



# Residue

Risk reduction of chemical residues in soils and crops:  
impact due to wastewater used for irrigation

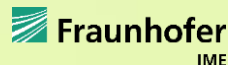
## Introduction to the RESIDUE project: motivation , project idea and project structure

Dr. Dieter Hennecke, Fraunhofer IME

International Spring School:

Innovative agronomic practices for healthy  
soils and sustainable farming systems

May 23-24, 2023, Copernico Zuretti, Milano



# Framework



PRIMA programme is supported by Horizon 2020, the European Union's Framework Programme for Research and Innovation

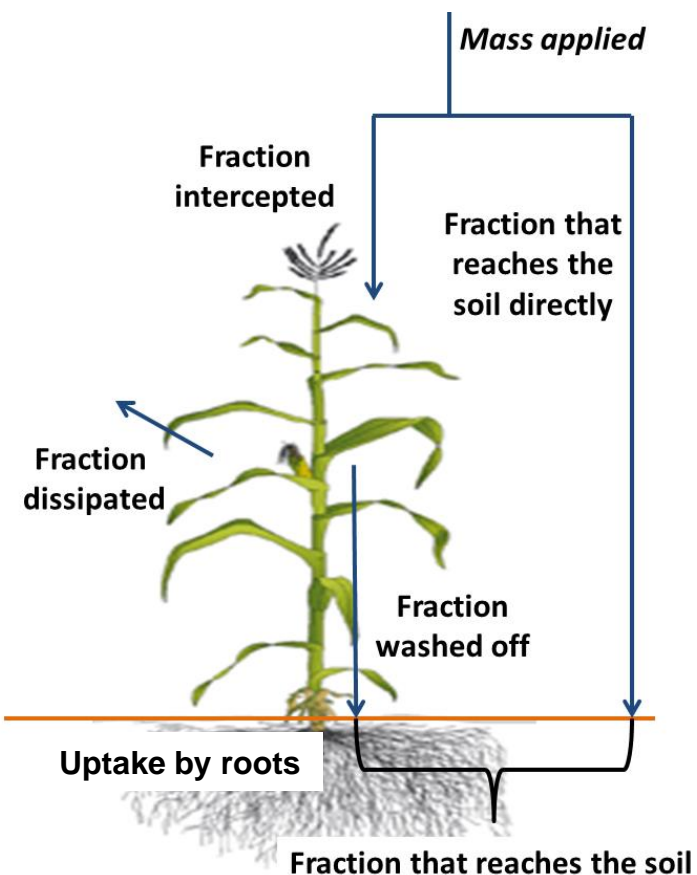
## About PRIMA

PRIMA –**P**artnership for **R**esearch and **I**nnovation in the **M**editerranean **A**rea– is an ambitious **science** diplomacy **program** that aims to build R&I capacities and **develop innovative solutions** for agro-food systems and integrated **water provision and management in the Mediterranean area** competitive calls for funding.

The partnership consists of 19 countries, including 11 EU Members States and eight non-EU Mediterranean Countries, on an equal footing basis (co-ownership, co-management and co-funding) supported by the European Commission.



