Carbon in the Uplands – What is the National Agricultural Soil Carbon Observatory Telling Us?

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Uplands Symposium 2026

Killarney, Co. Kerry

An Roinn Talmhaíochta, Bia agus Mara
Department of Agriculture, Food and the Marine

NASC

TEAGASC CLIMATE CENTRE

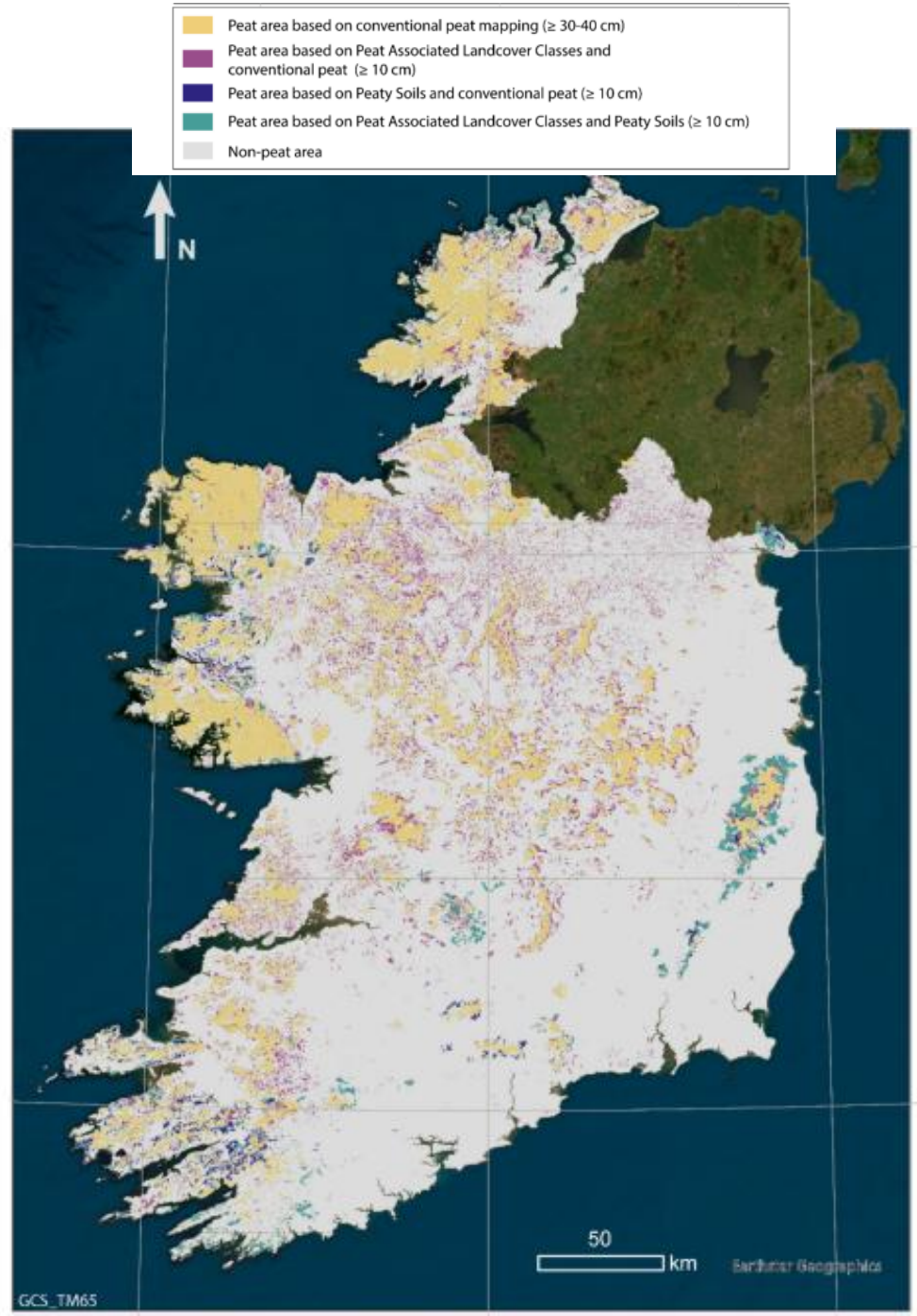
VistaMilk

NPWS
An tSeirbhís Páirceanna Náisiúnta agus Fiadhúlra
National Parks and Wildlife Service

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Irish Peat Soils

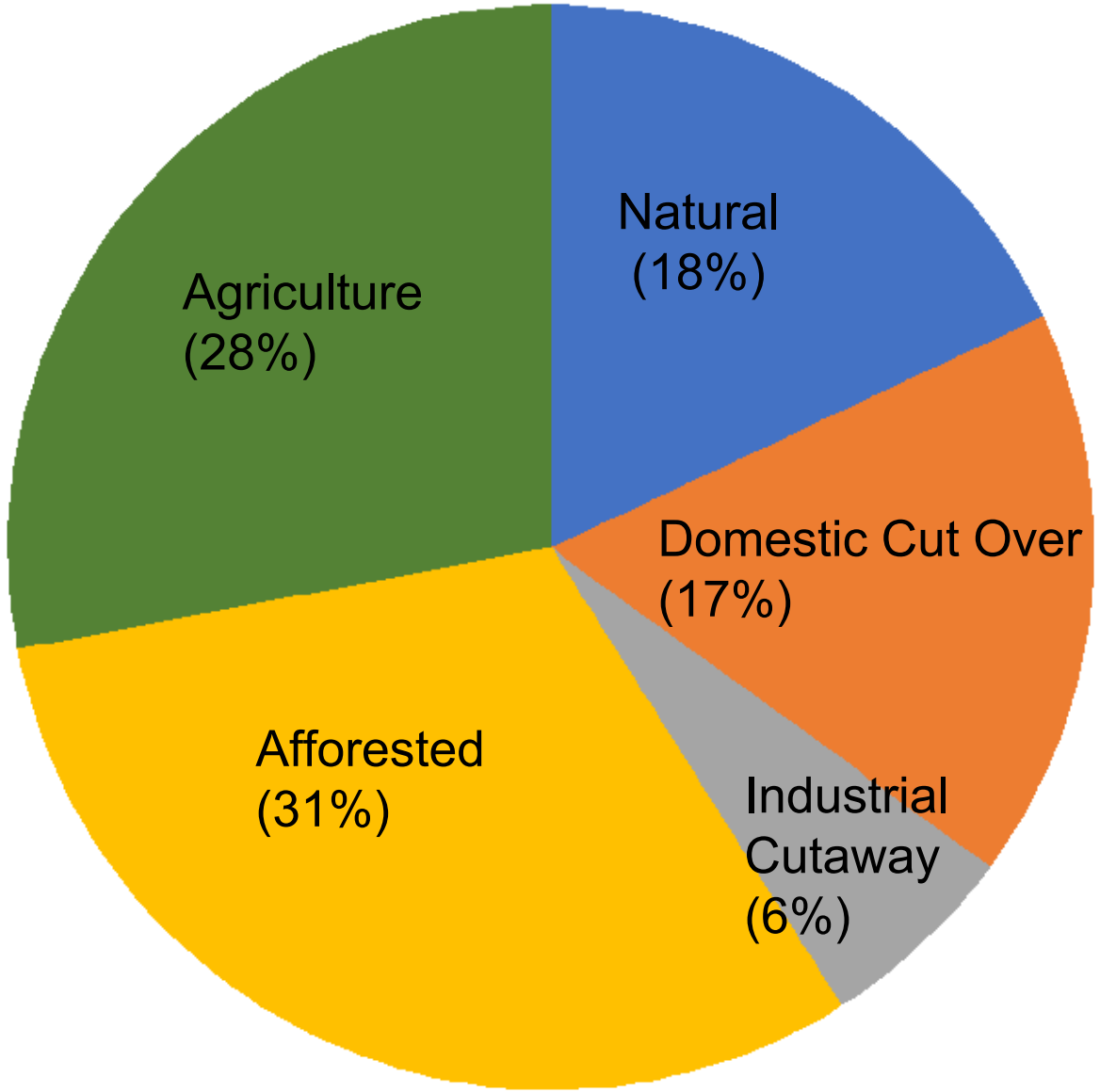
- Peat soils store 2.3 billion tonnes of carbon
- Peat soils cover 21% or 1.46 million ha of the land surface
  - 1/3 used in agriculture
- Grassland over drained peat accounts for approx. 90-120,000 ha
- Peat grasslands and wetlands are large net CO_2 sources



