Impact of heavy metals on human toxicity using LCA: the case study of Walloon corn

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Introduction

- Context
  - Study of biobased products
  - From cereals
- Detailed analysis of the results
  - Why toxicity so high?

Corn production in Wallonia

- Thanks to F. Van Stappen (CRA-W)
- Functional unit: 1 ha
- System boundaries:
  - Inputs production (mineral fertilizers, seed, machinery, phytosanitary product, etc.) + transport
  - Agricultural phase:
    - Soil preparation, sowing, fertilization, plant protection, harvest
    - Including field emissions: « mostly used » models

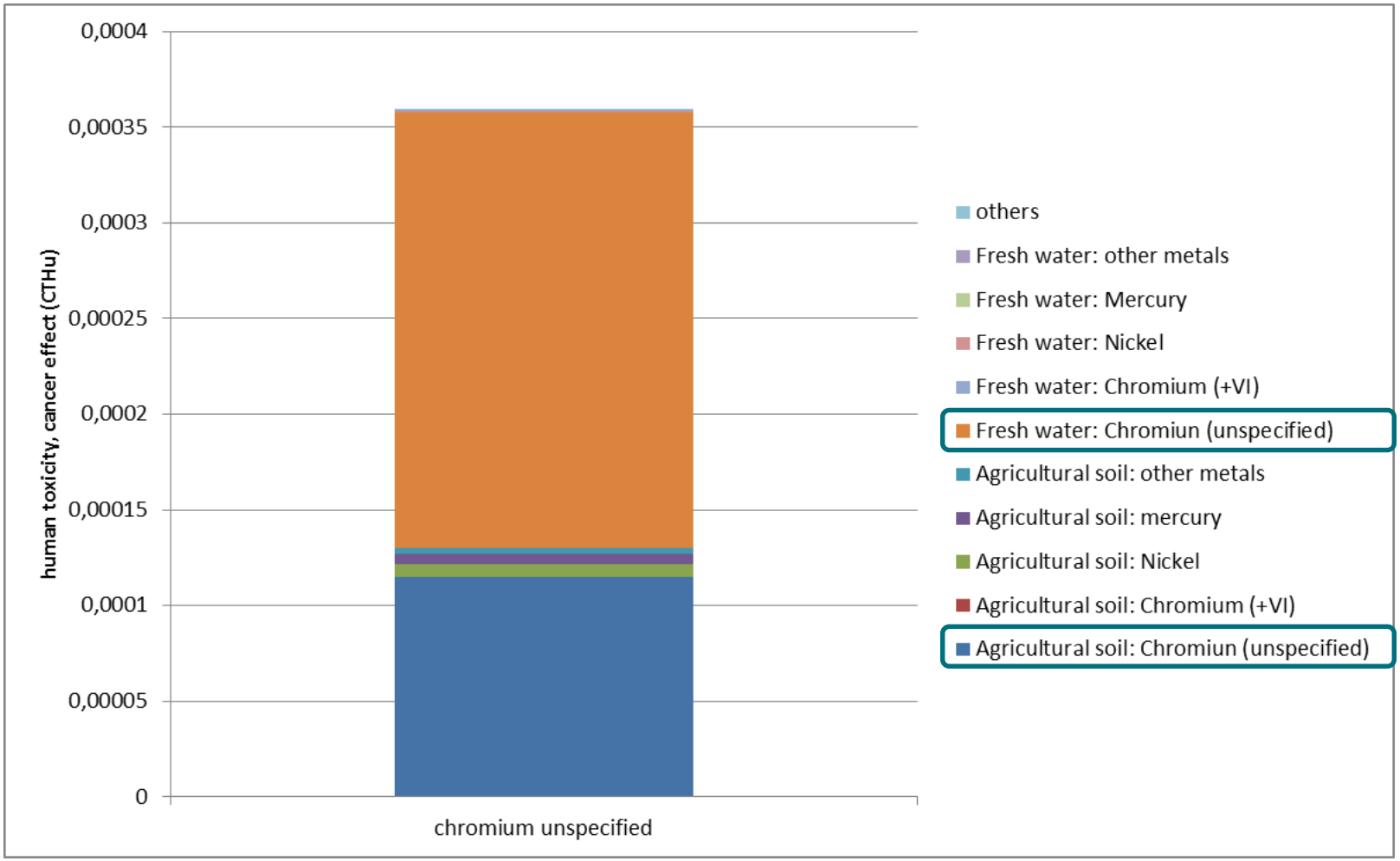
Toxicity

- Using USEtox as recommended by ILCD
  - Human toxicity, cancer effect
  - Human toxicity, non-cancer effect

USEtox®

The characterization factors (CF) = effects [cases/kg intake] * intake fraction [kg intake/kg emitted

Human toxicity, Cancer effect



Chromium unspecified?

