

# Does USEtox predict adequately Cu and Zn ecotoxicity in soils amended with animal effluents?

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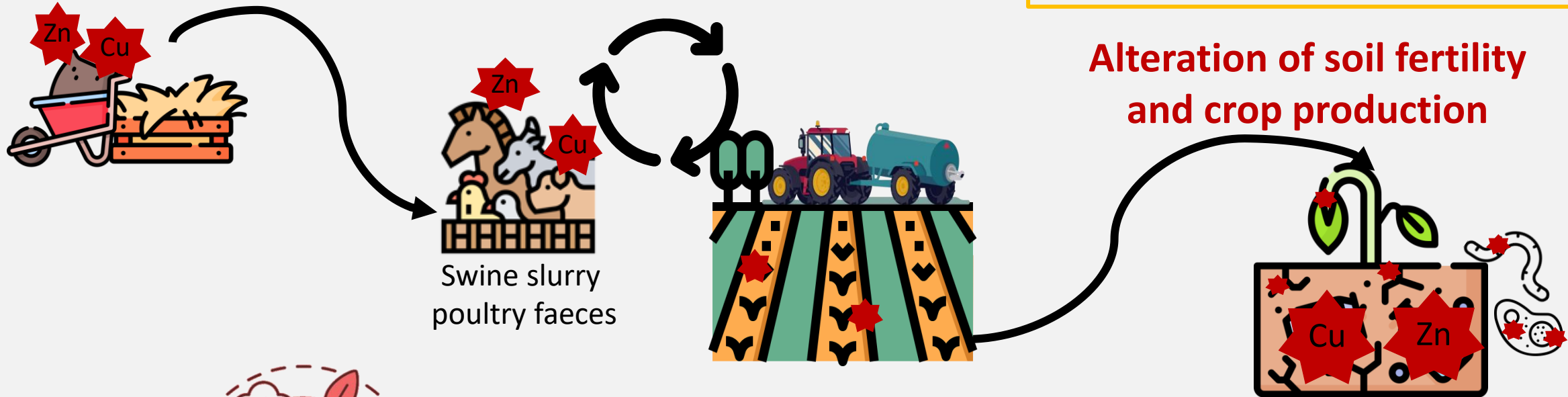
M.BRAVIN, A.AVADI, E.DOELSCH