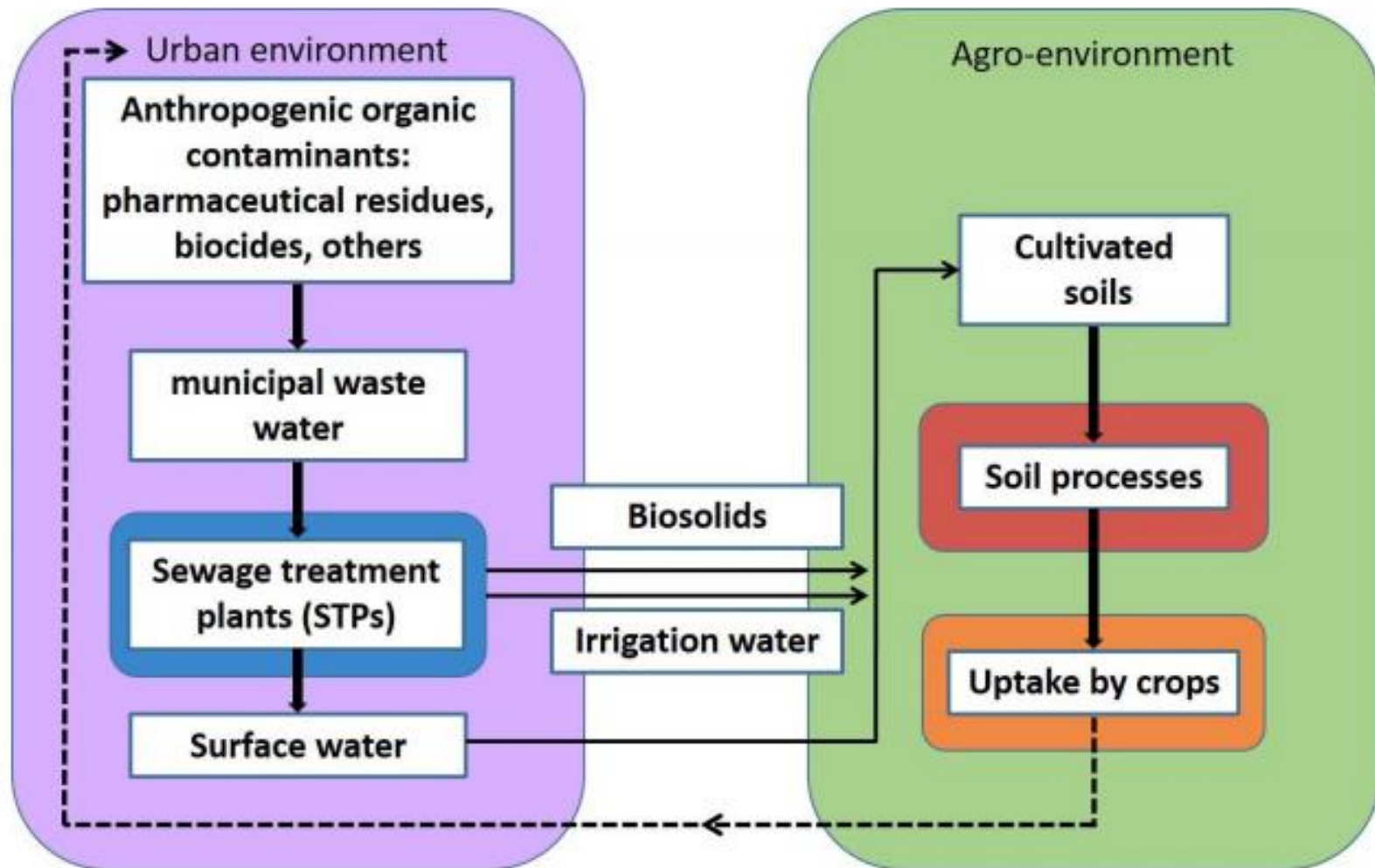
# Problem definition



- chemicals applied to agricultural fields might be taken up by the crops
- well known pathway and intensive research for pesticides, that are intentional applied
- data from experimental fate studies serve as basis for computer models which result in an exposure assessment.
- one exposure route considered in fate models: the substance is washed from the leaves by rainfall and enters the crop via the roots
- Uptake screening by hydroponic experiment

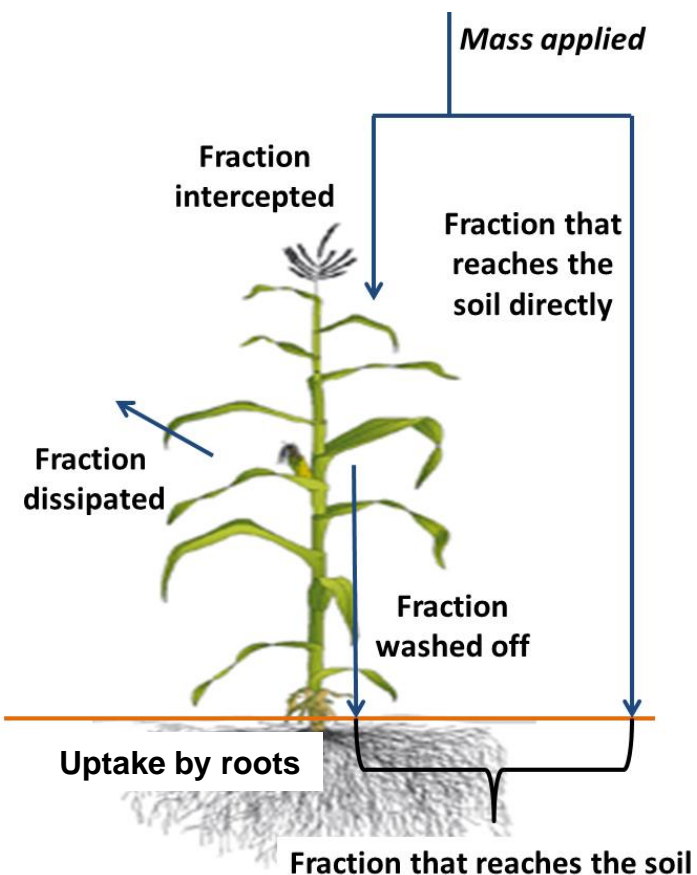


# Problem definition



- Use of waste water in agriculture inevitable due to water scarcity
- Potential exposure of crops with anthropogenic organic chemicals
- Risk of food contamination by crop uptake

