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RESEARCH
INSIGHTS
LEADING RESEARCH FOR
TOMORROW'S AGRI-FOOD SYSTEMS

Land Management and Carbon Sequestration

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Mission Area - Soil Health and Food

Soil health: "the describes a soil's ability to provide ecosystem services through its capacity to perform functions as a vital living ecosystem(USDA, 2020).

Water Regulation

Carbon storage

Habitat for Biodiversity

Primary Productivity

Nutrient Cycling

All soils have the capacity to perform all functions simultaneously!

Carbon storage and cycling

Soil Organic Matter contains approximately 50% of C and it's a crucial source of life in earth!

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How Carbon is distributed in our soils?

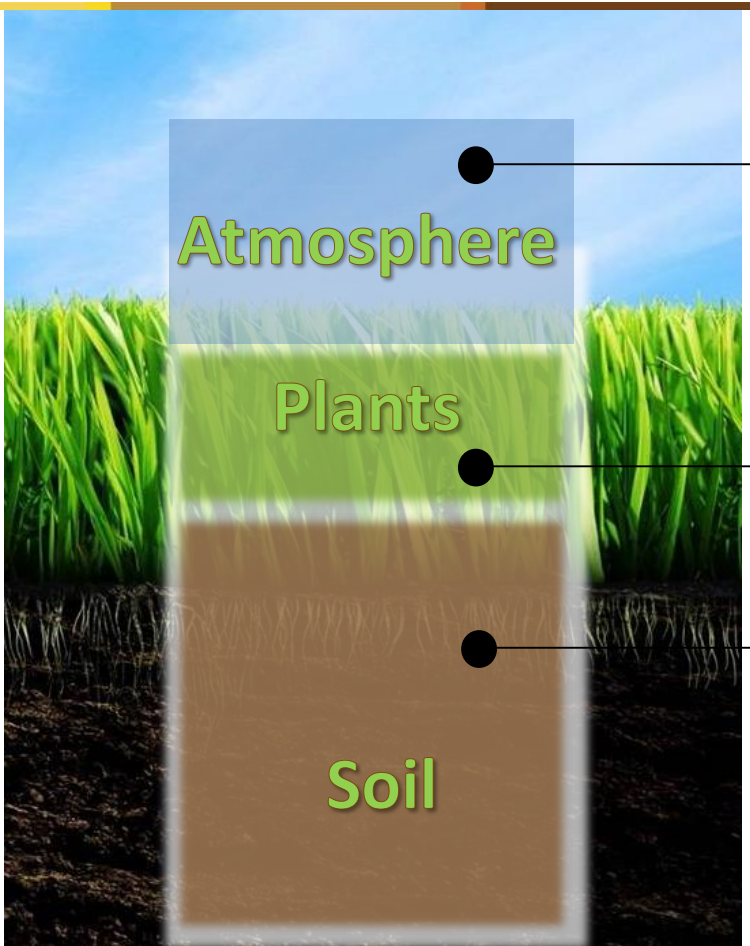
In Ireland, overall emissions 62.70 Mt CO_2 eq.

↓

about 35.3% of GHG emissions are coming from agriculture

↓

Responsibility!



750 Gt of Carbon in atmosphere

560 Gt of Carbon in vegetation

1417 Gt of Carbon in the 1st m of Soil

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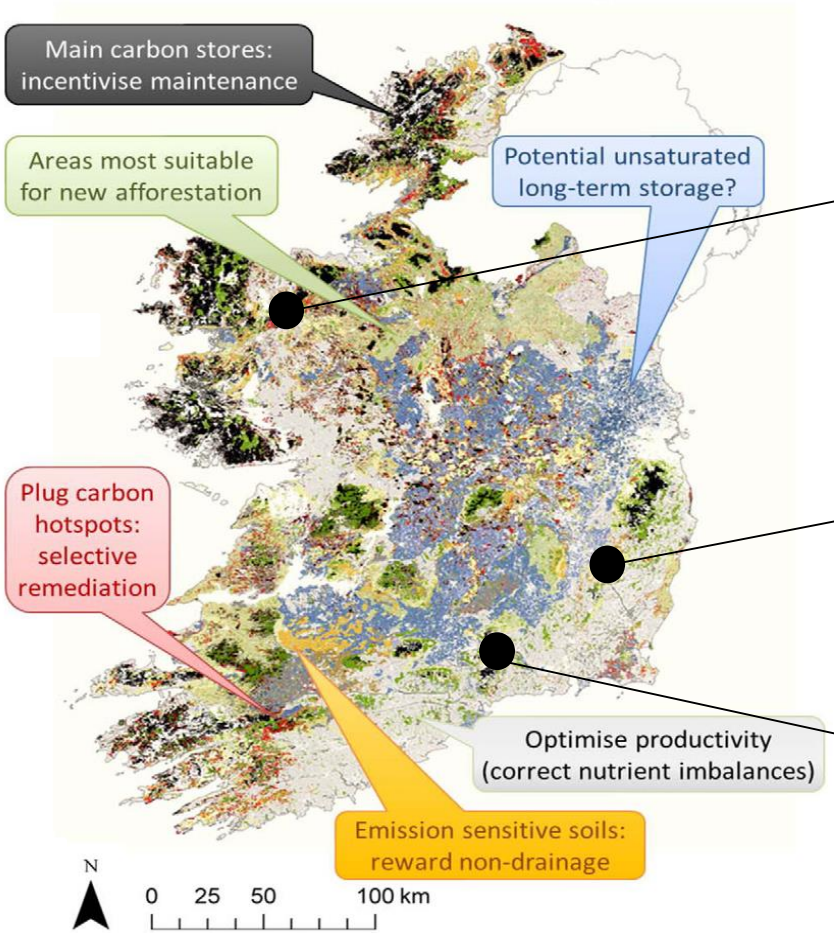
Framework for climate-smart land management

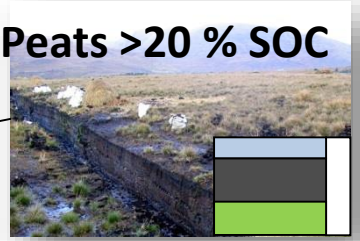
- Where is the C?
- Hotspots!