# Introduction: stakes of feed supplementation

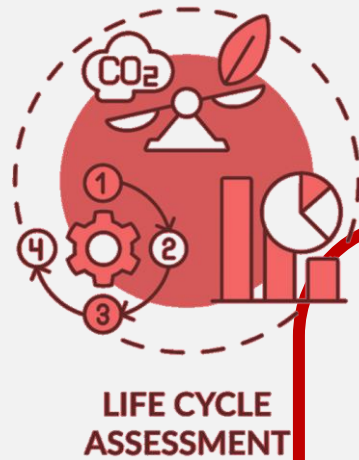
Feed supplementation

Agricultural recycling

Trace metal contamination of soils



**Alteration of soil fertility and crop production**



**Assessment of soil ecotoxicity**



Avadi et al. (2021) Advances in agronomy

# Introduction: terrestrial ecotoxicity of metals

Reference approach

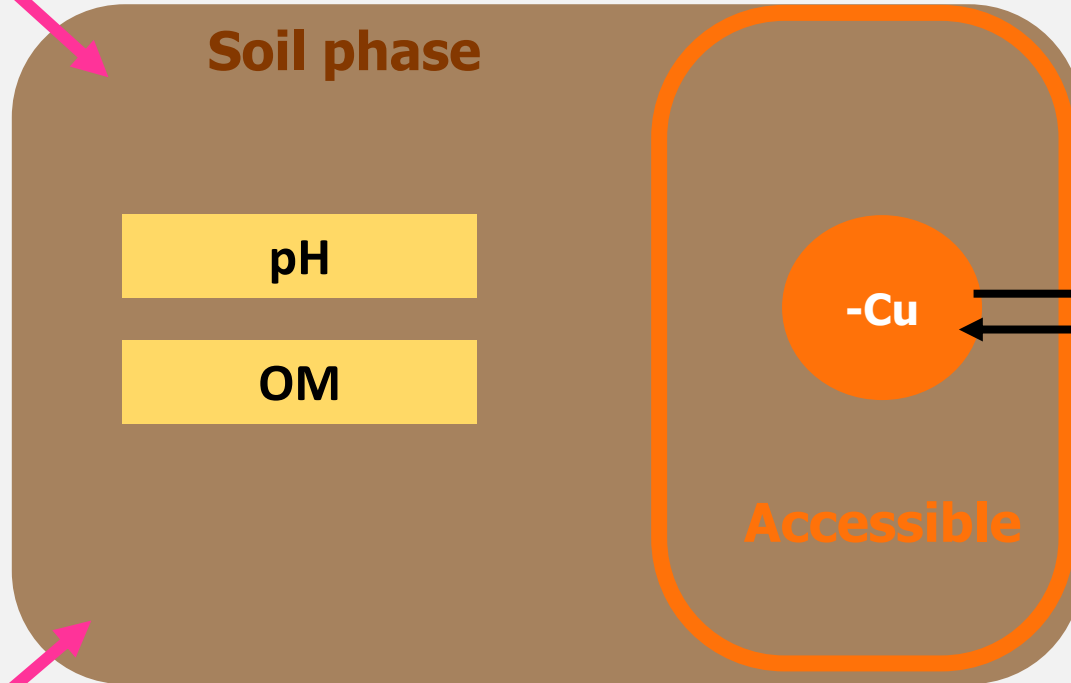
Owsianiak et al 2013, ES&T

Comparative toxicity potential

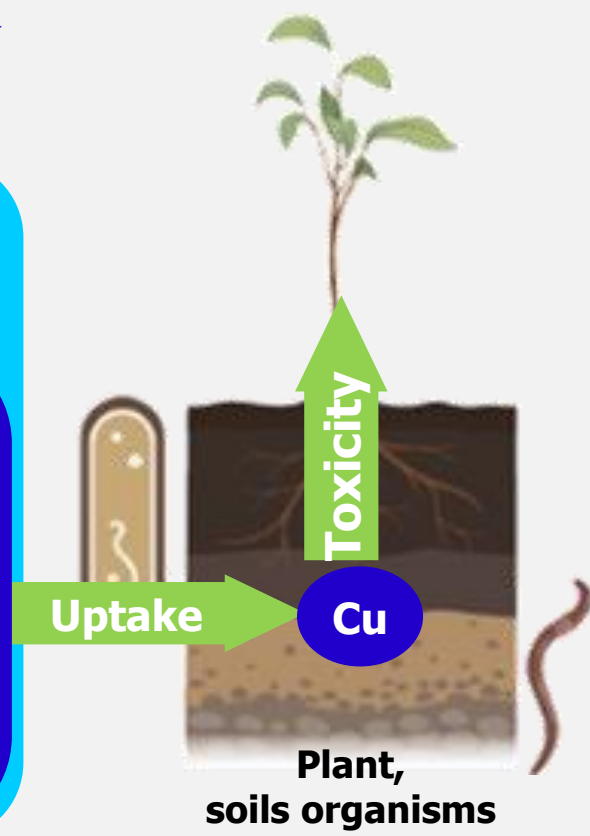
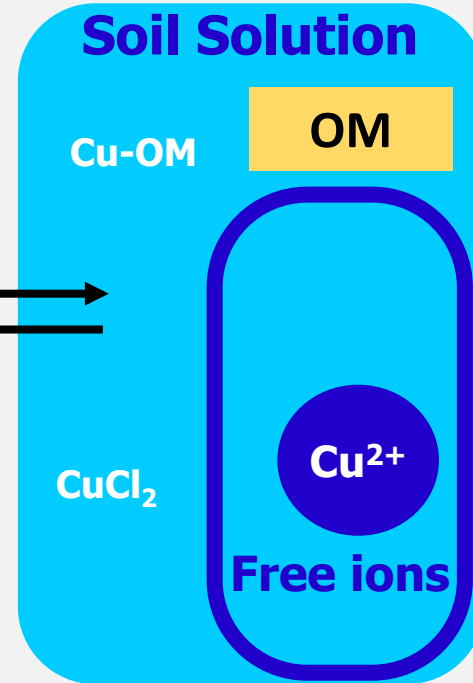
Soil properties considered constant