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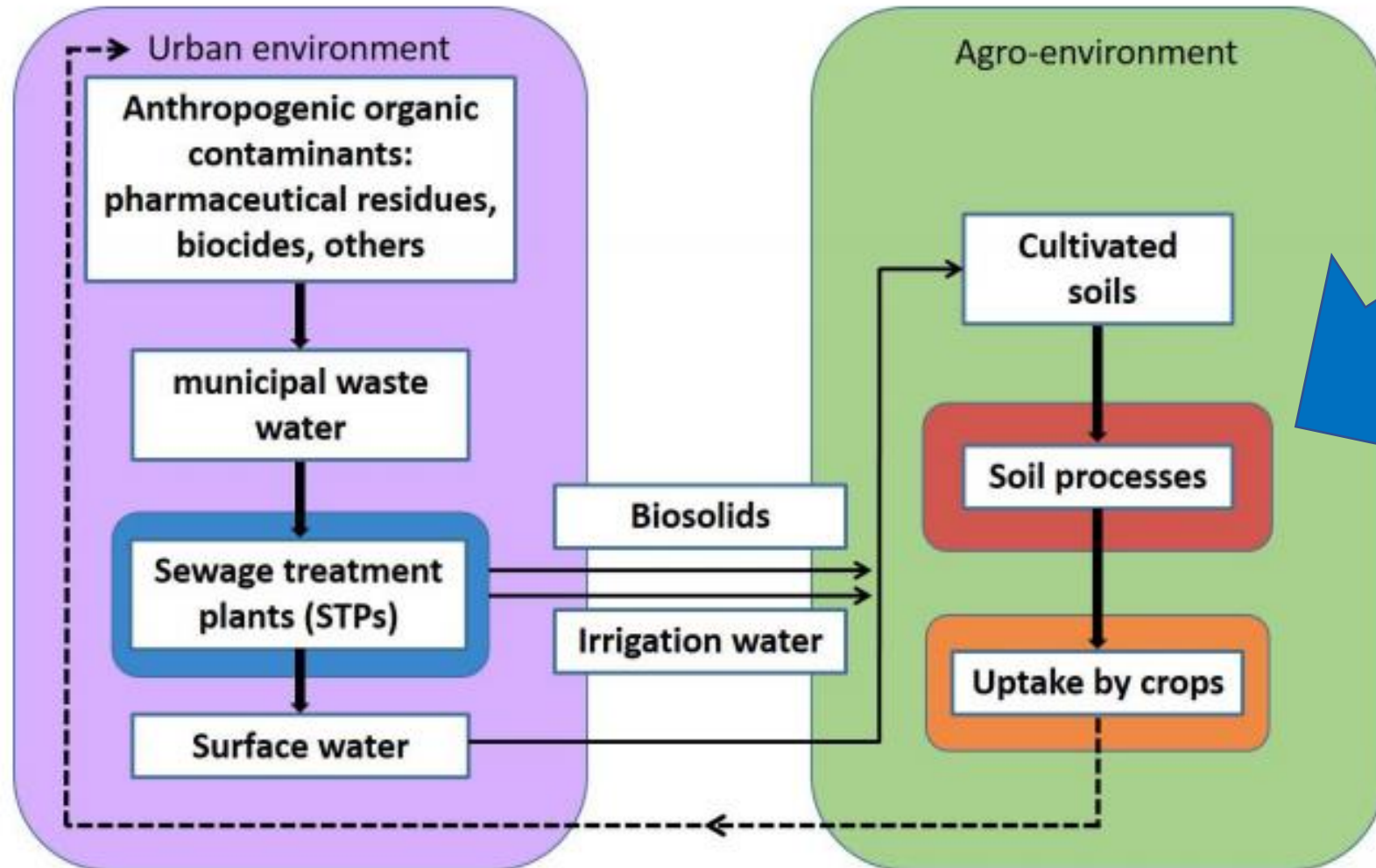


