GCRF Agriplastic project

Dr Perrine Florent - Bangor University

Plastics in the environment – Knowledge share workshop

Cardiff University, 17th of December 2024

Plastic pollution in agriculture

***Plastic pollution** in agricultural soils is an issue that often goes unnoticed*

- *Plastic waste associated with urban areas and oceans, BUT farmland also impacted by plastics*
- *Most commonly used plastics in farming: Plastic mulch film (PFM)*

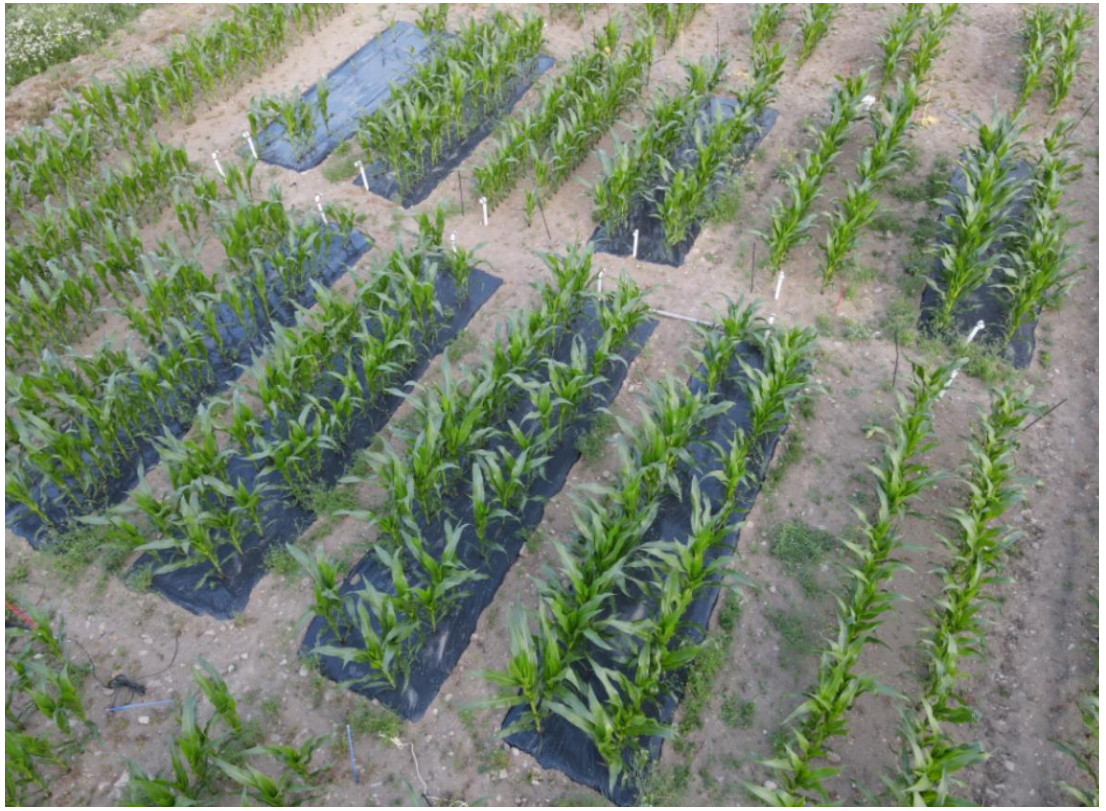
***LDPE** : Most commonly used plastic material*

- *Durable, resistant to degradation*
- *BUT can persist in the environment for many years*
- *North America and Asia as major users*

*Eco-friendly alternative: **biodegradable** PFMs*

- *Renewable resources like corn, or starch…*
- *Compostable & break down to carbon source*

Gaining popularity in Europe and some Asian countries



Long-term experiment at Bangor University to assess maize growth and changes in soil properties under LDPE and PLA/PBAT PFMs

