Planning for climate change mitigation and adaptation: The role of nature-based solutions

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Content

- Role of nature-based solutions in urban climate change adaptation and mitigation
- Green infrastructure planning to enhance implementation of nature-based solutions: potentials and limitations
Nature-based solutions

- “inspired by, using, copying from or assisted by Nature”*

- “NBS refers to the use of nature in tackling challenges such as climate change, food security, water resources, or disaster risk management . . .

- … this concept intends to additionally integrate societal factors such as poverty alleviation, socio-economic development and efficient governance principles.”**

- NBS corresponds to ecosystem-based adaptation (EbA)***

Potential of nature-based solutions for urban climate change adaptation and mitigation
Challenges of climate change

Hadley Centre Modell, SRES A2

Vienna

Vienna 2070?

Hallegatte et al. 2007
What is urban nature?

Urban morphology....

... green and blue

Gill 2006, Gill et al. 2007
Need to consider the full range of urban nature ...

Relics of natural ...

... & cultural landscapes

Designed green: From parks & gardens to roof & façade greening

Wastelands (urban wilderness)

*Kowarik & Langer 2005, Photos: S. Pauleit (1), I. Burkhardt (2-4)
... and ecosystem services

Provisioning

Regulating

Cultural

Urban Nature

Photos: S. Pauleit
Evapotransporative cooling & shading

- Air temperatures in parks can be 1-3°C cooler
- Cooling of adjacent built areas
Climatic role of urban green

Percentage cover of green

Surface temp.

Town centre: 31.2° C

Low density residential 21.7° C

Gill et al. 2007, Gill 2006
Green moderates intensification of the UHI

Low density residential: +3.1° C
Town centres: +4.3° C

Gill et al. 2007, Gill 2006
± 10 % green in the town centres of Greater Manchester

- Max. surface temperatures today: 31.2° C

Szenario 2080 high:
- Green cover unchanged: + 4.3° C
- + 10% green: + 0.6° C
- -10% green: + 8.2° C
The need for drought adapted green

Number of month without plant available water in the upper 30cm

Gill et al. 2007, Gill 2006
Stormwater runoff

1961-1990
18 mm precipitation

+ 56% precipitation:
+ 82% surface runoff

2080s Low
25 mm precipitation

2080s High
28 mm precipitation

Surface runoff (mm) after a rainstorm

Runoff (mm)
- 0 - 6 mm
- 6 - 12 mm
- 12 - 18 mm
- 18 - 24 mm
- 24 - 28 mm
- unclassified (water)

Gill et al. 2007, Gill 2006
Copenhagen‘s Rainstorm Plan: integration of grey ...

... and green

- Biodiversity
- Climate & air quality
- Aesthetic improvement
- Recreation
- Stormwater retention

Expected costs: 500 million € until 2033
But: Rainstorm in 2011 caused damage of appr. 800 million €!
New York’s million trees project

- New York’s trees store 1.35 million t C
- New York’s annual emissions: 58 million t C

http:// www.milliontreesnyc.org
Climate change adaptation via urban nature

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<th>Corridors</th>
<th>Patches</th>
<th>Urban matrix</th>
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Adopted from Gill 2007
Scale-dependent benefits of GI?

- CO\(_2\) reduction
- Thermal comfort and reduced energy use
- Improved air quality
- Improved water quality
- City, region
- Neighborhood, district
- Site, block
- Health and restorative benefits, social and individual coping capacities, education
- Reduced problems with flooding, peak flows and drought

Legend:
- Not defined: no empirical evidence
- Less relevant based on empirical evidence
- Not defined: empirical evidence conflicting or unclear
- Relevant based on empirical evidence

Demuzere et al. 2014
Synergies and trade-offs caused by GI?

Demuzere et al. 2014
Green infrastructure planning

A **strategic planning approach** that aims at developing **networks** of green and blue spaces in urban areas designed and managed to deliver a wide range of ecosystem services

- Can encompass all types of urban nature
- Contributing to a **broad range of policy objectives**: biodiversity, climate change adaptation, social cohesion, participation, green economy, human health

UGI planning is based on a **specific set of principles** that relate to the **content** as well as the **process of planning**
Green infrastructure planning

Principles

Content

- Multi-functional
- Multi-scale and multi-object

- Integrative
- Connective

Process

- Strategic
- Interdisciplinary
- Socially inclusive

based on Pauleit et al. 2011; Kambites and Owen 2006; Benedict and McMahon 2002
Barcelona’s green infrastructure and biodiversity plan 2020

- Biodiversity preservation
- Connectivity & renaturalisation
- Multiple social and environmental services
- Environmental education
- Resilience & adaptation to climate change

Photos: Medi Ambient i Serveis Urbans - Hàbitat Urbà. Ajuntament de Barcelona 2013
Seattle’s Green Stormwater Infrastructure

- Natural drainage systems (NDS) create multiple benefits
- Project life cycle costs for NDS are often lower than for traditional grey infrastructure

Example Pinehurst:
NDS: $4.6 million
Traditional: $8.9 million

http://www.seattle.gov/util/MyServices/DrainageSewer/Projects/GreenStormwaterInfrastructure/index.htm
GREEN SURGE

Green Infrastructure and Urban Biodiversity for Sustainable Urban Development and the Green Economy

GREEN SURGE will identify, develop and test ways of linking green spaces, biodiversity, people and the green economy in order to meet the major urban challenges ...

... It will provide a sound evidence base for urban green infrastructure planning and implementation...

24 partners (including 11 SMEs) from 11 countries

http://greensurge.eu
WP 5: "Green Infrastructure planning & implementation"

**Approach**
- Planning document analysis (N=32)
- Questionnaire & interviews (N=20)
- Contextual information

**Case studies**
- 20 cities
- 14 countries
Uptake of policy concepts in plans

- Biodiversity: 80% mentioned, 20% similar concepts mentioned, not embedded
- Adaptation to climate change: 50% mentioned, 50% similar concepts mentioned, not embedded
- Ecosystem services: 40% mentioned, 60% similar concepts mentioned, not embedded
- Health: 70% mentioned, 30% similar concepts mentioned, not embedded
- Green economy: 10% mentioned, 90% similar concepts mentioned, not embedded
- Social cohesion: 60% mentioned, 40% similar concepts mentioned, not embedded
Most important themes not yet included in existing plans according to city officials

- Climate change
- Green space management
- Social integration
- Mobility and connectivity
- Health and wellbeing
- Food production
- Biodiversity conservation
- Urban rehabilitation
- Pollution and waste management
Conclusions

- Nature-based solutions in cities need to adopt a wide definition & require holistic Green Infrastructure planning.
- Due to its multifunctionality, investment in Green Infrastructure can provide a valuable return and contribute to addressing a range of policy objectives, such as biodiversity, climate change, energy, health and well-being, and social cohesion.
- Climate adaptation rising on the agenda but need for integrated approaches to mitigation and adaptation.
- Develop evidence base from assessment of ecosystem services for entire green structure to good practice for GI planning.
- Strengthen socially inclusive and city-regional planning.
- Establish a framework for action to strengthen the deployment of green infrastructure in and around cities.
- EU can play an important role for promoting nature-based solutions and green infrastructure planning.