Druhý seminár pre samosprávy miest a obcí:
Biodiverzita: Klimatické zmeny a biodiverzita
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Hlavné mesto biodiverzity

Using green infrastructure to address climate change: a selection of successful initiatives

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Human alteration of the environment

Image sources (left to right):
http://michelemartin.typepad.com/thebambooprojectblog/images/biodiversity.jpg;
http://space.alglobus.net/Basics/whyImages/earthFromSpace.gif;
http://coe.mse.ac.in/images/air%20pollution.bmp

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Climate change in Slovakia

- Changes to the **seasonality and intensity of rainfall**;
- Increasing **frequency and magnitude of floods**;
- Increasing **scope and frequency of droughts and heat waves**;
- Increasing **frequency of fires**;
- Increasing **water stress**;
- Reduced periods of **snow cover**;
- Upward shifts in the **tree line**;
- Severe **loss of biodiversity**; and
- Increasing **erosion and landslides**.

(Czakó *et al.* 2008)

Image source: http://www.omikronkappa.gr/22-Stuff/04-Erga/04-01-Ektelesmena/04-01-09en-YDRAYLIKA.pdf

Urbanisation and green infrastructure

"Urbanisation replaces vegetated surfaces which provide shading, evaporative cooling, and rainwater interception, storage and infiltration functions, with impervious built surfaces."

(Gill *et al*. 2007)

"Green infrastructure is the interconnected network of green space that conserves natural ecosystem values and functions and provides associated benefits to human populations"

(Benedict and McMahon 2002)

Image source: www.virtualtrademission.com/images/dundee_aerial.jpg

An urban forest in the City of Chicago

1994 study: *Chicago Urban Forest Project*

Chicago's Department of Planning and Development mapped the city's tree coverage and green infrastructure using GIS.

4.1 million trees providing a range of benefits:

- → Pollution removal worth $1 million (1994 value);
- → 855 000 tons of carbon stored;
- → Reduction in surface rainwater run-off;
- → Interception of solar energy reducing the need for air-conditioning.

Image source: www.cabe.org.uk/case-studies/chicago-urban-forest?photos=true&viewing=6769

An urban forest in the City of Chicago

A heat wave killed 600 Chicago residents in 1995;

GIS data revealed that the worst affected areas had the lowest tree coverage.

Image sources (left to right): www.laurennassef.com/wp-content/uploads/chicago-map-det2.jpg; www.foxnews.com/images/388860/1_61_heat_wave_nyc.jpg

An urban forest in the City of Chicago

Urban forest regarded as a vital part of Chicago's infrastructure;

Authorities decided to use trees to mitigate extreme temperatures → identified targets for immediate action (mainly public land including school grounds and parks);

Robust and convincing GIS evidence helped to foster local support for the tree planting;

Communications strategies were employed, and partnerships established in order to outreach and educate unconvinced residents.

Image source: www.masmith48.org/greeniniatives/Image9.jpg

An urban forest in the City of Chicago

Gill *et al*. (2007) found that in Manchester on hot summer days, the shade provided by mature trees can keep surfaces as much as 15.6 ^{o}C cooler;

Besides temperature regulation, there are also multiple additional benefits of urban forest including:

- Carbon sequestration;
- Flood regulation;
- Price enhancement of adjacent properties;
- Health benefits;
- Purification of air and water;
- Enhanced ecological connectivity;
- Creation of communal areas;
- Etc.

Image source: www.cabe.org.uk/case-studies/chicago-urban-forest?photos=true&viewing=6771

Augustenborg: the revival of a Swedish neighbourhood

Background

32 ha neighbourhood in the City of Malmö, Sweden;

Built in the 1950s and initially successful but fell into decline in the 1970s;

→ buildings suffered dampness, ventilation problems and poor appearance;

Annual flooding overwhelmed the sewage system;

→ expensive damage to buildings and vehicles;

Social problems arose, including high levels of unemployment, the neighbourhood depopulated and flats remained unoccupied.