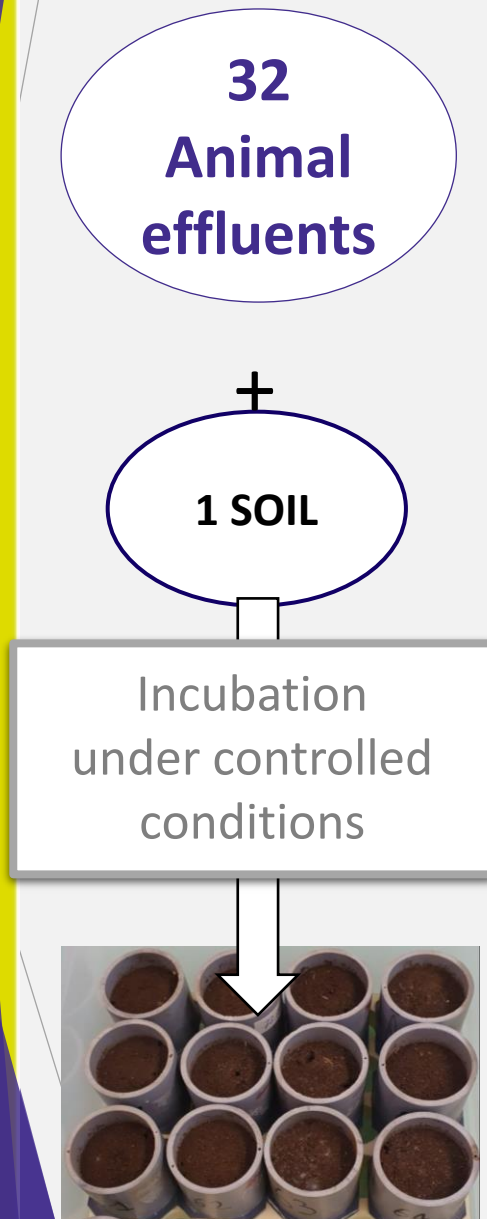
$$Cu_{free} = f(Cu_{accessible}, OM, pH)$$

Anthropogenic Cu input



Natural Cu background





## 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

$$Cu_{\text{soilsolution}} = f(Cu_{\text{accessible}}, \text{DOM}, \text{AlFe}_{\text{ox}})$$

