Improvement of degraded soil by wastes and waste derived products – case studies

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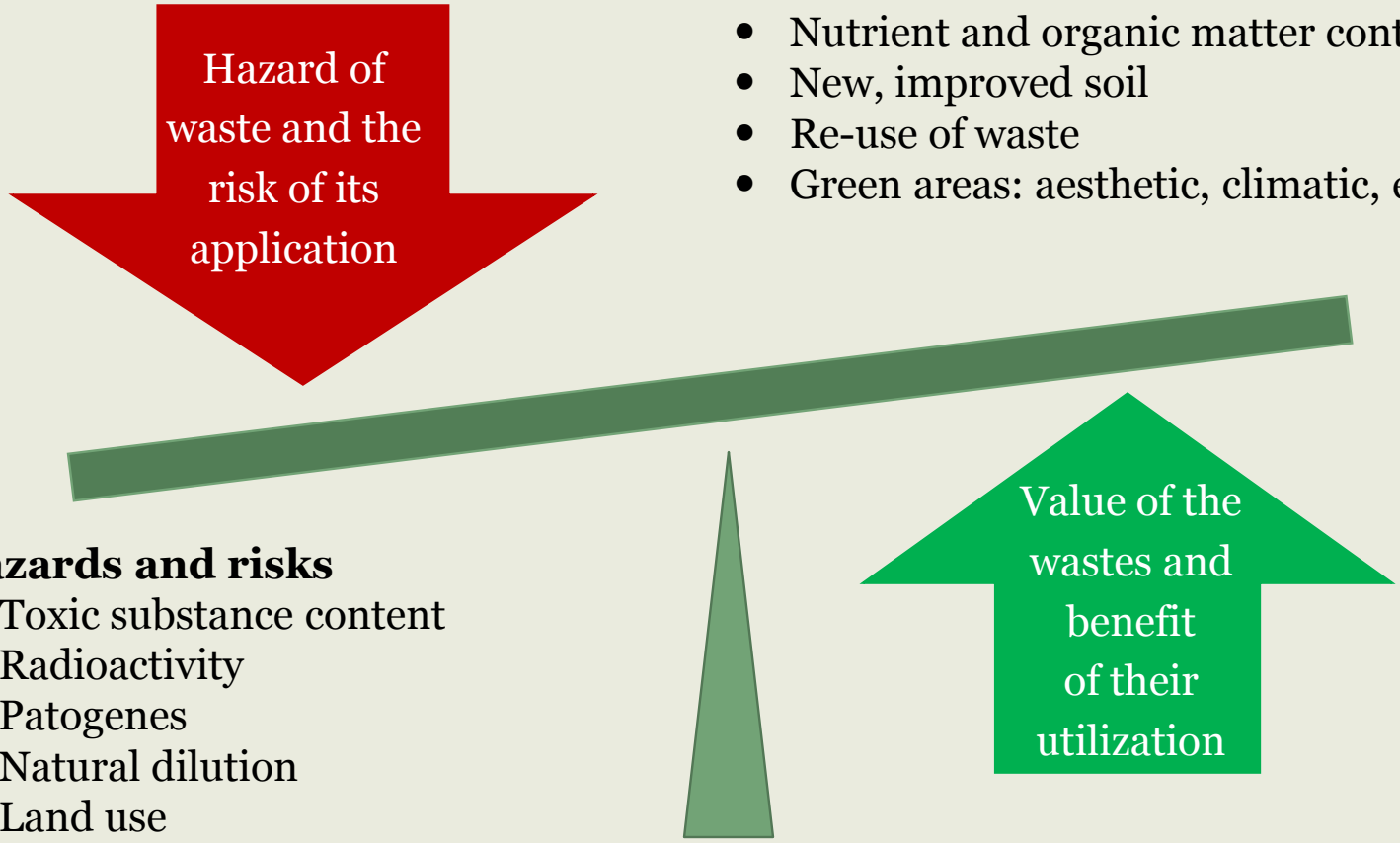
Evaluation of wastes and their application for soil based on their risks and benefits



