

Can we calculate organic matter?

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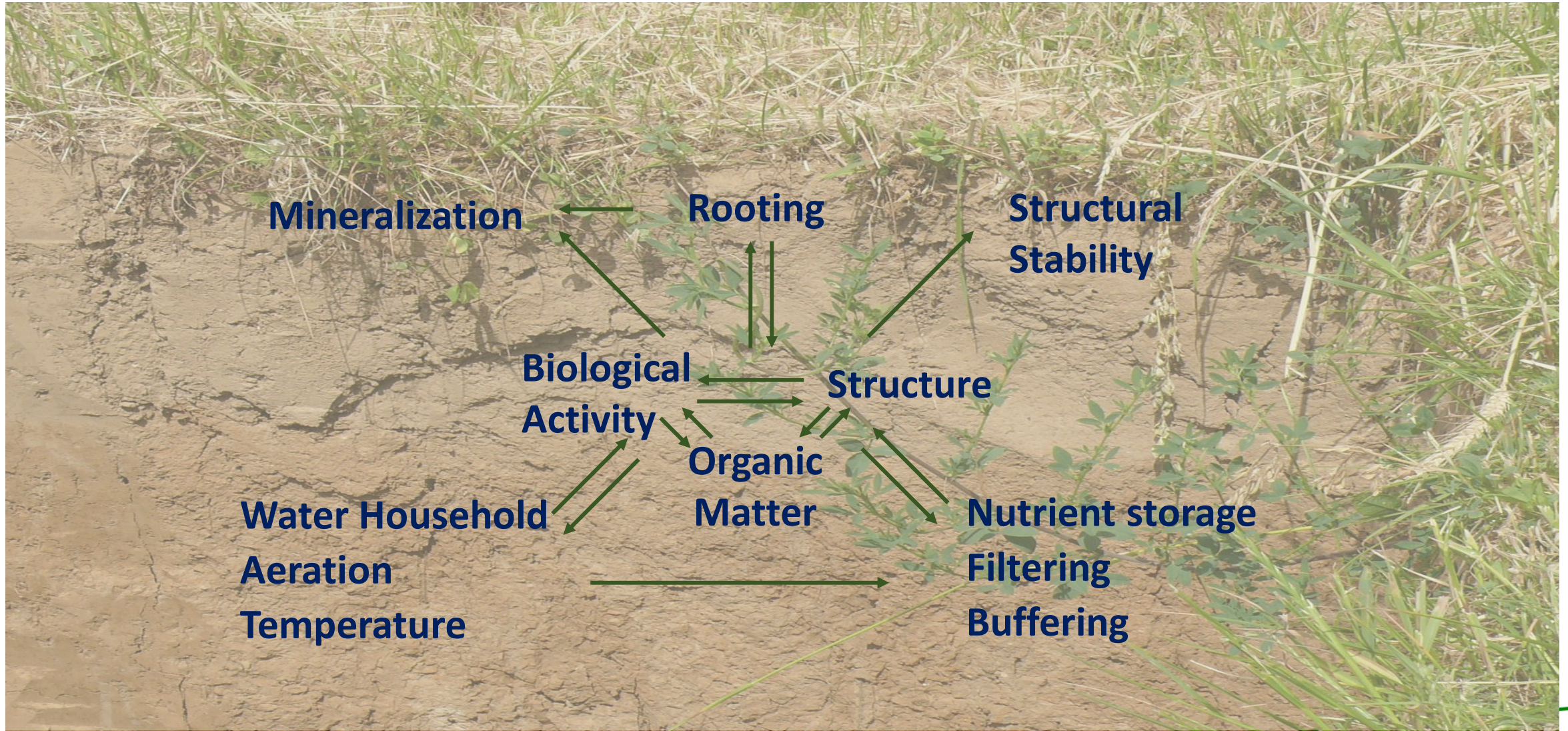


