



Icobte-ichmet
9th September
Session :

Is the USEtox model for assessing the terrestrial ecotoxicity of trace elements adapted to the agricultural recycling of organic residues?

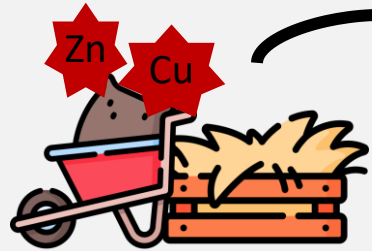
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Introduction: stakes of feed supplementation

Feed supplementation



Agricultural recycling

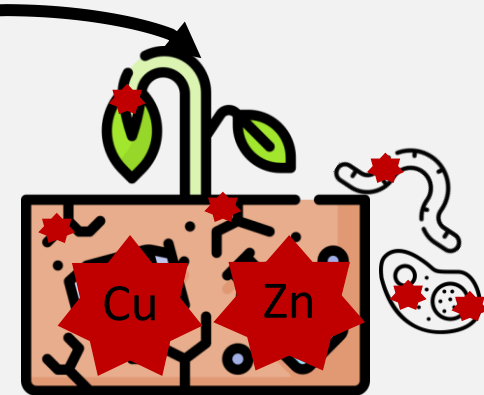


Sewage sludge
Compost
Digestate