- Sensitive soils!

- Enhance seq!
- Keep the balance in grasslands!

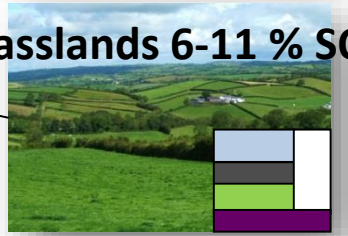


Peats >20 % SOC



Arable 5-6 % SOC

Grasslands 6-11 % SOC



Schulte et al., 2016

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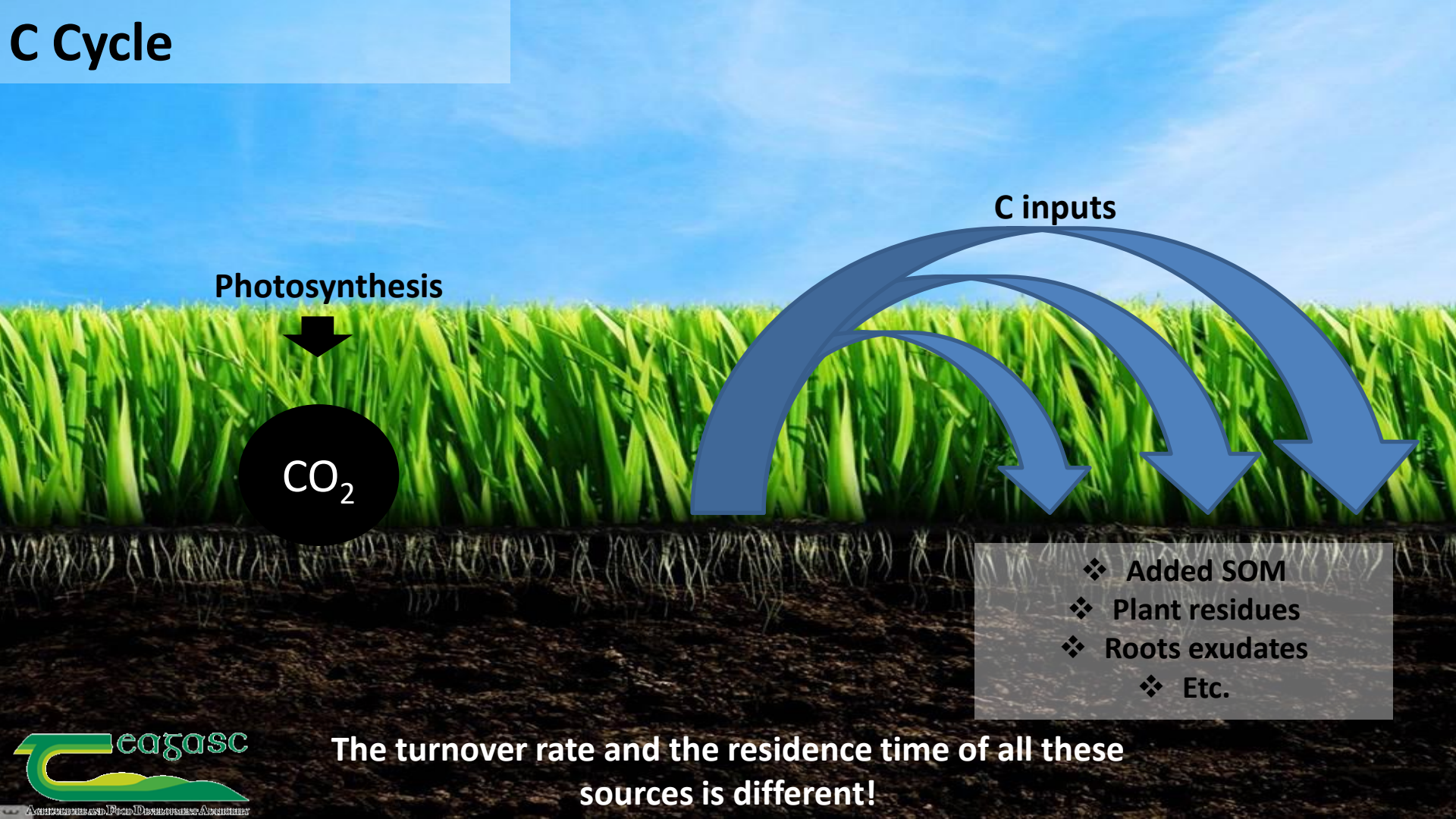
How can we managed agricultural land use to optimise C in the soil?

C Cycle

C Cycle



The turnover rate and the residence time of all these sources is different!

