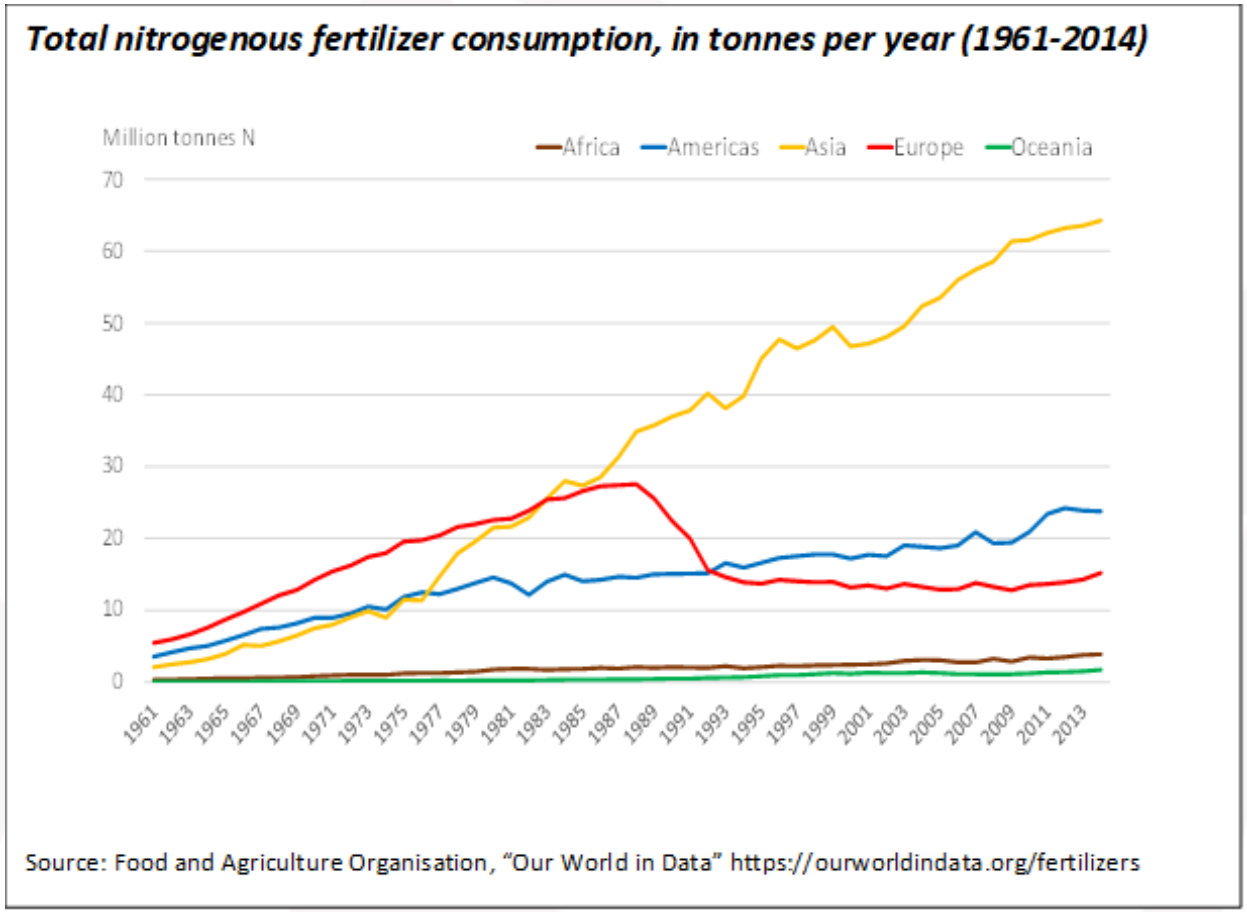
Nutrient Management and Nutrient Recovery Thematic Network

Biofertilisers in the context of Green Deal targets – case study Poland

Grzegorz Siebielec, IUNG

8.09.2021

Why do we need biofertilisers?



Excess of nutrients in ecosystem

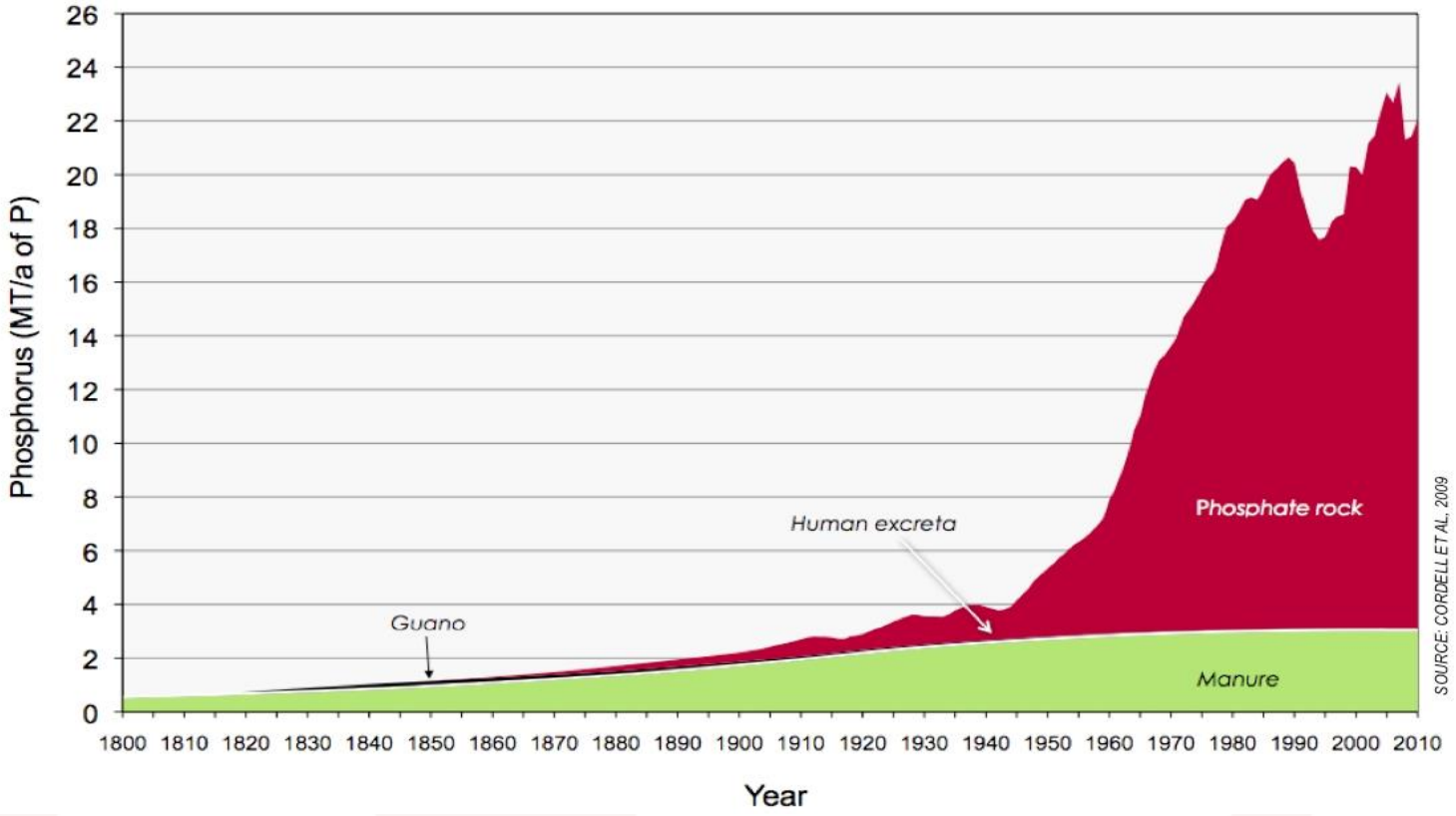
Solutions:

- Recovery of nutrients from waste
- Alternative sources of N and P

Justification – phosphorus related

- Without phosphorus, we cannot produce food - it is just as necessary as water, carbon, and oxygen.
- Phosphorus resources are non-renewable.
- The current average diet uses about 22.5 kilograms of phosphate rock per person per year (or 3.2 kilograms of phosphorus). This is 50 times the recommended daily intake of P.
- The risk related to the dependence of the EU on phosphate rock imports also has a geopolitical context, as most of the fossil phosphorus resources are located in only a few countries.
- Estimates indicate that the increase in phosphorus demand will reach a global peak around 2030. Therefore, phosphorus has been included in the list of critical raw materials by the European Commission.

Justification – phosphorus related



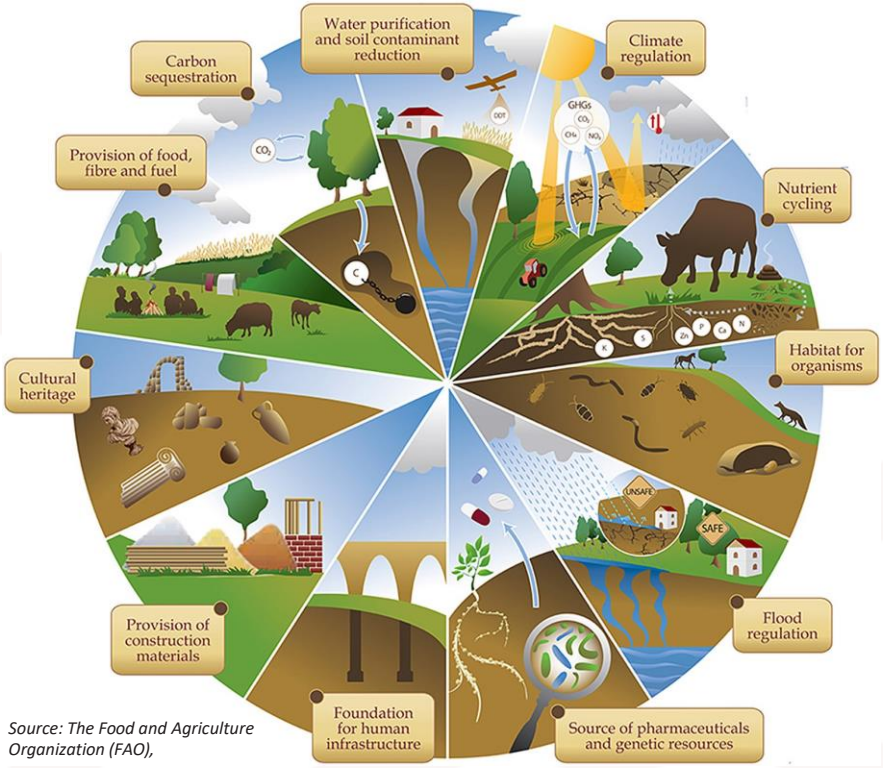
- Approx. 90% of the P extracted from phosphorus rocks is used in agriculture.
- It is estimated that at the current rate of use, these resources may be sufficient for 100 - 470 years.

EU strategies

- ✓ **The European Green Deal is an action plan for a more efficient use of resources through the transition to a circular economy, tackling biodiversity loss and reducing pollution. "Farm to Fork" aims to develop a sustainable food system in the EU to ensure food security and access to healthy food. The strategy also aims to reduce the environmental and climate footprint of the EU food system. The strategy aims to reduce pesticide use and risks by 50%, reducing the use of synthetic fertilizers by at least 20% and substantial reduction of their losses.**

Soil is a key resource and the circular use of carbon and nutrients is a key activity to achieve these ambitious goals