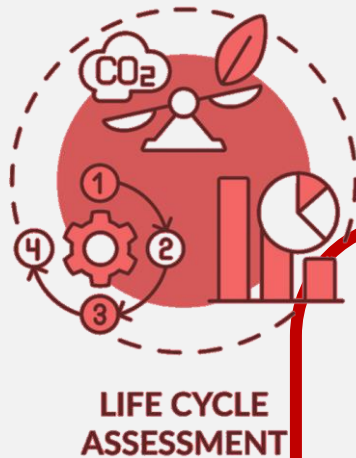


Trace metal contamination
of soils

**Alteration of soil fertility
and crop production**



Avadi et al. (2021) Advances in agronomy



**Assessment
of soil ecotoxicity**



Introduction: terrestrial ecotoxicity of metals

Reference approach

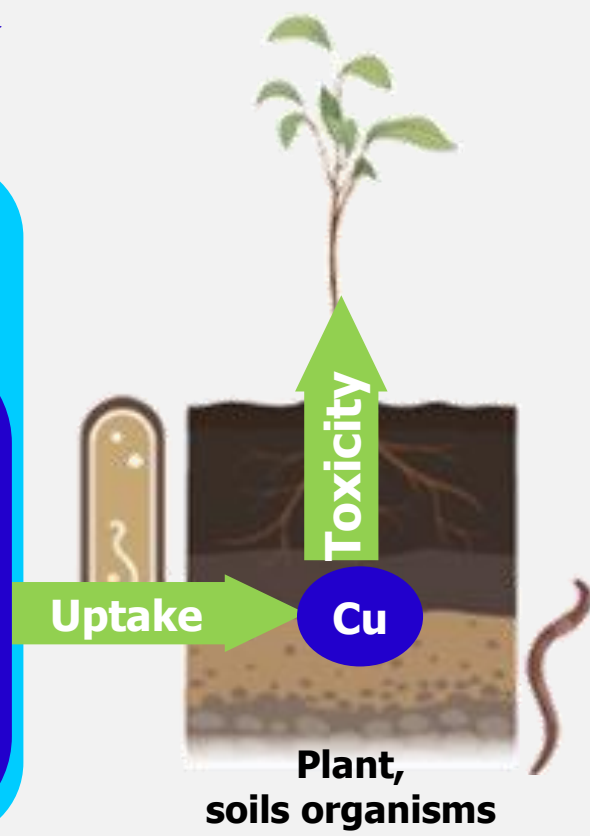
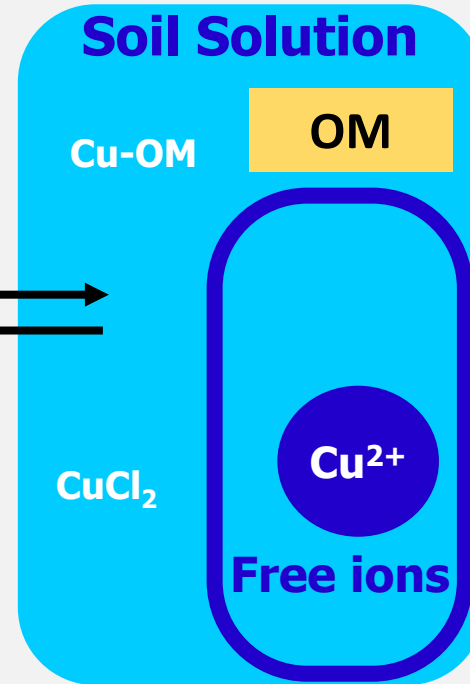
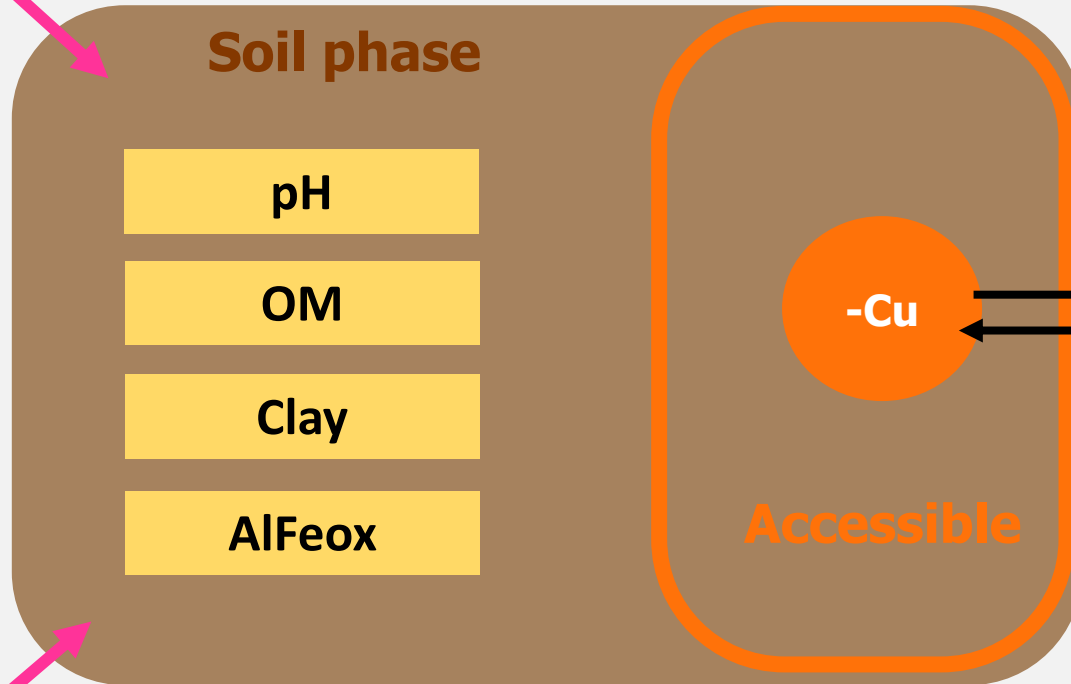
Owsianiak et al 2013, ES&T