FF

X

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

ACF

X

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

BF

X

EF

CTP

## Experimental approach

pH and DOM concentration

1 SOIL

Total concentration in soil solution

32 animal effluents

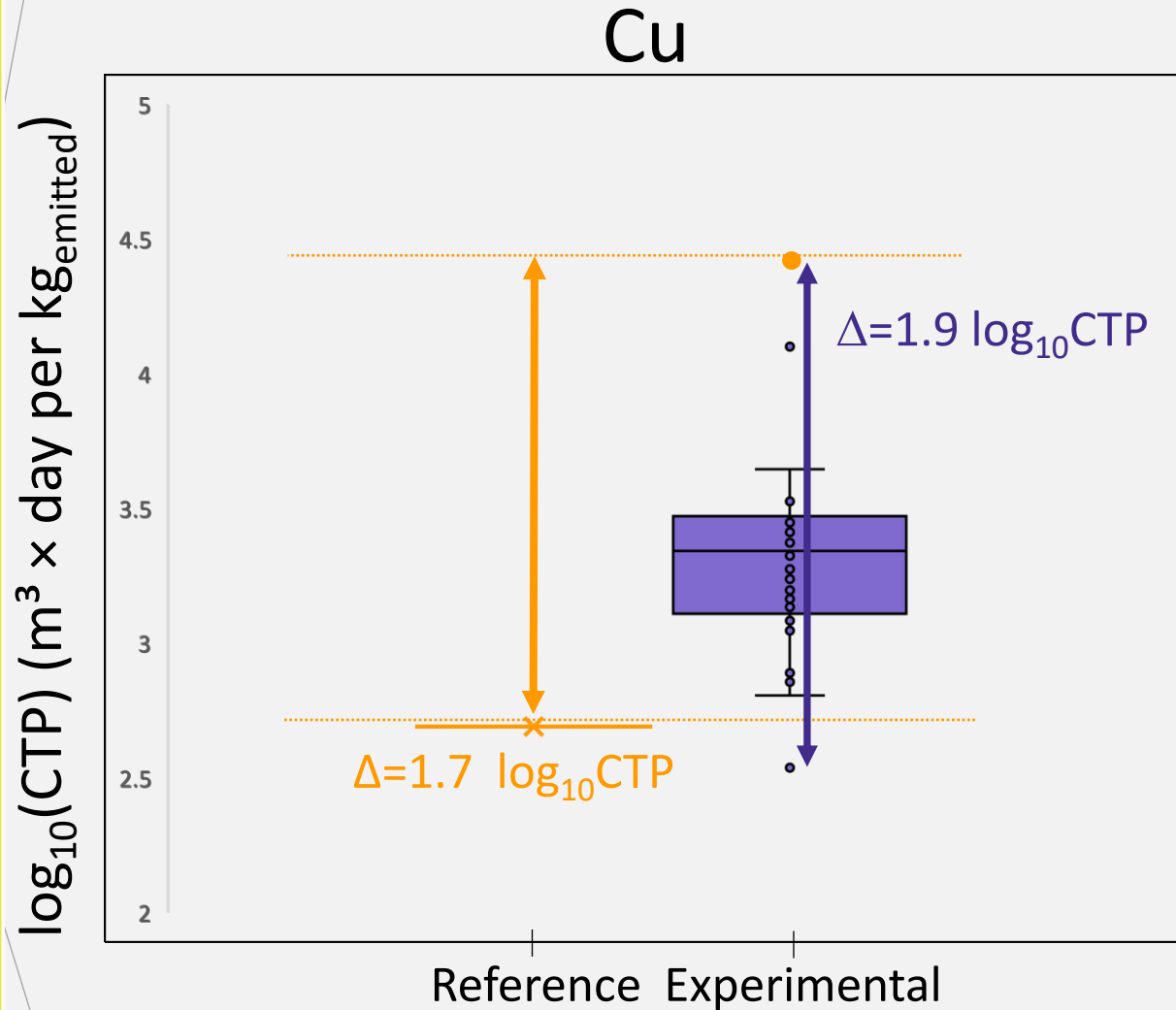
Incubation under controlled conditions

Accessible fraction in soil