**Missing: the soil!**





# Problem definition



- Use of water for agricultural purposes is available due to high population density
- Potential exposure of crops with anthropogenic organic chemicals
- Risk of food contamination by crop uptake

# Problem definition

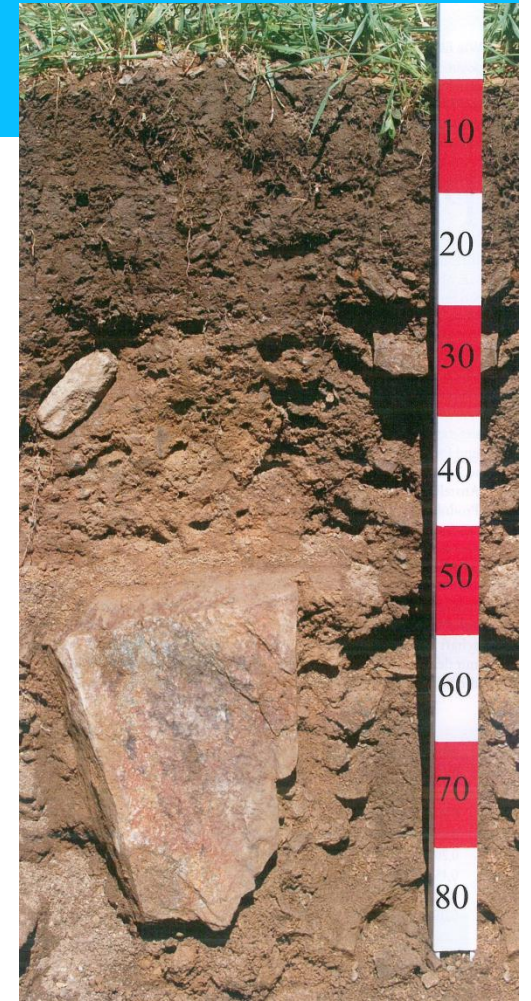
Soils serve very important functions!

- **E.G.: filtering and buffering**

Soil acts as a filter which influences the quality of water, air, and other resources. Chemicals or nutrients can be trapped and/or degraded.

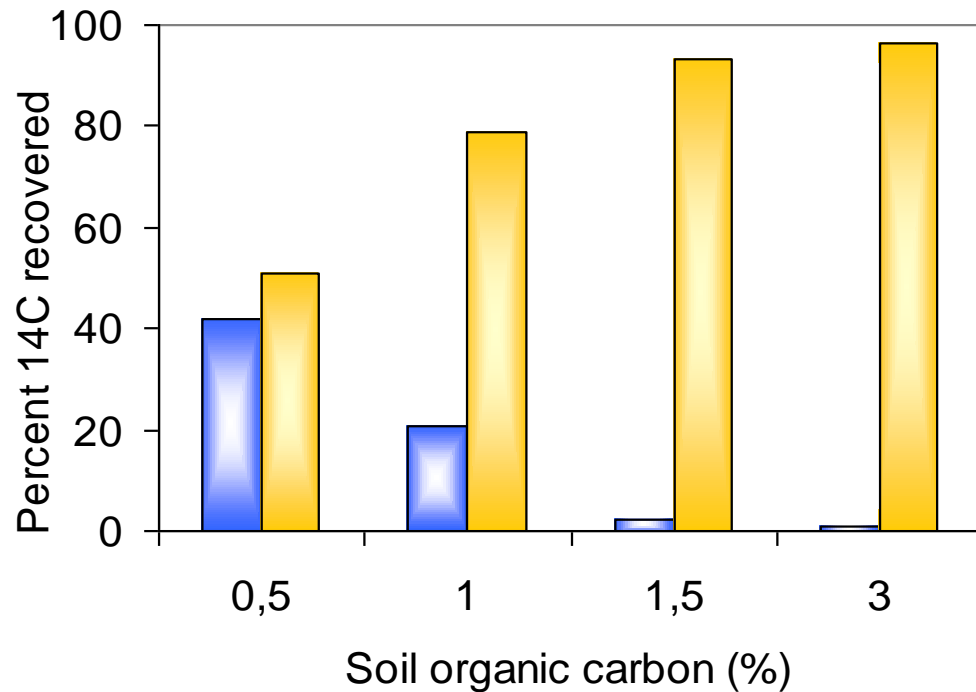
An important soil parameter that influences partitioning (retention of contaminants) and soil biology (degradation of organic contaminants) is the **soil organic matter SOM**.

Quality and Quantity.



