The Economics of Nature-Based Human Health Benefits

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International Arboriculture Summit
Hong Kong, 15 November 2017
in the background
trees & forests provide many community benefits!
Forest Economics 101
Economic Value of City Nature
Methods Challenges

Forest Products
= market goods
excludable
identifiable ownership
expenses-revenues
= profits

Trees/Green in Cities
= public goods
non-excludable
multiple “owners”
expenses-returns?
-profits?
Trees & Property Value

hedonic value

street trees
yard landscape

local revenues
## Yard & Street Trees

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

multiple studies:
Green Cities: Good Health > Local Economics
## Tree Retention In Development

<table>
<thead>
<tr>
<th>Value</th>
<th>Increase</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>18%</td>
<td>building lots with substantial mature tree cover</td>
</tr>
<tr>
<td></td>
<td>22%</td>
<td>tree-covered undeveloped acreage</td>
</tr>
<tr>
<td></td>
<td>19-35%</td>
<td>lots bordering suburban wooded preserves</td>
</tr>
<tr>
<td></td>
<td>37%</td>
<td>open land that is two-thirds wooded</td>
</tr>
<tr>
<td>Increase</td>
<td>Condition</td>
<td></td>
</tr>
<tr>
<td>----------</td>
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<td></td>
</tr>
<tr>
<td>10%</td>
<td>inner city home located within 1/4 mile of a park</td>
<td></td>
</tr>
<tr>
<td>17%</td>
<td>home near cleaned-up vacant lot</td>
<td></td>
</tr>
<tr>
<td>20%</td>
<td>home adjacent to or fronting a passive park area</td>
<td></td>
</tr>
<tr>
<td>32%</td>
<td>residential development adjacent to greenbelts</td>
<td></td>
</tr>
</tbody>
</table>
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 USD
- potentially increasing annual property tax revenues $15.3 million USD

Donovan & Butry. 2010
*Landscape and Urban Planning*
Community Economics

retail & shopper behavior
indirect economic measures
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%
retail & place marketing

“Companies stage an experience when they engage customers in a memorable way.”
summary

urban forests = human habitat

studies of trees in business districts
perception, preference & behavior
design & place messaging/identity
customer relationships
Trees as Place-Makers
the Chenoggye freeway in Seoul
~ 1970-2005
Cheonoggyecheon Stream Restoration

8.4 km, $900 M
1.45-mile-long (2.33 km) elevated linear park, greenway and rail trail

former New York Central Railroad spur, Manhattan

credit: NY City Parks
Economic Impacts

- between 2003 and 2011
- nearby property values increased 103% (despite deep recession)
- $2 billion USD was invested in nearby properties development
Awaji Landscape Planning & Horticulture Academy
retail street in urban Japan (and other Asian cities)
Namba Parks, Osaka
view from nearby hotel
interior retail space
ground level
small plazas
retail entry
up-close nature experiences

place of respite
Namba Parks
retail success & nature experience benefits
lessons learned?

social spaces
small rooms
variety within unity
Austin, TX

South Congress Avenue redevelopment district
public xeriscape

shared design & management
identity
affordable materials
message of renewal
Bainbridge Island, WA
“main street”
outdoor rooms
social spaces
sense of welcoming
nearby nature experiences
human habitat for wellness
disease prevention
health promotion
World Health Organization
health definition

a state of complete
physical, mental, and social well-being
and not merely the absence
of disease or infirmity (1946)
What are the economic values of nature and human health benefits?
Elements of Economic Valuation

• What are the benefits?
• Who experiences nature and gets benefits?
• What is the green condition or situation that provides benefits?
• Scale of value question (i.e., community, province/state, nation)
• What are the costs/income gained/lost associated with these benefits?
Nearby nature experiences are important across the entire life cycle, from cradle to grave.

