

# Ecosystem services

Origin and aim of the concept, and its application in design and planning

February 21<sup>st</sup>, 2014, Marjo van Lierop



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For quality of life

# MEA & TEEB



## Millennium Ecosystem Assessment

- Natural capital is critical to human survival and well-being

## TEEB: The Economics of Ecosystems and Biodiversity

- Global study on the economics of biodiversity loss
- Aims to guide practical policy responses to halt the ongoing losses of biodiversity and ecosystem services
- Reports
  - Sector studies
  - Country studies
  - Biome studies



# Ecosystem services

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## Definitions

### *Ecosystem services*

“the direct and indirect contributions of ecosystems to human well-being. The concept ‘ecosystem goods and services’ is synonymous with ecosystem services” (TEEB, 2010)

### *Natural capital*

“an economic metaphor for the limited stocks of physical and biological resources found on earth, and of the limited capacity of ecosystems to provide ecosystem services” (TEEB, 2010)



# Classification

## Most commonly used is TEEB classification

- Provisioning services
- Regulating services
- Cultural services
- Supporting services

**Provisioning Services** are ecosystem services that describe the material outputs from ecosystems. They include food, water and other resources.



**Food:** Ecosystems provide the conditions for growing food – in wild habitats and in managed agro-ecosystems.



**Raw materials:** Ecosystems provide a great diversity of materials for construction and fuel.



**Fresh water:** Ecosystems provide surface and groundwater.



**Medicinal resources:** Many plants are used as traditional medicines and as input for the pharmaceutical industry.

**Regulating Services** are the services that ecosystems provide by acting as regulators eg regulating the quality of air and soil or by providing flood and disease control.



**Local climate and air quality regulation:** Trees provide shade and remove pollutants from the atmosphere. Forests influence rainfall.



**Carbon sequestration and storage:** As trees and plants grow, they remove carbon dioxide from the atmosphere and effectively lock it away in their tissues.



**Moderation of extreme events:** Ecosystems and living organisms create buffers against natural hazards such as floods, storms, and landslides.



**Waste-water treatment:** Micro-organisms in soil and in wetlands decompose human and animal waste, as well as many pollutants.



**Erosion prevention and maintenance of soil fertility:** Soil erosion is a key factor in the process of land degradation and desertification.



**Pollination:** Some 87 out of the 115 leading global food crops depend upon animal pollination including important cash crops such as cocoa and coffee.



**Biological control:** Ecosystems are important for regulating pests and vector borne diseases.

**Habitat or Supporting Services** underpin almost all other services. Ecosystems provide living spaces for plants or animals; they also maintain a diversity of different breeds of plants and animals.



**Habitats for species:** Habitats provide everything that an individual plant or animal needs to survive. Migratory species need habitats along their migrating routes.



**Maintenance of genetic diversity:** Genetic diversity distinguishes different breeds or races, providing the basis for locally well-adapted cultivars and a gene pool for further developing commercial crops and livestock.

**Cultural Services** include the non-material benefits people obtain from contact with ecosystems. They include aesthetic, spiritual and psychological benefits.



**Recreation and mental and physical health:** The role of natural landscapes and urban green space for maintaining mental and physical health is increasingly being recognized.



**Tourism:** Nature tourism provides considerable economic benefits and is a vital source of income for many countries.



**Aesthetic appreciation and inspiration for culture, art and design:** Language, knowledge and appreciation of the natural environment have been intimately related throughout human history.



**Spiritual experience and sense of place:** Nature is a common element of all major religions; natural landscapes also form local identity and sense of belonging.

# Classification: provisioning services

Services that describe the material outputs from ecosystems



Food



Medicinal resources



Raw materials



Fresh water

# Classification: regulating services

Services that ecosystems provide by acting as regulators/regulating the quality of air and soil or by providing flood and disease control



Local climate and air regulation



Erosion prevention and maintenance of soil fertility



Carbon sequestration and storage



Pollination



Moderation of extreme events



Biological control



Waste-water treatment

# Classification: cultural services

The non-material benefits people obtain from contact with ecosystems



Recreation and mental and physical health



Spiritual experience and sense of place



Tourism



Aesthetic appreciation and inspiration for culture, art and design



# Classification: supporting services

Underpins almost all other services.