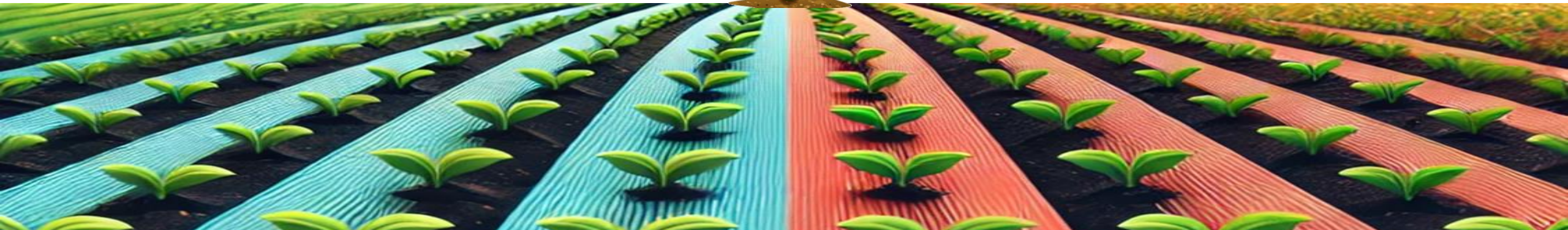
Plasticulture: Benefits and Risks

Benefits

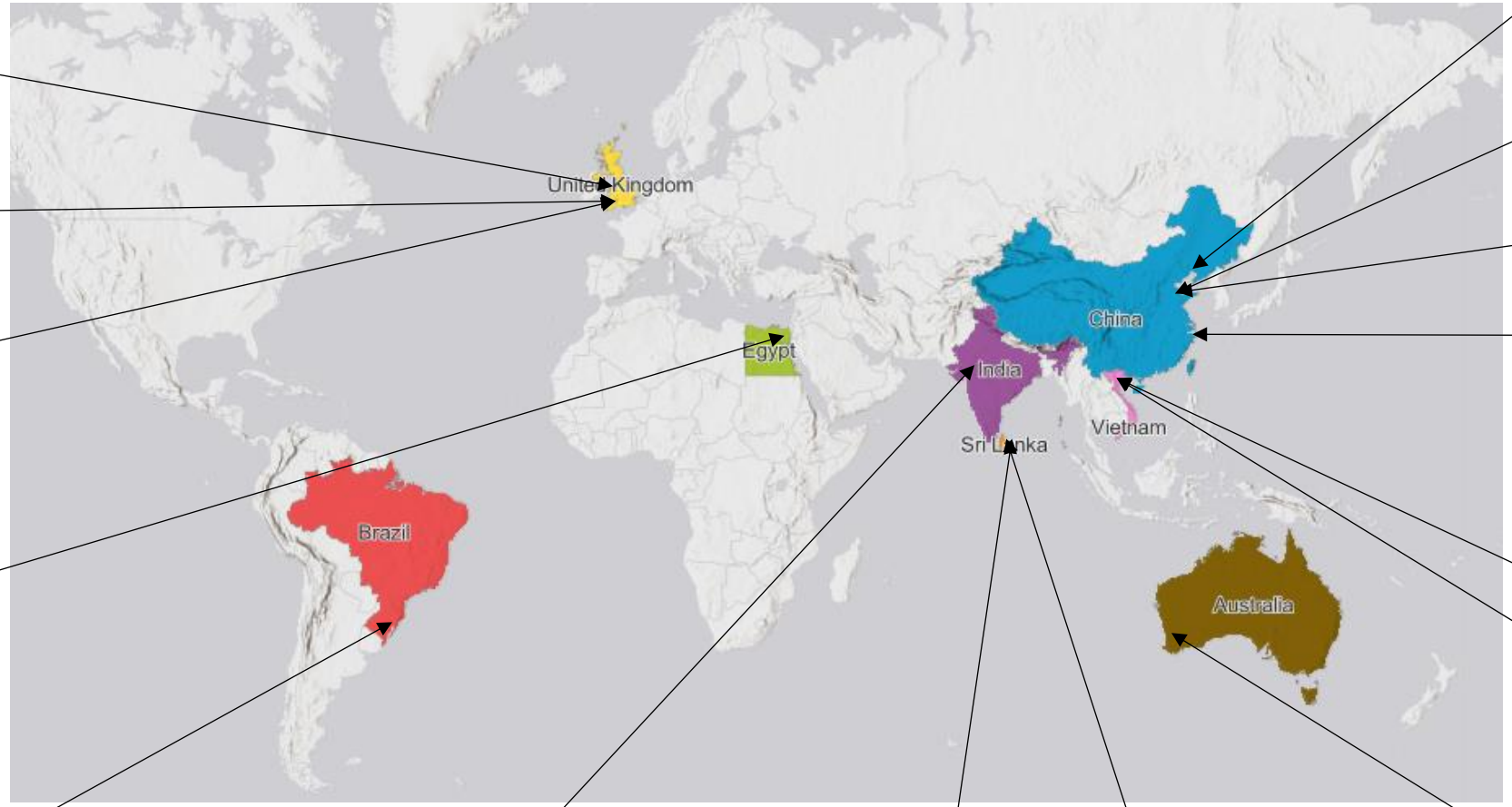
- *Regulates soil temperature*
- *Increases crop yields*
- *Pest and weed control*
- *Conserves water and fertilisers*
- *Reduces erosion*