Reference: Wilson, (2021); Gilet et al. (2024), NIR (2026)

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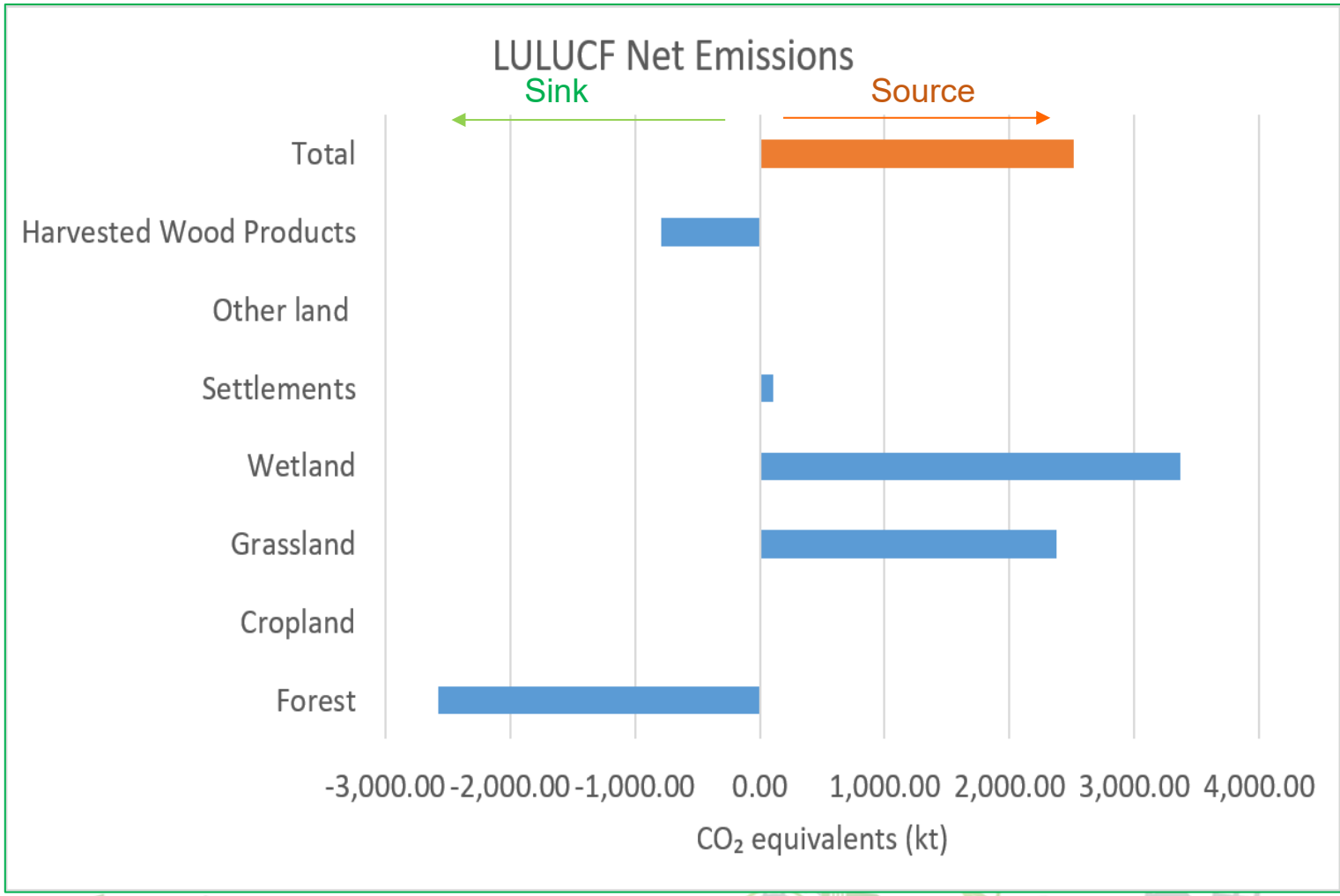
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National Agricultural Soil Carbon Observatory

NASCO = 28 flux towers

- 20 on mineral soils
- **8 peat soils**

- Tower measures the difference in carbon sequestered and emitted at the field scale

- Aim to investigate the impact of soil type, land-use and management on carbon sequestration