C Cycle

CO_2

CO_2 emission

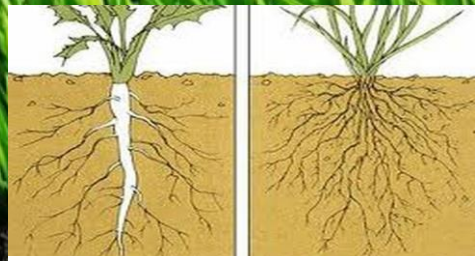
Photosynthesis

Respiration

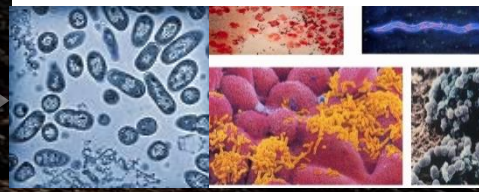
CO_2

Biomass respiration

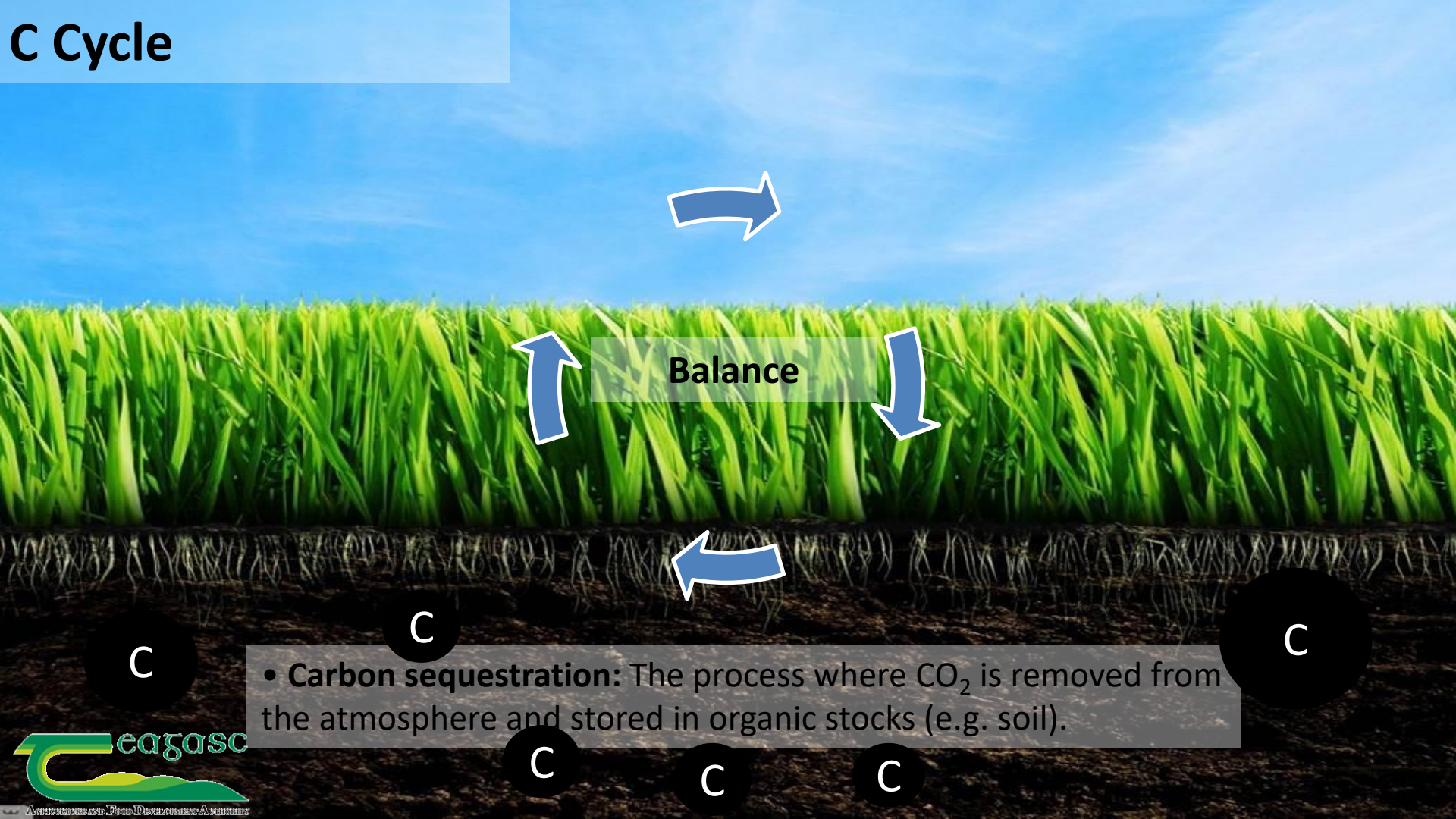
Microbes/fungi respiration



- Root derived respiration
- Rhizo-microbial respiration



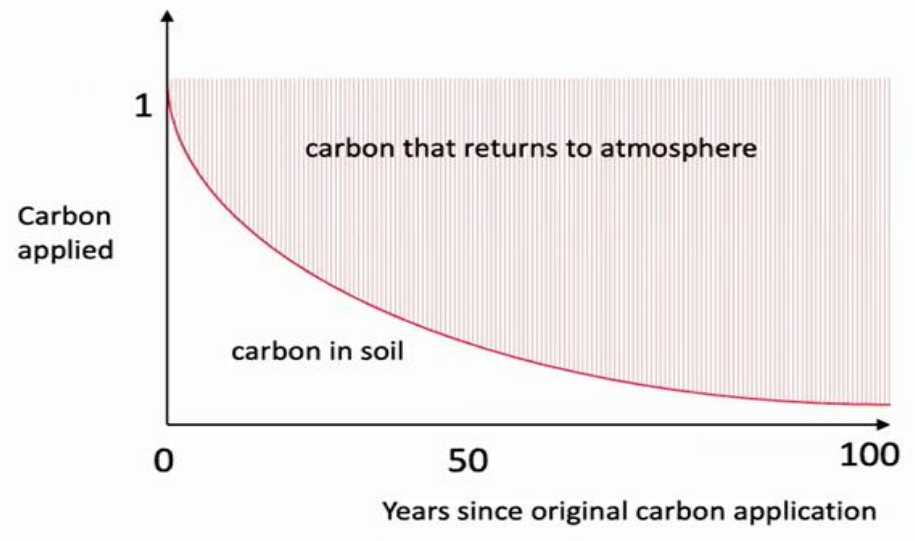
C Cycle



• **Carbon sequestration:** The process where CO_2 is removed from the atmosphere and stored in organic stocks (e.g. soil).

What is climate relevant when applying C to soil?