Agenda

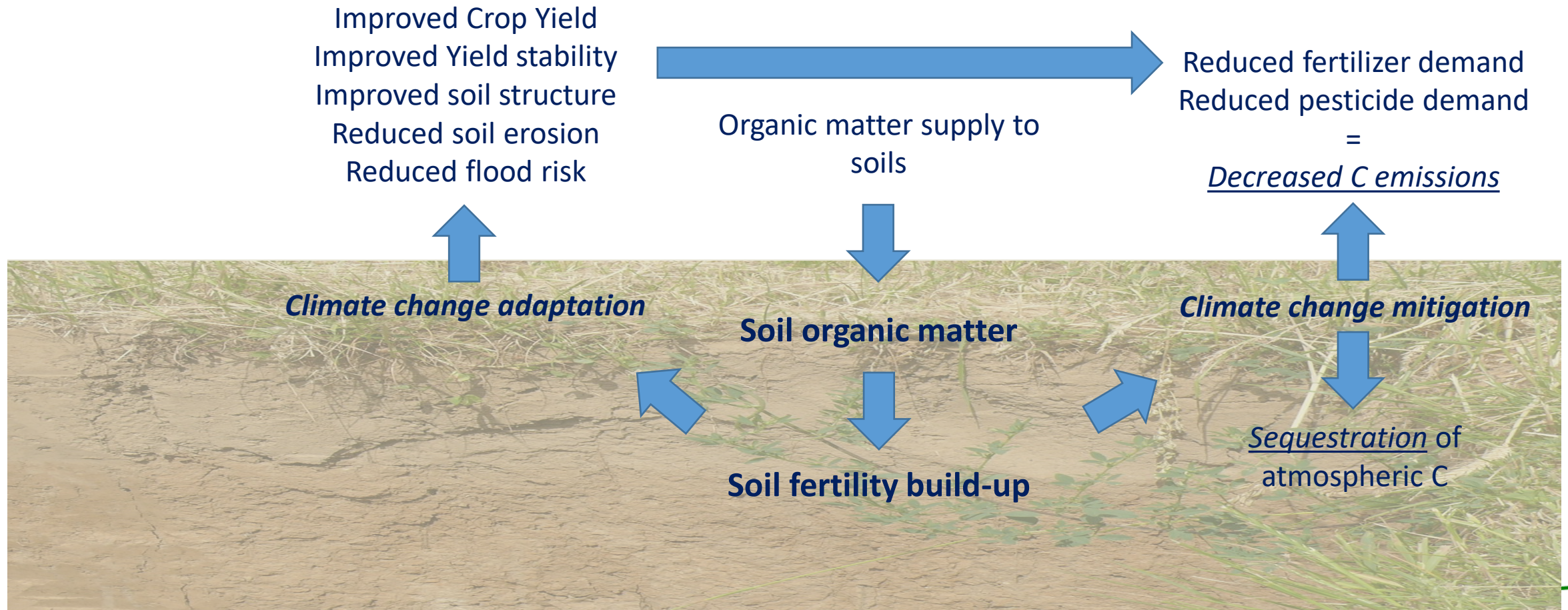
1. Carbon farming revisited – why we need organic matter in soils
2. Supplying soils with organic matter
3. Calculating organic matter supply to soils