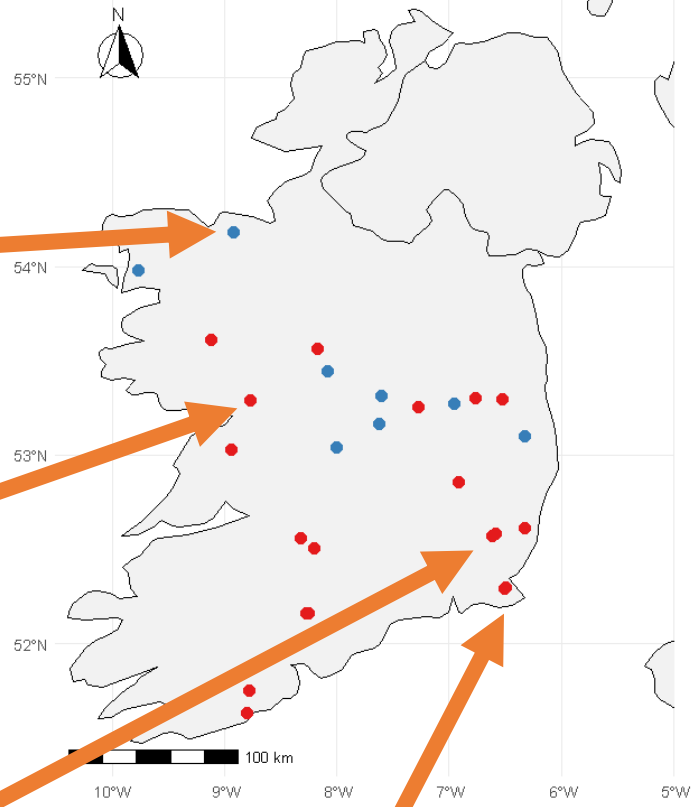






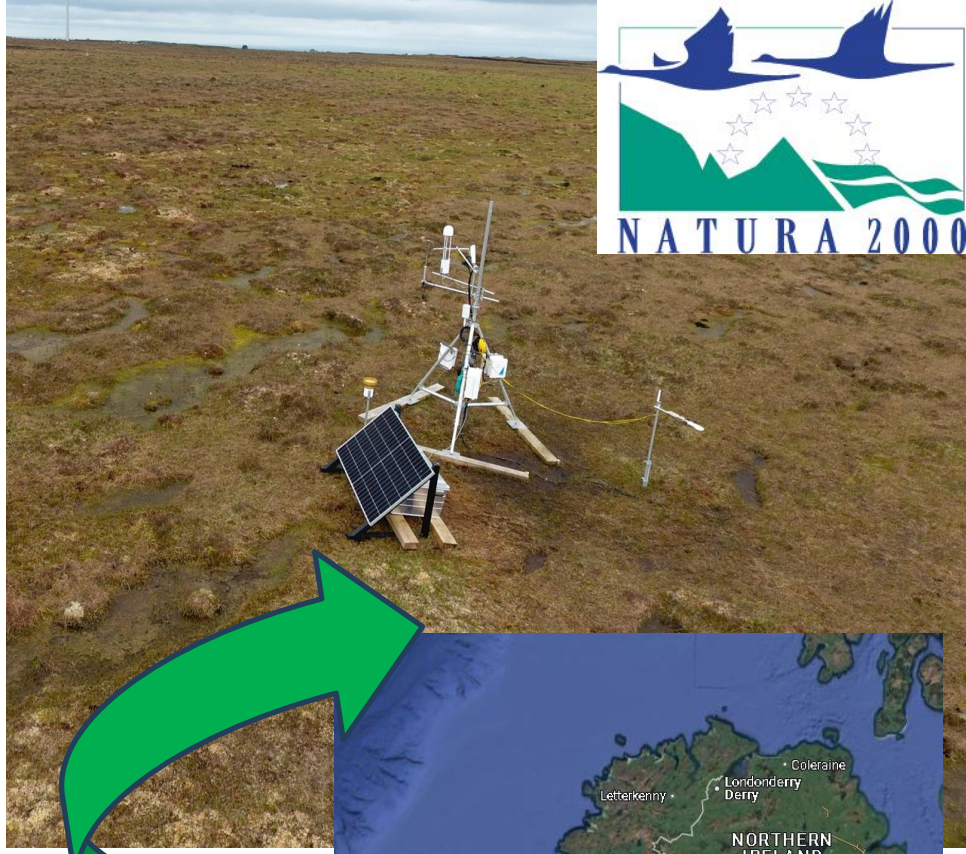


Peat and **Mineral** Soil



Letterunshin Co. Sligo

- Special Area of Conservation (SAC)
- Upland blanket bog rough grazed by sheep, nutrient poor
- Mixed vegetation consisting of graminoids, sphagnum and heather
- Peat depth > 2m
- Burning event in April 2023 that lasted 6.5 hours
- CO_2 measurements from 2023-2025 flux tower





NPWS An tSeirbhís Páirceanna Náisiúnta agus Fiadhúlra National Parks and Wildlife Service

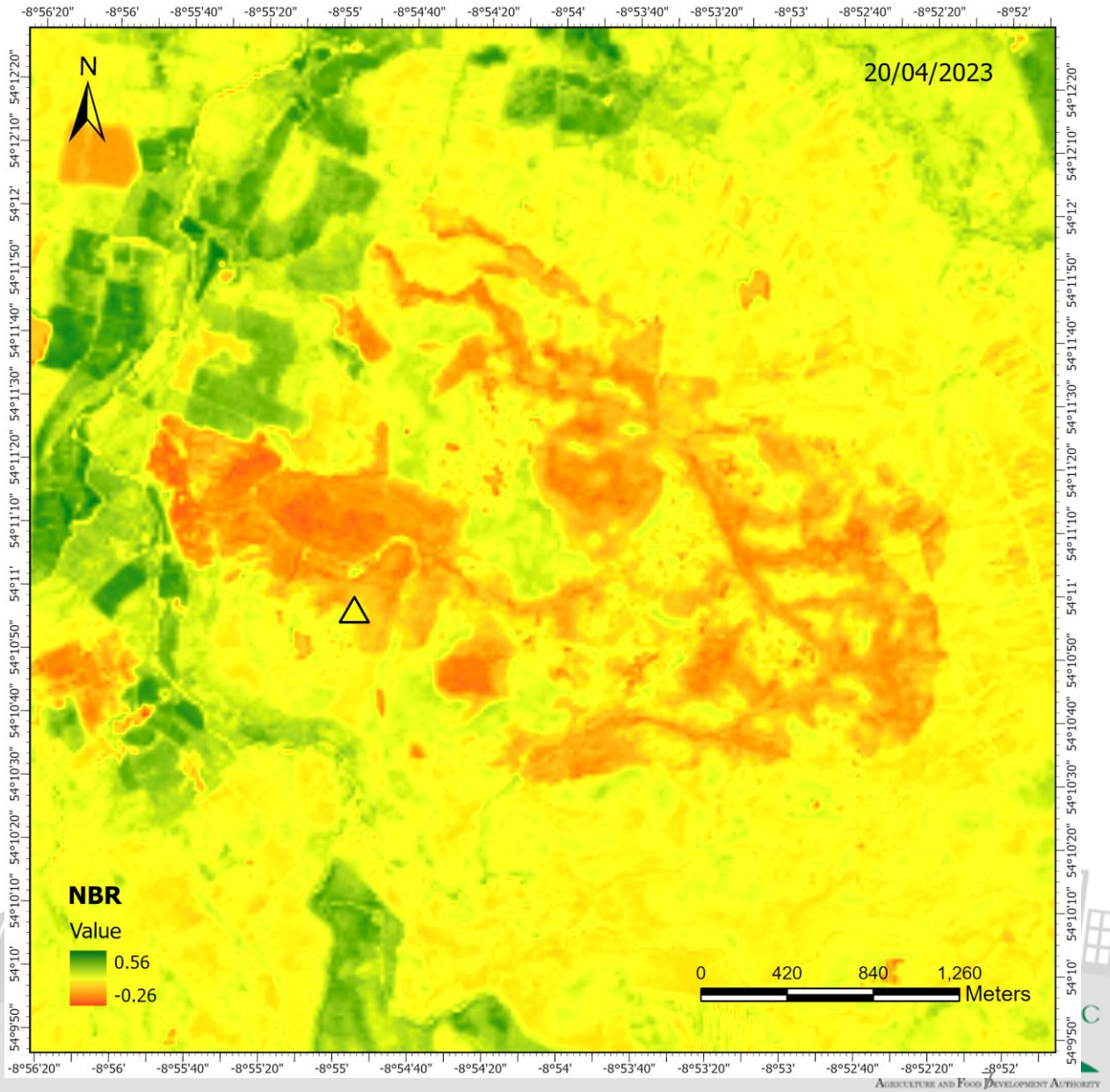
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No deep peat burning detected