Augustenborg: the revival of a Swedish neighbourhood

Regeneration partnership

In the 1990s the city council partnered MKB Housing company, housing landlords and local residents:

→ The regeneration project, “Ekostaden Augustenborg” commenced in 1998;

→ focus on **flooding**, **waste management**, **biodiversity** and **climate change**.

Image source: http://farm1.static.flickr.com/68/369931034_87292494de.jpg

Augustenborg: the revival of a Swedish neighbourhood

Storm water management

Urban drainage overwhelmed annually;

The Malmo Department of Water and Wastewater implemented a storm water management system;

→ water collected in gutters from rooftops and other impervious surfaces;

→ channelled through canals, ditches, ponds and wetlands before finally draining into a conventional closed sub-surface storm water system;

→ system retains 70% of all rainwater that falls in the neighbourhood.

Image sources: www.water-in-zicht.nl/projecten/augustenborg-malmo-zweden

Augustenborg: the revival of a Swedish neighbourhood

Green roofs

- All new developments feature green roofs;
- Many existing developments retrofitted;
- Developed in partnership with universities and private companies;
- Local, national and European funding sources;
- The green roofs intercept around ½ of total runoff each year;
- Provide insulation during winter and cooling during summer.

Image source: www.cabe.org.uk/files/imagecache/csLarge/case-studies/node/add/casestudy/ekostaden-augustenborg-004.jpg

Augustenborg: the revival of a Swedish neighbourhood

Green roofs

A 9500 m^2 botanical roof garden is the biggest in Scandinavia.

Image sources (left to right): http://www.water-in-zicht.nl/projecten/augustenborg-malmo-zweden; http://www.greenroof.se/data/archive/media/GreenRoofs09.pdf

Augustenborg: the revival of a Swedish neighbourhood

Green spaces

- Green spaces improved to accommodate flooding;
- Reconfiguration of public spaces;
- Creation of allotments to allow residents to grow vegetables;
- Planting of flowering perennials and trees, creation of wetlands and improving play areas.

Image source: http://www.water-in-zicht.nl/projecten/augustenborg-malmo-zweden

Augustenborg: the revival of a Swedish neighbourhood

Mitigating climate change

- 400 m^2 of solar thermal panels;
- 100 m^2 photovaltaic panels to generate electricity;
- Ground source heat pump;
- Improved insulation of buildings and underground water pipes;
- Fitting of low flow showerheads;
- Reduced speed limit to encourage cycling and walking;
- A community car club with electric and ethanol powered cars;
- An electric street train;
- A recycling scheme.

Image source: http://www.treehugger.com/solar-panels-bvbvbvbv-photo1.jpg

Augustenborg: the revival of a Swedish neighbourhood

Community involvement:

Public consultation, community workshops, etc.

Residents involved in the design process;

→ good local understanding of and support for the project.

Innovative environmental performance:

Compulsory competitive tendering for city services;

→ City tries to be promote environmental innovations.

Ongoing maintenance:

Management work jointly funded by the housing company, the water board and the city council's maintenance budget.

Image source: http://www.cabe.org.uk/case-studies/ekostaden-augustenborg?photos=true&viewing=5690

Augustenborg: the revival of a Swedish neighbourhood

Wide ranging benefits:

- → reduced housing turnover by 20%;
- → far fewer empty properties;
- → higher employment rates;
- → 20% reduction in energy consumption;
- → Storm water management system a proven success;
- → Now a desirable place to live;
- → Augustenborg a role model for others;
- → Image of Augustenborg positively enhanced.

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Green living takes root in Sweden

By Laurence Peter
BBC News, Malmo, Sweden

"Western Harbour" is not the most romantic name for a pioneering ecological housing development - but then Sweden is pursuing green goals with more pragmatism than flamboyance.

Sustainability is the motto of the Western Harbour (Vaestra Hamnen) project in the southern city of Malmo.

Western Harbour's vegetation is as diverse as the architecture

There are futuristic buildings sporting massive glass windows and glinting solar panels.

But turn a corner and you find a green courtyard with a little pond and some modest timber structures that remind you of Swedish villages.