Risks

- *Soil pollution with plastics*
- *Micro/nanoplastic accumulation*
- *Release of additives*
- *Toxic emissions to the atmosphere*
- *Transfer to watercourses*



Partnership – National & International



PRIFYSGOL BANGOR UNIVERSITY

University of BRISTOL

University of Reading

UFRGS UNIVERSIDADE FEDERAL DO RIO GRANDE DO SUL

SLINTEC SRI LANKA INSTITUTE OF NANOTECHNOLOGY (PVT) LTD.

Murdoch University

Aims & Objectives

***Objectives**:*

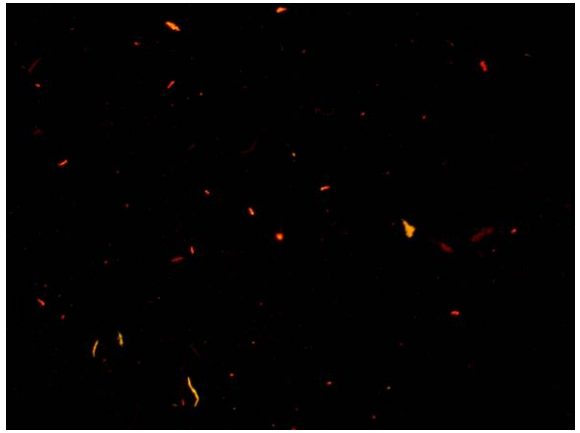
- *Quantify the risk that agricultural plastics and associated co-contaminants may pose to the long-term health of smallholder farms in LMICs, with specific reference to food security and rural livelihoods.*

- *Identify practical, economic, socially acceptable and politically viable solutions to help remediate land contaminated with plastic and prevent further pollution from happening through social behaviour and policy change*

