25 years SUITMAs
- a new research field of Soil Science.

What makes these soils and the interest in these soils so special

Wolfgang BURGHARDT
(Soil Technology, Fakulty of Biology, University Duisburg-Essen, Germany)

Why SUITMA: Establishment of ISSS WG Urban Soils, 1998, at the WCSS in Montpellier, France
by Wolfgang Burghardt, Essen, Germany and Jean-Louis Morel, Nancy, France

First international Conference on Urban Soils was hold in Essen, Germany by W. Burghardt and named/entitled
„Soils of Urban, Industrial, Traffic and Mining Areas – SUITMA“.

From that time, the ISSS/IUSS WG Urban Soils, was called ‚SUITMA, (today IUSS comission ‚SUITMA‘`), and

urban soils SUITMAs.

Content: Characteristics of urban areas and soils

1. Laws of nature versus human intentions and arbitrariness
2. Dissection of landscape in numerous plots
3. Water balance, drainage, storm water infiltration, irrigation
4. Climate effects by high buildings
5. Reduction of available soil space and soil volume
6. Increase of dust occurence
7. Reduced soil areation
8. Technosols, dominance of heat treated materials
9. Nitrogene accumulation

1. Laws of nature versus human intentions and arbitrariness - differences of **soil genesis in natural landscapes and in urban areas**

Natural landscape	**Urban areas**
Main factor, beside others	
Gravity forces	By-product of commercial, social, administrative decissions, to a minor extend targeted by them, or left natural
Attributes	
- soils are related in a landscape - carrier of information of landscape history and genesis (Similar to creature genetic) - in balance with natural environment	- related by any technical transport - on parcels of land restricted - soil scape strong dissected - new urban environment, land use