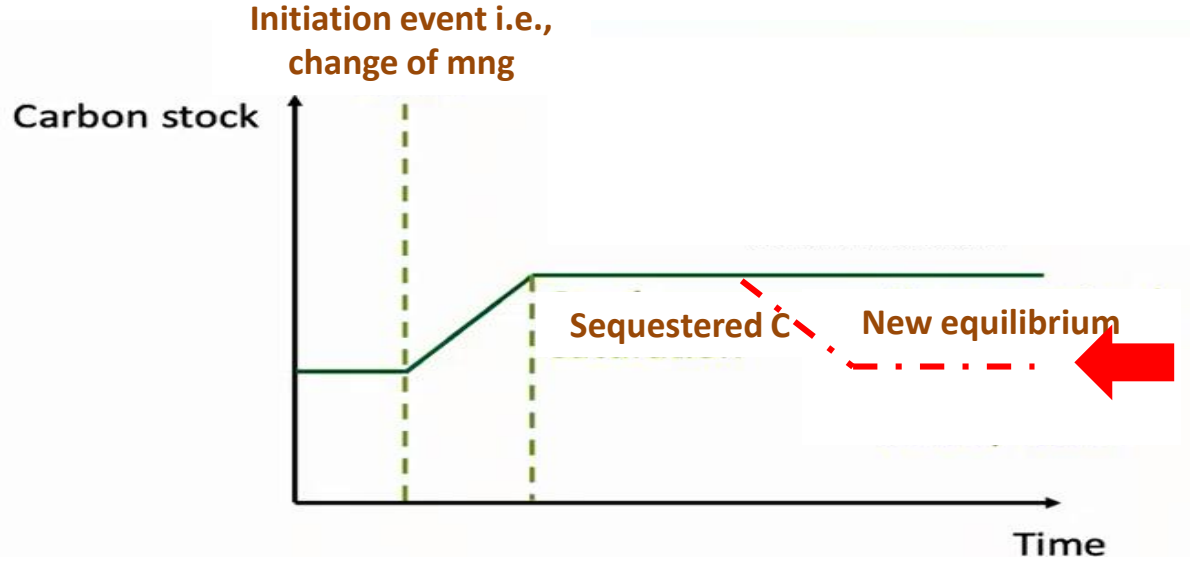
The majority of **C** applied to soil **is released back to the atmosphere** at some point in the near future.



Carbon that stays out of the atmosphere over a period of time has a **climate benefit**

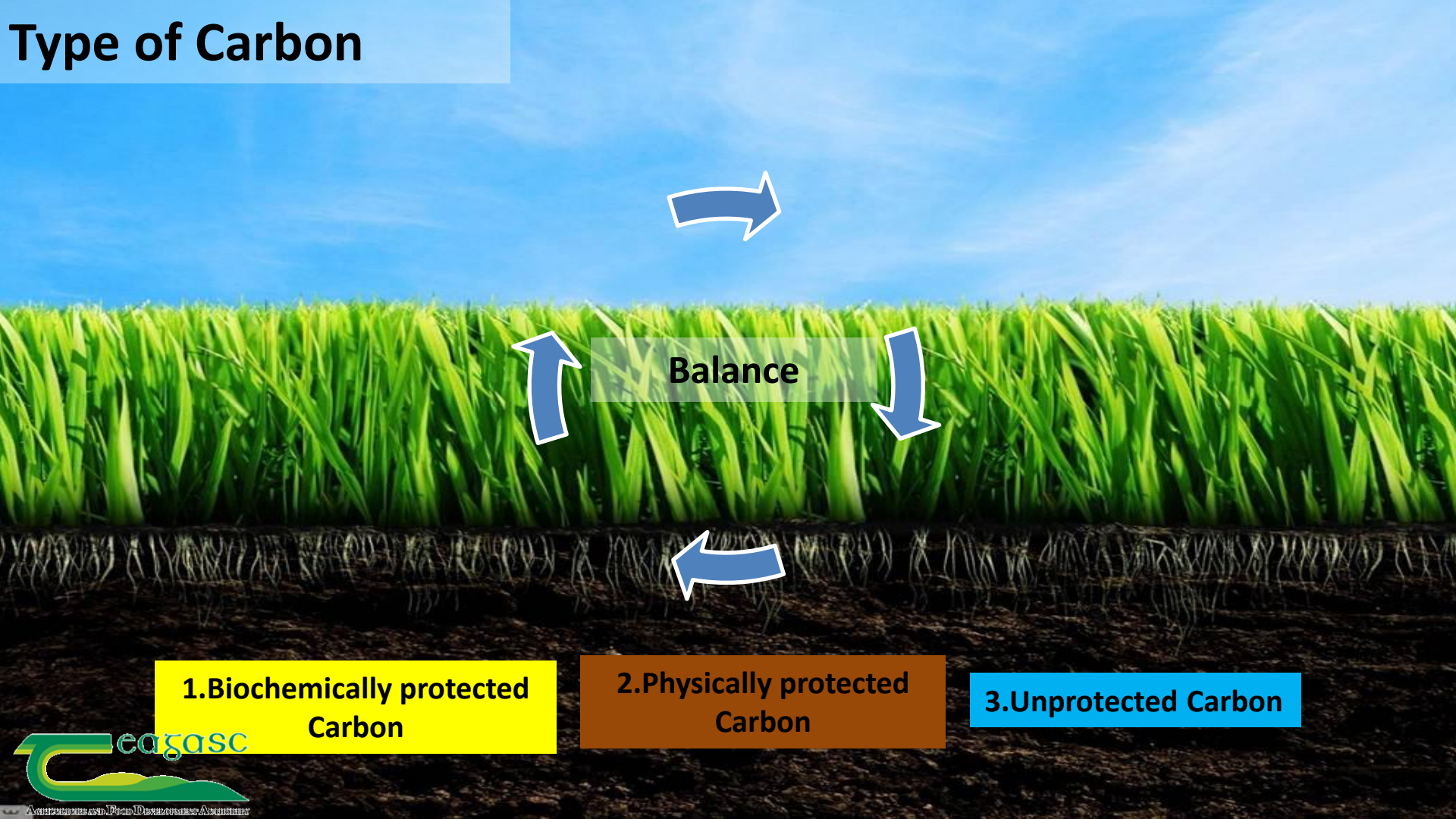
What is climate relevant when applying C to soil?

