Soil sealing – approach for testing

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- Agro-microbiology
- Herbology and Soil Tillage
- Agrometeorology and Informatic Systems
- Cereal Production
- Forage Crop Production
- Plant Breeding and Biotechnology
- Plant Nutrition and Fertilization
- Systems and Economics of Production
- Biochemistry and Plant Quality
- Soil Science Erosion and Land Protection
Soil sealing - definition

- Soil sealing means the permanent covering of an area of land and its soil by impermeable artificial material (e.g. asphalt and concrete), for example through buildings and roads.

- Land take, also referred to as land consumption, describes an increase of settlement areas over time. This process includes the development of scattered settlements in rural areas, the expansion of urban areas around an urban nucleus (including urban sprawl), and the conversion of land within an urban area (densification).

- Urban sprawl is the incremental urban development in suburban and rural areas outside of their respective urban centres, characterised by a low density mix of land uses on the urban fringe.
Transformation of agricultural soils into urban use in PL

based on GUS data
Prokop et al. (2011) has estimated that the detected land take between 1990 and 2000 in the EU was around 1 000 km² per year – an area larger than the city of Berlin – or 275 hectares per day, and settlement areas increased by nearly 6 %.

[Guidelines on best practices.... EC]
Soil functions

- **Air quality** is adjusted by soils resistant to erosion, and with high sorption capacity (not releasing contaminants) and able to produce biomass.

- **Mitigation of temperature extremes** in summer period by soils with high water storage capacity.

Gerst et al.
Potential measures to counteract soil sealing:

Preventing (limiting) – reduction of land take or preventing loss of most valuable soils (soil quality taken into account in spatial planning)

Compensation – loss of soil compensated by improvement of soil functions in other area

Mitigation – use of permeable materials, green infrastructure
### Existing policy instruments - Poland

| The law on agricultural and forest land protection | The Agricultural Land Protection Funds collects resources through collection of charges for taking agricultural land into other land use. The funds are used for agricultural land protection, soil remediation and improvement of land quality and productivity, erosion protection. Urban administrative areas excluded in 2008. |
| The law on environmental protection | In spatial planning a sustainable management of nature resources must be ensured through programs of balanced land use, proper waste management, transport systems, green areas management, soil and landscape value protection, etc |
| Local regulations | Taxes for impermeable land coverage |
Existing policy instruments

The Soil Protection Act of Upper Austria foresees the implementation of Soil Enhancement Plans. The public authority is entitled to ask the land user to deliver a plan containing soil enhancement measures, if the thresholds of soil measurements are exceeded, any other negative impact on soil is identified such as erosion or compaction or enhancement of soil quality seems necessary.

Decree of determined amount of payment and specification of payment for agricultural land consumption (Slovak Republic)

Guideline for the assessment of soils according to their performance (Federal Land of Baden-Württemberg, Germany)

5 soil functions are considered and taken into account in spatial planning:

- “Natural soil fertility”
- “Habitat for natural vegetation”
- ”Regulation of water balancing”
- “Filter and buffer for pollutants”
- “Archive of natural and cultural history”
URBAN SMS - project on urbanization impact on soils

www.urban-sms.eu
### Availability of low quality soil vs. consumption rate

<table>
<thead>
<tr>
<th>Test area</th>
<th>Low quality soils(^1)</th>
<th>Low and medium quality soils</th>
<th>Land demand(^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milan</td>
<td>160</td>
<td>3103</td>
<td>364</td>
</tr>
<tr>
<td>Bratislava</td>
<td>3033</td>
<td>8941</td>
<td>391</td>
</tr>
<tr>
<td>Wroclaw</td>
<td>5547</td>
<td>7806</td>
<td>412</td>
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<tr>
<td>Stuttgart</td>
<td>706</td>
<td>1693</td>
<td>138</td>
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<tr>
<td>Prague</td>
<td>6863</td>
<td>18825</td>
<td>718</td>
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<tr>
<td>Salzburg</td>
<td>791</td>
<td>5601</td>
<td>82</td>
</tr>
<tr>
<td>Vienna</td>
<td>418</td>
<td>1850</td>
<td>213</td>
</tr>
</tbody>
</table>