2. Dissection of landscape and river catchment areas

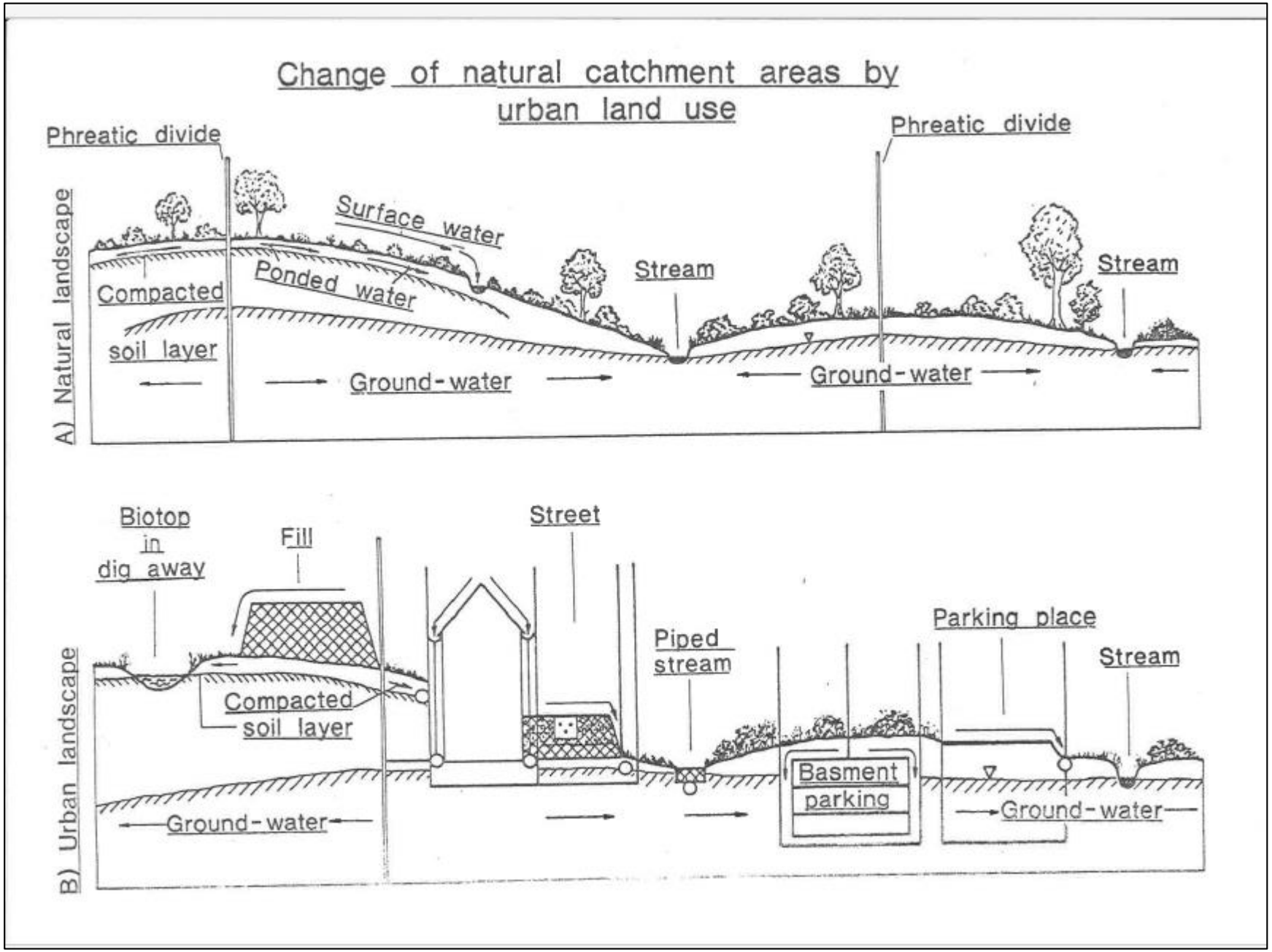


Figure 1. Natural landscape, large catchments Figure Urban landscape, many small catchment areas

3. **Changed urban water balance**, by

- change of **surface distance to groundwater** by soil excavation or fill-up, change of evapotranspiration
- deep and **dropped groundwater table** by drainage, and reduced roof/street water supply
- **stormwater infiltration** for keeping the water in the city
- **irrigation**

Figure 2: Storm water infiltration plots, effects dust accumulation and strong leaching of soils

Roof water infiltration site

Street water infiltration site

4. Climate effects by high buildings

Luv –windward side, wet by precipitation catched on a high wall and collected on a small space, **wet soils**

Lee – side, sheltered from the wind, no precipitation catched, **dry soils**

Figure 3:
High building affect on climate

5. Reduction of available soil space and soil volume for soil functions by

- **above ground and underground sealing**
- **technic erosion**
- **stone content**

Rare soils should become more valuable!

