Impact of microplastics on soil nutrients of UK farmlands arising from sludge application

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The importance of microplastics in sewage

Microplastics (MP) are small plastic pieces that are 1–5,000 µm. Water treatment plants (WWTPs) remove microplastics from water, where they eventually get concentrated in sewage sludge. The sludge is then spread in agricultural soils that are used for crop production. While sewage sludge can supply nutrients, it could also introduce potentially toxic elements. Microplastics in soil could induce changes in soil fertility, thereby creating a potential threat to plant performance and crop productivity

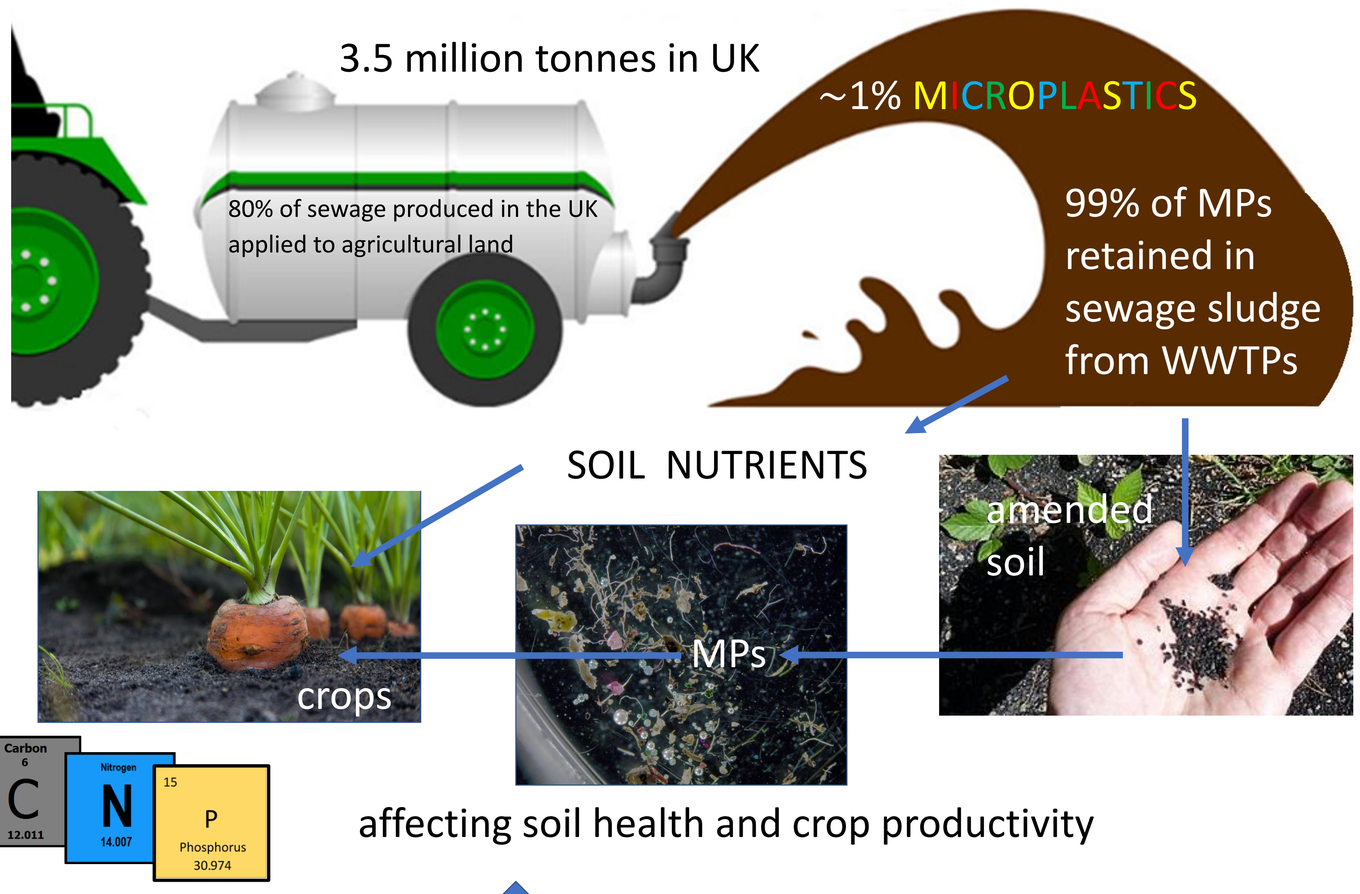
Research Objectives

- Investigate the relationship between soil nutrients concentration with sludge treatment to understand the impact coming from microplastics addition

