: green infrastructure, complete/green streets
Human Dimensions of Urban Forestry and Urban Greening

featuring research on people's perceptions and behaviors regarding nature in cities

Nature and Consumer Environments
Research about how the urban forest influences business district visitors.

Trees and Transportation
Studies on the value of having quality landscapes in urban roadsides.

Civic Ecology
Studies of human behaviors and benefits when people are active in the environment.

Policy and Planning
Integrating urban greening science with community change.

Urban Forestry and Human Benefits
More resources, studies and links...

Projects Director
Kathleen L. Wolf, Ph.D.