Why it's so difficult to measure C seq:
i. It is a small build up, very small quantity; **ii.** it take a long time to build up



Gains in sequestered carbon are considered **reversible out of precaution**

Type of Carbon



1.Biochemically protected Carbon

2.Physically protected Carbon

3.Unprotected Carbon

Soil compaction and Carbon?

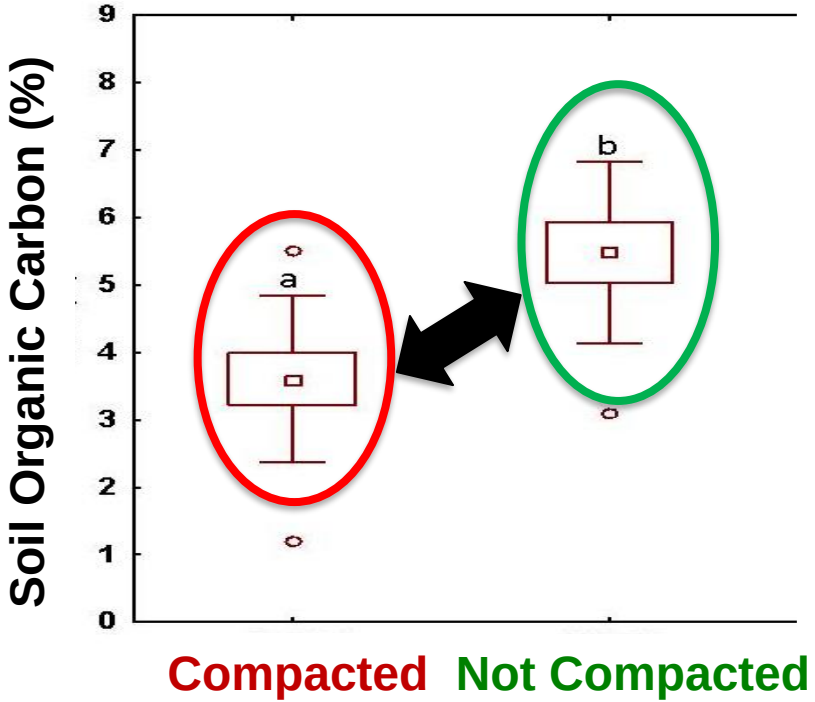
Management:

- physical disturbance to the soil!
- ***Increased machine weight***
- ***Increased intensity of operations***
- ***Continuous tillage***
- ***Extended grazing***

Compaction!