# Problem definition

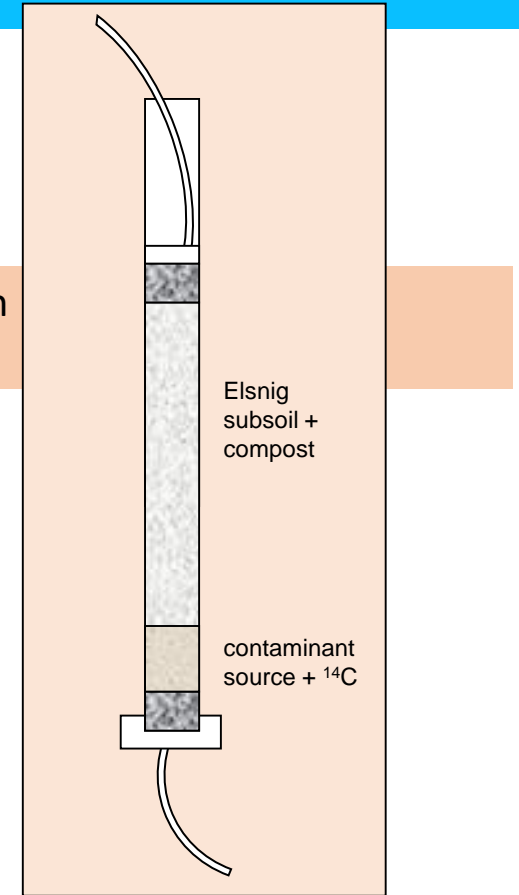
Soil column experiment with different SOM-content  
(sandy subsoil applied with fresh compost)



Flow-rate 100 mm / month  
Test duration: 4 month

■ Leachate  
■ Soil

Focus of current work:  
safe soil amendments,  
functional and affordable





# Project goal

- improve the safety of agricultural products grown in countries, which are obliged to use waste materials for irrigation and fertilization in agriculture
- no setting of new limits but develop a technology with significantly reduced risks of transfer of organic contaminants into the agricultural products
- to enhance the in situ removal and detoxification of introduced organic pollutants by the improvement of soil functions
- new production methods for safe soil amendments using local waste streams