1 within areas covered by the soil maps  
2 rate of artificial surface increase within 15 years in the area covered by the soil maps
The average impact (across all cities) of soil protection scenarios on social, economic and environmental soil functions. Bubble size represents the average (across all cities) importance of the soil function.
Urban-SMS conclusions

- The most valuable soils in cities of Central Europe were taken for urbanization, sometimes preferentially. Soil management systems in these cities did not efficiently protect the best soils.

- There is no strong conflict between soil protection goals and demand for land related to economic development of cities.

- Baseline scenario assuming no change in protection of most valuable soils would result in continuation of non-sustainable soil transformation trends.

- According to stakeholders – strengthening of soil protection (medium protection scenario) would not limit the economic development.

- Effective instruments and raising awareness are needed!
RECARE case studies for soil sealing

- Wroclaw and Warsaw, PL
- Utrecht or Arnhem, NL
- Seville, ES
Area (in ha): 293 km²
Land use(s) now and planned:
Agricultural lands cover 44%, sealed surfaces 39%, forests 7%, recreation area 7%,
water bodies 3.5% of total area.
Status of urban planning: Local plans for particular parts of the city (or investments)
are produced constantly. The Concept for Directions of Spatial Development of the
Commune (LAU-2), which is more general comparing to the local plans, updated in May
2010.
Legal aspects: Urban soils excluded from The act on agricultural and forest land
protection.
Urban sprawl in Wroclaw between 1991 and 2006 on soil quality map
Method for analysis of degradation status in relation to soil protection regulations and spatial planning approaches

<table>
<thead>
<tr>
<th>Warsaw</th>
<th>Wroclaw</th>
<th>Utrecht or Arnhem</th>
<th>Seville</th>
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</thead>
<tbody>
<tr>
<td>Soil maps</td>
<td>Satellite images</td>
<td>Classification of image objects</td>
<td></td>
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<tr>
<td>Soil quality maps</td>
<td>Land use maps for 2-3 periods</td>
<td>Land use change maps</td>
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<td>Spatial analysis of soils lost for urbanization</td>
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<td>Transition indexes for soils of different quality</td>
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<td>Analysis of efficiency of current soil protection regulations</td>
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Transition index

(Stuczynski et al., 2007)

A simple conversion index is proposed to characterize the intensity of transition of different soils to artificial areas, classified according to the ranges of soil quality

3 classes: 1-high quality, 2-medium, 3-low quality

\[\text{transition index} = \frac{\text{percent of soil class } \textit{n} \text{ in new urban area}}{\text{percent of soil class } \textit{n} \text{ in whole urban area}}\]
CS approach:

• Assess soil sealing trends in 4 diverse CS with uniform methodology

• Explain to past and current soil protection regulations and spatial planning approaches

• Recommend good practice examples to stakeholders

Other activities:

• Metronamica modelling

• Stakeholder participatory assessment of measures
Data availability

Wroclaw, PL:
Soil maps (1:5000 and 1:25000) with texture and land quality
Land use maps for 1992, 2007
SOM, pH maps (less detailed)

Warsaw, PL:
Soil maps (1:5000 and 1:25000) with texture and land quality
Land use maps for 1992, 2007
Detailed SOM, pH, salinity, contamination maps and database
Data availability

Sevilla (María Anaya-Romero, Evenor-Tech):
- Soil Map containing soil types:

  Mapa de Uso y Cobertura de Andalucía. Escala 1:50.000. Junta de Andalucía.

  There is specific national regulation for the transformation of soil from agricultural to urban.

- there are maps of the soil vulnerability for Andalusia region

Utrecht/Arnhem:
To be determined