New momentum for the soil – from a dirt to ecosystem services



Source: The Food and Agriculture Organization (FAO),

Soil vs Sustainable Development Goals

Ambitious targets in EU strategies

Reduction of synthetic fertilisers and pesticides

Carbon sequestration

Increase area of nature protection

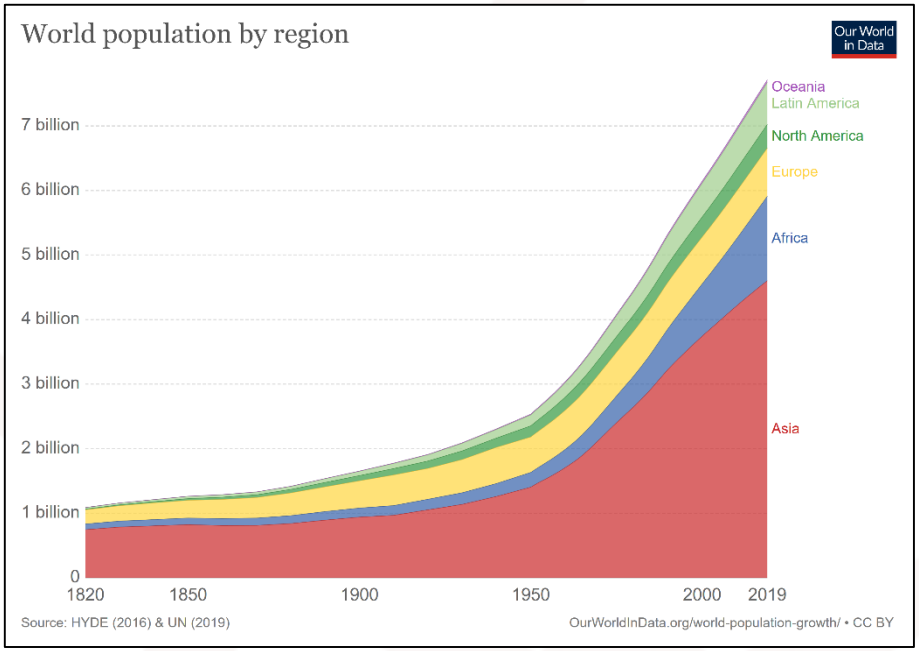
75% soils healthy

At the same time:

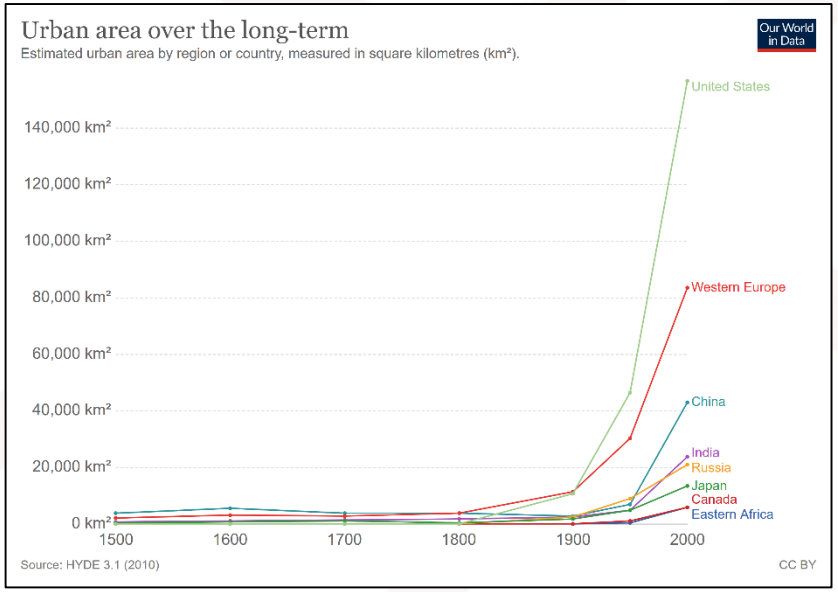
Increasing global population

Climate change – more common droughts

Urbanisation reducing soil resources



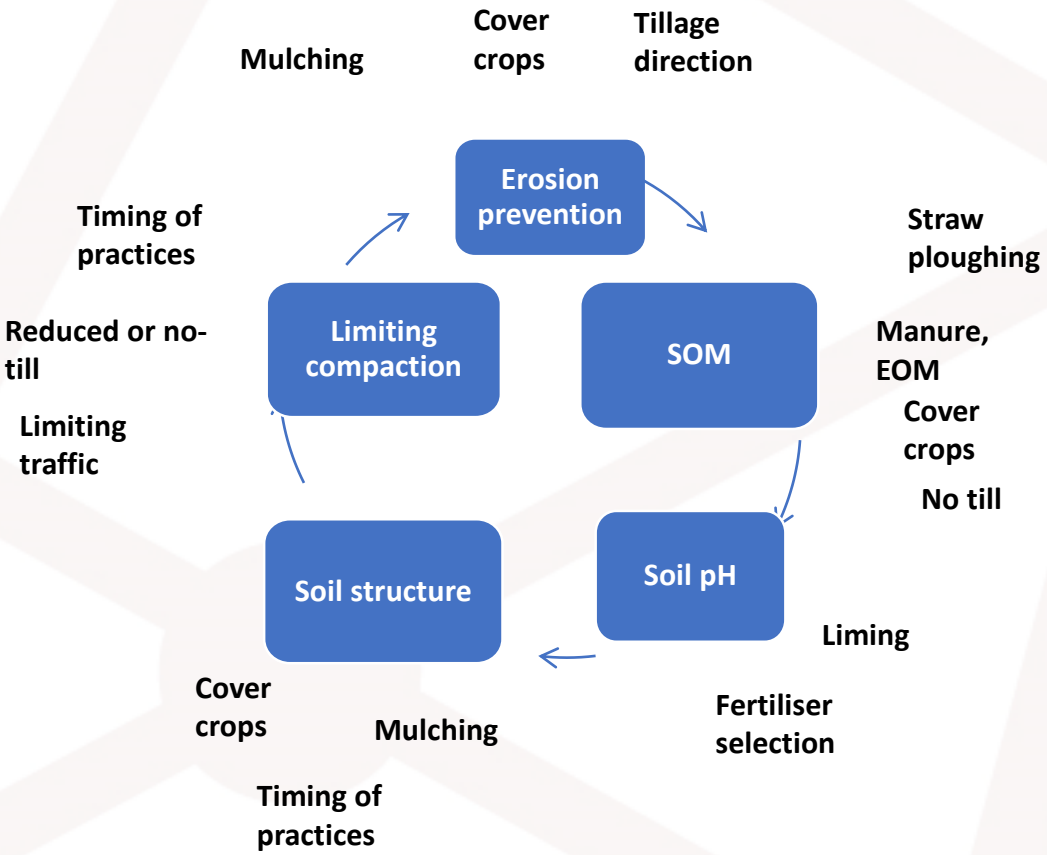
Population



Urban area

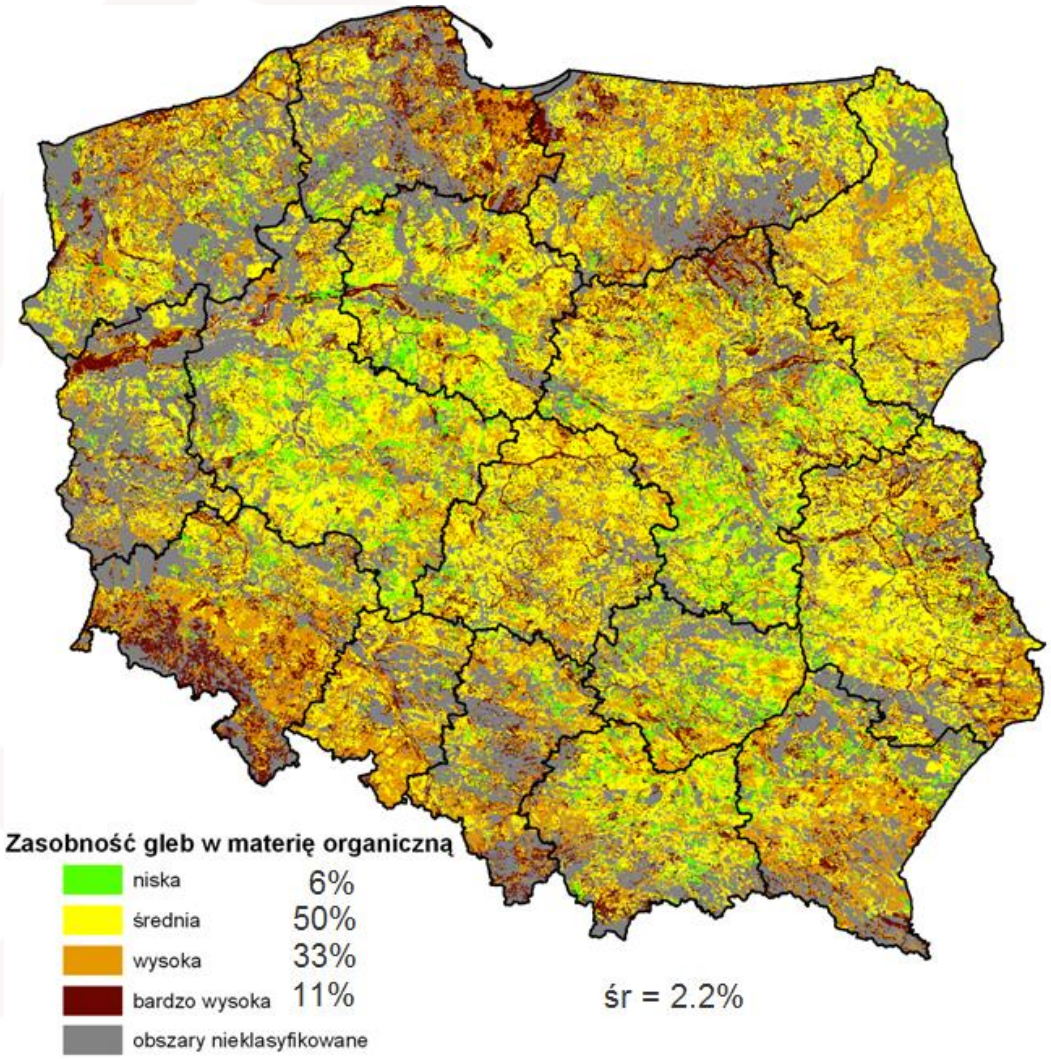
Soil management in the context of combating drought and achieving the objectives of the Green Deal, Farm to Fork, Biodiversity Strategy