Free ion concentration in soil solution



# Results: Comparative toxicity potential



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

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

Soil alone

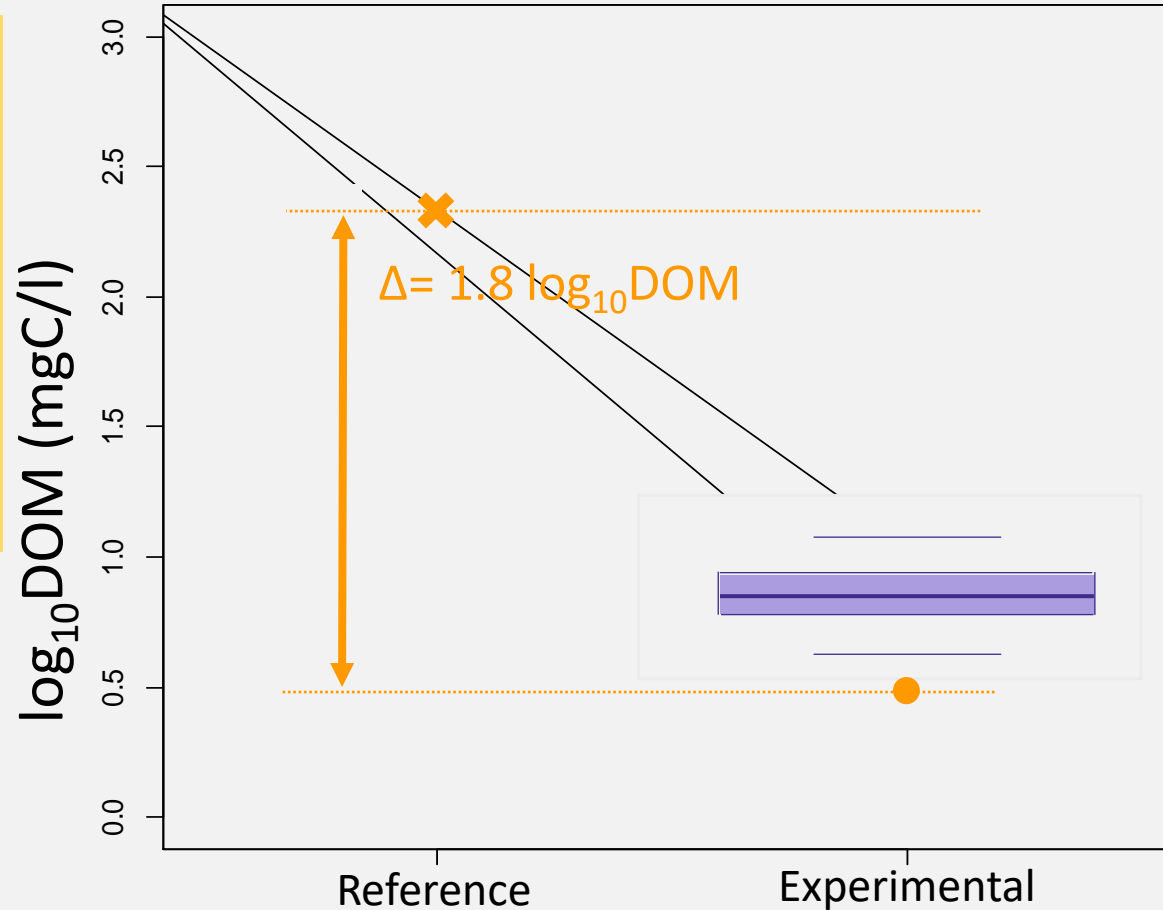
Soil + 32 animal effluents input

# Results: Soil properties

**logDOM**  
DOM=f(OM,pH)