Soil compaction impact **‘Carbon Cycling and sequestration ’**

C Sequestration potential: Effect of soil compaction



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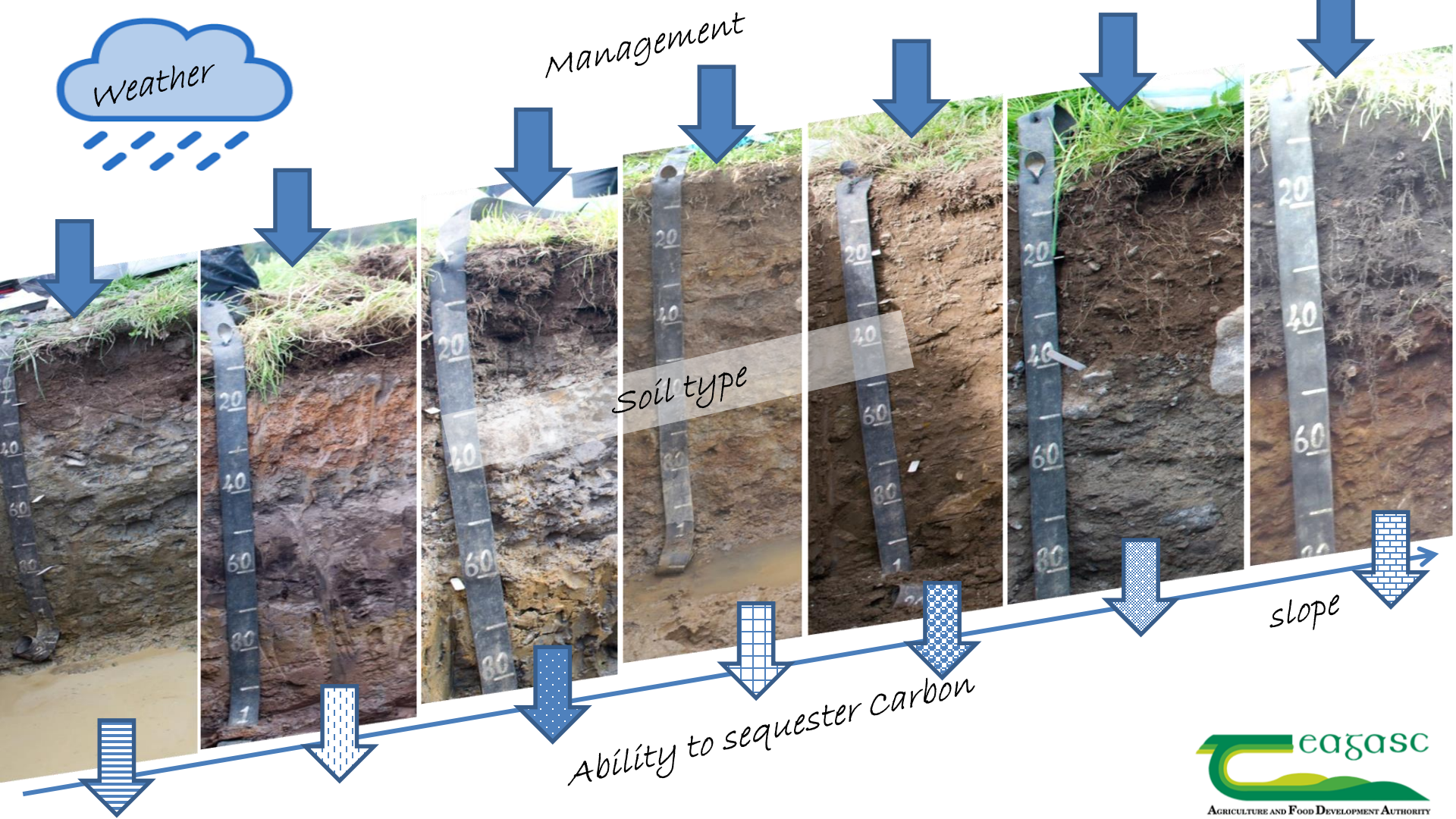
Weather
Management
Soil type
slope
Ability to sequester carbon
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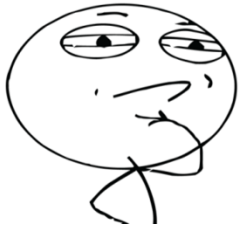
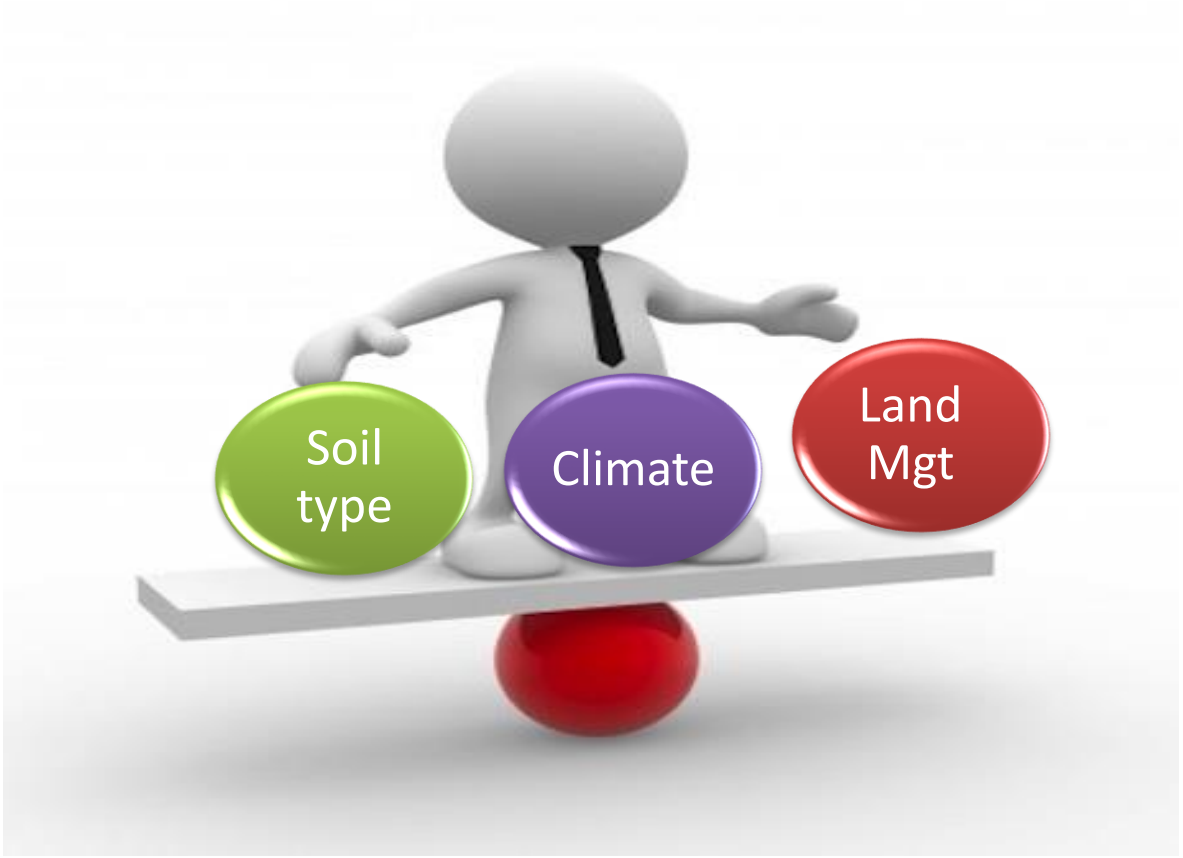
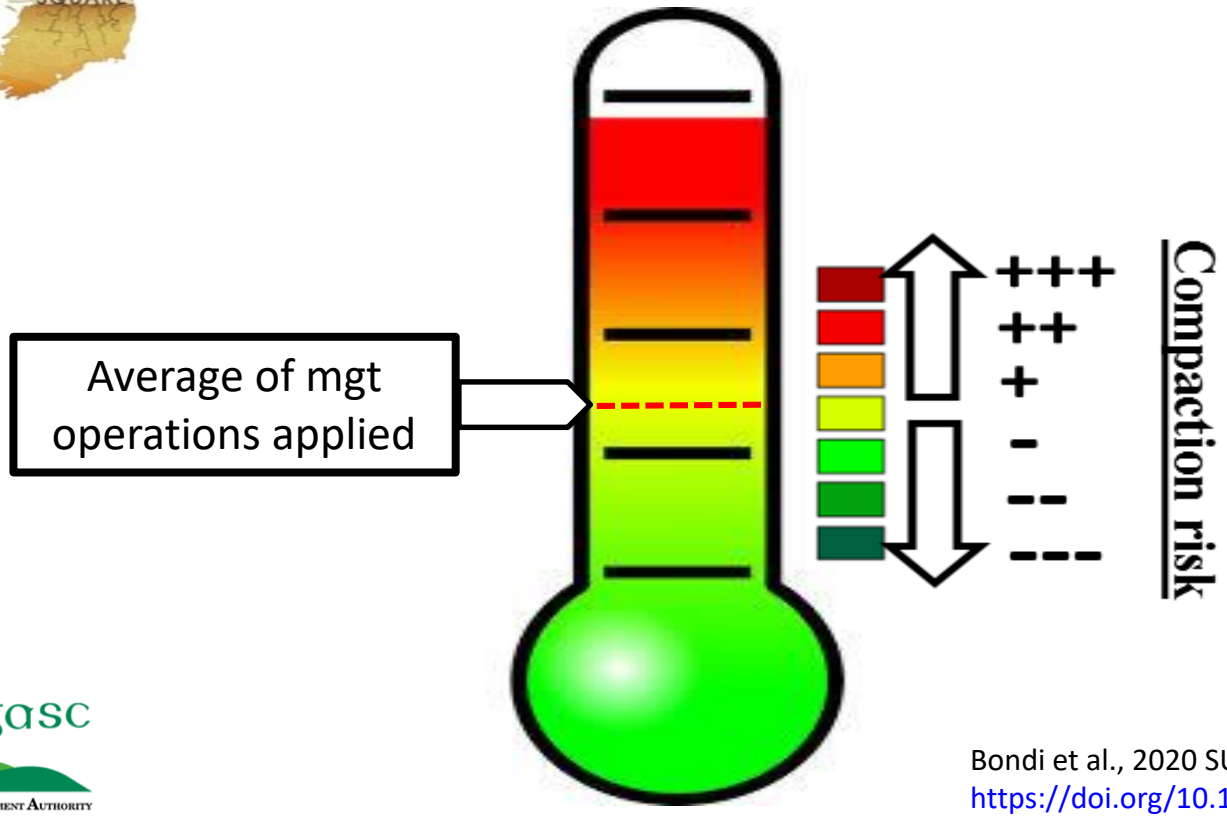