Soil as an organism of interlinked properties and functions



Biofertilisers as SOM source

Soil organic matter in Poland

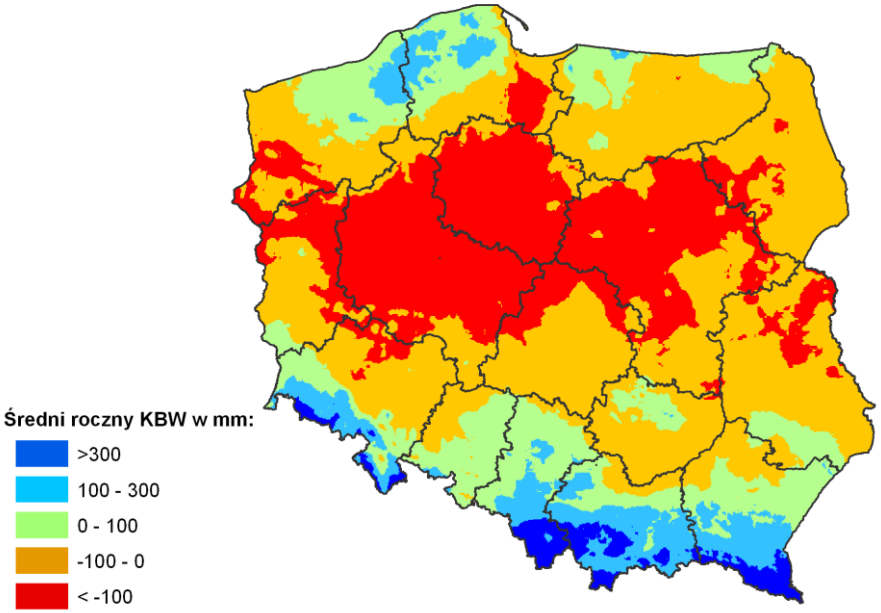


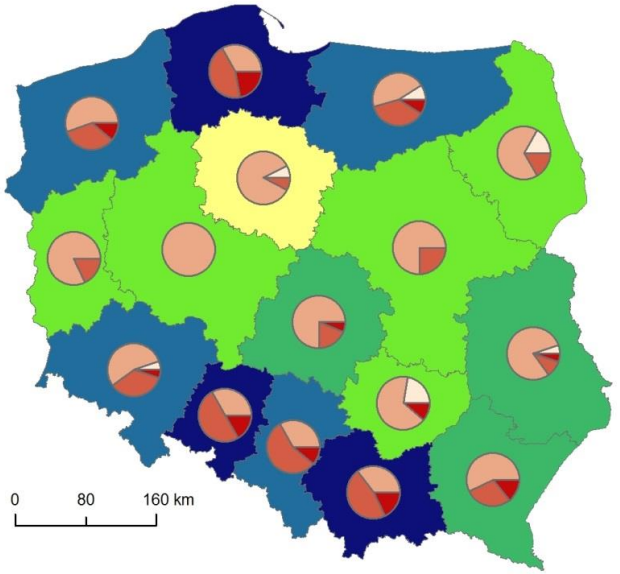
<1%
1-2%
2-3.5%
>3.5%

Average in Monitoring= 1,97%

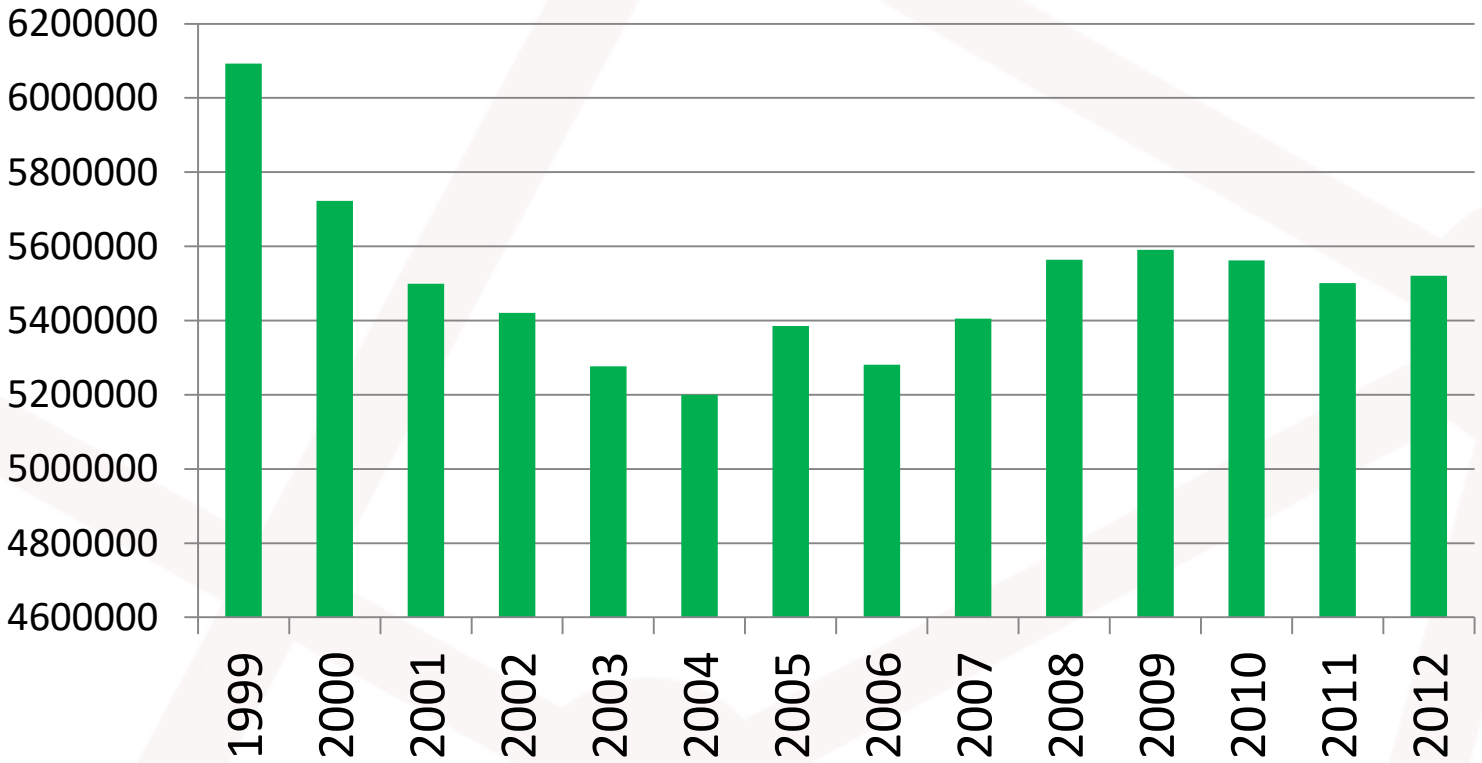
Soil organic matter in Poland

Climatic water balance



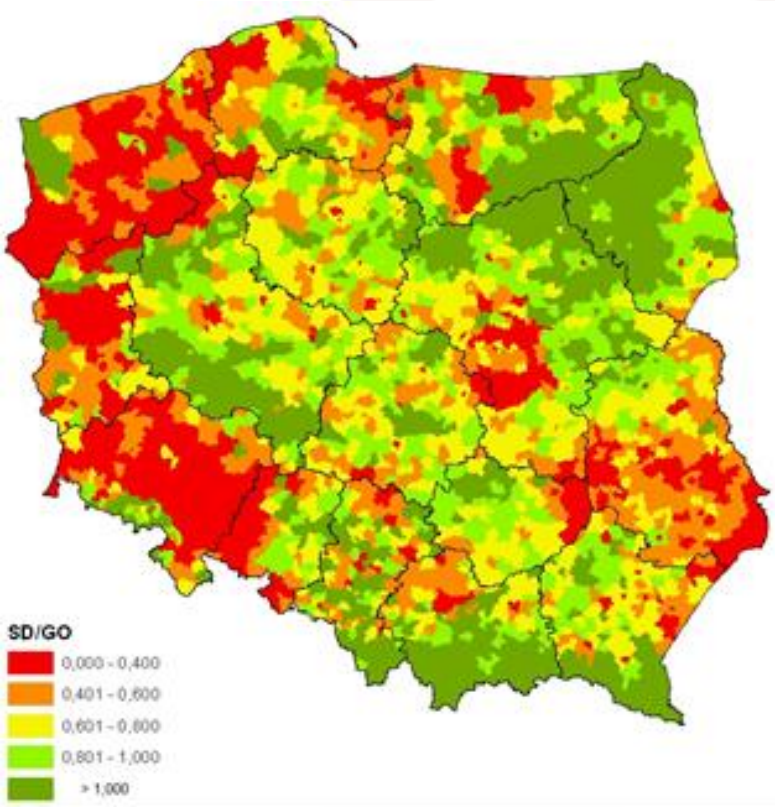


Reduction of manure application



Cattle in Poland

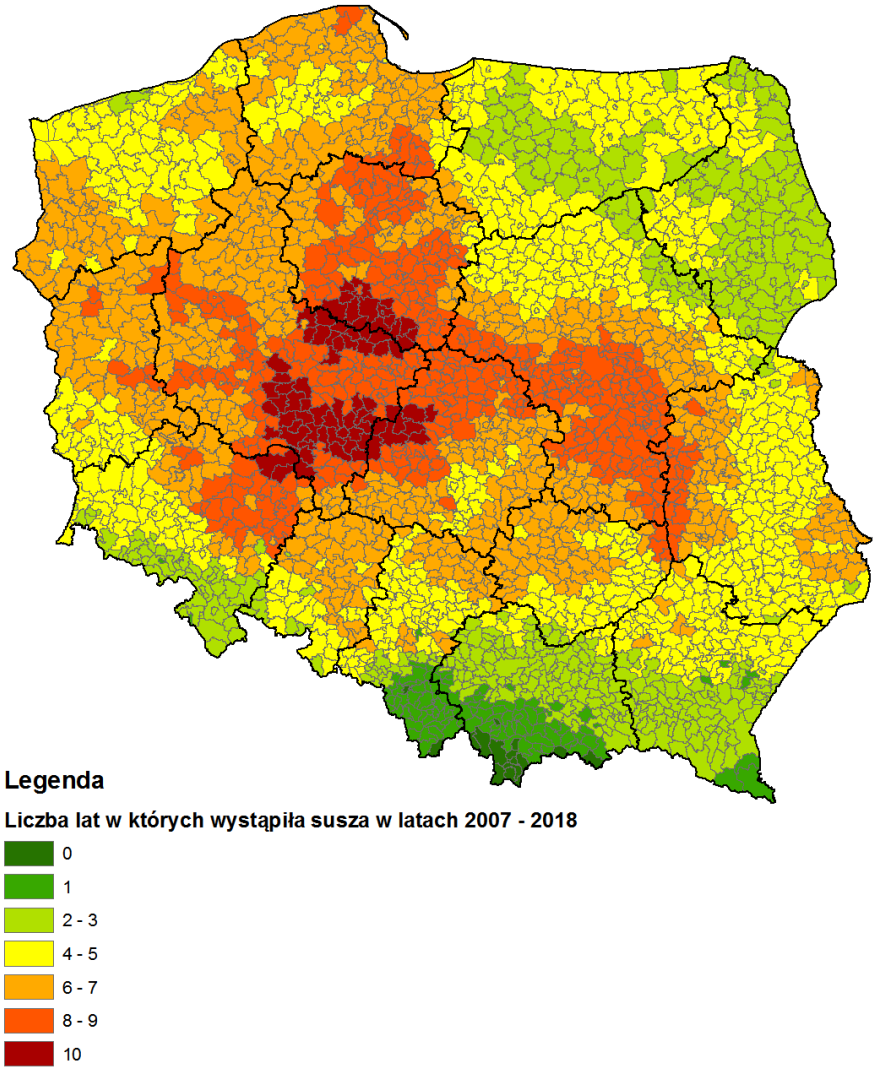
Simulation of manure availability



Livestock density per arable land

Long term data on the occurence of drought

Number of seasons with drought reported for potato, vegetables, legumes, fruits, hop



Interreg South Baltic STEP project – compost testing (dry season)

The role of SOM in combating drought

- Retention properties of SOM itself
- Positive effect on soil structure
- Higher compaction resistance
- Positive impact on the activity of microorganisms supporting plants during periods of drought - microorganisms can support drought resistance of plants by e.g. production of polysaccharides, improving soil structure, deaminase synthesis, production of IAA and proline, etc.

In order to sustain soil functions and soil fertility, soil organic matter **must be kept at a stable level**.

This can be achieved through:

- a positive balance of organic matter in the soil,
- reducing soil disturbance by tillage,
- bringing exogenous organic matter.

- **Bringing sufficient amounts of plant residues to the soil** is a common measure for sustaining SOM. These practices include growing green manure crops, catch crops, perennial forage and cover crops, and leaving crop residues in the field. The plant residues are ploughed in and slowly decomposed by the soil biota to constitute a source of soil humus.
- **Organic fertilisers applied to soil can be a significant source of soil carbon. It must be emphasized that only safe (uncontaminated) organic materials can be applied to soil. Organic soil amendments might include animal manure or recycled organic matter, e.g. compost, composted sludge, food waste, digestate.**
- **Conservation tillage** reduces the disturbance of the soil profile, protecting soil structure and enhancing SOM accumulation. Reducing tillage involves **limiting the aeration** of soil and related SOM mineralization. However, reduced or no-till practices result in carbon accumulation only when applied in **long-term**. **Permanent grasslands** are effective for carbon accumulation in mineral soils, especially when grass and legume species are combined.