1. Carbon farming revisited – why we need organic matter in soils

Organic matter – a key factor of soil fertility

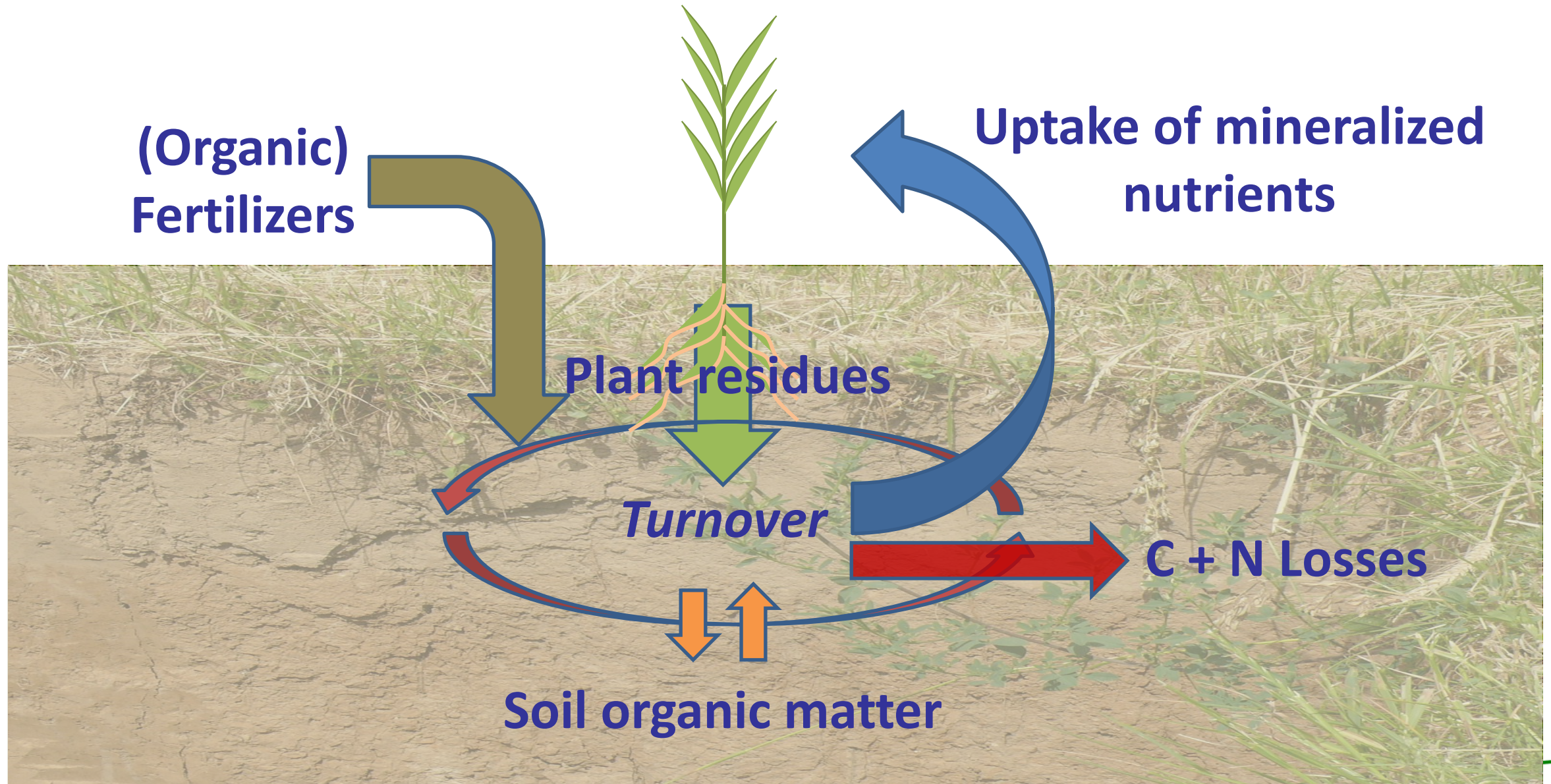


Farming with carbon, not farming for carbon !



2. Supplying soil with organic matter

What happens with organic matter in the soil?



Turnover of organic matter

- Turnover of OM is a function of site, management and history

Management impact = Organic inputs with plant residues and fertilizers, nutrient input, export of mineralized nutrients, tillage

History impact = Legacy of former organic matter supply and management, SOM stock