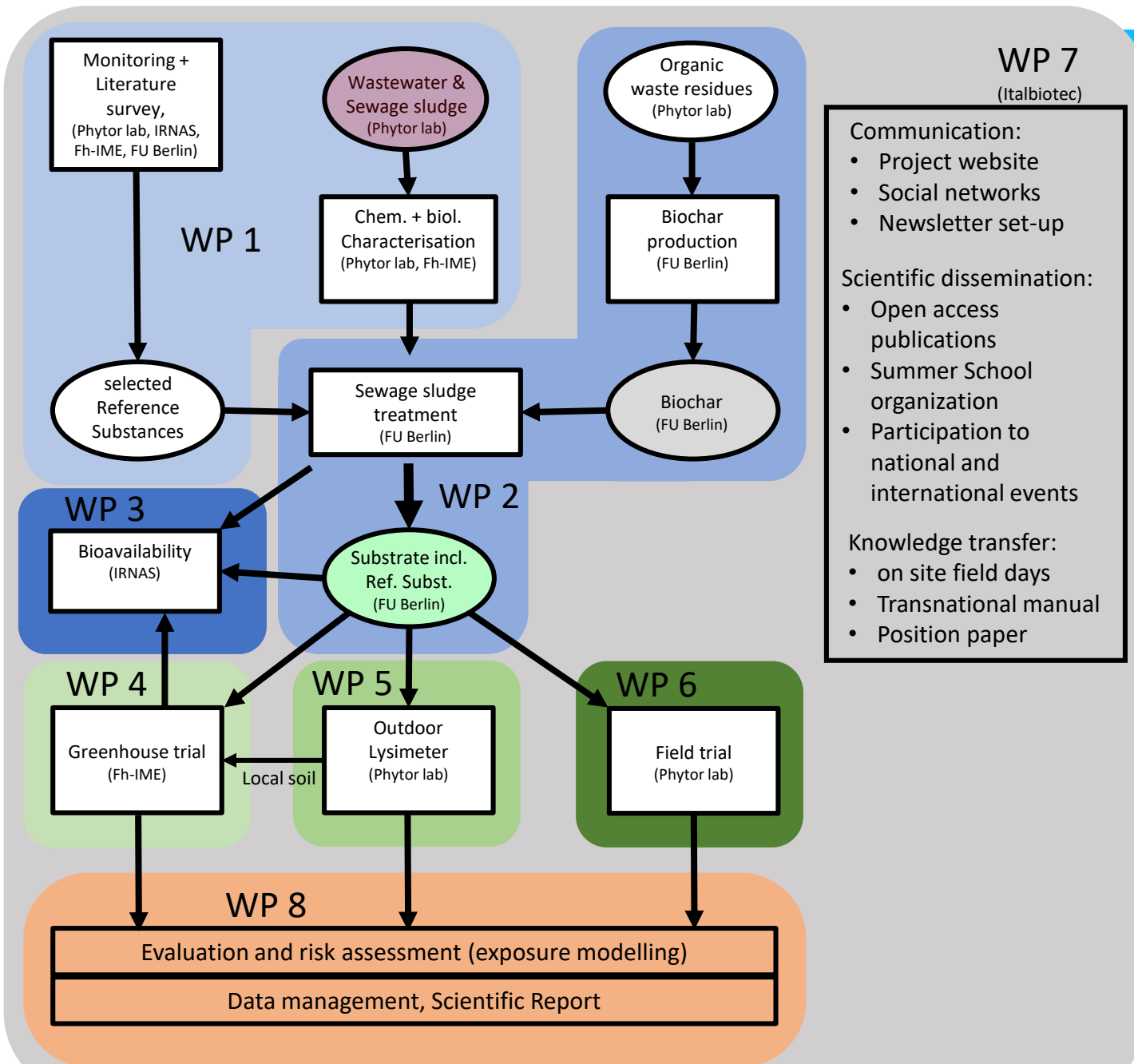


# Project Partner

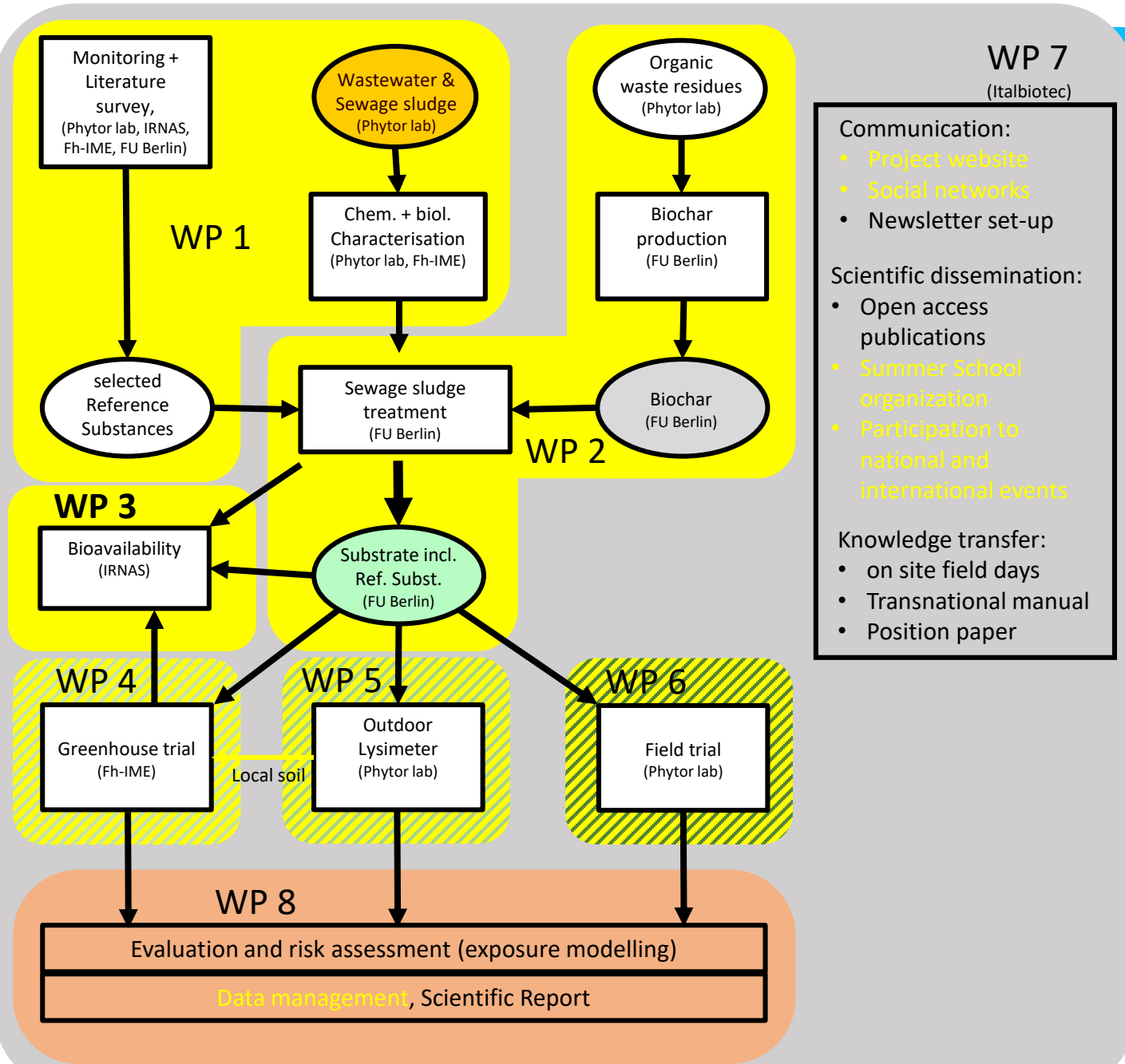
- ❖ PHYTOR Ltd. LAB Jerusalem, Israel
- ❖ Institute of Natural Resources and Agrobiolgy of Sevilla (IRNAS)-CSIC, Seville, Spain
- ❖ Working Group Geoecology Free University, Berlin, Germany
- ❖ Consorzio Italbiotec, Milan, Italy
- ❖ Faculty of Agriculture, Hebrew University, Jerusalem, Israel
- ❖ Fraunhofer IME, Schmallenberg, Germany (Project coordination)



