Extended Abstract
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Paper/Poster Title	Achieving net zero: exploring the contribution of new woodlands

Abstract prepared for presentation at the 97th Annual Conference of the Agricultural Economics Society, The University of Warwick, United Kingdom

27th – 29th March 2023

Abstract	*200 words max*

With the adoption of achieving net zero by 2050, reducing greenhouse gas emissions is of increasing importance. While woodlands have the potential to contribute to achieving the climate change targets through the carbon they sequester, planting rates within Northern Ireland remain low. This study reports on a spatial land-use model which has been developed to capture the ecosystem services delivered by alternative land-uses to understand the low planting rates. The model identified that while planting an additional 1,600 ha of woodland annually in Northern Ireland has the potential of reducing GHGs by 1.5 million tonnes of CO2e in 2050, reducing emissions from the agricultural sector in Northern Ireland by 26% and total emissions from Northern Ireland by 7%. However, the study found that when only ecosystem services with market values were considered, tree planting would incur a cost. Including greenhouse gas emissions into the model demonstrated that planting new woodlands delivered net benefits, with greater GHG reductions from the same area of woodland planted as the carbon value used within the model increased. In addition, 87% of avoided GHGs were due to the cessation of agriculture, rather than carbon sequestration. Policy implications for these results are discussed.

Keywords	Agriculture, Net zero, land-use, carbon, woodland, ecosystem service,
JEL Code	Q180 Agricultural Policy; Food Policy; Animal Welfare Policy see: www.aeaweb.org/jel/guide/jel.php?class=Q)

Introduction	*100 – 250 words*

With the adoption of achieving net zero by 2050, reducing greenhouse gas emissions is of increasing importance. The potential of planting new woodlands and increasing carbon sequestration to offset GHG emissions and therefore contribute to achieving climate change targets was first introduced in the Kyoto Protocol of 1997. However, woodland planting rates within Northern Ireland remain low, minimising their potential contribution to achieving net zero.

To understand why these rates are so low and explore how they can be enhanced, this study reports on a spatial land-use model which has been developed to capture the ecosystem services delivered by alternative land-uses, taking into account both market and non-market benefits and the spatial variation of the ecosystem services.

This edit of the model is focused on the land-uses of agriculture and woodlands and includes the ecosystem services of agricultural and timber production and climate regulation.

Methodology	***100 – 250 words***

A Land-Use Model for Northern Ireland (LUMNI) has been developed based on The Integrated Model (TIM) developed by Bateman et al (2014) for Great Britain. In this modelling approach, sub-models for each of the ecosystem services in question were developed to identify the benefits or costs resulting from each potential land-use. To capture the spatial variation in the delivery of ecosystem services, Northern Ireland was divided into 5 Km2 land parcels, with the model applied to each one. Therefore, the potential net benefit from a change in land-use was determined for each 5 Km2 land parcel.

This edit was focused on the impact of increasing the rate of woodland planting on agricultural land by attributing an economic benefit to the climate change impacts in the form of a carbon value as well as the market values delivered by agriculture and timber. Therefore, sub-models were developed for (1) agricultural production, (2) timber production, (3) GHGs from agriculture and (4) GHGs from new woodlands (carbon sequestration). In (1) and (2), market prices were used while in (3) and (4), a range of carbon values were used from £20 to 240 t/CO2e, the former being the value of carbon sequestered by woodlands in recent auctions in the UK and the latter, the value recommended by government guidance (BEIS, 2021).

A range of woodland planting scenarios were explored using LUMNI, with annual planting rated of 200, 900 and 1,600 hectares. To identify where woodlands should be planted, an optimising programme was run for each scenario based on the woodlands being planted in 20 hectare blocks.

Results	***100 – 250 words***

LUMNI demonstrated that when deciding to plant new woodlands:

1) The financial value of timber alone is insufficient to offset their loss from agricultural production, apart from a few small areas of poor agricultural land.
2) Including carbon values (cessation of agriculture and carbon sequestration) of at least £101/tonne of CO2e will deliver net benefits when planting 1,600 ha of new woodland annually.

3) Using a higher value for carbon of £240/tCO2e under government guidance (BEIS, 2021) will deliver:
    a. Greater GHG reductions from the same area of woodland planted.
    b. Woodlands planted on higher quality agricultural land.
4) The GHG reductions emissions from a change from agricultural use to woodlands are predominately from the cessation of agriculture (87%) rather than carbon sequestration from the new woodlands.

Discussion and Conclusion	***100 – 250 words***

This application of LUMNI has shown that introducing a value of carbon ensures that planting new woodlands will deliver a net benefit to the landowner and contribute to achieving net zero. Planting an additional 1,600 ha of woodland annually in Northern Ireland has the potential of reducing GHGs by 1.5 million tonnes of CO2e in 2050. This would reduce current emissions from the agricultural sector in Northern Ireland by 26% and total emissions by 7%. The study found that the majority of avoided GHGs were due to the cessation of agriculture (87%) when the land-use changed from agriculture to woodlands, rather than carbon sequestration of the new trees.

These findings have a direct impact on the development of new incentive schemes for woodland planting. The English Woodland Carbon Guarantee (WCaG) scheme has recently been introduced which enables farmers to sell the carbon sequestered by their woodlands at auctions. The average price of carbon was £20 t/CO2e in its first four auctions (Forestry Commission, 2022). which is lower than the break-even value of £101/tCO2e for 13% of the GHGs included within the model.,

These results indicate that the current value for carbon used in the current strategy are unlikely in isolation to deliver the desired levels of woodland planting in the locations which will have the greatest contribution to achieving net zero.