The role of soil structure in increasing drought resistance

- Improving water permeability in clay soils
- Improved retention in light soils
- Preventing erosion – preventing loss of nutrients and water holding capacity
- Improving plant root development

The effects of soil compaction on the occurrence of drought

- Water losses due to surface runoff
- Decrease in soil biological activity
- Deterioration of drought resistance of plants
- Poor root system development

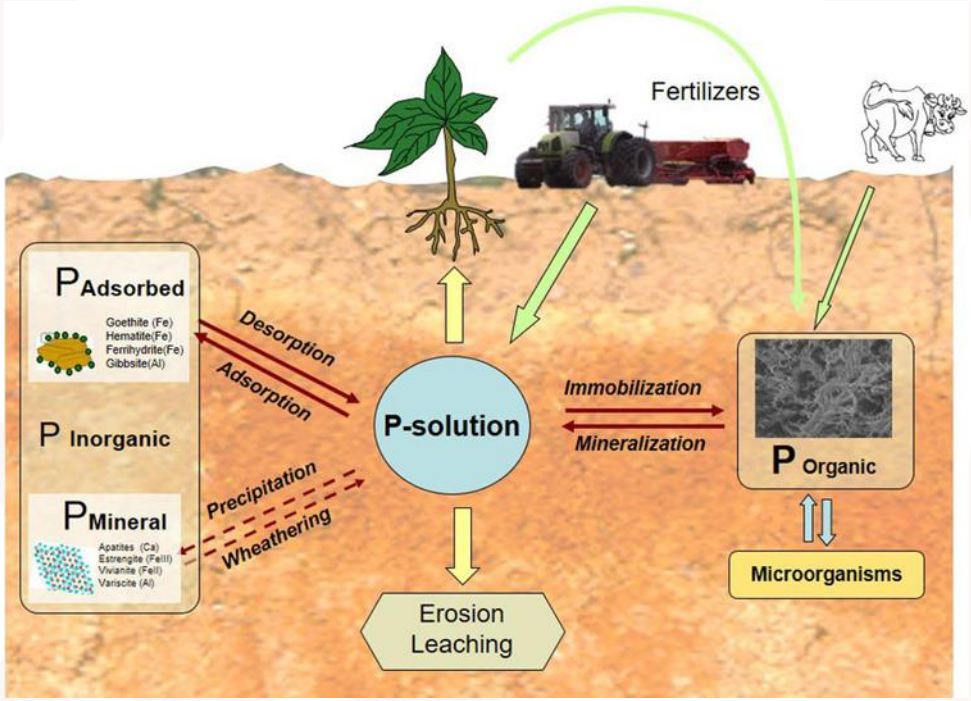
Soil degradation threats in Poland

- Erosion
- **Decline of SOM**
- **Acidity**
- Sealing

- Contamination
- Compaction
- Salinisation
- Emerging pollutants

How can we reduce use of fossil phosphorus in agriculture?

- Care for soil,
- precision of use,
- **alternative sources**,
- increasing P use efficiency for introduced into the soil and found in the soil



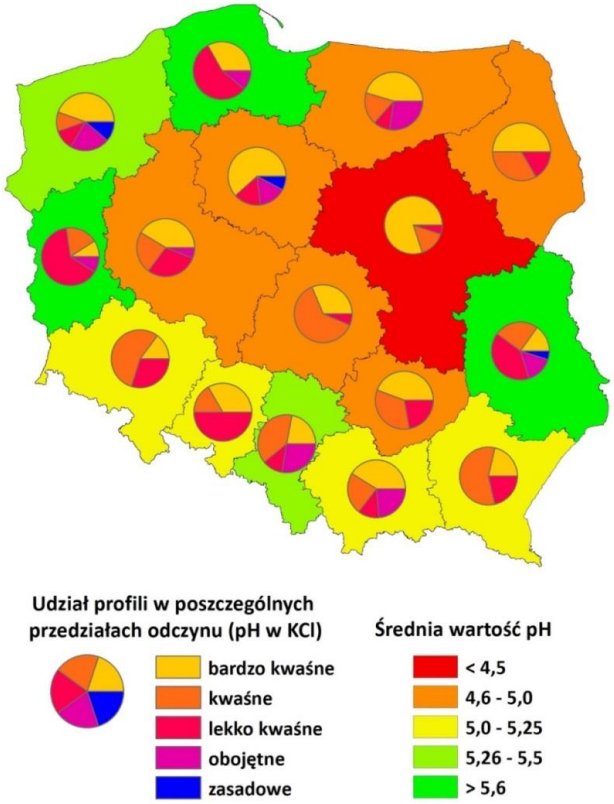
It is estimated that the phosphorus accumulated in agricultural soils is sufficient to sustain plant production worldwide for about 100 years (Zhu et al., 2017)

Utilisation of biodegradable waste

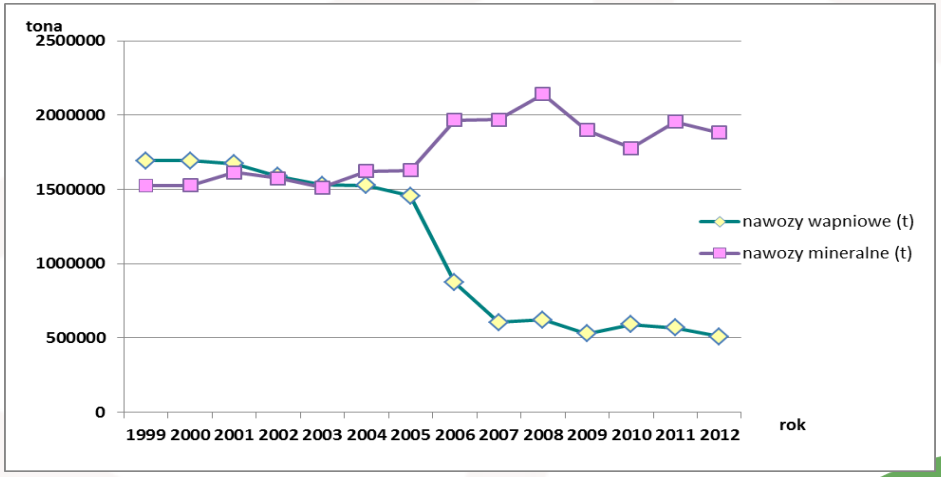
- How to utilise
- Nutrients and organic matter
- Manure deficits