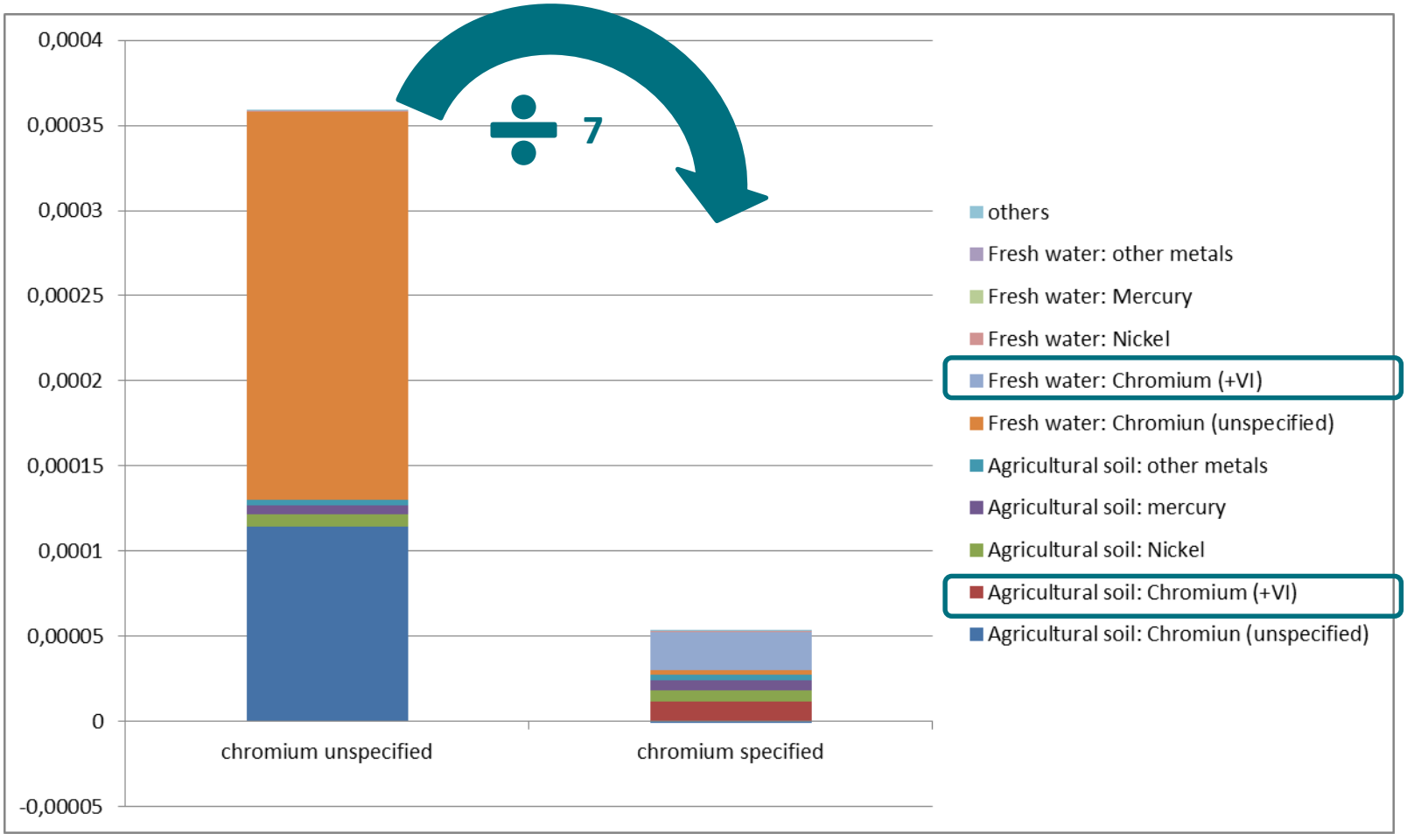
- From organic and mineral fertilizer (field emissions)
- C.F. = average of C.F. of Cr (+III) and Cr (+VI)
  - Cr (III): harmless
  - Cr (VI): very toxic
- Problem: in fertilizer only TOTAL Cr is dosed
  - no speciation: too expensive

Chromium unspecified?

- Could we predict Cr speciation?
- Cr (VI) is extremely reactive
  - Organic compounds: Cr (VI) react to Cr (III)
  - Mineral fertilizer: Cr comes from natural rock
    - in the natural environment: only Cr (III)
  - ➔ Most of the Cr = Cr (III)
  - ➔ Confirmation in literature

Chromium unspecified?