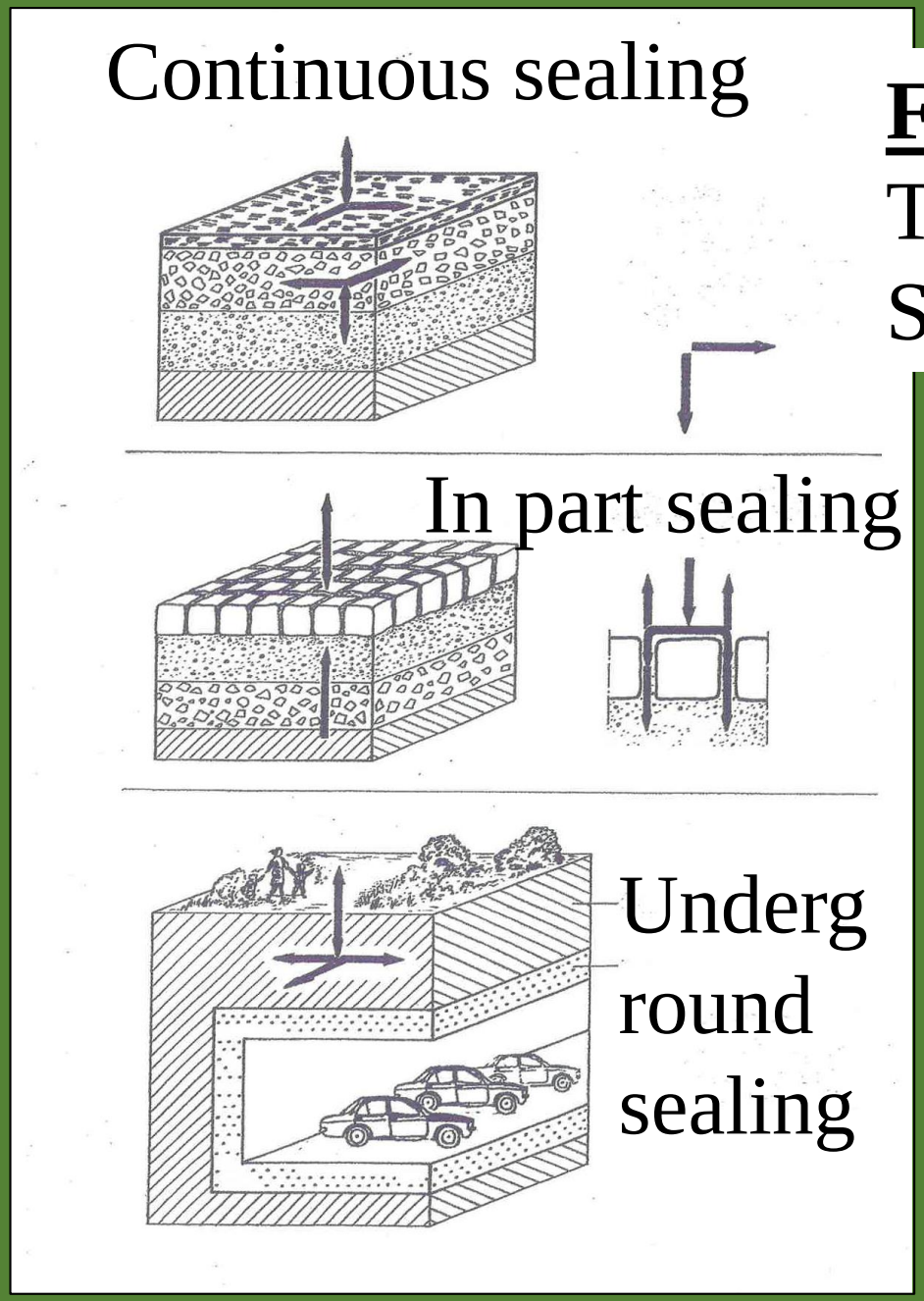


Figure 4: Types of Sealing

Erosion by gravity in natural landscape

Figure 5: Natural and technical erosion

High soil volume loss by Techno-erosion by excavation

Figure 6: Stone content **reduces** the content of **fine earth**.