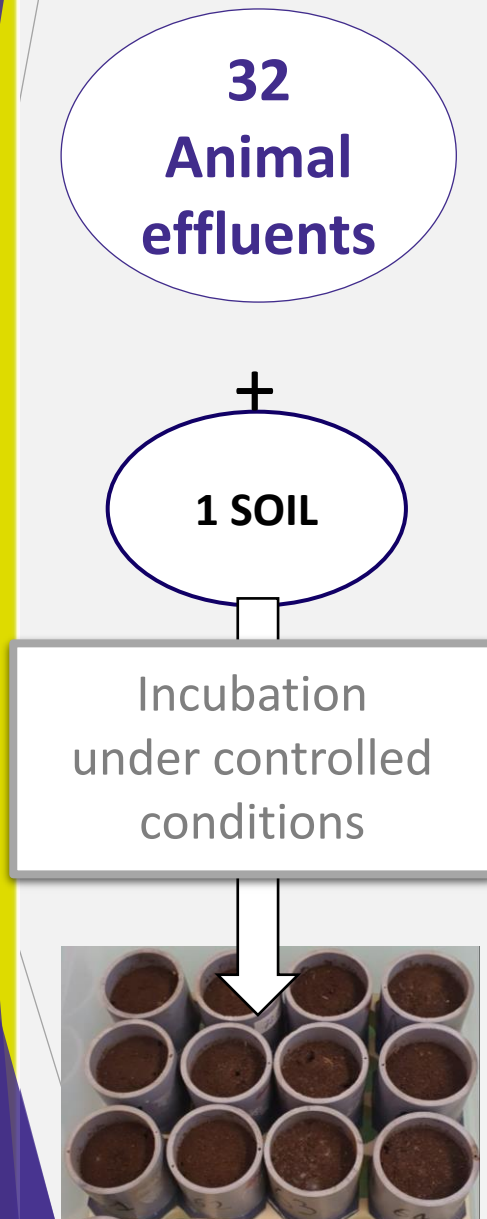
Comparative toxicity potential

Soil properties considered constant

$$Cu_{free} = f(Cu_{accessible}, OM, pH)$$

Anthropogenic Cu input





Objective:

Critical assessment of the reference approach
Comparison with experimental study

Animal effluents: pig / piglet slurries + poultry faeces

- Cu and Zn 10 to 1000 ppm

Soil: European agricultural soil

- Organic matter ~1%
- Soil acidity : pH ~5.9

26-d lab incubation

Methodology: experimental outcomes

Reference modelling approach

Soil properties considered constant

$$Cu_{soilsolution} = f(Cu_{accessible}, DOM, AlFe_{ox})$$

FF

X

$$Cu_{accessible} = f(OM, Clay, M_{tot})$$

ACF

X

$$Cu_{free} = f(Cu_{accessible}, OM, pH)$$

BF

X

EF

CTP

Experimental approach

pH and DOM concentration

1 SOIL

Total concentration in soil solution

32 animal effluents

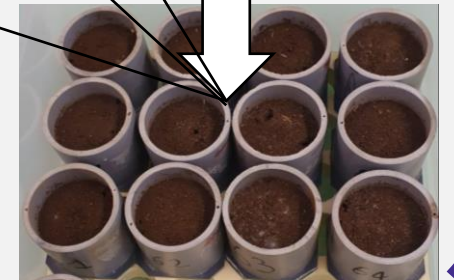
Incubation under controlled conditions

Accessible fraction in soil

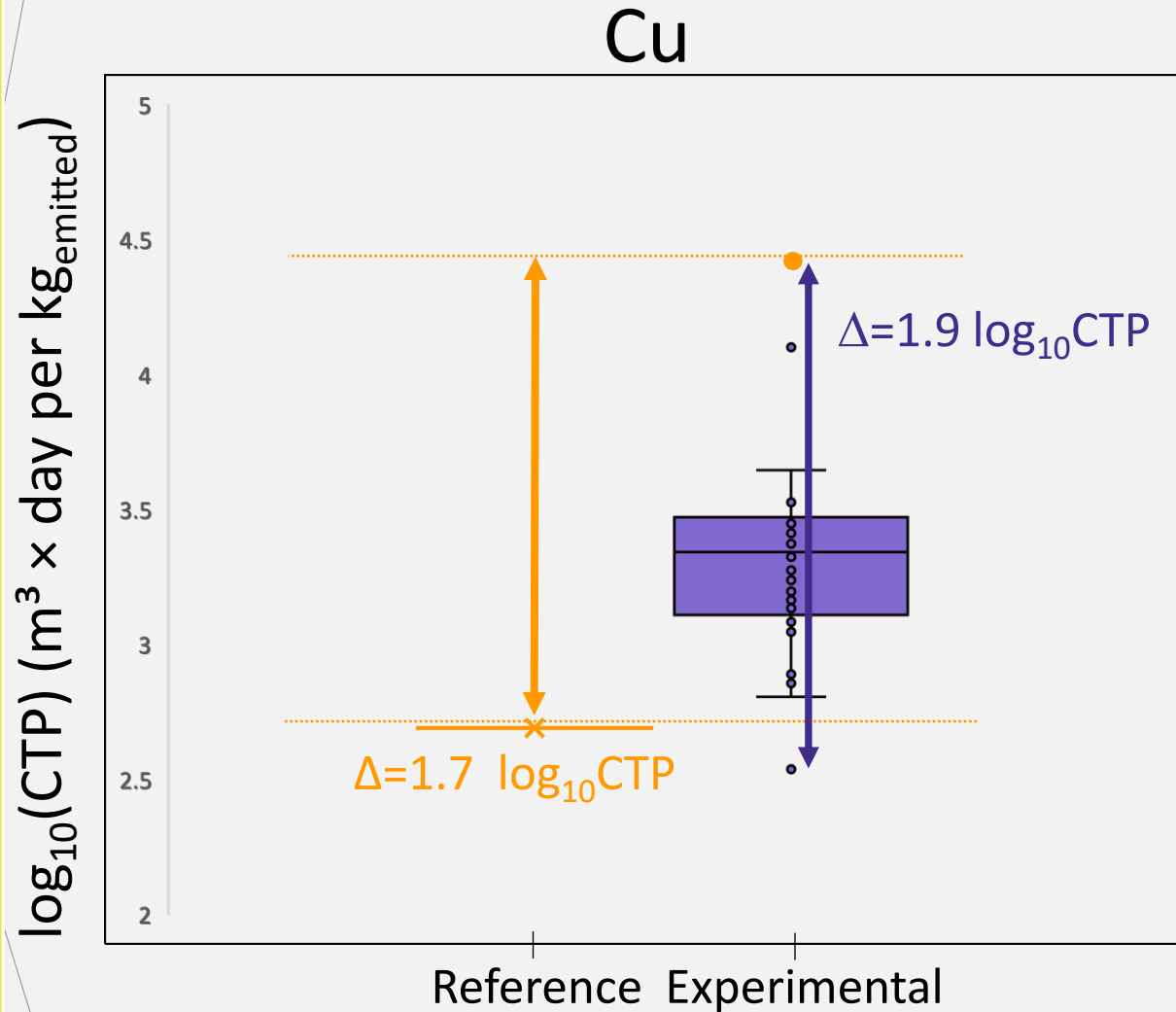
HNO₃ 0.43 M extracted

Free ion concentration in soil solution

Ionic selective electrode (Cu)
WHAM (Zn)