**INFANTS**

**BIRTH WEIGHT**

ECONOMIC IMPLICATIONS
- **STUDY ON MEDICATION SAVINGS PER YEAR**
  
  Millions of infants are born each year in the U.S. Nature exposure is a potential alternative treatment, studies show activity within nature or green spaces, such as play or just 30 minutes of walking, can reduce symptoms.

**FAMILY DYNAMICS**

ECONOMIC IMPACT
- **INCREASED PHYSICAL ACTIVITY, REDUCED ACHICICAL OR LEADING CAUSE OF EMERGENCY DEPARTMENT VISITS, HOSPITALIZATIONS AND MORTALITY RATES.**

**FUTURE FINANCIAL SUCCESS**

ECONOMIC IMPACT
- **HIGH SCHOOL GRADUATES LIFELONG INCOME**


**CHILDREN & TEENS**

**OVERALL HEALTH AND WELL-BEING**

ECONOMIC IMPLICATIONS
- **HIGH SAVINGS ON MEDICATION COSTS.**

**DEPRESSION AND STRESS**

ECONOMIC IMPACT
- **REDUCED FLEXIBILITY, MENTAL DYSTOXIS AND DEPRESSION DISORDERS, AND IMPROVED BODY IMAGE, SELF-Esteem AND LIFE SATISFACTION.**


**ADULTS**

**CARDIOVASCULAR DISEASE**

ECONOMIC IMPLICATIONS
- **REDUCED RISK OF HEART ATTACK AND DEATH.**

**MOBILITY & QUALITY OF LIFE**

ECONOMIC IMPACT
- **HIGHER SAVINGS ON NURSE AIDING SERVICES PER YEAR.**

**OLDER ADULTS**

**HYPERTENSION**

ECONOMIC IMPACT
- **LOW SAVINGS ON NURSE AIDING SERVICES PER YEAR.**

**COGNITIVE DISORDERS**

ECONOMIC IMPACT
- **LOW SAVINGS ON NURSE AIDING SERVICES PER YEAR.**


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**Contributing Analysts:**

Dr. Stephen Grado & Marcus Measells, MSU; Dr. Alicia Robbins, Weyerhaueser
Publications


* Research and publications were funded in part by the U.S.D.A. Forest Service, National Urban and Community Forestry program, as recommended by the National Urban and Community Forestry Advisory Council (NUCFAC).
Analysis Process

- scale of individual to community
  screen for benefits

- green condition
  urban forestry, parks, gardens, etc.

- market & non-market valuation strategy
process #1: screen for benefits
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 Reviews & 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
ADHD and nature contact

- 96 children aged 7-12 diagnosed ADD or ADHD
- Parents gave postactivity attentional functioning ratings (PAAF) –
  - 4 measures:
    - Can’t stay focused on unappealing tasks (homework or chores)
    - Can’t complete tasks
    - Can’t listen and follow directions
    - Easily distracted

Faber Taylor. 2001. *Environment & Behavior*
ADHD and nature contact

- 17 children aged 7-12 with diagnosed ADHD
- 20-minute guided walks
  - Park
  - Neighborhood
  - Downtown
- Pre-walk puzzles
- Post-walk cognitive test

Faber Taylor & Kuo. 2009. *Journal of Attention Disorders*
Change in % Population on ADHD Treatments
2001 - 2010

America’s State of Mind, Medco Health Solutions, Inc
% of Americans Ages 20-44 on ADHD Meds
2001 - 2010

America’s State of Mind, Medco Health Solutions, Inc
ADHD Hong Kong

The overall pooled-prevalence of ADHD among children and adolescents in China was 6.26%.

The prevalence of ADHD among children and adolescents in China is generally consistent with the worldwide prevalence; ADHD affects quite a large number of people under 18 years old.