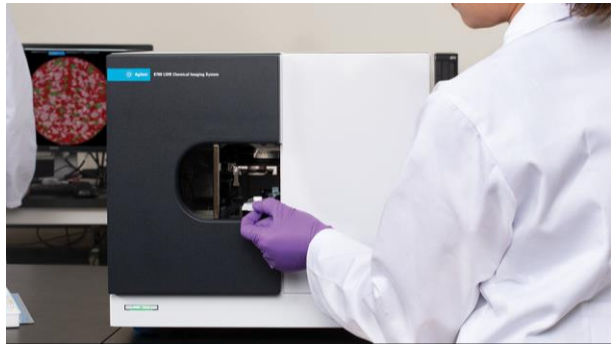
- *Use the UK as a comparator site*

Development of standard protocols

Filtration step of MP extraction



Microscopy image of dyed MPs



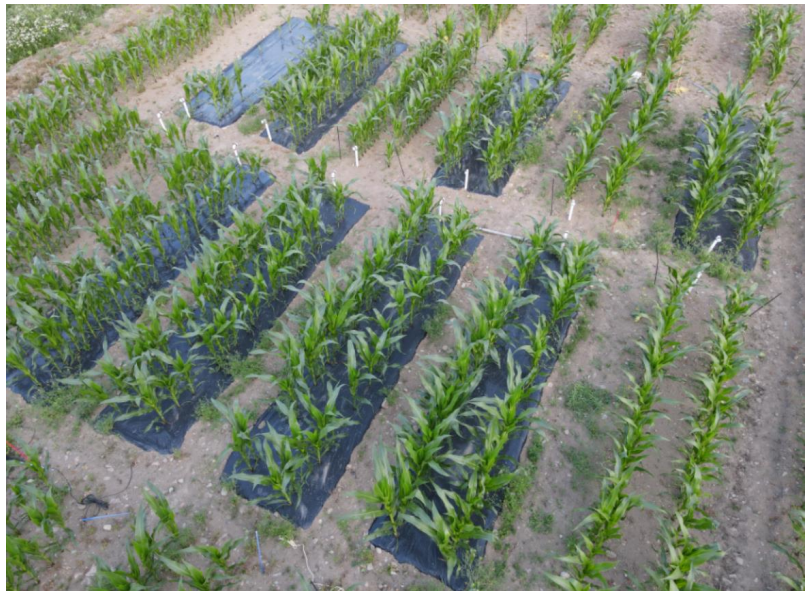
LDIR for polymer identification

Standard protocol to determine the abundance and identification of MPs from soil/compost samples

- *MP extraction from samples*
- *Determination of abundance, shape and size*
- *Polymer identification*

Paper under review in Journal of Visualized Experiments (JoVE)

Impact & fate of (micro)plastics (1/2)



Agronomy common experiment

- *Long-term*
- *Conventional vs. Biodegradable*
- *Impact on soil health & plant yield*
- *Assessment of plastic degradation*

Atmospheric deposition of MPs

- *Long-term*
- *MP composition of atmosphere*
- *Evaluate their deposition onto soil*
- *Source identification*

Soil column experiment

- *Vertical mobilisation of plastics*
- *Conventional vs. Biodegradable*
- *Effect of size on transport*
- *Assessment of MP degradation*

Impact & fate of (micro)plastics (2/2)

Agronomy common experiment

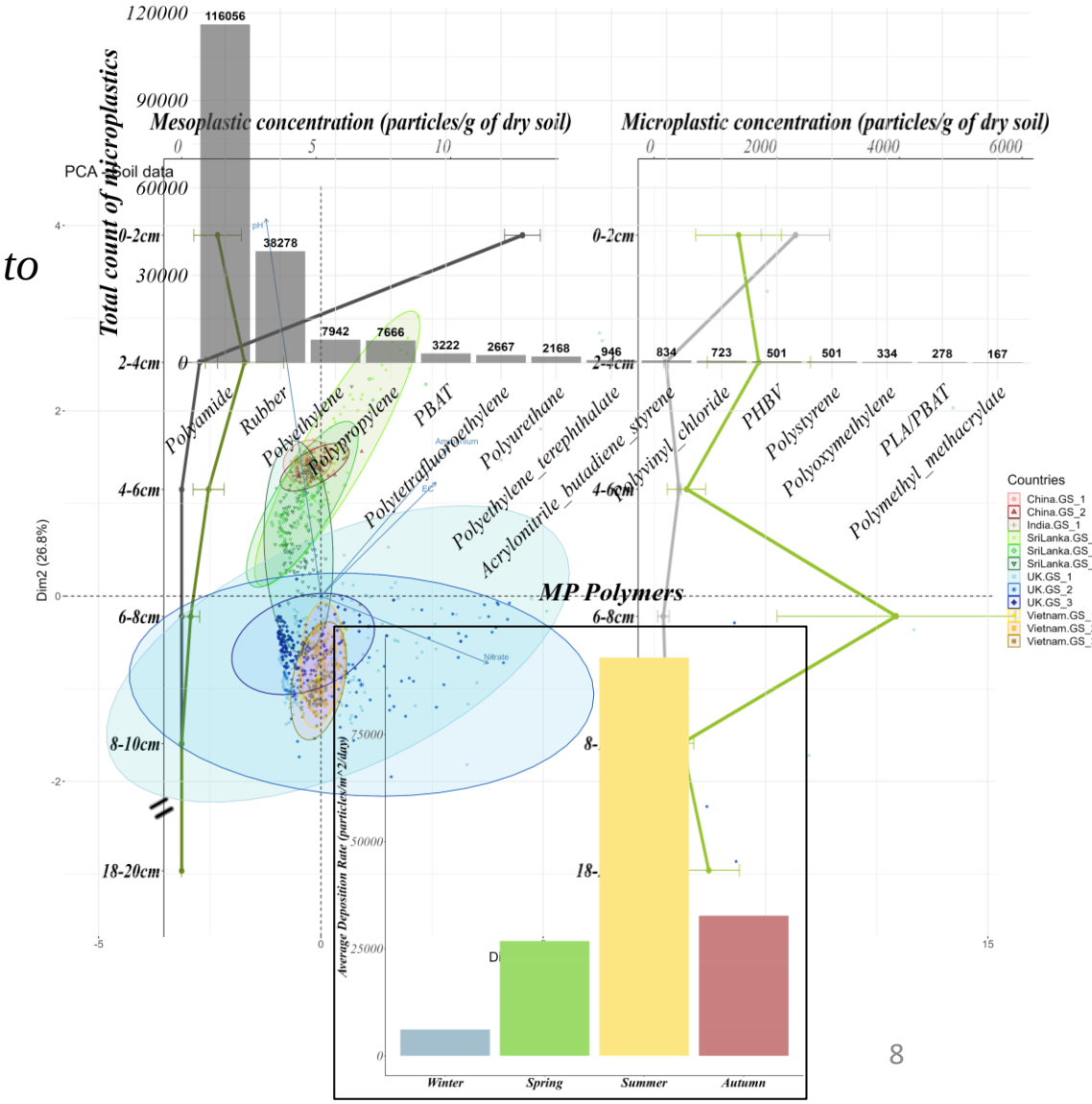
- *No significant differences between the treatments (conventional/biodegradable/No PFM) on soil health*
- *Higher crop yield for conventional and biodegradable compared to no PFM*
- *Differences mainly noticed between countries*