Habitats for species



Maintenance for genetic diversity



# More ecosystem services classifications

## Different classifications

- Based on scale
- Including energy sources
- Including disservices
- Different places, different services
- Different application, different classification

**Table 1 – EcoServices classified according to their spatial characteristics**

1. Global non-proximal ( <i>does not depend on proximity</i> )
1&2. Climate regulation
Carbon sequestration (NEP)
Carbon storage
17. Cultural/existence value
2. Local proximal ( <i>depends on proximity</i> )
3. Disturbance regulation/ storm protection
9. Waste treatment
10. Pollination
11. Biological control
12. Habitat/refugia
3. Directional flow related: <i>flow from point of production to point of use</i>
4. Water regulation/flood protection
5. Water supply
6. Sediment regulation/erosion control
8. Nutrient regulation
4. In situ ( <i>point of use</i> )
7. Soil formation
13. Food production/non-timber forest products
14. Raw materials
5. User movement related: <i>flow of people to unique natural features</i>
15. Genetic resources
16. Recreation potential
17. Cultural/aesthetic

Source: Costanza, 2008

# Ecosystem services and human well-being

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- Links between human well-being, indirect drivers, direct drivers, and ecosystem services
- Different scales
- Different time scales
  
- Biodiversity underpins ecosystem resilience
- Requires maintenance of minimum ecological assets

Source: Millennium Ecosystem Assessment, 2005

# Ecosystem services: the problem

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- ES valuable for human well-being
- Many ES are seen as common or public goods
- Values beyond the immediate and private are often ignored
- Or only the value of one or a few ES are considered
- ES are overlooked, neglected, undervalued or poorly understood
- ES are missing from decisions, indicators, accounting systems and market prices
- Ecology and economy are interdependent

# Ecosystem services concept's aim

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Making the value of ES visible by (monetary) valuation

- Can help reveal the importance of ecosystem services
- Allows for comparisons with financial costs
- Allows for comparing the benefits between options, or setting priorities
- Creates an evidence base for decisions
- Reduces the potential for bias, and risk of overlooking real environmental costs
- Can lead to better informed, more efficient, cost-effective and fair choices
- Allows to create a more inclusive involvement of stakeholders
- Investing in natural capital can yield high returns

# Ecosystem services: linking ecology and economy

**institutions & human  
judgements**

# Linking ecology and economy

Economic value is linked to the number of beneficiaries and the socio-economic context

Investments more attractive when several ES are provided by an ecosystem

Economic valuation has its limits

Values of non-market ES are estimations

Not only economic values

Valuation dependent on social, cultural context

*Social value*

*Moral value*

*Spiritual value*

*Educational value*

*Aesthetic value*

*Cultural value*

*Religious value*

*Place-based value*

*...*

# EST in design and planning: examples

Two Dutch examples of EST application

- TEEB City – Green pays off
  - Quantitative, calculations, planning, decision-making
- The Green City Guidelines
  - Qualitative, design and implementation focused, measures
- Other examples (certification)
  - The Sustainable Sites Initiative
  - LEED
  - BREEAM
  - GPR – Urban planning



# TEEB City – Green pays off

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TEEB City: Green pays off

Extent of the benefit dependent on:

- Quality improvement
- Measure of effectiveness: deal with the problem instead of symptoms, and various effects
- Number of beneficiaries
- Measure of the benefit
- Meet the needs
- Time of the benefit
- Cost reduction

# TEEB City – Green pays off

## Example Apeldoorn

- Park 28 ha + new urban development
- Park = part of urban green infrastructure
- Benefits park
  - Benefits: 19.4 million euro
  - Costs: 10.2 million euro
  - +84% living comfort
  - +14% property value
  - Improved water storage
  - Raised recreational value
- Beneficiaries:
  - Project developers
  - Inhabitants