- Satellite data was used to determine the extent of the burning in the Letterunshin catchment

- Map legend:
- **Green** = Low burn severity
- **Yellow** = Moderate burn severity
- **Red**/**Orange** = High burn severity
- △ = Flux tower

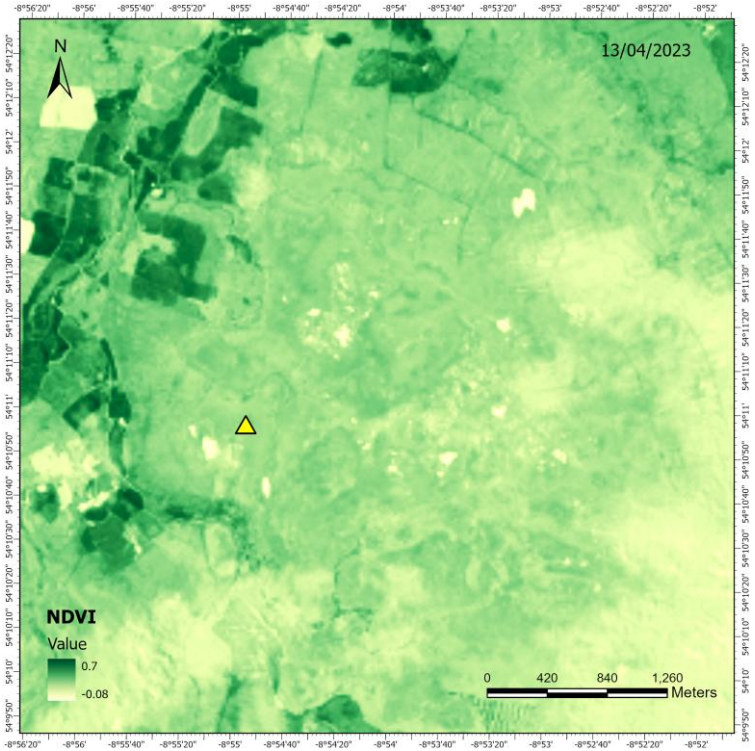
- Low to moderate burn severity affecting surface vegetation → no deep peat combustion found



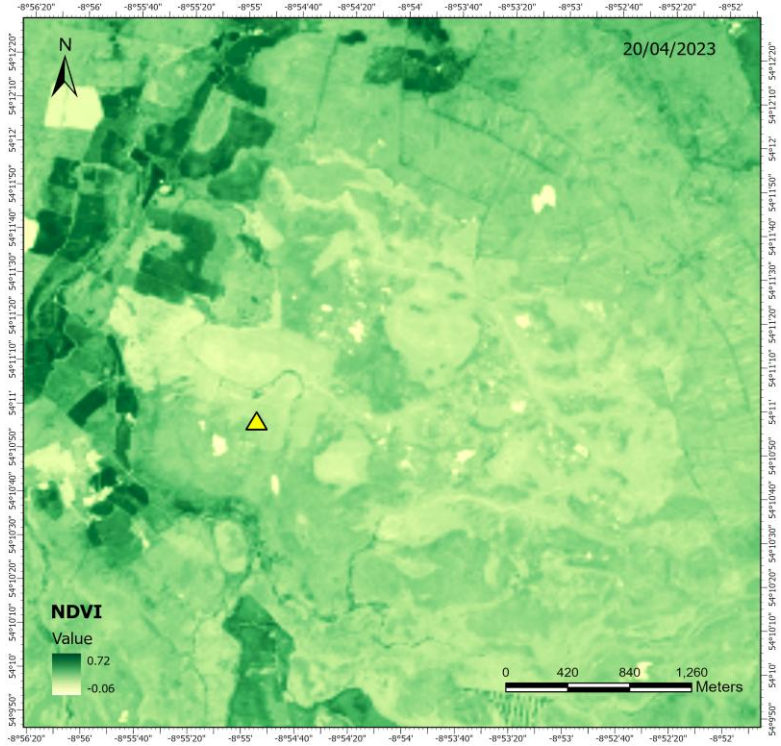
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Rapid vegetation regrowth shows resilience of a well managed blanket bog to burning

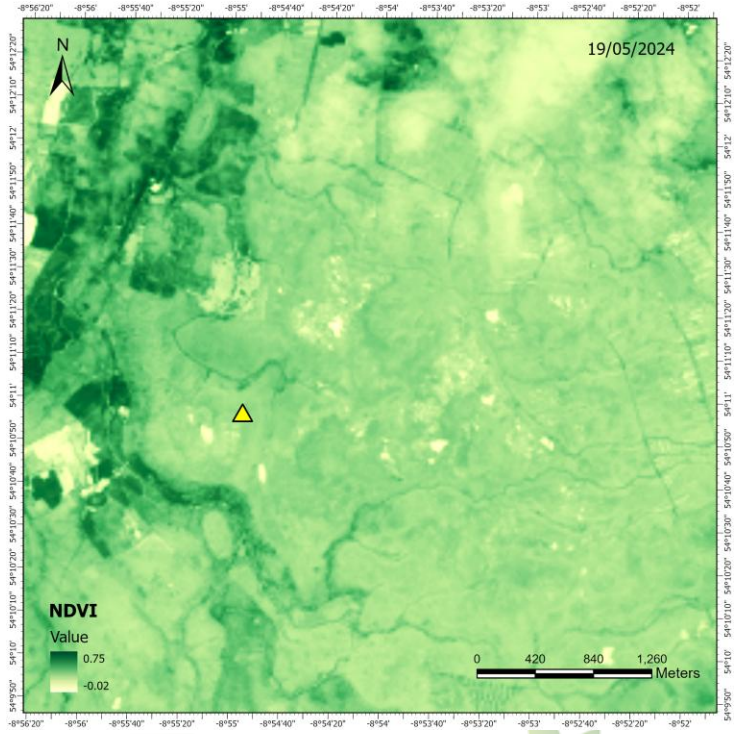
Pre-Burning



1 Day Post Burning



1 Year Post Burning



Satellite imagery where **light green** colours = little/no vegetation and **dark green** colours = more vegetation