Soil column experiment

- *Conventional meso- and microplastics do not transport*
- *Biodegradable MPs showed vertical transport up to 8cm deep*

Atmospheric deposition of MPs

- *Polyamide and rubber as main MP polymers*
- *MP abundance follows seasonality (higher in summer vs winter)*
- *Abundance of MPs lower in soil vs atmosphere*



Soil survey & Farm budget survey

***Soil survey**: Systematic examination and analysis of soil samples to detect, quantify, and assess the presence and distribution of microplastics*

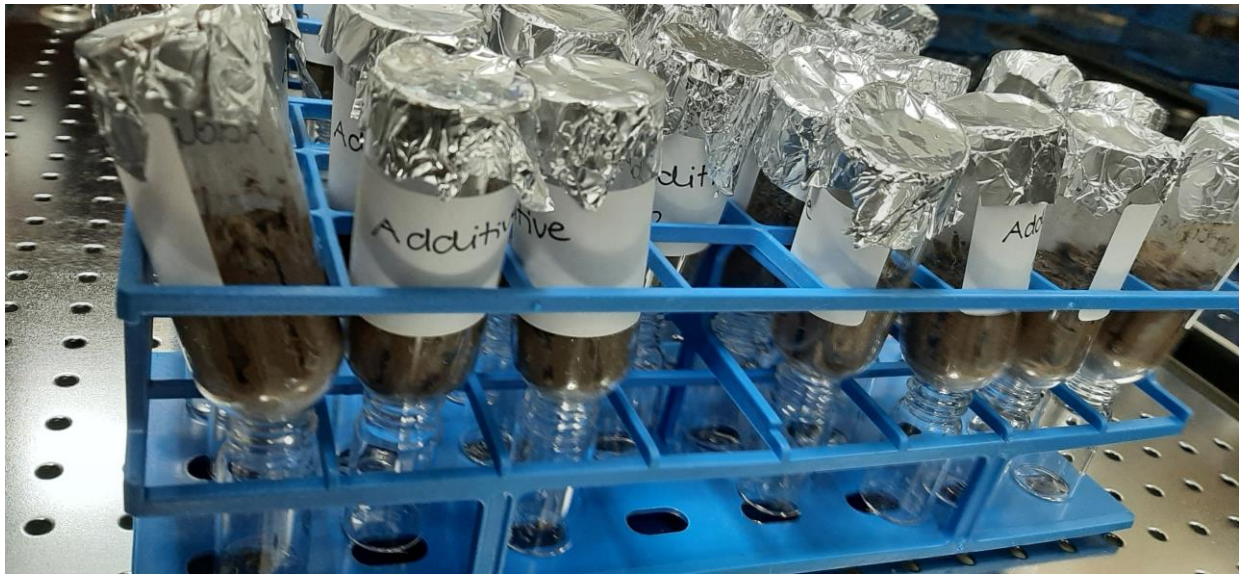
- *In 40 farms in each country, 3 soil depths*