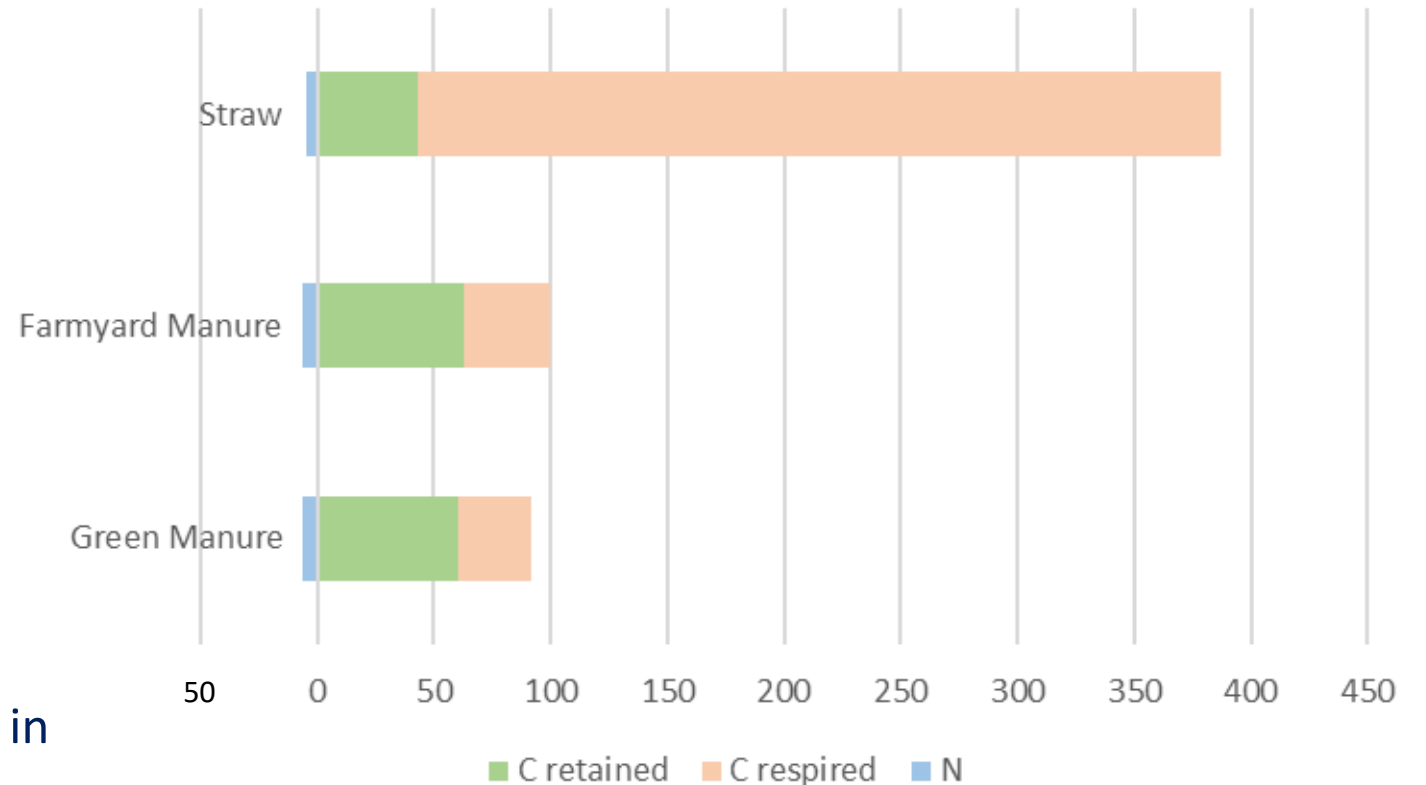
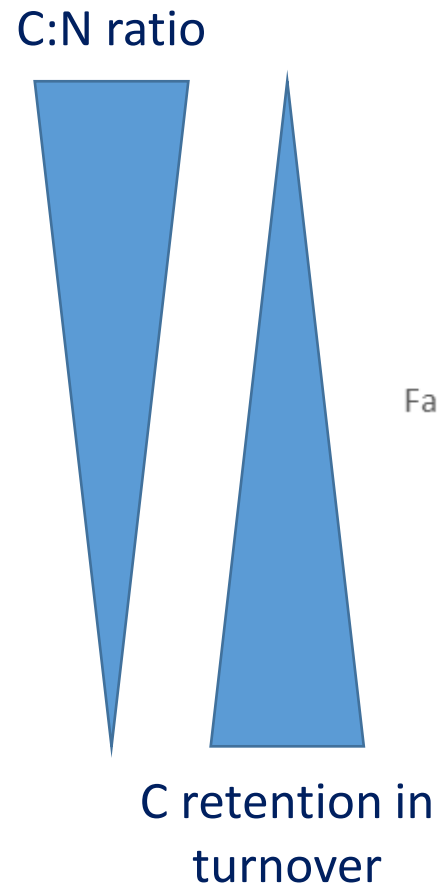
Site impact = Textural binding capacity, structural accessibility of OM for microbial turnover, water/air/temperature

Some general facts about OM supply

- Soil health is related to biological activity – building up soil organic matter requires increased inputs, not retarded decomposition.
- Organic matter retention in soils is not a matter of chemical recalcitrance, but of physical inaccessibility.
- Soil organic matter is no inert end product of turnover, but matter in all stages of decomposition and biological re-composition.
- Carbon alone does not build up soil organic matter – You need also N (and more).