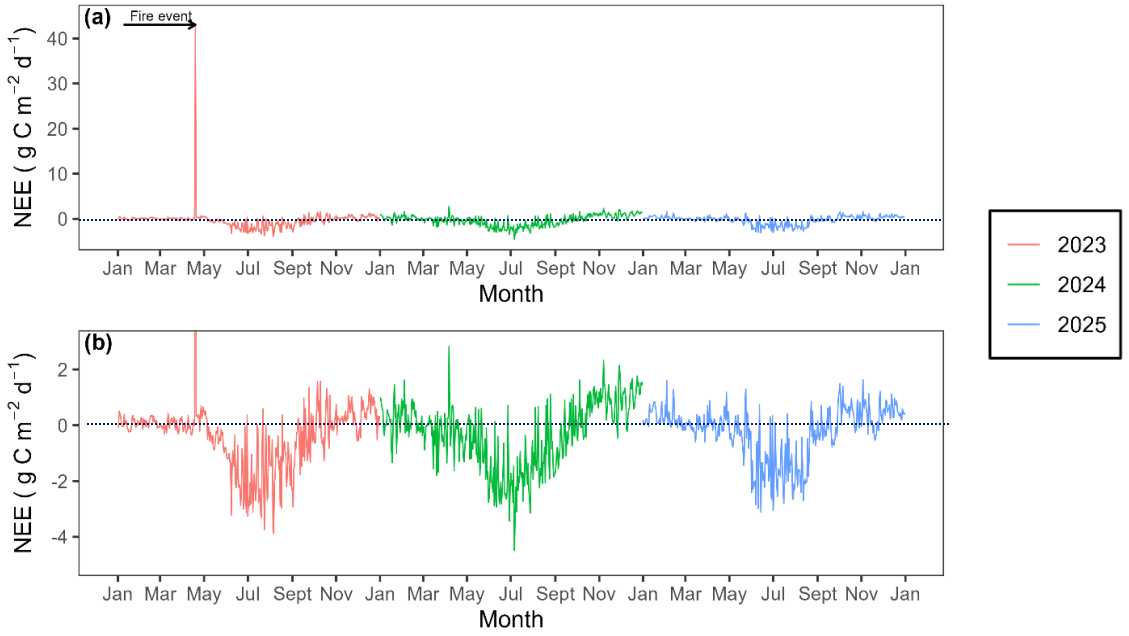
△ = Flux tower

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Inventory C Value from Biomass Burning on Peat Validated at Letterunshin

Negative Numbers = Gain of Carbon; Positive Numbers = Loss of Carbon

- Cumulative emissions of 42.7 g C m^{-2} or 0.42 t C ha^{-1} measured during the 6.5 hr combustion period
- Comparable with the inventory value for biomass burning on peat at 45.1 g C m^{-2} or 0.45 t C ha^{-1}