"I really like the diversity of houses - and they've made it easy here to live in a sustainable way," says Helena Parker, who was among the first to move into the area in 2001.

Image source: http://news.bbc.co.uk/2/hi/europe/5413960.stm

Strategic forestry in the Swiss Alps

Climate change will increase the severity of all types of hydro-meteorological hazards;

→ altered intensity and seasonality of rainfall + periods of rapid snow and ice melt;

→ more landslides.

In Switzerland, recent increases in landslides due to:

- Torrential rainfall;
- Overgrazing; and
- Forest clearance.

The EC notes that "*the reforestation of hill slopes can help to reduce the occurrence of shallow but still dangerous landslides (mainly mud flows and debris flows)"* and that *"excessive deforestation has often resulted in a landslide*".

Strategic forestry in the Swiss Alps

On 15th August 1997, a heavy storm hit the region of Sachseln…….

- 150 litres of rainfall per m^2 in just 2 hours;
- Over 400 severe landslides;
- Village of Sachseln completely destroyed;
- Blocked roads, rail links and supply lines;
- Buried large areas of cultivated land;
- Over CHF 100 M (≈ EUR 70 M) of damage.

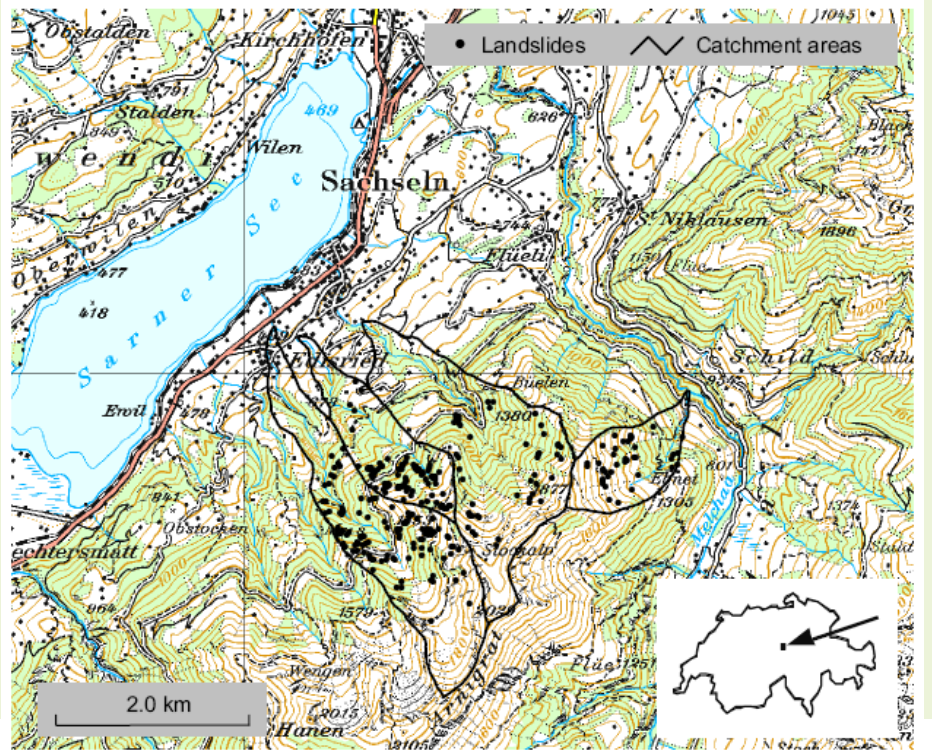

Image source: www.wsl.ch/forschung/forschungsprojekte/vegetationswirkungen_rutschungen/rickli_et_al_2001.pdf

Image source: http://parmanu.wordpress.com/page/12

Strategic forestry in the Swiss Alps

The **Swiss Research Institute for Forest, Snow and Landscape** conducted a study on the relationship between forests and landslides, and arrived at the following conclusions:

- → *Under otherwise comparable conditions, there were significantly fewer - one third fewer - landslides in the forested areas than in the non-forested areas;*
- → *The state of the forest plays an important role: in the forested part of the study area, there were ten times more landslides in locations with poor quality forest;*
- → *Stable forest stands comprising mosaics of trees of different species, ages and heights offer the best protection.*

The Swiss Government now recognises forests as a major component of disaster prevention and today the forests are managed primarily by their protective function, providing services estimated to be worth several billion euros per year.