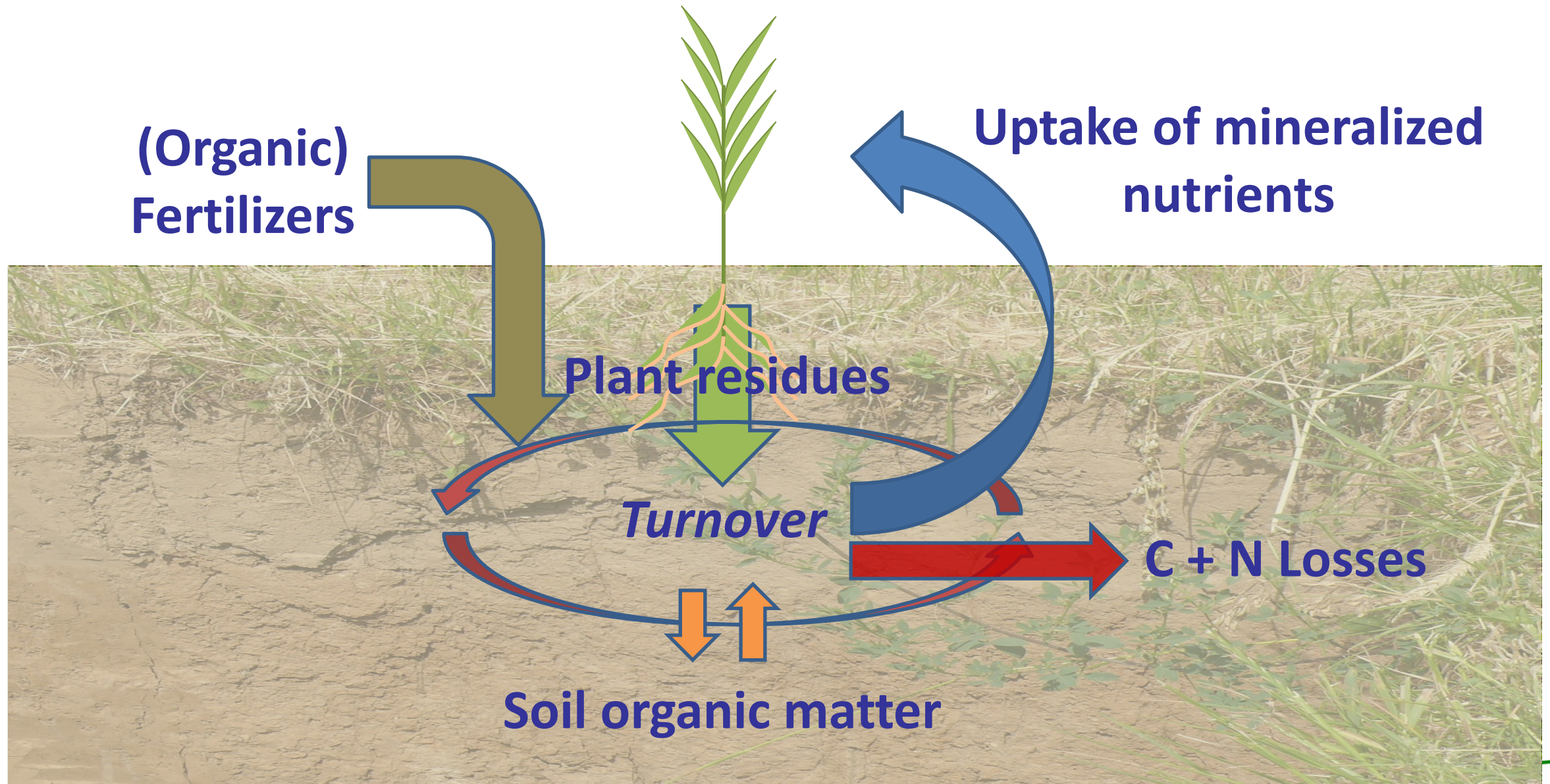
Where is all the carbon gone?

- Microbes need N to take up C!
- Excess C is respired!