This means the capacity of soil is reduced for storage of

- water,
- nutrients,
- carbon,

and for

- dilution of contaminated dust

6. Increase of dust occurence

- New Ah from dust deposition

- Ash layer of an unfortified place

- Burried Ap-horizon from arable land

- Relict Bv-Horizon

Figure 7: Dust in cities.
Deposits of dust: church yard wall

4 - 5 cm dust deposited in 30 years above an ash layer of an abandoned place

7. Reduced soil areation

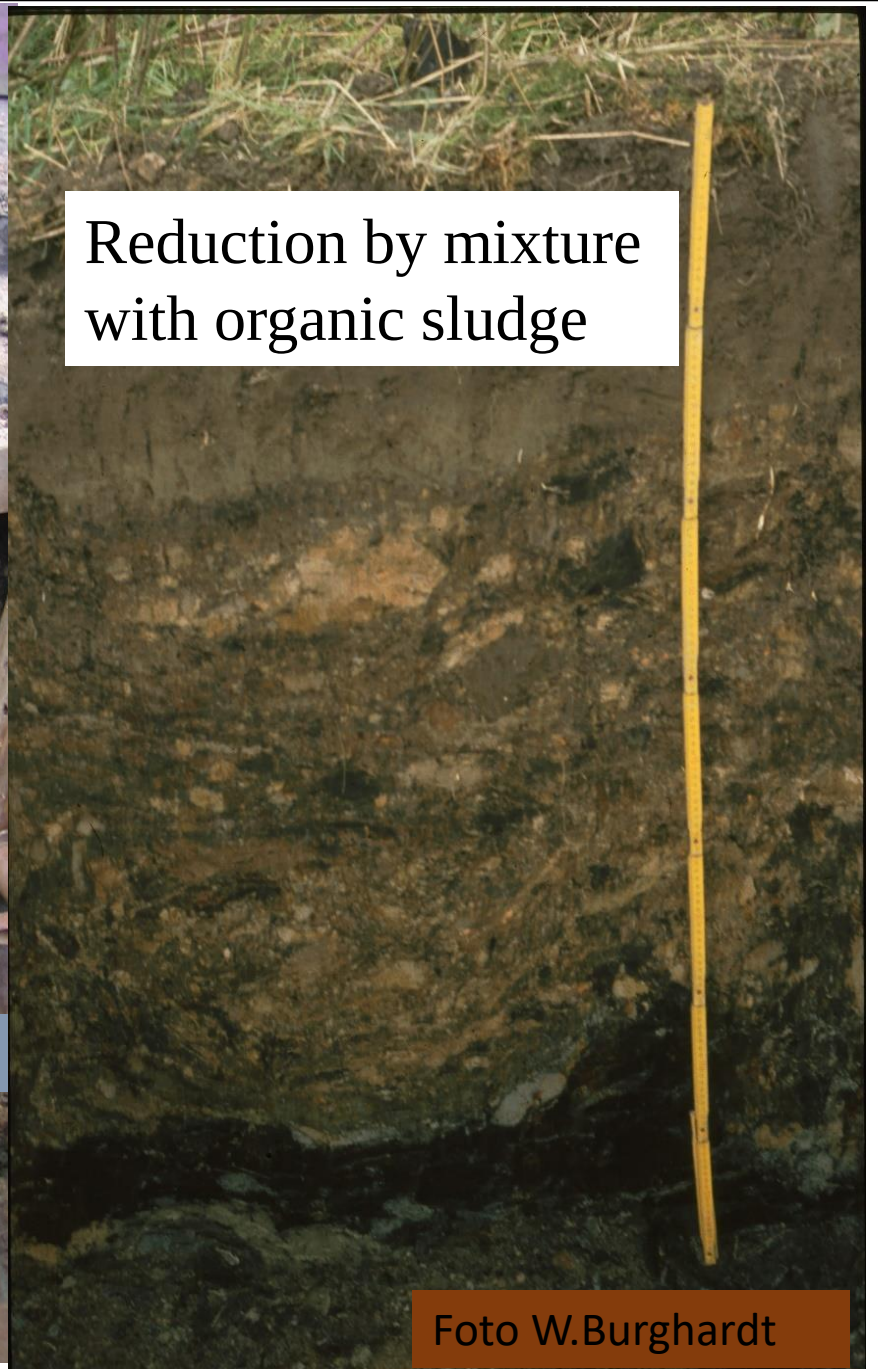
Figure 8:
Lack of aeration

Reduction by lack of soil aeration under road surface

Foto W.Burghardt

Foto W.Burghardt

Reduction by lack of soil aeration under road surface and ground water influence



Reduction by mixture with organic sludge

Foto W.Burghardt

8. Soil group **Technosols**

from freqent ocurrence of
technogenic substrates:

dominance of soil and soil compounds
from heat treated materials

Table 4: Heat treated materials dominate technogenic substrates						
Ash	**Fly ash**	**Slag**	**Cement/ Concrete**	**Bricks**	**Iron**	**Plastic**
Components						
Silicates		Calcium-silicates	Calcium-silicates	Clay minerals	Magnetit, Maghemit	Organic polymers
Characteristics						
Varying pH		pH up to 12 Zeolite formation	pH up to 12	Baked	Magnetit suscepti-bility	Inert, inactive, netted, chain-like

9. Nitrogene accumulation

- Immissions, **washing-off of gaseous compounds** (NO_x) of air by rain
- Nitrogene processes in **burial ground**
- Nitrogene of **compost economics**

Studies are missing.

Accumulation of polluted compounds in soils are frequent studied.

Conclusion I

There are nummerous new, and specific urban interplays of factors of soil formation by urban

- **land use,**
- **surface figuration,**
- **water management,**
- **climate**,
- **techno-erosion,**
- **artificial rocks.**

Conclusion II

We have to add the view of very specific demands

- of **way** and **quality of life** in cities on urban soils
  by
  - supply of food and water
  - physical and mental health
  - security

- of **urban nature** on soils, the **high diversity** and **many nishes** with extraordinary properties of soils.

Final

The soil creation of a gardener

Autosol: Car Trabi used as planter

For your attention many thanks

END

10. Occurrence of a high number of altered and new soils

Table 5: The list of changed and new soils distinguished in urban areas up today is already long

- **relict** natural soils, by change of environment
- burried, **fossil** soils
- soils with **shortened profile**
- filled-up natural soil material, **Deposol**
- young soil formations (Ah-horizon) on natural and artificial materials, **Regosols**
- vegetable garden soil, deep organic matter enrichment, **Hortisol**
- cemetary soil, sporadic deep mixed in organic matter, **Nekrosol**
- street soil, **Ekranosol**
- with plates or cobbles paved walkway soil, **Dialeimmasol**
- unfortified walk ways, **Podosol**
- with dust filled rail ballast and stone layers, **Particle Intrusol**
- soils from artificial Ca-silicates (slag, concrete), **Carbonatosol**
- lack of aeration, gas intrusion, **Reductosol**

Figure 2: Soils should be dry in cities, groundwater table is lowered

By use, sequences of different soils in one profile: relictics of

1. **Gleyosol**,
2. Hortisol, now abandoned.
3. Regosol, new development of Ah-horizon.