Values and benefits

- Nutrient and organic matter content, pH
- New, improved soil
- Re-use of waste
- Green areas: aesthetic, climatic, ecological

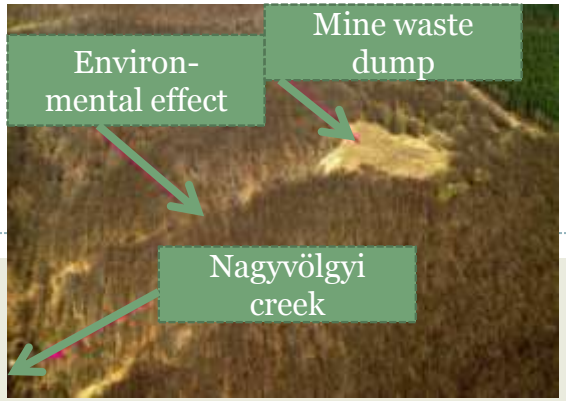
Hazards and risks

- Toxic substance content
- Radioactivity
- Patogenes
- Natural dilution
- Land use
- Frequency of application
- Untreated degraded land

Case studies: wastes for soil improvement

- **No. 1.** Remediation of mine waste with fly ash and other amendments
- **No. 2.** Remediation of metal contaminated soil with fly ash
- **No. 3.** Revegetation and rehabilitation: creation of a fertile topsoil layer from fly ash and organic wastes
- **No. 4.** Soil substitute from red mud
- **No. 5.** Acidic sandy soil improvement with biochar

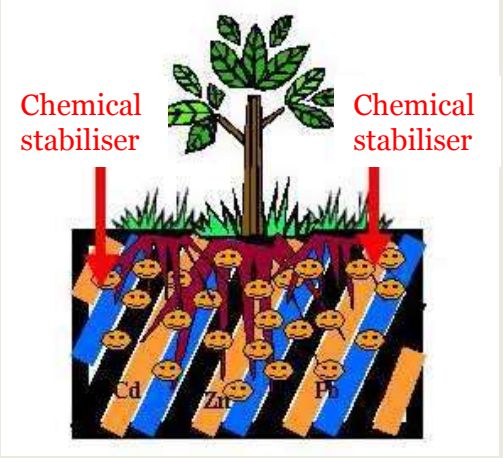
Case study No 1.



Metal ore mine waste to be treated

- **Site:** Gyöngyösoroszi mining site
- **Problem:** acidic (pH=2.8), Cd, Zn, Pb and As containing mine waste on the surface for 40 years
- **Solution:** combined chemical and phytostabilisation
- **Amendments:**
  fly ash, lime, iron grit
- **Plants:**
  grass mixture, broom corn, sudan grass

Combined chemical and pytostabilisation



Field experiment

Fly ash

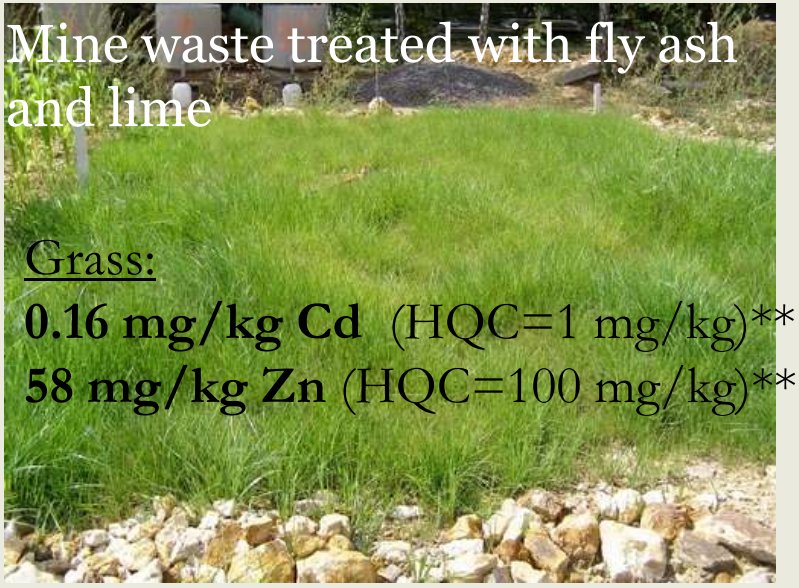
Effect of chemical stabilisation

<u>Leachate:</u>

Cd: 441 µg/l (HQC: 5 µg/l)* → **0.12 µg/l**

Zn: 89 079 µg/l (HQC: 200 µg/l)* → **29.3 µg/l**

(Untreated mine waste, 2007 → Fly ash+lime+iron, 2009)