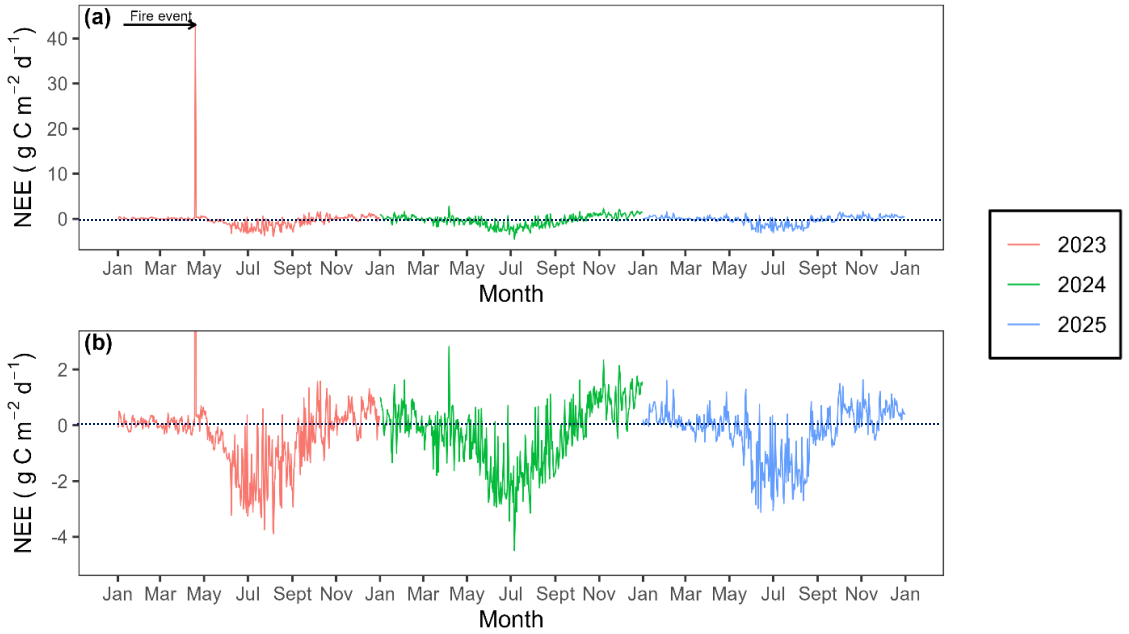


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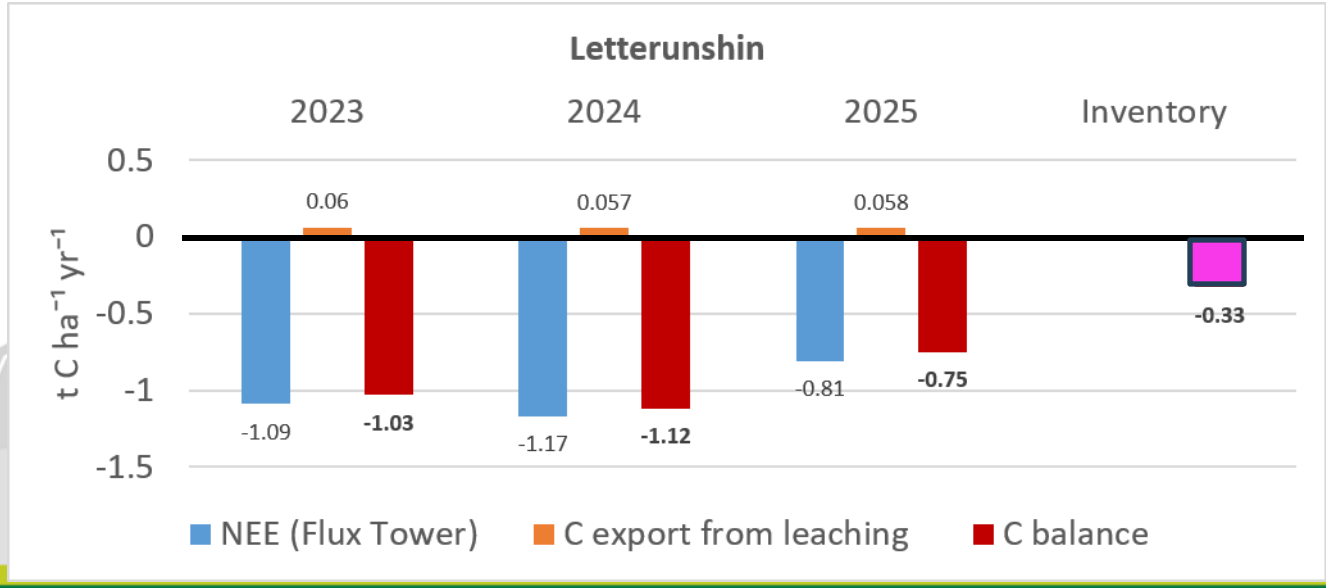
Higher net C sink reported at Letterunshin compared to the inventory

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- Comparable with the inventory value for biomass burning on peat at 45.1 g C m^{-2} or 0.45 t C ha^{-1}



- Annual cumulative net C balance
  - -1.03 t C ha^{-1} yr^{-1} (2023)
  - -1.12 t C ha^{-1} yr^{-1} (2024)
  - -0.75 t C ha^{-1} yr^{-1} (2025)
- Higher net C sink compared to the inventory value for near natural wetlands (-0.33 t C ha^{-1} yr^{-1})



Slide source: saw.min@teagasc.ie

Why did the site remain a sink of Carbon?

Main Recovery Drivers

1. High Water Table Protected Peat

Saturated conditions limited deep peat combustion

2. Low Burn Severity

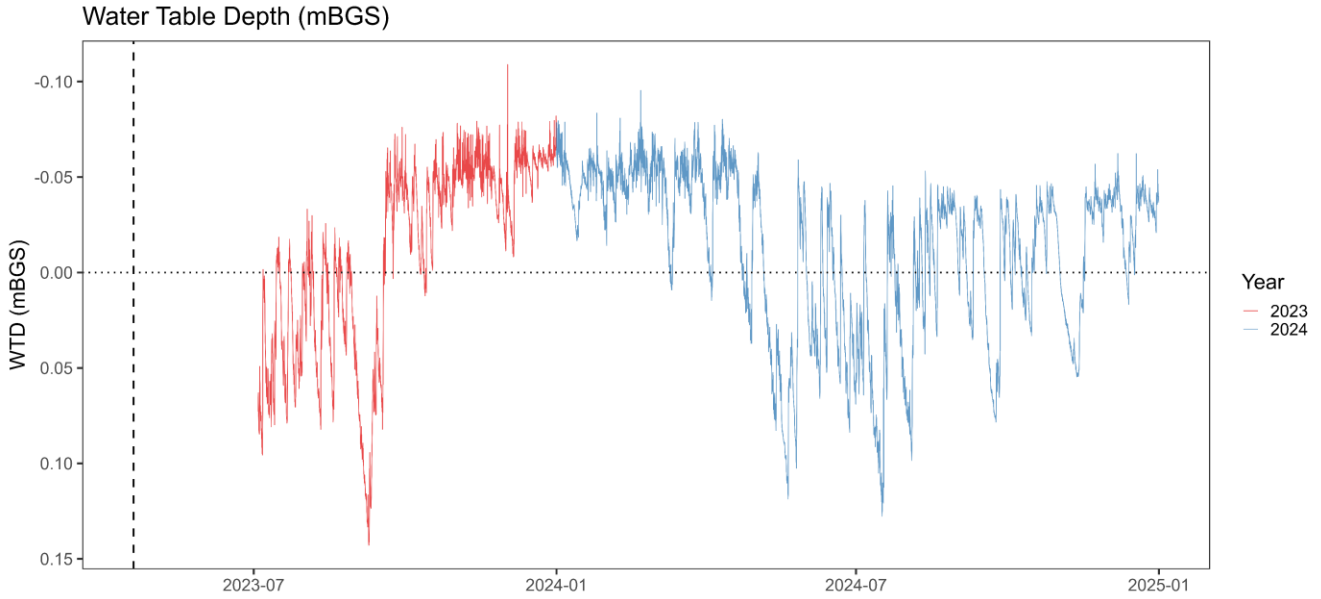
Carbon loss mainly from surface vegetation