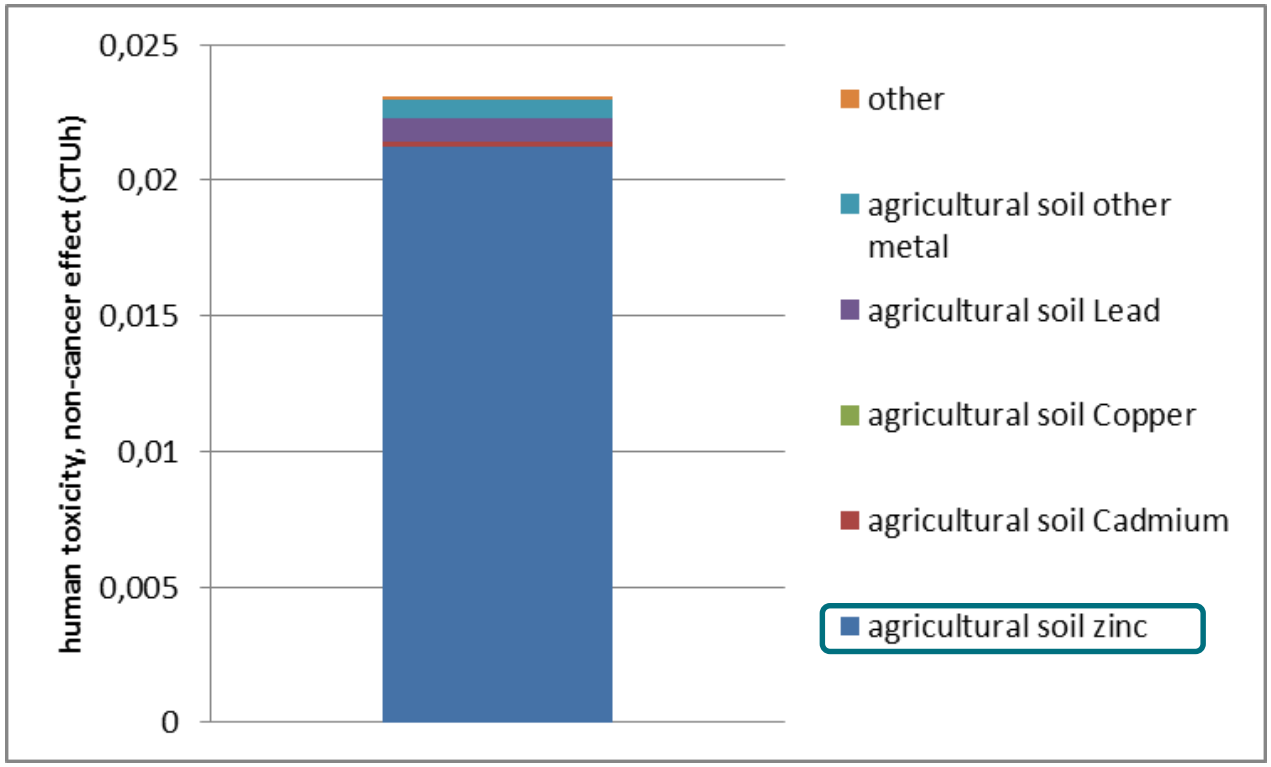
- Test with 95 % of Cr as Cr (III) and the rest as Cr (VI)



Human toxicity, Cancer effect

- Pesticide contribution negligible
  - 2.2 kg of pesticides applied by hectare: only 1.2 kg is characterized
  - Most of them have only C.F. in human toxicity non-cancer effect
    - Glyphosate: only a C.F. in human toxicity, non-cancer effect
    - classified as probably carcinogenic by the World Health Organization
  - C.F. of the pesticides is small compared to the C.F. of metals