Results: Comparative toxicity potential



→ **reference approach:
underestimation
of the ecotoxicity impact**

→ **Animal effluent variability
not taken into account**

Soil alone

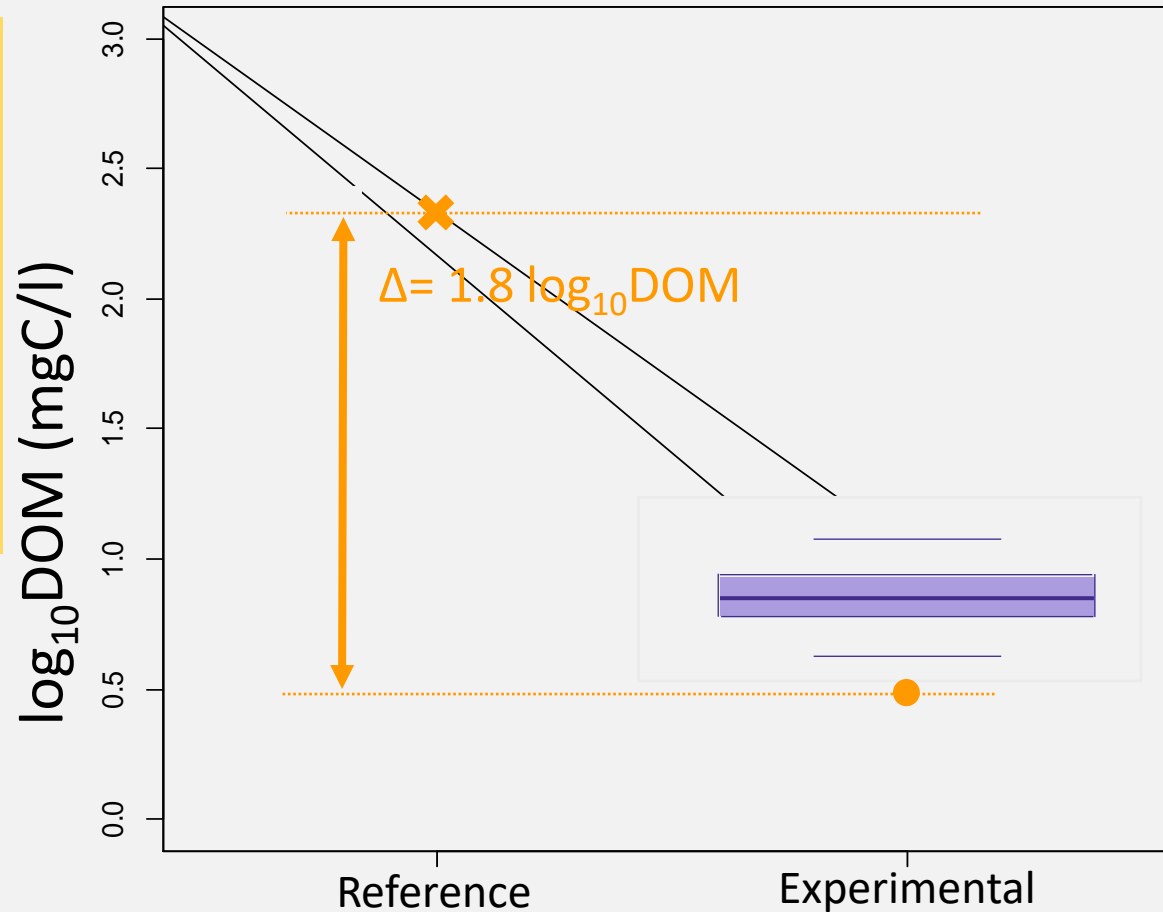
Soil + 32 animal effluents input

Results: Soil properties

logDOM
DOM=f(OM,pH)