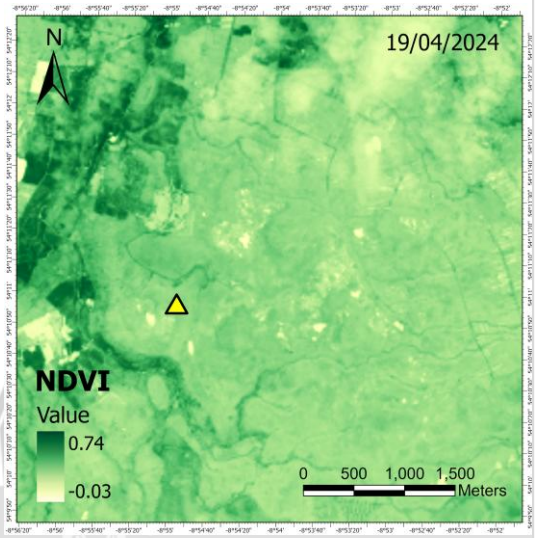
3. Rapid Vegetation Regrowth

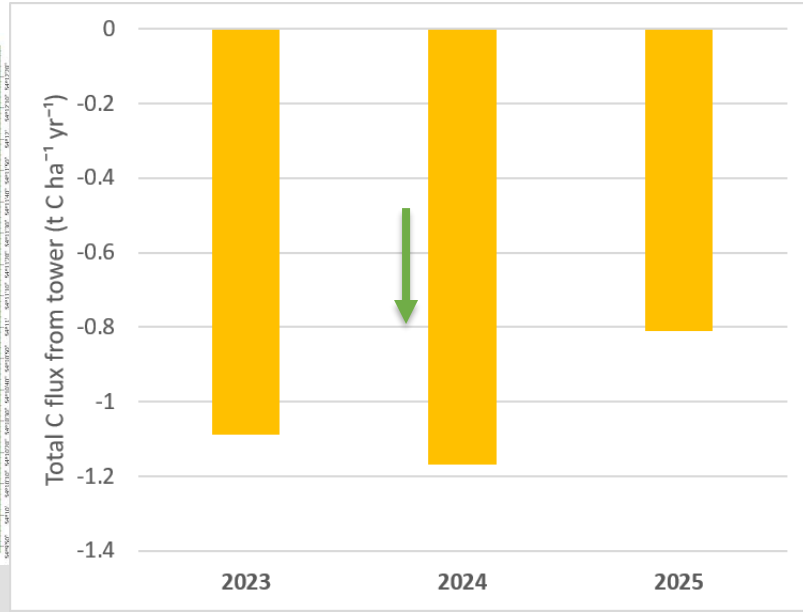
Vegetation recovered quickly

4. Photosynthesis Rebounded

Higher C sink in 2024 supported sink recovery







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What can we learn from Letterunshin?

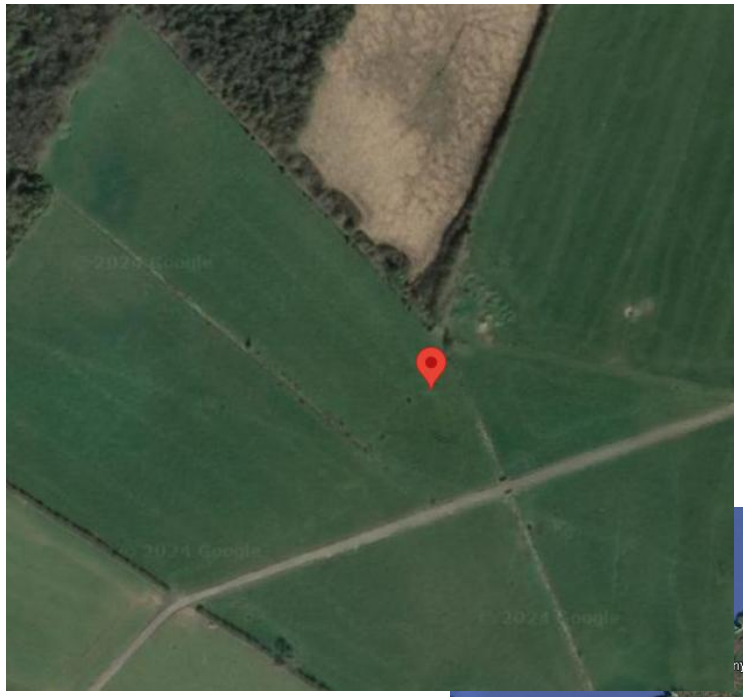
- Well managed upland blanket bogs, under good hydrological conditions, are higher net C sinks compared to the inventory for near natural wetlands
  - Longer term measurements from other blanket bog sites are needed

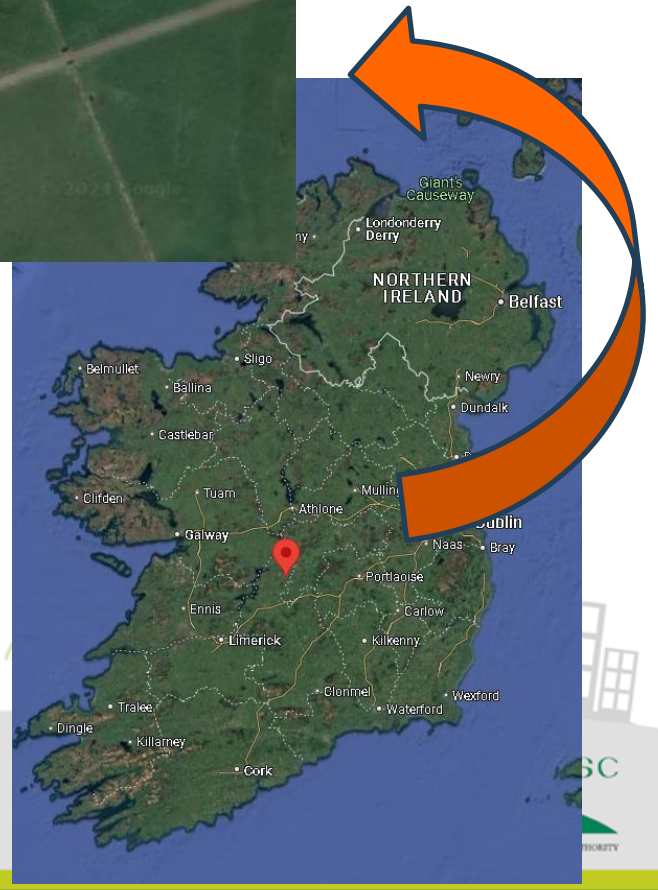
- Where the water table is high and the burning severity is limited to vegetation and not peat, the site showed strong resilience to burning

- The broader implications of burning on other peatland ecosystem services such as biodiversity and water quality need to be quantified

Gurteen, Co. Tipperary

- Grassland over drained fen peat
- Nutrient rich and grazed by sheep and beef livestock
- Received 79 – 93 kg N ha
- Peat depth ~ 60 cm
- CO_2 flux tower measurements from 2023-2025





