Nature & Health ::
From Evidence to Economic Value

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School of Environmental and Forest Sciences

GA Urban Forest Council Conference
Savannah :: November 2015
## Ecosystem Services

<table>
<thead>
<tr>
<th>Ecosystem Services</th>
<th>Supporting Services</th>
<th>Regulating Services</th>
<th>Cultural Services</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nutrient cycling</td>
<td>Air quality regulation</td>
<td>Aesthetic values</td>
</tr>
<tr>
<td></td>
<td>Soil formation</td>
<td>Climate regulation (global, regional, and local)</td>
<td>Spiritual and religious values</td>
</tr>
<tr>
<td></td>
<td>Primary production</td>
<td>Water regulation</td>
<td>Recreation and ecotourism</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Erosion regulation</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Water purification and waste treatment</td>
<td></td>
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<td></td>
<td></td>
<td>Disease regulation</td>
<td></td>
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<td></td>
<td></td>
<td>Pest regulation</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Pollination</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Natural hazard regulation</td>
<td></td>
</tr>
<tr>
<td>Provisioning Services</td>
<td>Food (crops, livestock, wild foods, etc...)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fiber (timber, cotton/hemp/silk, wood fuel)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Genetic resources</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Biochemicals, natural medicines, pharmaceuticals</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fresh water</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Millennium Ecosystem Assessment**

2005
Landscape Gradient: *Ecosystem Services*

- **Mountain and Polar**
  - Local climate regulation
  - Water supply and regulation
  - Erosion and sediment control
  - Human health and well-being benefits
  - Food and renewable non-food products
  - Cultural benefits

- **Forest & Woodlands**
  - Global climate regulation
  - Local climate regulation
  - Air and water cleansing
  - Erosion and sediment control
  - Habitat functions
  - Waste decomposition and treatment
  - Human health and well-being benefits
  - Food and renewable non-food products
  - Cultural benefits

- **Drylands**
  - Global climate regulation
  - Erosion and sediment control
  - Pollination
  - Waste decomposition and treatment
  - Human health and well-being benefits
  - Cultural benefits

- **Cultivated**
  - Pollination
  - Food and renewable non-food products

- **Urban**
  - Global climate regulation
  - Local climate regulation
  - Air and water cleansing
  - Human health and well-being benefits
  - Cultural benefits

- **Islands**
  - Air and water cleansing
  - Water supply and regulation
  - Hazard mitigation
  - Human health and well-being benefits
  - Food and renewable non-food products

- **Inland Water**
  - Water supply and regulation
  - Hazard mitigation
  - Waste decomposition and treatment
  - Human health and well-being benefits
  - Food and renewable non-food products

- **Coastal**
  - Water supply and regulation
  - Hazard mitigation
  - Habitat functions
  - Waste decomposition and treatment
  - Human health and well-being benefits
  - Food and renewable non-food products

- **Marine**
  - Global climate regulation
  - Waste decomposition and treatment
  - Food and renewable non-food products
  - Cultural benefits

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Forest Economics
Community Economics

place
real estate value
retail behavior
rather than product supply/demand
### Yard & Street Trees

<table>
<thead>
<tr>
<th>Increase</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>2%</td>
<td>mature yard trees (greater than 9-inch dbh)</td>
</tr>
<tr>
<td>3%</td>
<td>larger street trees (up to 100’ away)</td>
</tr>
<tr>
<td>3-5%</td>
<td>trees in front yard landscaping</td>
</tr>
<tr>
<td>6-9%</td>
<td>good tree cover in a neighborhood</td>
</tr>
<tr>
<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>
</tbody>
</table>
# Parks & Open Space proximate principle

<table>
<thead>
<tr>
<th>Value</th>
<th>Increase</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10%</td>
<td>inner city home located within 1/4 mile of a park</td>
</tr>
<tr>
<td></td>
<td>17%</td>
<td>home near cleaned-up vacant lot</td>
</tr>
<tr>
<td></td>
<td>20%</td>
<td>home adjacent to or fronting a passive park area</td>
</tr>
<tr>
<td></td>
<td>32%</td>
<td>residential development adjacent to greenbelts</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
- potentially increasing annual property tax revenues $15.3 million

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

retail behavior
indirect economic measures
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%
“Companies stage an experience when they engage customers in a memorable way.”
Trees as Place-Makers
the Chenoggye freeway in Seoul ~ 1970-2005
Chenoggyeon – 8.4 km, $900 M

initial public criticism!
- between 2003 and 2011
- nearby property values increased 103% (despite the deep recession)
- $2 billion was invested in nearby properties development
ALPHA
Awaji Landscape Planning & Horticulture Academy
typical retail street in urban Japan
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
outdoor rooms
social spaces
sense of welcoming
Austin, TX

South Congress Avenue redevelopment district
public xeriscape

shared design & management
identity

affordable materials

message of renewal
Public Health Economics

avoided costs
reduced costs
income potential
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.
Green Cities: Good Health > 3,000 article database
Step 1: Evidence screening

% distribution of entire database
Metro Nature & Health Evidence Framework

Synthesis of 40 years of peer-reviewed literature

Elements of Economic Valuation
Step 1: Screen Benefits Research

- 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?
i-Tree

Eco (UFORE)
Streets (STRATUM)
Hydro
Vue

tools provided by USDA
Forest Service

STRUCTURE

FUNCTION

VALUE

MANAGEMENT

photo credits: Seattle i-Tree Training by Al Zelaya
Valuation Strategies
Step 2: Benefits Transfer and Value

- 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
Valuation Sources

Step 3: Benefits Focus for Valuation

<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>
Potential Annual Cost Savings and Increased Income Associated with Human Health and Well-being Benefits Derived from Metro Nature

<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>Totals</td>
<td>2,694.4</td>
<td>6,754.5</td>
</tr>
</tbody>
</table>

Millions of U.S. Dollars (2012)

Summary

• Urban forest/urban green heterogeneity = Metro nature

• Human health & well-being benefits (Research portal: Green Cities: Good Health)

• Benefits subset = substantial annual economic value

• Future needs – consistent interface of health benefit measures and nature element measures