What's the challenge?



Compaction management in grasslands

We aimed to measure the impact of grasslands operations!



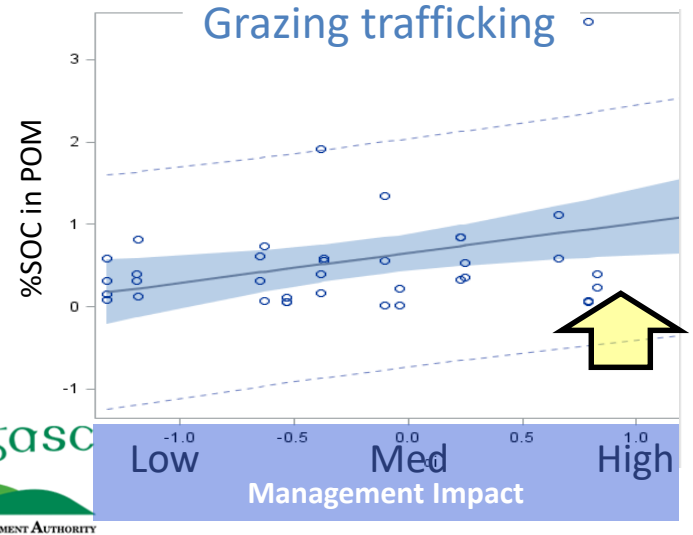
Bondi et al., 2020 SUM
https://doi.org/10.1111/sum.12586

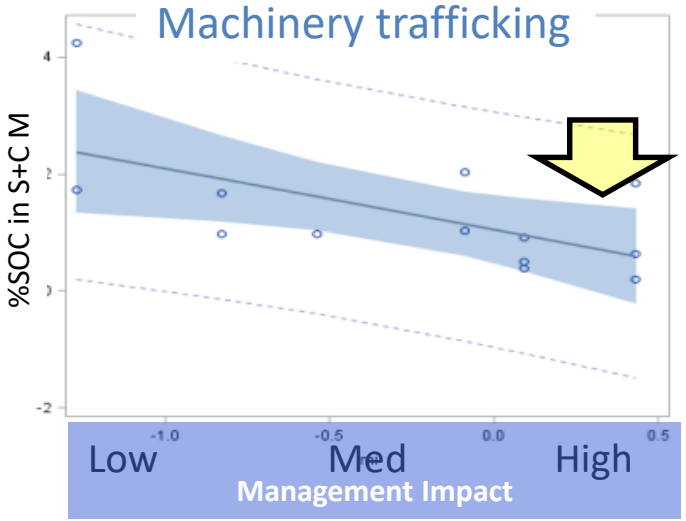
Proportion of physically protected Carbon

Subsoil

High Machinery trafficking → Less Physically protected C

High Grazing trafficking → More Labile C





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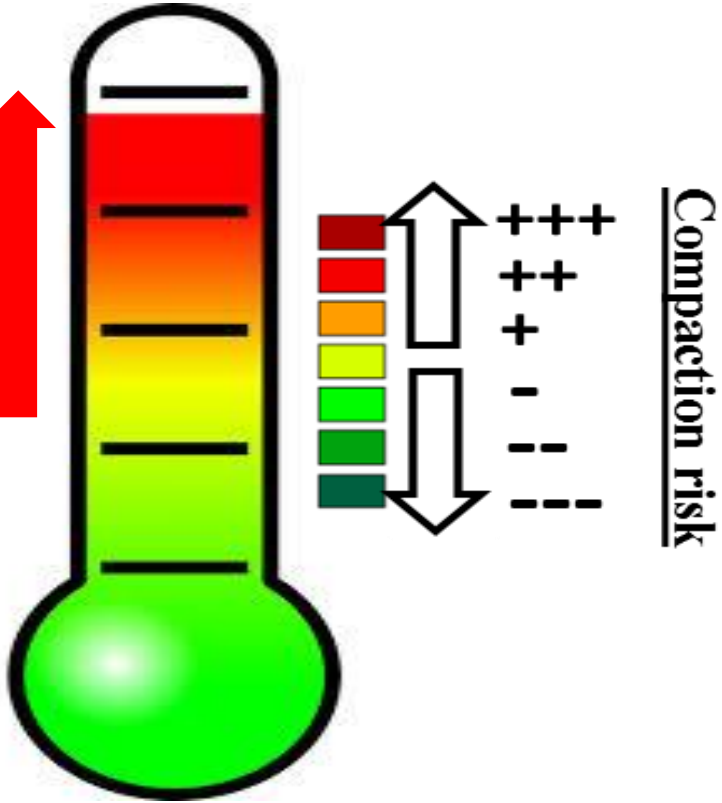
On-going Research

How much C we loose while progressively increasing the management pressure?