## REASON 1

Reference approach  
DOM  
over estimation



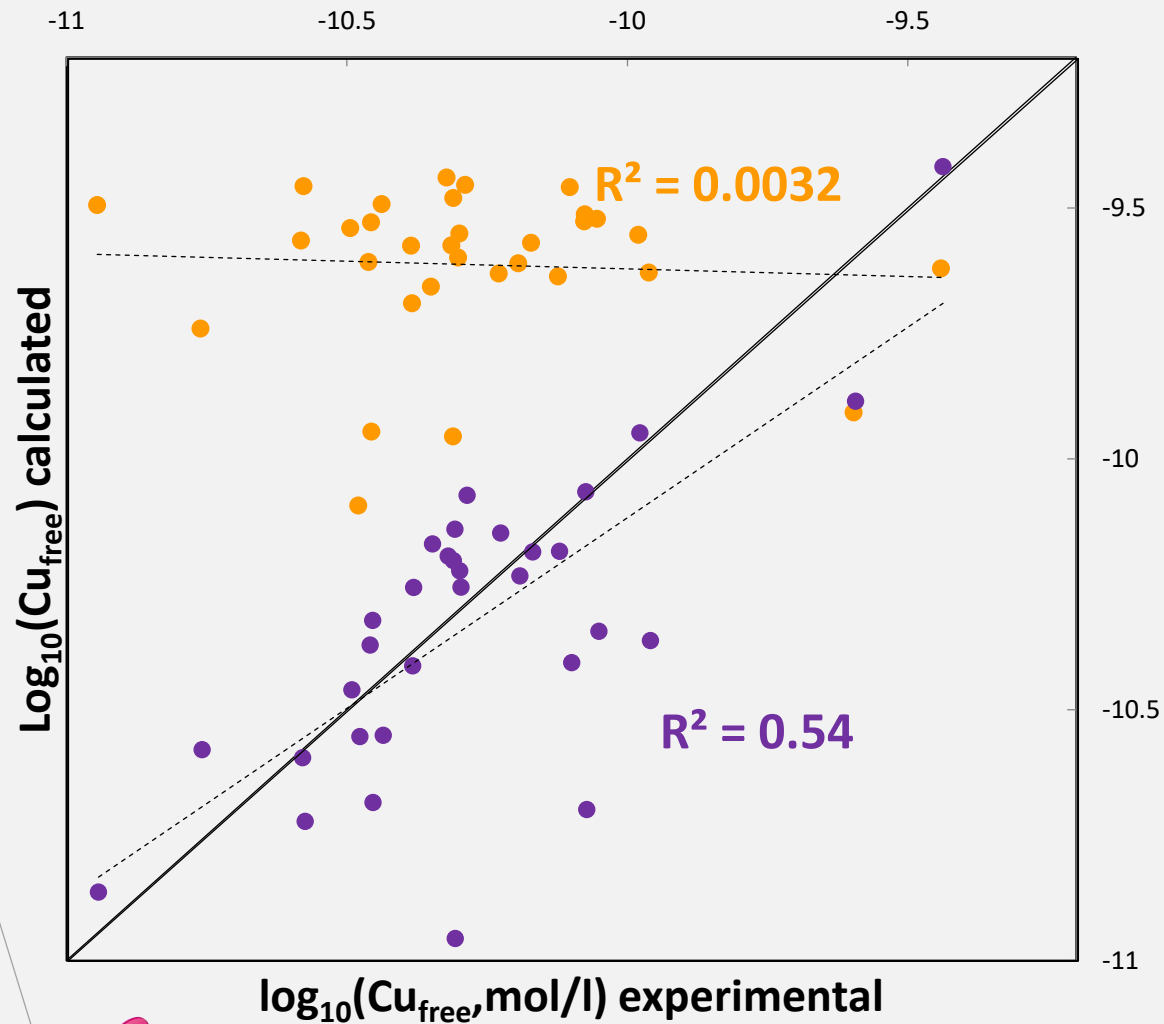
## REASON 2

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



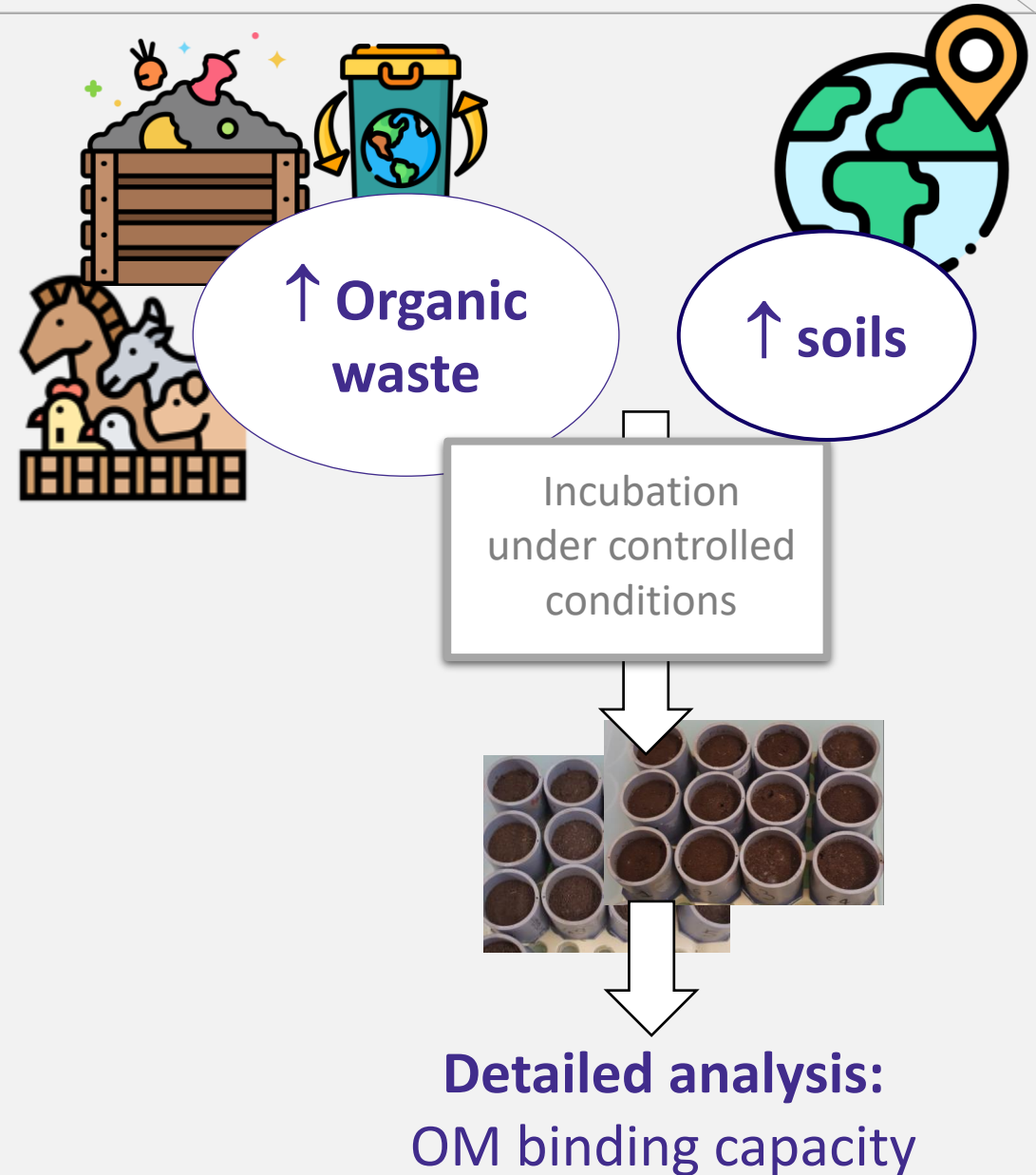
# Conclusions and on going research

## 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 you attention



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