REASON 1

Reference approach
DOM
over estimation



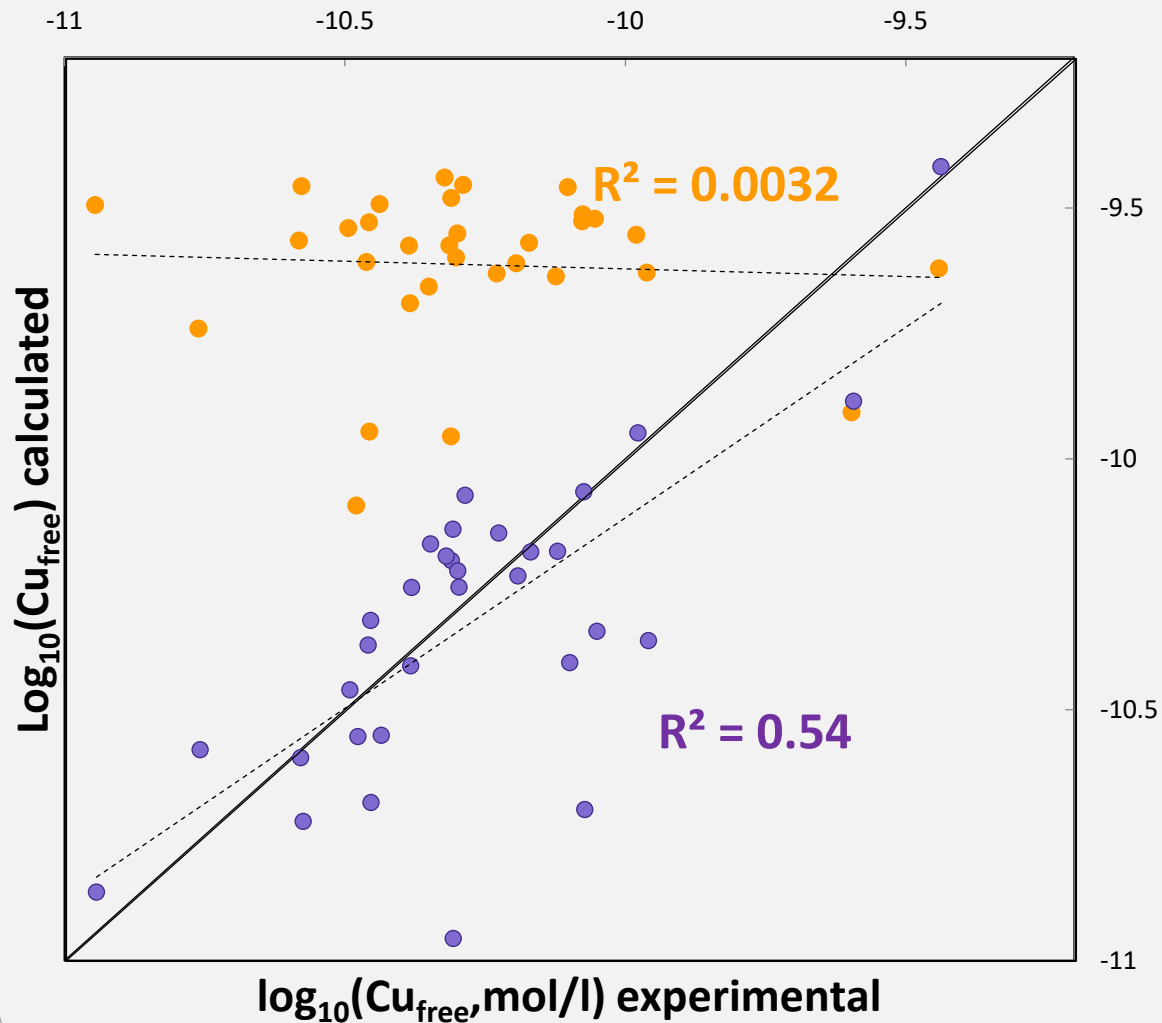
REASON 2

Reference approach
does not consider
soil properties evolution

Soil alone

Soil + 32 animal effluents

Results: estimation of Cu_{free} in soil solution



$$CTP = FF \times ACF \times BF \times EF$$

REASON 3:

Reference approach
does not account for major drivers

BC DOM = binding capacity of dissolved
organic matter

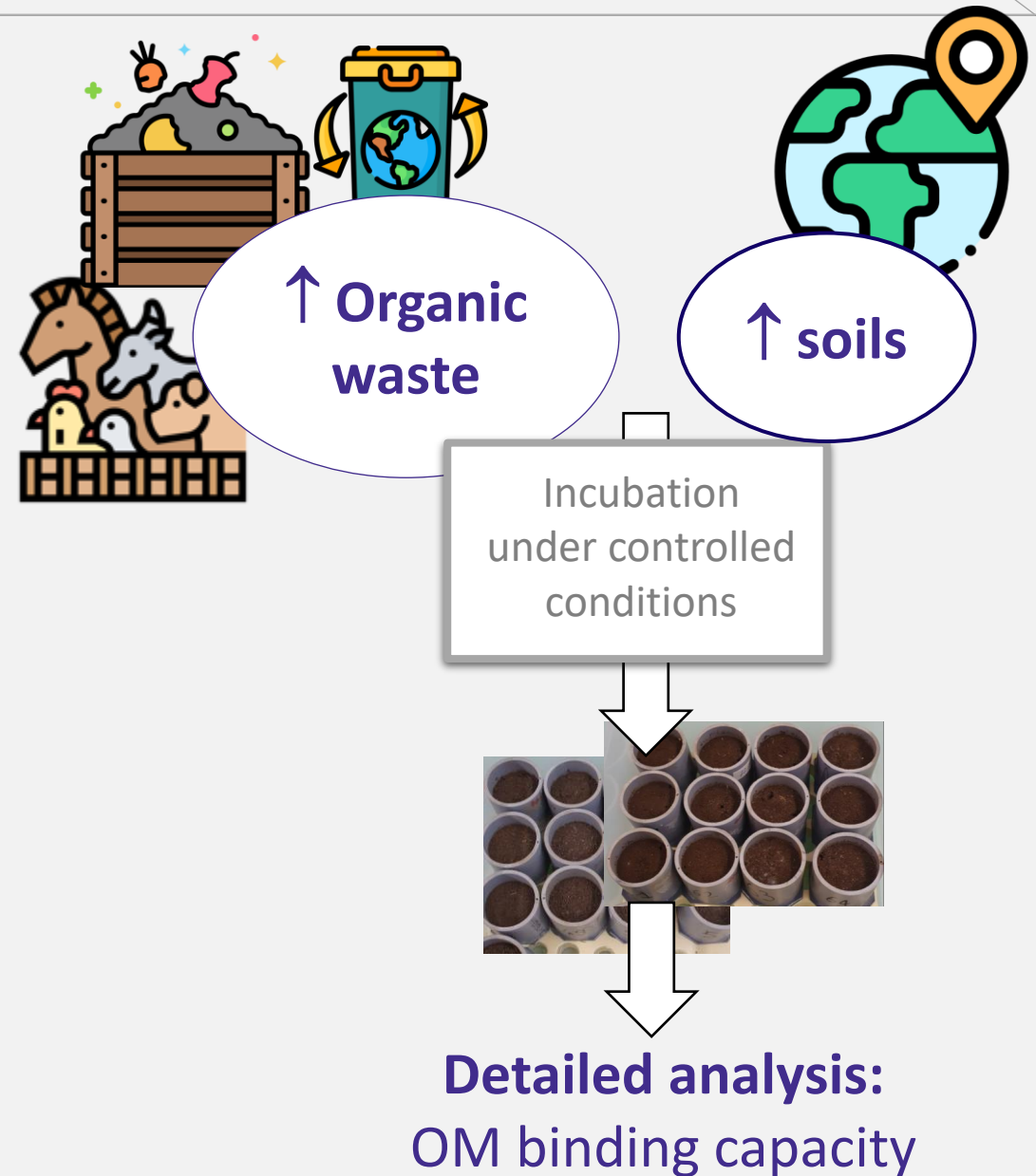
Conclusions and on going research

The reference approach induce a bias

to the assessment of trace elements impact

3 ways of improvement

1. Estimate soil properties: **DOM**
2. Integrate animal effluents impact on soil properties: **DOM and pH variation**
3. Add parameters in metal formalism:
Binding capacity DOM \rightarrow Cu_{free}





Thank you for your attention



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