3. Calculating organic matter supply to soils

Organic matter change is a function of inputs, SOM and turnover



Step 1: Calculate organic matter inputs

- Easy: crop yields, fertilizer amounts
- Difficult:
 - Belowground biomass (roots)
 - Harvest residues
 - Litter

Step 2: Calculate turnover

- 1) Based on site data (soil texture, soil structure, water, air, temperature)
 - Concept: Direct parametrization of turnover factors.
 - Advantage: Direct parametrization of turnover factors.
 - Challenge: Very high data demand for site-specific dynamic calculation.
- 2) Based on N export with crops
 - Concept: N export tells You about the required supply to compensate for actual mineralization of SOM
 - Advantage: N export is easily assessible, calculation becomes site-specific and dynamic
 - Challenge: Need to calculate the contribution of other N-inputs than SOM mineralization (fertilization, biological fixation) to N supply. Need to calculate losses of mineralized SOM-N.

Step 3: Relate Inputs to turnover

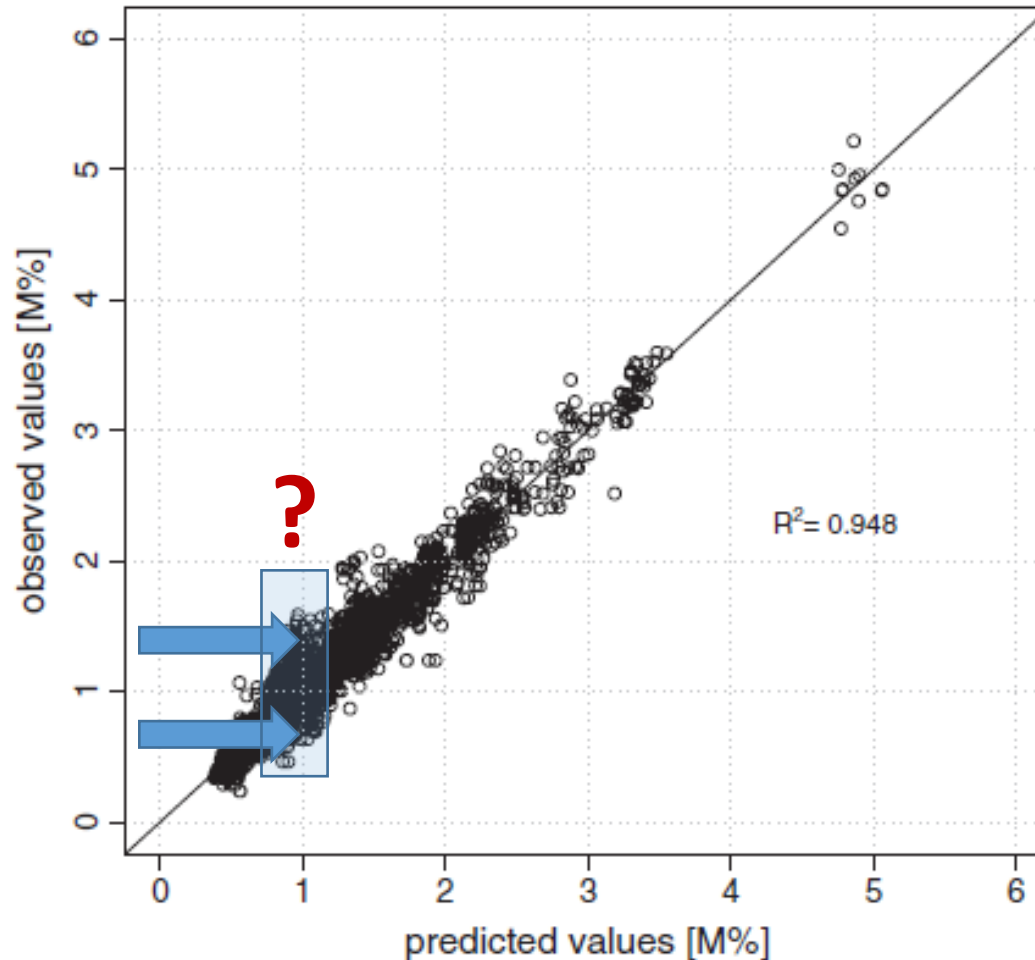
1) $\text{SOM change} = [\text{Input} * \text{Turnover rate}] - [\text{SOM stock} * \text{Turnover rate}]$

- Turnover rates decrease over time

2) $\text{SOM change} = [\text{N input} * \text{Soil C:N}] - [\text{N export} - \text{N supply from other sources} * \text{Soil C:N}]$

- Consider possible C limitation!