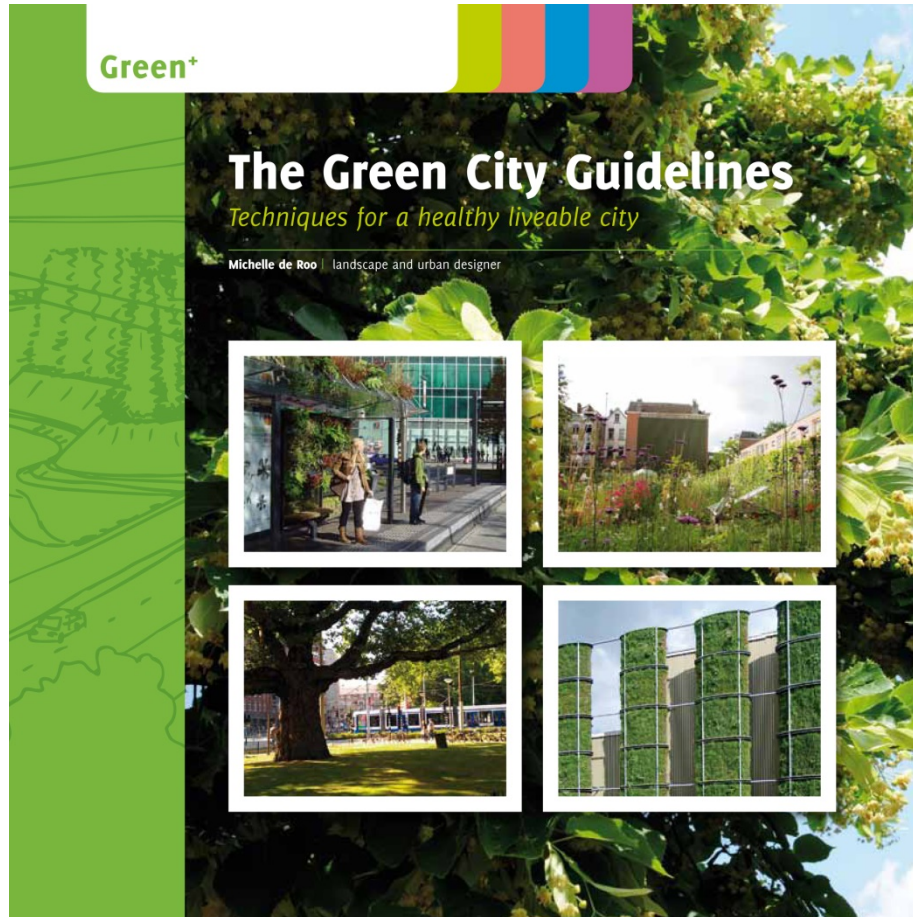


# TEEB City – Green pays off

## Outcomes:

- Costs of green solutions cheaper than grey solutions in terms of investment and management
- There are more benefits of green than at first instance is thought about
- Thinking about and involving beneficiaries creates a more socially viable process, more support, quicker process
- Longer time terms in cost-benefit assessments are needed to make investments in energy, water, and material profitable
- Finding the beneficiaries does not mean you found investors. It is not just presenting the bill. It is about cooperation.
- Calculation models difficult and asks additional expertise
- Long-term measurements will still be hard to sell.
- Different way of designing
- Turn qualities into measures

# The Green City Guidelines



- Practical guidelines for greening the city
- Division in scale: city – neighbourhood – street – building
- The whole planning process – from start up to management
- Dutch context
- Services and disservices

Source: de Roo et al., 2011



# The Green City Guidelines

Examples:

“Communicate the benefits to various parties”

“Use business parks as a green link between the edge of the city and its surroundings”

“Place planting near ventilation ducts”



Deciduous trees along the south-facing office windows provide shade in the summer and allow sun to pass through in the winter.

Source: de Roo et al., 2011

## Trees, shrubs and vines\* that are effective in capturing PM<sub>10</sub>

<i>Picea abies</i>	<i>Hedera</i>
<i>Pinus mugo</i>	<i>Prunus padus</i>
<i>Pinus nigra</i>	<i>Betula pubescens</i>
<i>Pinus sylvestris</i>	<i>Ilex x. meservae</i>
<i>Taxus sp.</i>	<i>Corylus colurna</i>
<i>Metasequoia glyptostroboides</i>	<i>Acer pseudoplatanus</i>

## Trees, shrubs and vines\* that are effective in absorbing NO<sub>x</sub>

<i>Robinia pseudoacacia</i>	<i>Prunus Yoshino</i>
<i>Sophora japonica</i>	<i>Zelkova serrata</i>
<i>Magnolia</i>	<i>Populus nigra</i>
<i>Salix babylonica</i> 'Tortuosa'	

## Trees, shrubs and vines\* that are effective in absorbing O<sub>3</sub>

<i>Chamaecyparis lawsoniana</i>	<i>Betula pendula</i>
<i>Crataegus monogyna</i>	<i>Acer campestre</i>
<i>Larix decidua</i>	<i>Pinus nigra</i>
<i>Prunus laurocerasus</i>	<i>Alnus glutinosa</i>
<i>Acer platanoides</i>	

## Trees and shrubs\* that emit biogenic volatile organic compounds (limit widespread planting)

<i>Liquidambar styraciflua</i>	<i>Cercidiphyllum japonicum</i>
<i>Koelreuteria paniculata</i>	<i>Platanus</i>
<i>Quercus</i>	<i>Salix</i>
<i>Robinia pseudoacacia</i>	

\*plants used in The Netherlands

# The Green City Guidelines

For practitioners: easy, quick, simple & practical

Qualitative methods

Benefits mentioned, not measured

Mainly based on expert knowledge

No clear referencing to sources

No clear link with EST concept

## Benefits of neighbourhood green space

- Healthier, happier residents (5-15% more)
- More outdoor play (10% more)
- More social contact and social cohesion\*
- Less overweight or obese residents (15% less)
- Less doctor visits, less depression, for some diseases up to 33%\*
- More likely to be physically active (24% more) if green space is easily accessible

\* especially noticeable with children, the elderly and people with a lower social/economic status



# EST in design and planning: conclusion

- Clear link between science on EST and EST in practice needs improvement
- Working with EST requires multi-/interdisciplinary teams
- EST requires linking design and implementation with management
- Mix of quantitative and qualitative data
- Time, space and scale aspects
- Cost-benefit assessment at the start > include beneficiaries, optimise the plan and create more enthusiasm, & bigger profits
- Use collaborative planning for intangible values
- Take EST in all plans: design, planning and policy, integral and sectoral



Thank you for your  
attention

Any questions?



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