***Farm budget survey of plastic use and disposal**: to assess the contribution of PFMs to the total agriplastics used on farms, and understand the fate of the different sources*

- *30 farms in each country*

Looking for farmer network contacts to support our UK AgriPlastic on-farm survey

Additive degradation experiment



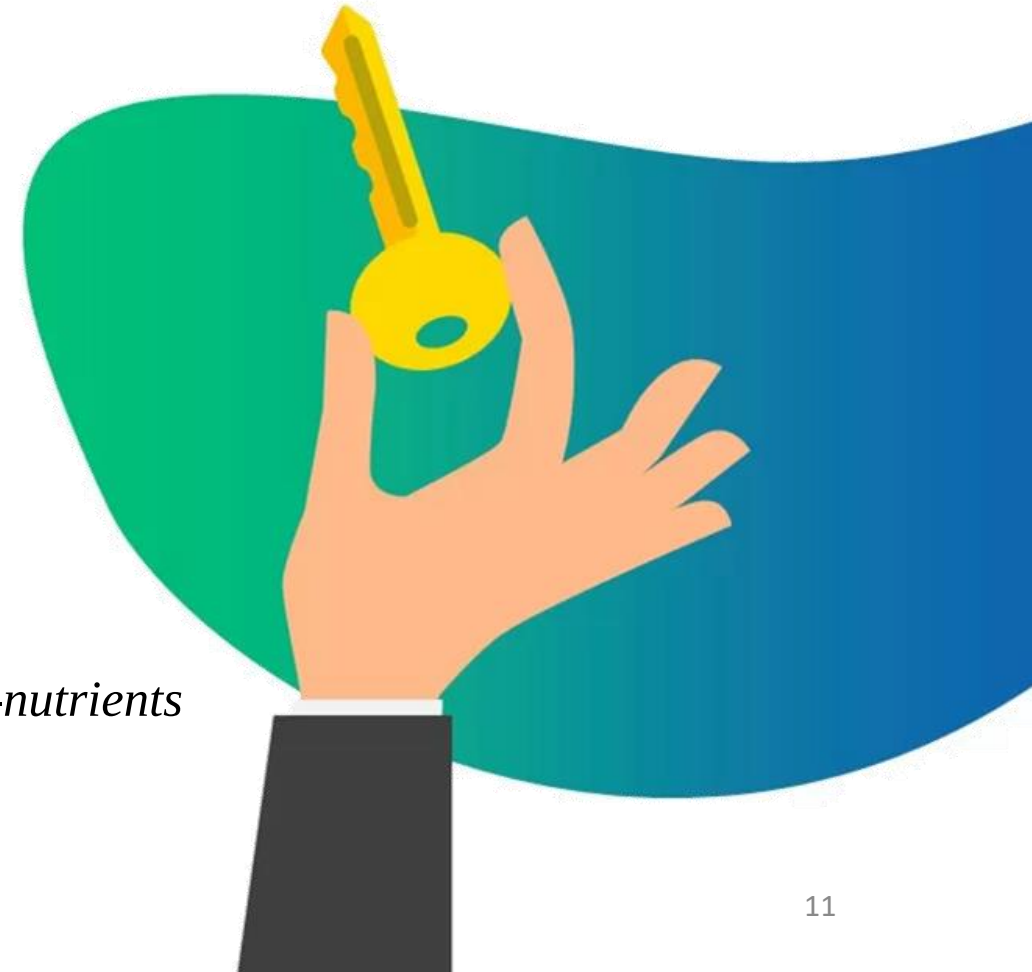
Investigate additive leaching from mulch films into the soil during the degradation process