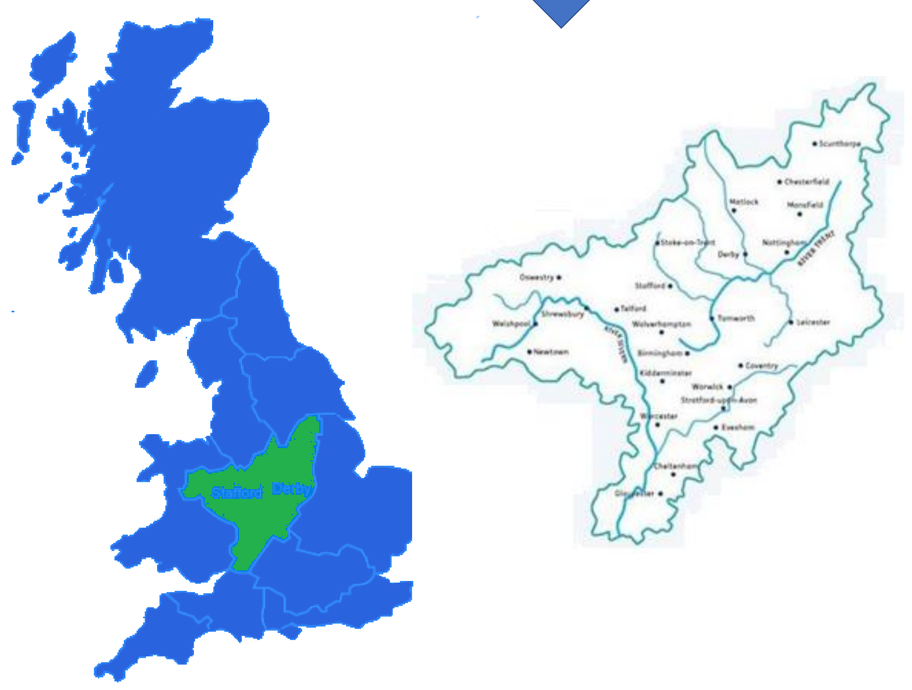
Research Aims

- What are the levels of different soil nutrients (Mo, Cu, Ni, Zn, Cr, Se) in soil samples with and without microplastics?
- What is the distribution of microplastics in studied area?

SLUDGE APPLICATION ON UK FARMLANDS



affecting soil health and crop productivity



Study area farmlands with different history of sludge application in central UK, soil type, agricultural practices and crop controlled

Microplastics in sewage sludge

Average concentration of microplastics in biosolids from UK wastewater treatment plants (mg/kg (DW))

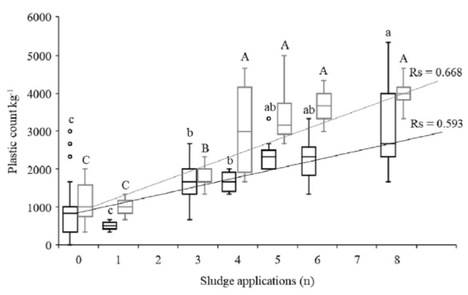
Horton et al., (2017)	37
Lee et al. (2021)	10.6

The export of MP from sludge to land in UK

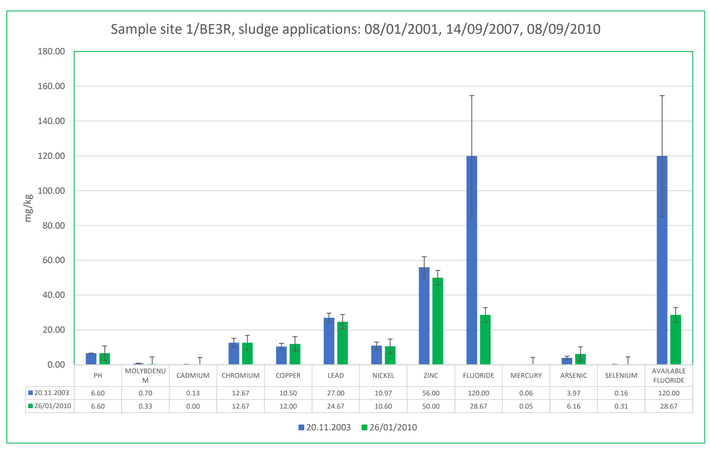
- can be in the region of 2.25 x 10^12 MP/d, around 1.000.000 MP/kg sludge, 9.6 g/kg (UKWIR 2022)
- 1.61 × 10^10 of microplastics end up in the biosolids every month from one waste water treatment work in England (Harley-Nyang et al., 2022)

Accumulation of microplastics in soils

- increase in microplastic content was observed with each successive sludge application (van den Berg et al., 2020)



Preliminary Results



Determinand	Units
04A MERCURY	mg/kg
07V ARSENIC	mg/kg
09H SELENIUM	mg/kg
0JO PH	No Unit
0R7 MOLYBDENUM	mg/kg
0US DRY SOLIDS	%
0Y1 CADMIUM	mg/kg
0V2 CHROMIUM	mg/kg
0V3 COPPER	mg/kg
0V4 LEAD	mg/kg
0V5 NICKEL	mg/kg
0V6 ZINC	mg/kg
L2Z AVAILABLE FLUORIDE	mg/kg

- Dataset: sludge application and nutrient concentration

Conclusion

- Sewage sludge as a fertilizer can provide nutrients necessary for crops. However it is the biggest contributor to soil microplastics
- Microplastics from sludge accumulate over time after each application despite the nutrient is being taken up by crops.
- Microplastics can affect geochemical cycling of elements (such as C, N, and P) in soil.
- Furthermore, there is still need to research on other soil nutrients in relation to microplastics

References

Alice A. Horton et al., https://doi.org/10.1016/j.scitotenv.2017.01.190; *Hee-Jee Lee et al, https://doi.org/10.1016/j.jhazmat.2020.123743 * The National Chemical Investigations Programme https://ukwir.org/water-industry-technical-report?object=91d0b63a-a522-4880-9c1e-fa05cdb763a8 * Daisy Harley-Nyang et al., https://doi.org/10.1016/j.scitotenv.2022.153735.; * Pim van den Berg et al, https://doi.org/10.1016/j.envpol.2020.114198.