How accurate is the calculation of C changes?

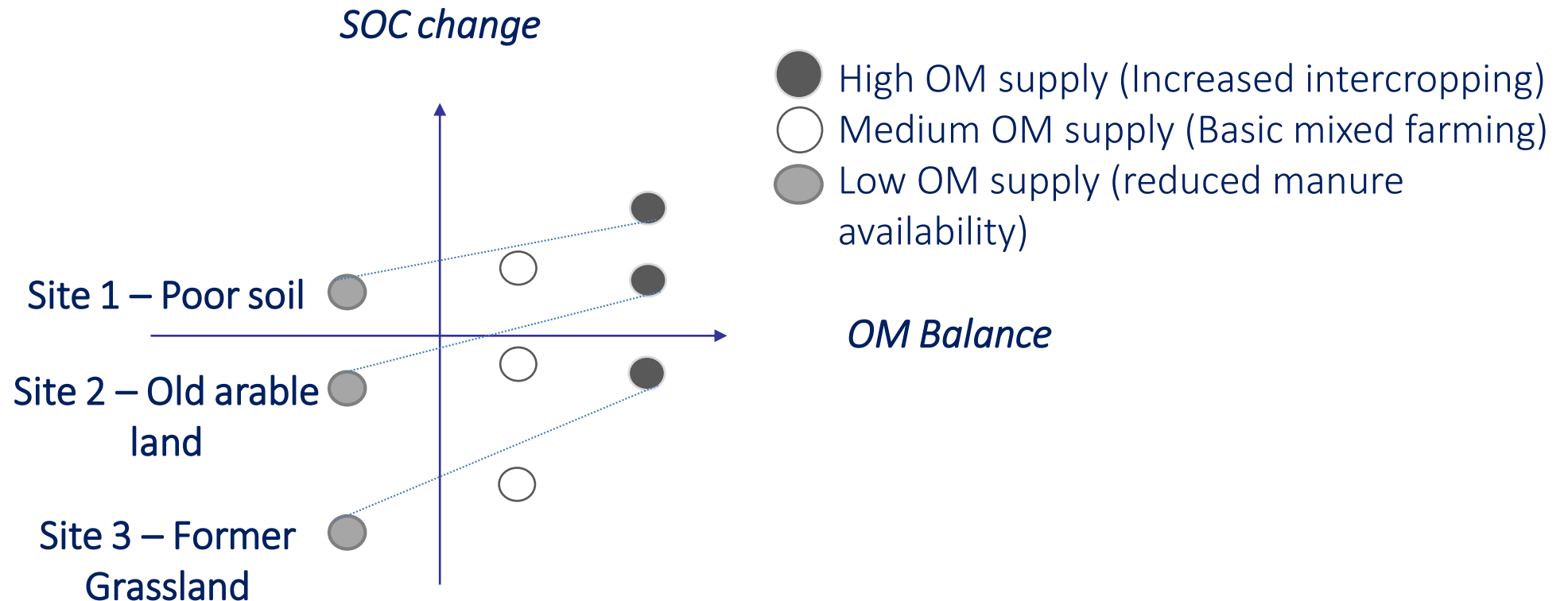


The quality of the calculation is dependent on the quality of the input data!

Don't bet on the calculation! It gives You a rough estimate, no absolute numbers!

Franko et al (2011): Multi-site validation of a soil organic matter model for arable soils based on generally available input data. Geoderma 166, 119-134.

Using organic matter balances for decision support on the farm



- ✓ The balance tells You about OM supply. You can use it to evaluate different scenarios, e.g. planned changes in Your farming system.

Further Information

- Brock C., Franko U., Oberholzer H.-R., Kuka K., Leithold G., Kolbe H., Reinhold J. (2013): Humus balancing in Central Europe – concepts, state of the art, and perspectives. Review article. Journal of Plant Nutrition and Soil Science 176, 3-11.
- Brock C. (2017): Humusbilanzierung. Lebendige Erde 4/2017, 12-15. (in German)
- Brock C (2022): Humusbilanzierung – Ein Crashkurs. Naturland Nachrichten 1/2022, 21-23. (in German)

Hvala!

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