(Greminger 2002)

Designing green roofs as habitats in Basel

Basel's building and construction law was amended in 2002 making it compulsory for all new flat-topped buildings to have green roofs.

→ Guidance provided on creation and species assemblages;

→ Specific design criteria to benefit biodiversity i.e. vary the substrate thickness and use locally sourced soils.

The United Bank of Switzerland, Basel

Image source: www.zinco-greenroof.com/referenzen/einfache_intensivbegruenung.php

Additional benefits of green infrastructure

Carbon sequestration; **food supply**; **pollination**; **water purification**; **disease regulation**; **cultural services**; **religious fulfilment**; maintaining a **sense of place**; **psychological benefits** increasing with biological complexity (Fuller *et al*. 2007); enhanced **patient recovery** (Ulrich 1984); opportunities for **social interaction**; **eased mental fatigue**; opportunities for **reflection**; **leisure** and **recreation**al opportunities; attraction of **high quality professionals**; increasing **property prices**; **inspiration** for creative thinking (e.g. bio-mimicry); **ecotourism** potential; etc.

Helping nature to adapt to climate change

Species ranges are moving northwards and to higher altitudes in response to climate change;

However, their movement is often obtruded by human-made barriers including, urban areas, dams, and even agricultural fields;

Ecological connectivity is key to facilitating these range shifts;

Green infrastructure in the form of stepping stones, ecological corridors and buffer zones can provide lifelines for species;

Where gaps exist opportunities should be explored to strengthen ecological connectivity, by establishing functional connections between habitat patches to support local wildlife.

Image source: www.hermonslade.org.au/projects/HSF_02_1/HSF_02_1_image_01_full.jpg

Helping nature to adapt to climate change

‘Ecoducts’ or ‘green bridges’ help species to cross barriers and move between areas. They already exist in Denmark, Beligum, the Netherlands, Austria, UK, Portugal and Greece.

Image source: http://upload.wikimedia.org/wikipedia/commons/thumb/c/c5/Ecoducthogekempen.jpg/250px-Ecoducthogekempen.jpg

A green bridge for wildlife in Mile End Park

- Mile End Park, London;
- 1st green bridge in the UK;
- 25m wide, traversing 5 motorway lanes uniting two areas of the park;
- Contains birch trees, evergreens, shrubs and grasses;
- Includes a cycle/footpath.

Image source: http://www.cabe.org.uk/files/imagecache/csLarge/case-studies/node/6624/edit/mile-end-005.jpg

The Dorsale Verde (Green Ridge) in North Milan

A large open system extending for more than 65 km between Adda and Ticino;

Thorough preparatory work including a year-long public consultation;

The Province of Milan aims to improve the connectivity of protected areas, which already occupy 80% of non urban land.

Image source:
http://www.provincia.milano.it/pianificazione_territoriale/parchi/progetti_in_corso/verso_una_dorsale_verde_Nord_Milano/index.html

Conclusions 1

- Green infrastructure (GI) is especially important in helping humans and wildlife meet the challenges of climate change.
- GI can regulate storm flows thereby attenuating flooding and landslide risks
- GI can regulate temperatures thereby reducing demand for, and associated GHG emissions of, air conditioning;
- GI sequesters carbon from the atmosphere;

Conclusions 2

- GI helps nature to adapt to climate change by enhancing the connectivity of habitat patches;
- GI also provides multiple additional benefits not directly related to climate change;
- Projects can be implemented more easily if the envisaged benefits are supported with science;
- Consultative approaches that involve local stakeholders from the outset can foster greater understanding, support, and sense of ownership within communities for environmental projects.

→ To help biodiversity is to help ourselves!

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Image source: www.unep.org/NewsCentre/InsertImage.asp?ImageSizeID=1&DocumentID=589&ArticleID=6209