Human toxicity, Cancer effect



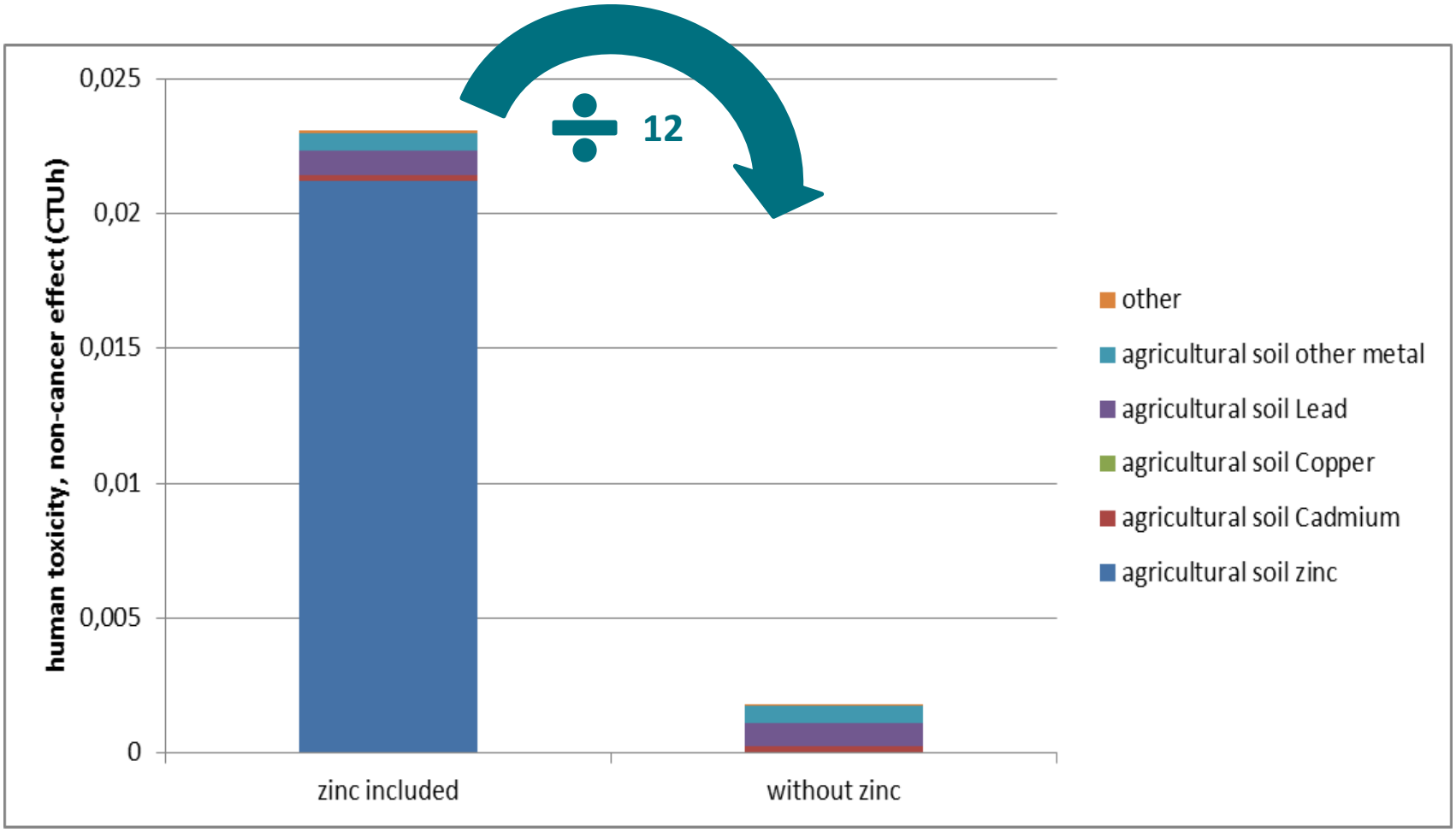
Zinc?

- From organic fertilizers (pig manure)
- Zinc: abundant/ important trace element in the human body:
  - useful for growth, bone and brain development, etc.
- European Commission recommendation: 7- 10 mg/person/day
- Human bodies are able to eliminate the zinc to maintain a constant level
- Only the exposure to high doses can have toxic effects:
  - interferes with the uptake of copper

Zinc?

- USEtox:
  - CF= the effects [cases/kg_{intake}] * the intake fraction [kg_{intake}/$kg_{emmitted}$]
- Zinc
  - effect factor: small in comparison to other metals
  - intake fraction: high
  - ➔ a substance that is relatively harmless obtains a large impact in toxicity.
- But is the exposition so high that we are in a toxic case?
- And pesticides?

Human toxicity, non-cancer effect



Conclusion

- Small contribution of pesticides
  - no difference between organic and traditional agriculture if only the farming is considered
- Importance of the speciation of some metals!
- Detailed analyze is mandatory! Especially for toxicity categories
- Some C.F. are difficult to understand…

Conclusion

Human toxicity, cancer effect

- Why C.F. of pesticides so small?
- Why C.F. of Cr unspecified is the average of Cr (III) and Cr (VI) even if Cr(VI) is so rare in the environment?

Human toxicity, non-cancer effect

- How can we know that zinc is in so large amount that it is toxic?
- Overestimation?
- Why C.F. of pesticides so small?

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