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RESILIENT DAIRY LANDSCAPES:
SEQUESTERING CARBON BY PLANTING HEDGEROWS

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RESEARCH SUMMARY

Carbon sequestration by vegetation and soil is an essential part of addressing climate change and achieving net-zero commitments. In the UK, the Climate Change Committee has proposed that extending hedgerows by 40% will help reaching net-zero carbon by 2050. In England's arable and grassland landscapes, this would require the planting of ~190,000 km of new hedgerows, which equates to about half the length of the UK's road network.

This raises two important questions for climate change mitigation planning:

- What is the rate of CO_2 sequestration associated with planting hedgerows?
- Are the goals of hedgerow planting achievable via current initiatives?

The Resilient Dairy Landscapes project at the University of Leeds conducted a study to quantify the change in soil organic carbon (SOC) stock as a result of planting hedgerows on dairy farms, one of the options offered in the 'Milk Plan', a sustainable supply chain initiative run by Nestlé-First Milk in Cumbria.

We found that extensively planting hedgerows will contribute towards reaching net-zero targets; however, the rate of planting needs to increase substantially through both public and private initiatives.

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KEY MESSAGES

- Planting hedgerows is a tool for carbon sequestration and storage
- Rates of planting in agri-environment schemes are too slow to meet the Climate Change Committee goal of 40% increase in hedgerows
- Planting rates could be increased by:
  - Increasing payments in agri-environment schemes for the delivery of public goods as well as compensating for costs and time of implementation/management
  - Harnessing private sector funding
  - Allowing farmers to sell carbon credits in private markets

PROJECT RESULTS

Soil beneath hedgerows stores more soil organic carbon (SOC) than adjacent fields. On average, planting hedgerows stores an additional 31% (42 t C ha^{-1}) in the top 50 cm of soil compared to improved grassland fields. Larger additional stocks are found beneath older hedgerows than young ones, indicating progressive build-up in time.

Using the absolute change in sock stock associated with planting 37 years old hedges, we derived a SOC sequestration rate of 1.49 t C ha^{-1} yr^{-1}, which is larger than current aboveground sequestration estimates (1 t C ha^{-1} yr^{-1} [1]). Thus, 1.5 m wide hedgerows will sequester 820 kg CO_2 km^{-1} yr^{-1} in the soil beneath them, or 1094 kg CO_2 km^{-1} yr^{-1} when considering the uptake by soil and biomass.

These results allowed us to estimate the soil carbon sequestration potential of planting hedgerows in agricultural landscapes in England. Using our estimate of SOC sequestration rate, the length of existing hedgerows [2], the length and planting rates of hedges in agri-environment schemes (2004-2019) [3], and annual agricultural CO_2 emissions [4] we estimated the amount of carbon sequestered in soil as a result of hedgerows planted in agri-environment schemes and the carbon sequestration potential of increasing hedgerow length by 40% in England.

- Soil beneath hedgerows planted by agri-environment schemes will sequester annually only 0.02% of annual agricultural CO_2 emissions for 50 years after planting.
- Increasing hedgerow length by 40% will result in 7.9 Mt CO_2 being captured and stored in the soil, annually sequestering 2.8% of annual CO_2 emissions from agriculture for 50 years. This figure increases to 4.7% when accounting for both soil and aboveground biomass.
- If the width of newly planted hedgerows is increased from 1.5 to 2 m, this would sequester annually 6.4% of annual agricultural CO_2 emissions.

Planting rate is a key factor for the climate change mitigation potential of hedges to be realised. Today, planting by agri-environment schemes is too slow: in arable and grassland landscapes, at the highest planting rate achieved yet (425 km in 2019), it would take 455 years to reach the planting targets set by the Climate Change Committee. If planting rates can increase to ~12,000 km yr^{-1} to replicate that achieved by the 'Milk Plan' in Cumbria, it will only take 16 years for hedgerows to increase by 40%. If this can be achieved, hedgerows will contribute towards climate change mitigation and the UK net zero targets.

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Sources [1] Falloon, et al. Soil Use and Management 20, no. 2 (2004): 240-247. [2] Carey, P. D. 'Countryside Survey: UK Results from 2007' (2009). [3] Natural England Open Data Geoportal. (2020). [4] DEFRA 'Agricultural Statistics and Climate Change' (2019).

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