* B contamination level for underground water, 6/2009 (IV. 14.) KvVM-EüM-FVM joint decree

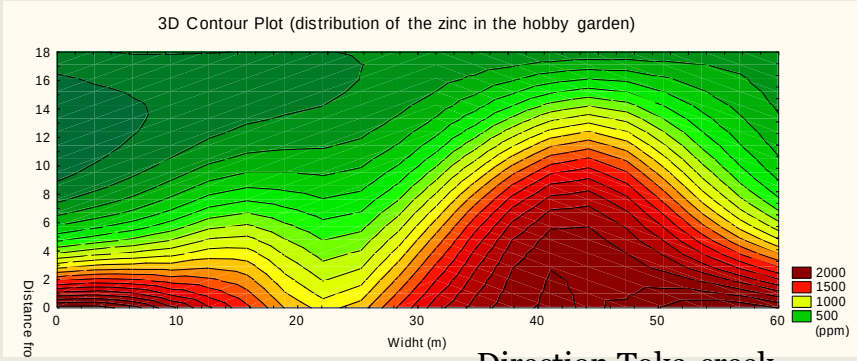
** Hungarian quality criteria for food and fodder, 44/2003. (IV.26.) FVM and 17/1999. (VI. 16.) EüM decree

Case study No 2.

- **Site:** Gyöngyösoroszi mining site
- **Problem:** agricultural soil contaminated with Cd and Zn by flooding
- **Solution:** combined chemical and phytostabilisation
- **Amendment:** <u>fly ash</u>
- **Plant:** grass mixture, broom corn, sudan grass, maize

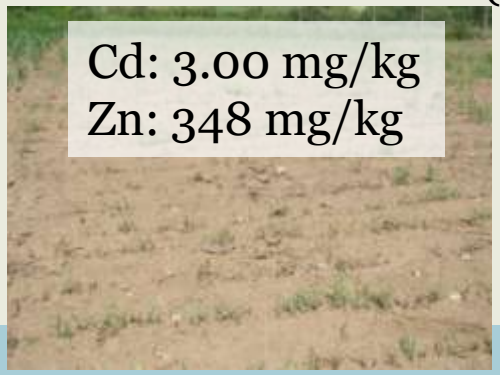
Flooding in Gyöngyösoroszi

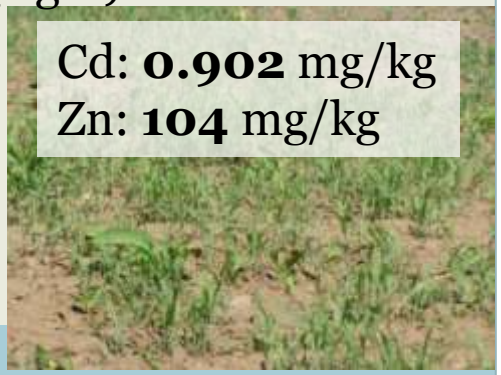
Mine waste in the Toka-creek



Direction Toka-creek

Sudan grass on untreated (left) and fly ash treated (right) soil





Case study No. 3.