Slide source: clancyia@tcd.ie

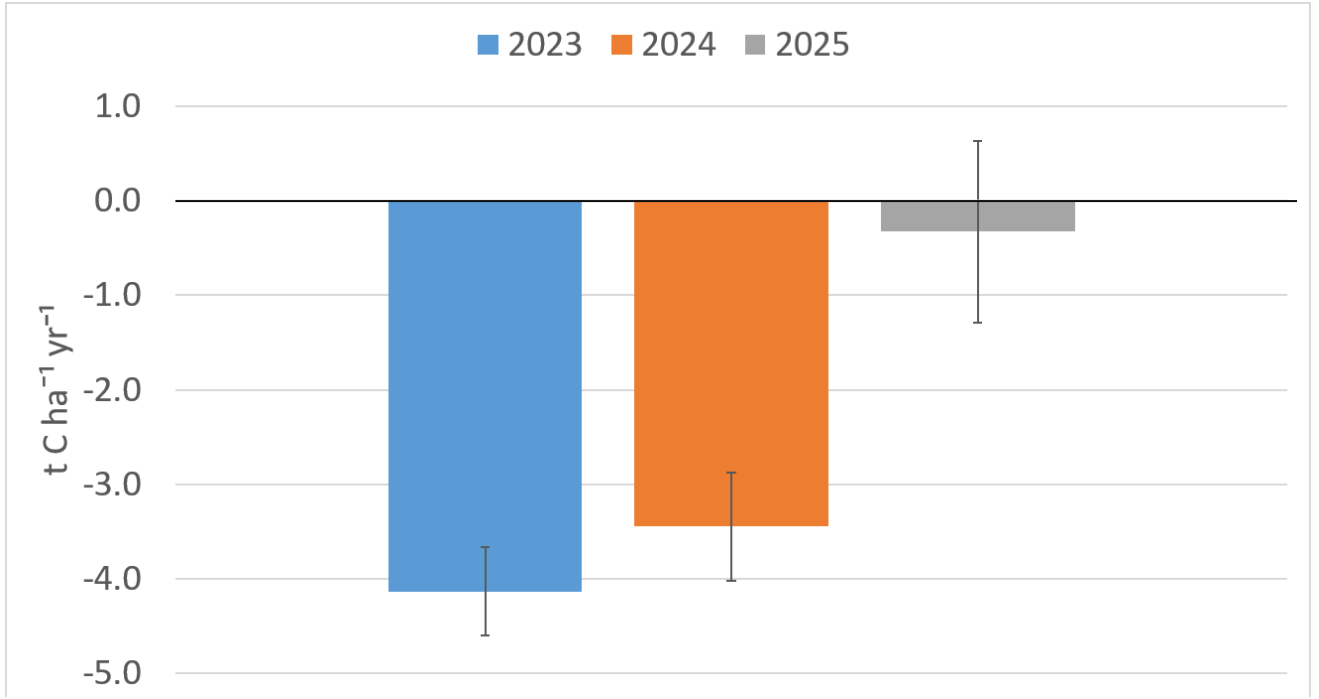
Variation in the atmospheric C sink coincided with inter-annual variability in climate

- The tower measured a net sink of C expressed as the difference in C uptake through plants and plant and soil respiration
  - -4.1 t C ha^{-1} yr^{-1} (2023)
  - -3.4 t C ha^{-1} yr^{-1} (2024)
  - -0.3 t C ha^{-1} yr^{-1} (2025)

- Mean annual water table depth
  - 27.2 cm (2023)
  - 63.8 cm (2024)
  - 52.6 cm (2025)

- Annual cumulative rainfall
  - 1080.3 mm(2023)
  - 864.4 mm (2024)
  - 963.5 mm (2025)

- Mean monthly air temperature
  - 5.8 – 16.1 ^{o}C (2023)
  - 4.5 – 15.1 ^{o}C (2024)
  - 4.5 – 16.3 ^{o}C (2025)



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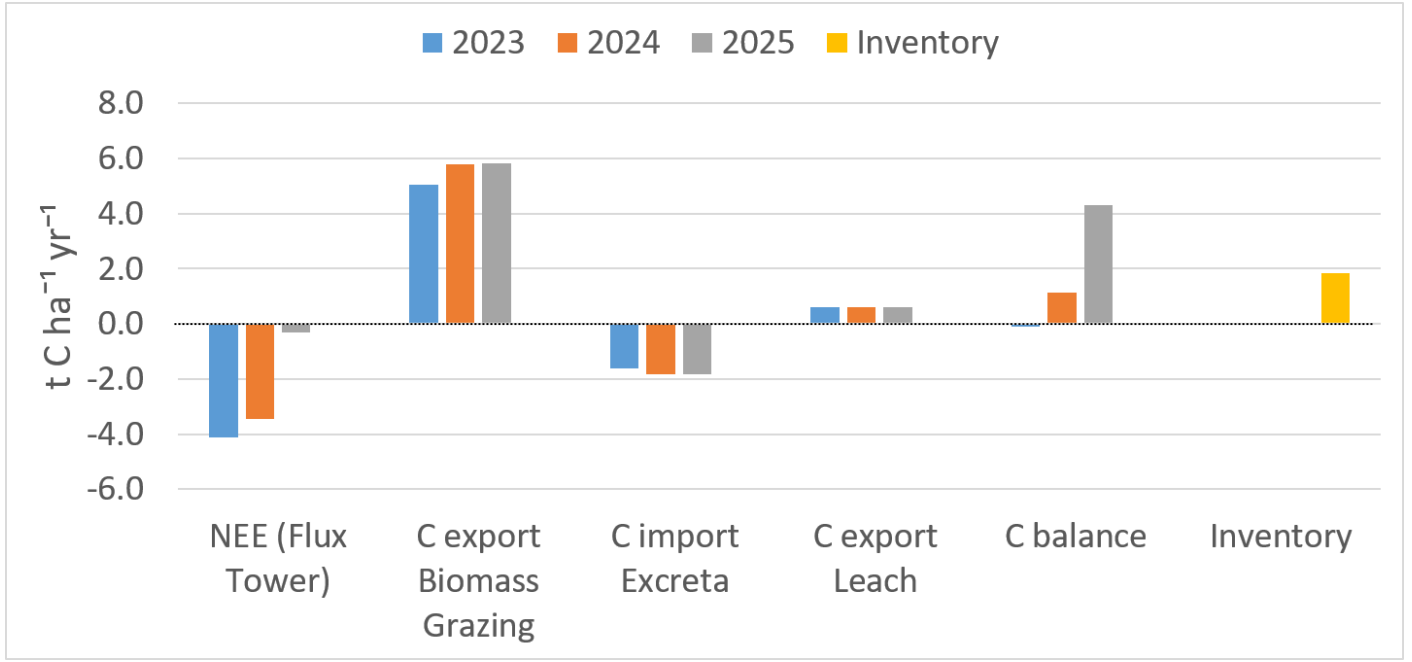
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High inter-annual variability in the net C source from Gurteen

- Carbon (C) balance accounts for imports and exports of C from management practices combined with the flux tower C data

- Annual cumulative net C balance
  - 0.1 t C ha^{-1} yr^{-1} (2023)
  - 1.1 t C ha^{-1} yr^{-1} (2024)
  - 4.3 t C ha^{-1} yr^{-1} (2025)
  - Average 1.8 t C ha^{-1} yr^{-1}

- Average C balance aligns with the Inventory value for grasslands over peat (1.84 t C ha^{-1} yr^{-1})



Negative Numbers = Gain of Carbon; Positive Numbers = Loss of Carbon

Slide source: clancyia@tcd.ie

What can we learn from Gurteen?

- This grassland over peat was a net source of C (0.1 – 4.3 t C ha^{-1} yr^{-1}) and on average similar to the inventory value (1.84 t C ha^{-1} yr^{-1})

- Grassland management has the potential to reduce or enhance the net C sink

- Longer-term monitoring is required to understand the inter-annual variability and climate resilience of these systems



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