# Project Structure



# Project Status



# Project status

WP 1 finished: selection and shipment of input material for Biochar production

Input material: **composted sewage sludge**

regional residual materials from Israel

60% green waste and 40% sewage sludge

originate from wooden residues from garden pruning and sewage treatment plants from all over the country (collected in the largest production plant of Israel)

Composting process:

2 months (8 weeks) for the maturation phase & 3-4 months for the curing phase

max. temperatures up to 70°C

Pre-treatment (drying, autoclaving) and shipment of 40 kg composted sewage sludge for a test carbonization from Israel to Berlin, Germany

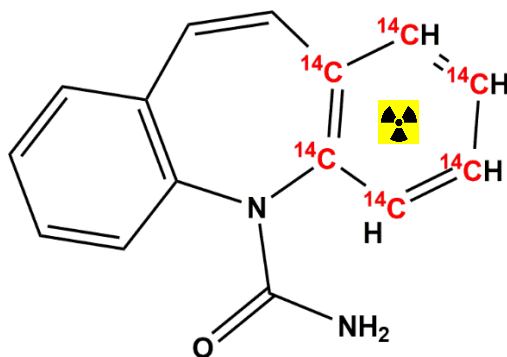




# Project status

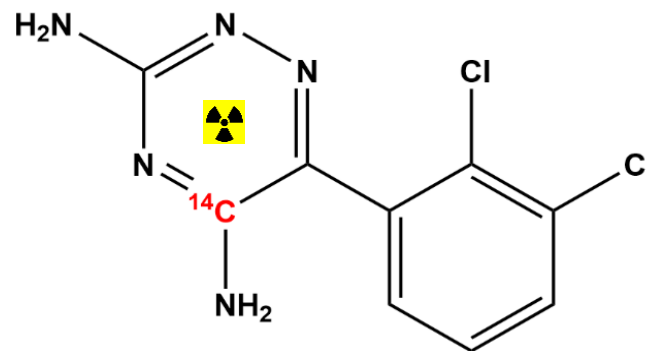
WP 1 finished: selection and purchase of  $^{14}\text{C}$ -radiolabelled test substances

Carbamazepin  
(antiepileptic)



$^{14}\text{C}$ -phenyl-label,  
specific radioactivity: 11,67 MBq/mg

Lamotrigine  
(anticonvulsant)



$^{14}\text{C}$ -triazinyl-label  
7,77 MBq/mg

$^{14}\text{C}$ -label enables

- Mass balance
- To follow unknown pathways
- Detect metabolites in any matrix



# Project status

Fotos: outdoor carbonization plant FU Berlin

WP 2 finished: Biochar production **but substrate production didn't work**

## Carbonization

- Pyrolysis plant with continuous mass flow
- Three temperatures (500/600/700°C) were applied to determine an optimal carbonization process
- Mass balance determination and characterization of resulting biochar

## Challenge

Composting of fresh sewage sludge with biochar amendment:

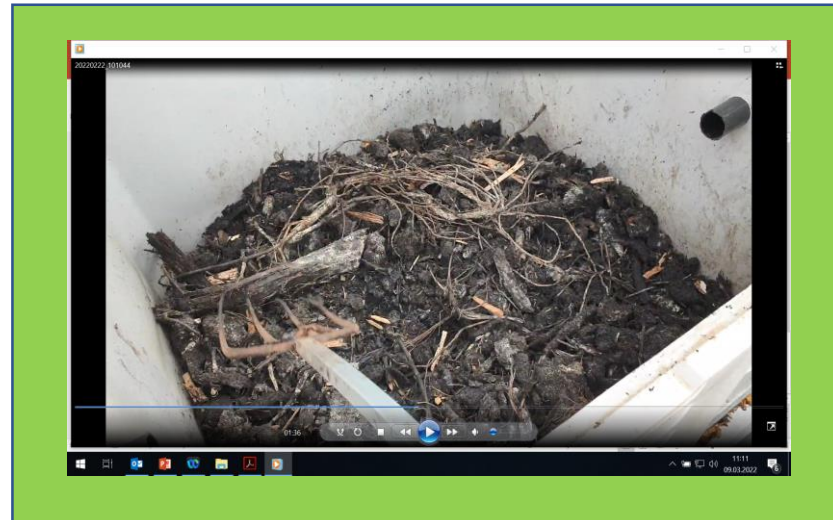
- no import of fresh sewage sludge possible
- composting process affected by biochar



# Project status

WP 2 support from Compost Or

Composting of sewage sludge amended with biochar under supported conditions (forced ventilation)



**Time loss: 6-8 months**

# Project status

WP 3 status: bioavailability testing with pre-substrates and  $^{14}\text{C}$ -labelled test substances. Details see Dr. J. J. Ortega-Calvo

WP 4 status: import of 8 tons of soil and substrate from Israel to Germany for greenhouse trial. Trial setup, start of experiments

WP 5+6 status: irrigation experiments started, setup modified





# Project status

## Soil sampling at Nir Oz (Southern Israel)





# Project status

Soil arrival at Fraunhofer IME



Preparation of plots at IME-greenhouse, 0.5 m<sup>2</sup> per plot



# Project status

## Experimental plots at Fraunhofer IME

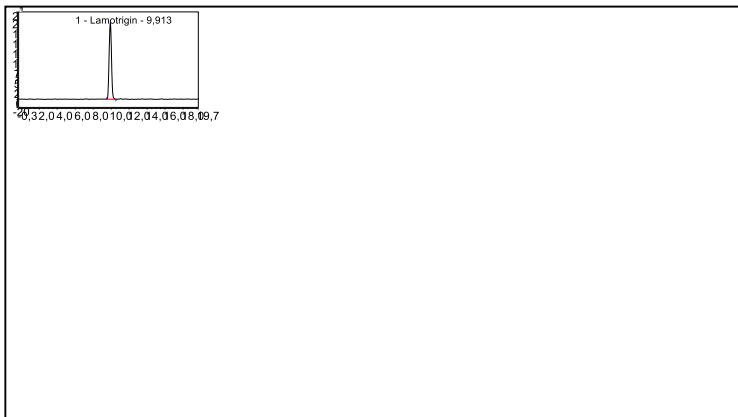
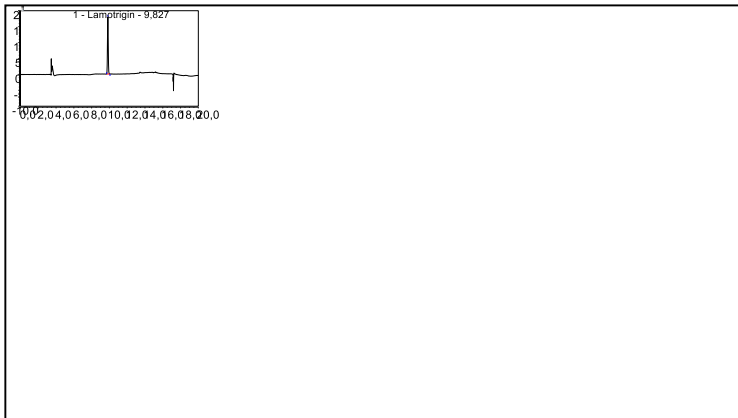




# Project status

## Development of analytical methods, radio HPLC, radio TLC

Lamotrigine by HPLC



### Preparation for greenhouse trial

- Extraction and recovery from soil
- Extraction and recovery from plant material (Alfalfa)



# Many thanks for your attention

Contact

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