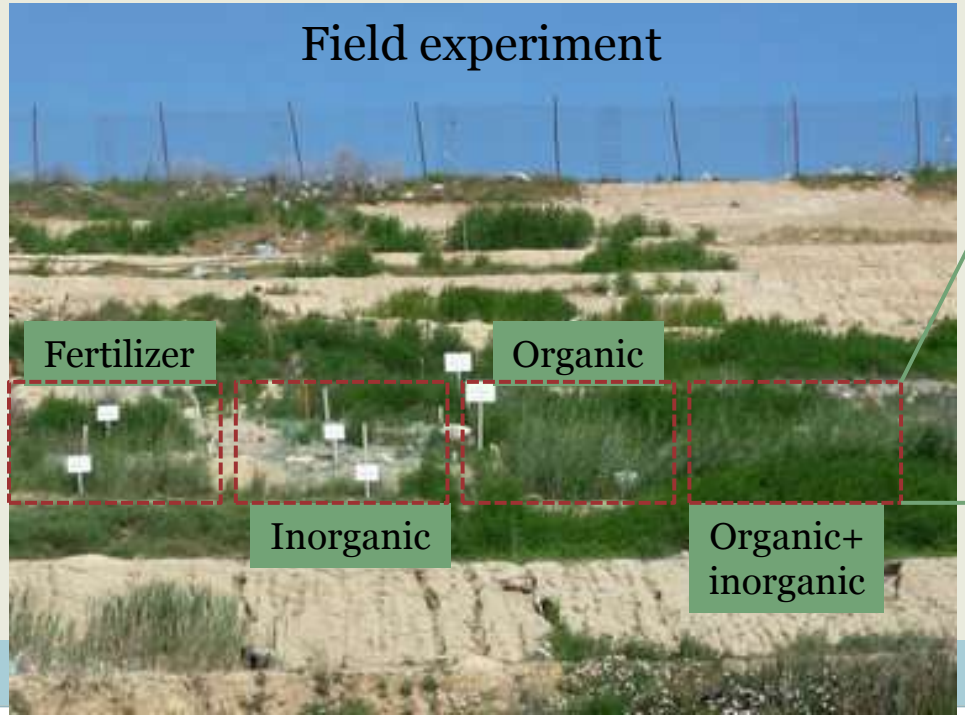
- **Site:** .A.S.A. Hungary Ltd. municipal landfill site at Gyál
- **Problem:** steep ringwall with no vegetation – bad aesthetic view, erosion
- **Solution:** *in situ* waste mixing
- **Amendment:** fly ash; wood ash; raw, digested and composted sewage sludge
- **Plant:** grass mixture

Barren ringwall
of the municipal landfill

Eroded
ringwall

Long term effect of waste treatment (2.5 years)

- One-time treatment, but improvement from year to year
- Improvement in texture, nutrient-availability, biological activity
- No toxic effect
- Best option: organic+inorganic amendment together



Grass on the organic + inorganic waste amended plot

Case study No. 4.

Experimental plots

- **Site:** .A.S.A. Hungary Ltd. municipal landfill site at Gyál
- **Problem:** cheap and fertile cover material needed
- **Solution:** soil substitute from waste
- **Wastes:**
  - subsoil (construction waste)
  - red mud (Ajka)
  - red mud contaminated soil (removed after Ajka accident)
  - compost, green waste, saw dust
- **Plant:** grass mixture

Plants grown on the waste mixtures

Best combinations:

- subsoil + 2% Ajka red mud + 10% green waste or compost
- subsoil + 20% red mud contaminated soil

Soil substitute with ideal water balance, available nutrient and organic matter content, active microflora, no toxic effect

Case study No. 5.

Biochar

Experimental field plots

Maize in pot experiments

- **Site:** Nyírlúgos, agricultural land
- **Problem:** acidic (pH=4.5) sandy (85 w/w% sand) soil
- **Solution:** biochar amendment
- **Biochar from waste:**
  - Grain husks
  - Paper fibre sludge
  - Pyrolysis: 500 °C, 20 min
- **Plant:** maize

Best options:

- 1% biochar
- 0.5% biochar + microbial soil inoculant

Improved plant growth & productivity,
higher pH, available K and P,
water holding capacity,
more active microflora & soil as habitat

Wastes are solution for degraded land!

Thank you for your attention!

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The experiments were carried out in the frame of the BÁNYAREM (GVOP 3.1.1-2004-05-0261/3.0), the MOKKA (NKFP-020-05) and the SOILUTIL (TECH_09-A4-2009-0129) Hungarian R&D projects, the TERRA PRETA (HU09-0029-A1-2013) Norway Grants project