CDC moderate activity recommendations

parks, active living, active transit
Improving Depression

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
% of U.S. Population Using Mental Health Medications
2001 vs 2010

America’s State of Mind, Medco Health Solutions, Inc
Prevalence of Adult Antidepressant Use 2001 vs 2010

America’s State of Mind, Medco Health Solutions, Inc
Alzheimer’s Disease & Dementia
Provide wander gardens & horticulture therapy

- 10.5% reduction in amount of medications used in dementia facility
- 30% fewer falls, accompanied by a reduction in fall severity

Detweiler et al. 2009. *American Journal of Alzheimer’s Disease and Other Dementias*
Lifecycle :: disease & illness

Cumulative U.S. DALYs for the Leading Disease/Disorder Categories by Age (2010)

- Disability Adjusted Life Year

Data courtesy of WHO
Prison Inmates :: nature videos
solitary confinement, video room/exercise option

- felt significantly calmer, less irritable, more empathetic
- committed 26% fewer violent infractions

process #2: understand green condition
Diversity in Metro Nature

NEARBY NATURE INCLUDES A VARIETY OF SPACES AND PLACES

- URBAN FOREST CANOPY
- BIOPHILIC DESIGN
- PARKS AND GARDENS
- GREEN STORMWATER INFRASTRUCTURE
process #3: apply valuation strategy
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
Natural Resources Valuation

- travel cost
- income loss
- hedonic margin
- willingness to pay
Stormwater Ecosystem Services

green infrastructure

goal: co-design for co-benefits

Image courtesy of the Center for Urban Forest Research
Grey Infrastructure

Drain, direct, dispatch

Green Infrastructure

Slow, spread, soak

Source: Low Impact Development: A Design Manual for Urban Areas, 2010
Valuation Sources

Benefit x Nature x Health Outcome

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Metro Nature</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newborn Birth Weight</td>
<td>increased tree canopy cover near mothers' homes</td>
<td>fewer small for gestational age babies</td>
</tr>
<tr>
<td>Attention Deficit Hyperactivity Disorder</td>
<td>greener play areas vs built outdoor or indoor settings</td>
<td>reduced symptoms potentially reducing medication</td>
</tr>
<tr>
<td>School Performance</td>
<td>green views from classrooms and cafeteria</td>
<td>reduced dropout rate - average annual income</td>
</tr>
<tr>
<td>Crime Reduction</td>
<td>trees and lawn in outdoor common areas</td>
<td>reduced violent and non-violent incidence and costs</td>
</tr>
<tr>
<td>Cardiovascular Disease</td>
<td>presence of residential tree canopy</td>
<td>reduced incidence or severity of cardiovascular disease</td>
</tr>
<tr>
<td>Alzheimer's Disease</td>
<td>wander garden in care facility</td>
<td>reduced medications for patients</td>
</tr>
</tbody>
</table>

common values: avoided costs & burden of illness
Avoided Costs Potential?

$3 trillion  
17% of US GDP


$222 billion  $134 billion  $57 billion
What is the Value?
Analysis Process

- scale of individual to community
  - screen for benefits
- green condition
  - urban forestry, parks, gardens, etc.
- market & non-market
  - valuation strategy
## 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>

Summary

• evidence-based human health & wellness benefits
• economic consequences!
• market & non-market valuations
• first efforts – promising!
• = demonstrating return on investment
Urban Forests for Human Health: A Focused Economic Valuation

Support arboriculture research with a donation to the TREE Fund

Healthy trees are rooted in research! Donate now at www.treefund.org

Cultivating Innovation in Arboriculture and Urban Forestry
TREE Fund · 552 S. Washington St., Ste. 109, Naperville, IL 60540
Human Dimensions of Urban Forestry and Urban Greening

features research on peoples' 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.

www.naturewithin.info
Course/Session Name: International Arboriculture Summit (Hong Kong) 2017 13-15

The Economics of Nature-Based Human Health Benefits

Date: Nov 14 2017

Course Code: HK 17 046

Speaker(s): Dr. Kathleen Wolf

Certified Arborist: 1  Utility Specialist: 1  Municipal
Specialist: 1

BCMA - Science: 0  BCMA - Practice: 0  BCMA -
Management: 1

TW Climber Specialist: 1  TW Aerial Lift Specialist: 1