- *Physical and chemical changes in film and identification of the release of additives*
- *Potential effect of additives on the microbial communities, other fauna, and crops*

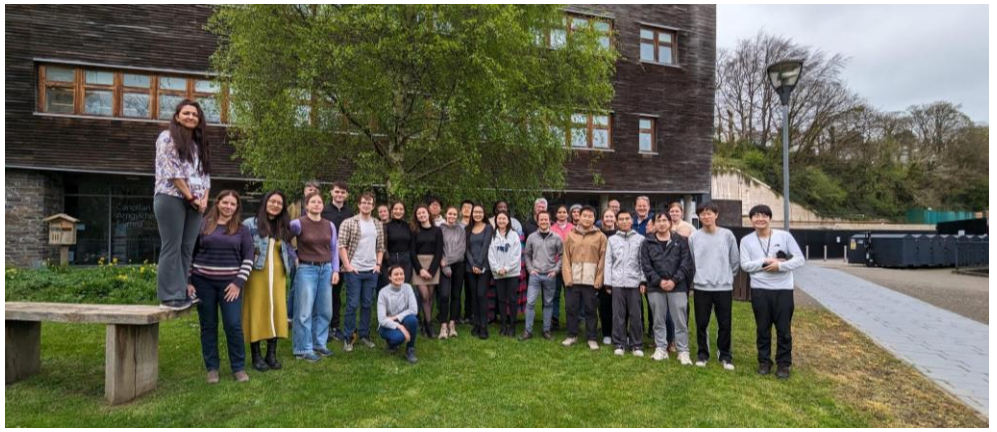
*'**Potential of additives to leach into the soil and their degradation across soil types**' – Michaela Reay (18th Dec, 10 am)*

Key takeaways from the use of PFMs

- *Many societal benefits of plastic mulch films*
  - *Increased yields*
  - *Reduced need for irrigation water*
  - *Reduced inputs of herbicides*
- *Potential risk to soil and crop health*
  - *Some poor science has been published*
    - *Atypical concentrations of MP used*
    - *Non-standard protocols have been used*
- *PFMs offer some solutions*
  - *Biodegradable – smart plastic films to deliver plant micro-nutrients*
  - *Resilience to future weather extremes*



Thank you!



Bangor University
Prof Davey Jones
Prof Dave Chadwick
Prof Peter Golyshin
Prof Roland Bol
Dr Michelle Jones
Martine Graf
Ben Collins

China Agricultural University (CAU)
Prof Xuejun Liu
Prof Ji Ma
Prof Kai Wang
Jinrui Zhang
Siyang Ren

Chinese Academy of Agricultural Sciences (CAAS)
Prof Yan Changrong
Prof Qin Liu

Bristol University
Prof Richard Evershed
Dr Charlotte Lloyd
Dr Michaela Reay

Reading University
Prof Henny Osbahr
Prof Chris Collins
Mondira Bhattacharya

Southern University of Science and Technology
Dr Ruimin Qi

Shenyang Agricultural University
Prof Wang Jingkuan
Prof Fan Ding
Shitong Li

Mansoura University
Prof Ahmed Mosa
Prof Hazem Kassem
Dr Mohamed Rady
Mona Tolba

Ningbo University
Prof Ge Tida
Prof Zhu Zhenke
Prof Xiao Mouliang

Soils and Fertilizers Research Institute
Prof Tran Minh Tien
Dr Nguyen Van Hien
Dr Mai Thi Ha
Dr Dang Thi Thanh Hao

Institute of Agricultural Environment
Dr Tran Van The

Indian Institute of Soil Science (ICAR)
Dr Tapan Adhikari
Dr JK Thakur
Dr Asit Mandal
Dr Aditya Prakash

University of Peradeniya
Dr Mojith Ariyaratne
Dr Anurudda Karunarathna
Dr Senal Weersooriya

Sri Lanka Institute of Nanotechnology (SLINTEC)
Dr Surani Chathurika
Meththa Gimhani

Murdoch University
Samantha Viljoen

Universidade federal do rio grande do sul
Prof Andreia Neves Fernandes
Gabriela Albara Lando