Is the soil resilience the same for any soil type?



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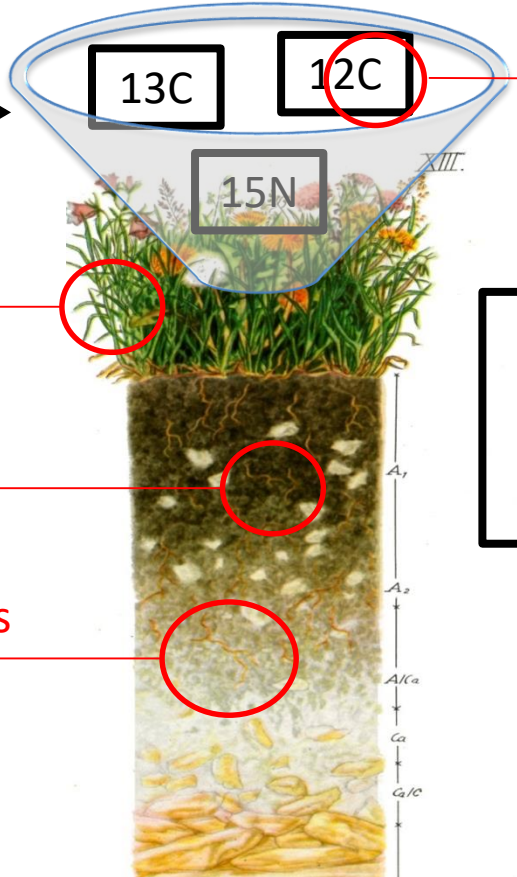
On-going Research

AIM: Determine the **fate, the dynamics and the temporal trends** of soil nutrients

Different sources of C i.e. Plant residues Slurries, etc.



Air - CO_2

Plant

Soil – chemical fractions

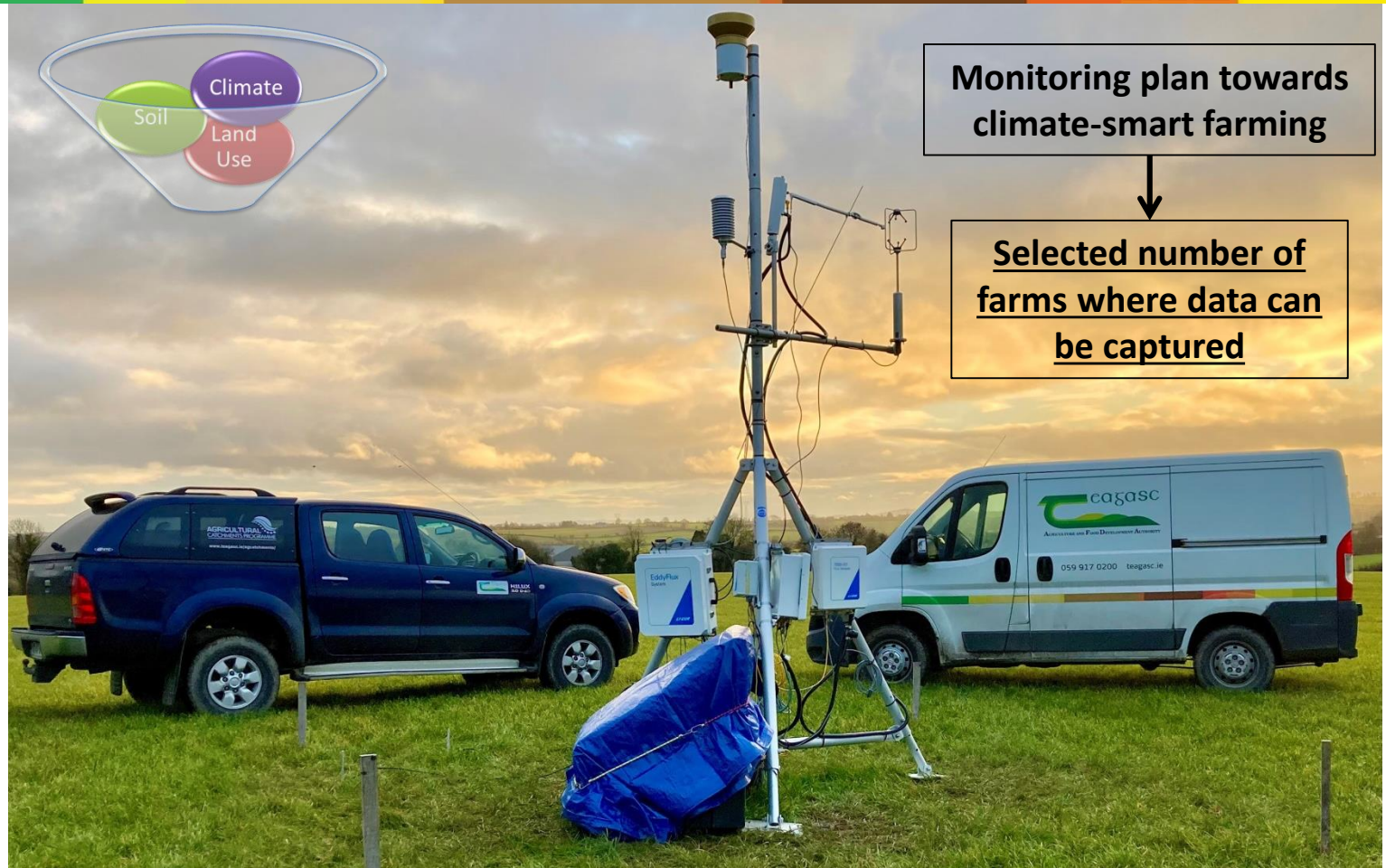
Soil – physical fractions

Isotopes tracing experiment

Understanding the **time/type/rates** of nutrients application for **good nutrients use efficiency**

Pics credits: “Atlas of Soil Profiles" by W.L. Kubiëna

On-going Research



Thanks for the attention

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