←

Foto W.Burghardt

Figure 9:

Dust in cities,

from traffic

Figure 9:

Dust in cities

Playing football
in a cloud of dust

References I

Burghardt, W. (2024) 25 years of SUITMAs: Urban soils - a new research field in soil science. What makes these soils and the interest in these soils so special? Journal of Soils and Sediments; https://doi.org/10.1007/s11368-024-03826-6; file:///C:/Users/Burkardt/Saved%20Games/Downloads/s11368-024-03826-6-3.pdf

Open access

Burghardt,W., Kneib,W. D.,Hoeke, S., Lehmann, A.,Makowsky, L., Kocher, B., & Steinweg, B. (2022). Soil science within German cities. Journal of Plant Nutrition and Soil Science, Vol.185,4,462-474. https://doi.org/10.1002/jpln.202200211

Burghardt W., Niggemeyer M., Braunersreuther M. (2020): Ways of soil development on stony substrate from hard coal mining spoil. SOIL SCIENCE ANNUAL, 71(4), 382–394. https://doi.org/10.37501/soilsa/132446; https://www.soilsa.com/pdf-132446-62142?filename=Ways%20of%20soil%20development.pdf

Open access

Burghardt W., D. Heintz, and N. Hocke *(*2018) Soil Fertility Characteristics and Organic Carbon Stock in Soils of Vegetable Gardens Compared with Surrounding Arable Land at the Center of the Urban and Industrial Area of Ruhr, Germany. *ISSN 1064-2293, Eurasian Soil Science, 2018, Vol. 51*, No. 9, pp. 1067-1079.

Burghardt W. (2017): Soil sealing - ways, constraints, benefits and management. In: Levin, M.J., Kim, K.-H.J., Morel, J.L., Burghardt, W., Charzynski, P., Shaw, R.K., edited on behalf of IUSS Working Group SUITMA: Soils within Cities. – Catena-Schweizerbart, Stuttgart, p169-175.

Burghardt W., von Bertrab, M. 2016. Dialeimmasol, urban soil of pavements. Journal of Soils and Sediments. November 2016, Volume 16, Issue 11, pp 2500–2513. DOI: 10.1007/s11368-016-1526-y; http://link.springer.com/article/10.1007/s11368-016-1526-y

References II

Burghardt W, Schneider Th. (2016). Bulk density, and content, density and stock of carbon, nitrogen and heavy metals in vegetable patches and lawns of allotment gardens in the north-western Ruhr area, Germany. Journal of Soils and Sediments. 18(2), 407-417; DOI 10.1007/s11368-016-1553-8; electronically: http://link.springer.com/article/10.1007/s11368-016-1553-8

Burghardt, W. (2024): Impact of urban land use as public bath and park lawn compared to rural meadows on soil pH, compaction, and organic carbon and nitrogen content and stock, C/N ratio. Journal of Soils and Sediments. https://doi.org/10.1007/s11368-024-03871-1; file:///C:/Users/Burkardt/Saved%20Games/Downloads/s11368-024-03871-1-1.pdf.

Open access

Burghardt W., Hoeke S. (2016): The soil resources in urbanized areas. In: Louwagie G., Kibblewhite M., Morris J. (2016): Soil resource efficiency in urbanised areas - analytical framework and implications for governance. EEA Report 7/2016. European Environmental Agency, Copenhagen; 94p. ISSN 1977-8449. http://www.eea.europa.eu/publications/soil-resource-efficiency

Burghardt W., Morel JL, Zhang G-L 2015. Development of the soil research about urban, industrial, traffic, mining and military areas (SUITMA). Soil Science and Plant Nutrition. Special Issue: Soils of anthropized environments. Volume 61, Supplement 1:3-21. DOI:10.1080/00380768.2015.1046136 http://www.tandfonline.com/doi/full/10.1080/00380768.2015.1046136

Open access

Burghardt, W. 2011. Soil Sealing – the Looser by Economic Players. Needs and Ways of the Implementation in the European Strategy for Soil Protection. In: Tóth, G., Németh,T.(Eds). LAND QUALITY AND LAND USE INFORMATION IN THE EUROPEAN UNION. Keszthely. 2011. European Commission, Joint Research Centre, Luxembourg, p151-171. http://lq2015.georgikon.hu/wp-content/uploads/2014/08/22_Burghardt.pdf http://bookshop.europa.eu/en/land-quality-and-land-use-information-in-the-european-union-pbLBNA24590/?CatalogCategoryID=0A4KABsty0gAAAEjqJEY4e5L