Assuming the forecasted annual production of sludge at 706.6 thous. tonnes, at the country level they contain almost 18.5 thousand. tonnes N and 13 thousand. tonnes P.
For example, this amount could replace mineral fertilizers P in the area of 618 thousand hectares of agricultural land (6.2% of the total arable land area), because the average value of application of P in Poland is 20.9 kg ha-1 (GUS, 2017) .

Soil pH in Poland



Bio-fertilizers that combine organic matter and liming potential are of particular interest

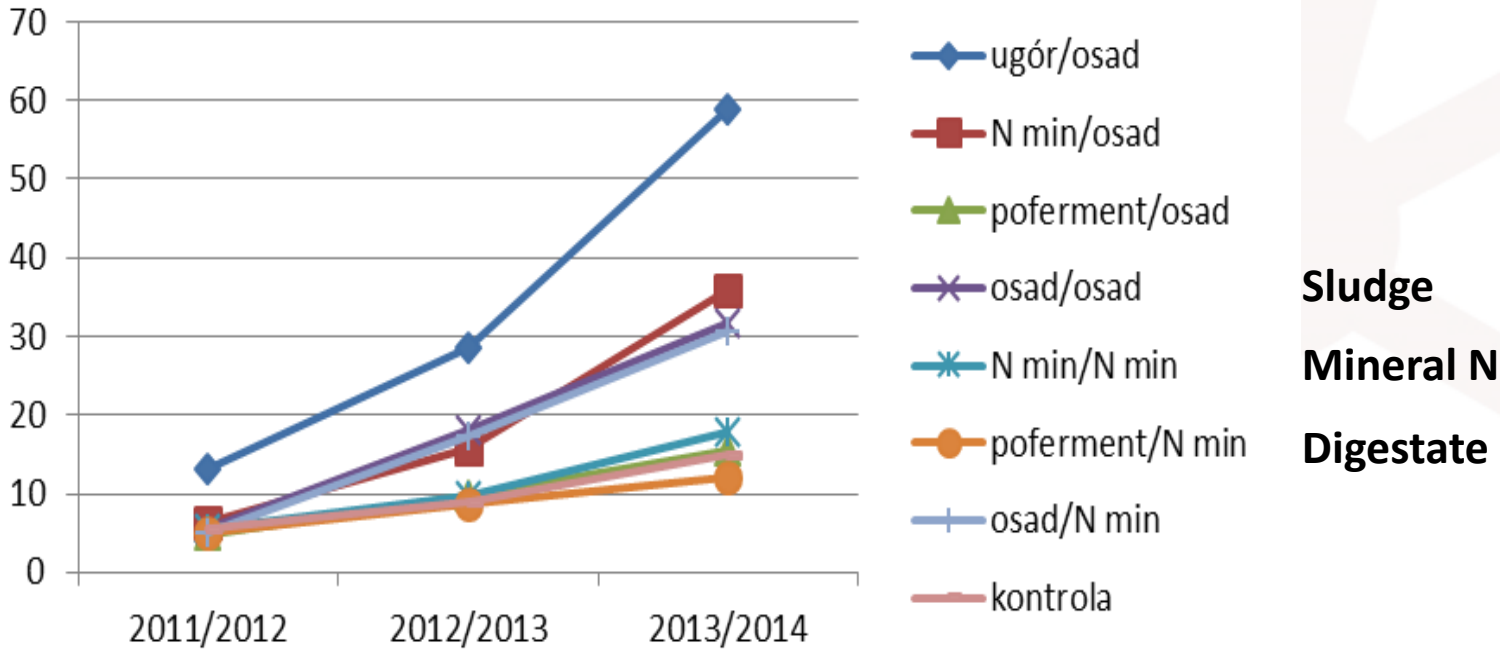


Mineral and Ca-fertilizers utilized in Poland

The role of pH management in shaping drought resistance

- Better conditions for the accumulation of organic matter - greater retention
- Soil structure improvement (pH plus calcium) - optimization of permeability and retention
- Greater stress resistance of plants
- Greater biological activity supporting the efficiency of water use by plants

Annual Nitrogen leaching (kh/ha)



Sludge

Mineral N

Digestate

Compost as biofertiliser - benefits

- The introduction of organic matter
- Activation of biological life
- Slowly released nitrogen
- Improving water retention in the soil
- Improving the soil structure
- Improving the resistance to erosion
- Reuse of nutrients
- More stable organic matter

Composting is auto-thermal and thermophilic proces of biomass decomposition in the presence of oxygen by microorganisms, leading to the formation of compost.

Digestate as biofertiliser - benefits

- Introduction of organic matter
- Activation of biological life
- Nitrogen with varying availability
- Improving the soil structure
- Improving the resistance to erosion
- Reuse of nutrients
- Closed loop production
- Improving the condition of plants

The digestate is a by-product of the fermentation process in a biogas plant. Biogas and digestate can be produced from plant biomass, agricultural by-products, animal waste, manure, and selectively collected organic waste (e.g. kitchen waste)

Compost as soil amendment in phytostabilisation

Nutrient Management and Nutrient Recovery Thematic Network

www.nutriman.net

@NUTRIMANnetwork

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 818470.