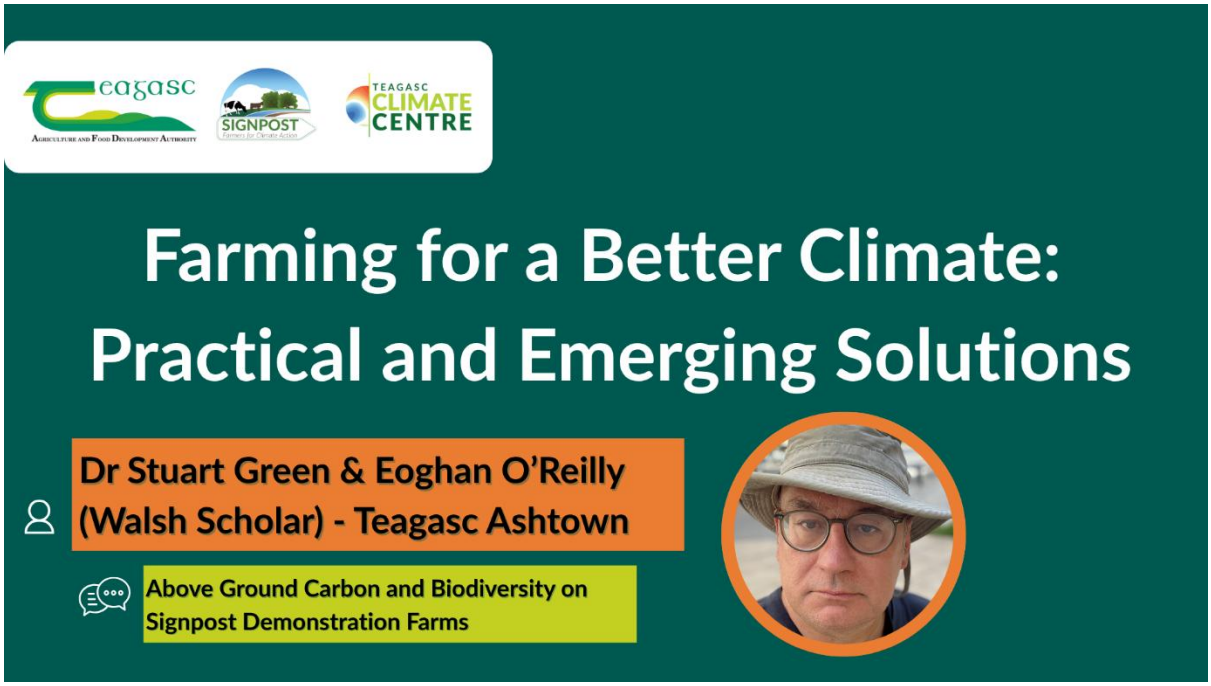

Above Ground Carbon and Biodiversity on Signpost Demonstration Farms

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In the winters of 2022/2023 and 2023/24, a total of 92 Signpost demonstration farms were surveyed using drone mounted cameras and LIDAR. The colour imagery taken by the drone gives a snapshot of the farmland cover and habitats. The LIDAR is a scanning technology the sends out laser pulses and measures the time it takes for the pulse to be reflected from the surface back to the drone. The imagery allows for mapping of biodiversity and the LIDAR data allows for estimating carbon stored in hedgerows.

Biodiversity

To achieve the highest possible accuracy in labelling and delineating habitat on the farm it was decided to hand map each farm from imagery. This is a laborious process, approximately a day per farm, but existing methods for automating (using Machine Learning) can achieve

accuracies of approximately 85% and it was considered insufficient to map change over time reliably. The farms are mapped using labels based on the National Land Cover Map classes but adapted for the Signpost Programme.

There are 45 possible labels with land covers including BUILDINGS, IMPROVED GRASSLAND and CROPS. Habitats include HEATH, SCRUB and WET GRASSLAND. Hedgerows and other woody biomass receive particular attention, with hedgerows split into managed (straight sided, topped), unmanaged (larger, less regular) and hedgerow with trees (field boundaries largely made up of bushes / trees greater than 10m). Individual trees are also mapped.

To assess the value of the habitats on the farm, an approach developed in Teagasc (Ruas et al, 2024) was used. Within that research, expert panels were set up to agree on a *Conservation Value* (CV) for a hectare of a habitat. So, for example, the panel gave blanket bog a CV score of 9 and improved grasslands a CV of 3 per hectare. Hedgerows received a value of 6 per hectare (this is a hectare covered by hedgerows, not a hectare of land surrounded by hedgerows).

In the paper, the trial area of Slaney Catchment had a median value CV score of 3.5 (area weighted average) with a value greater than 4.5 identified as showing areas in high conservation value. Using this scoring system, an area weighted conservation value score for each Signpost demonstration farm was calculated (Figure 1). The most common CV score is between 2.2 and 3.2. Most farms have values less than 4.5. Those with higher values are farms with wetland / upland components.

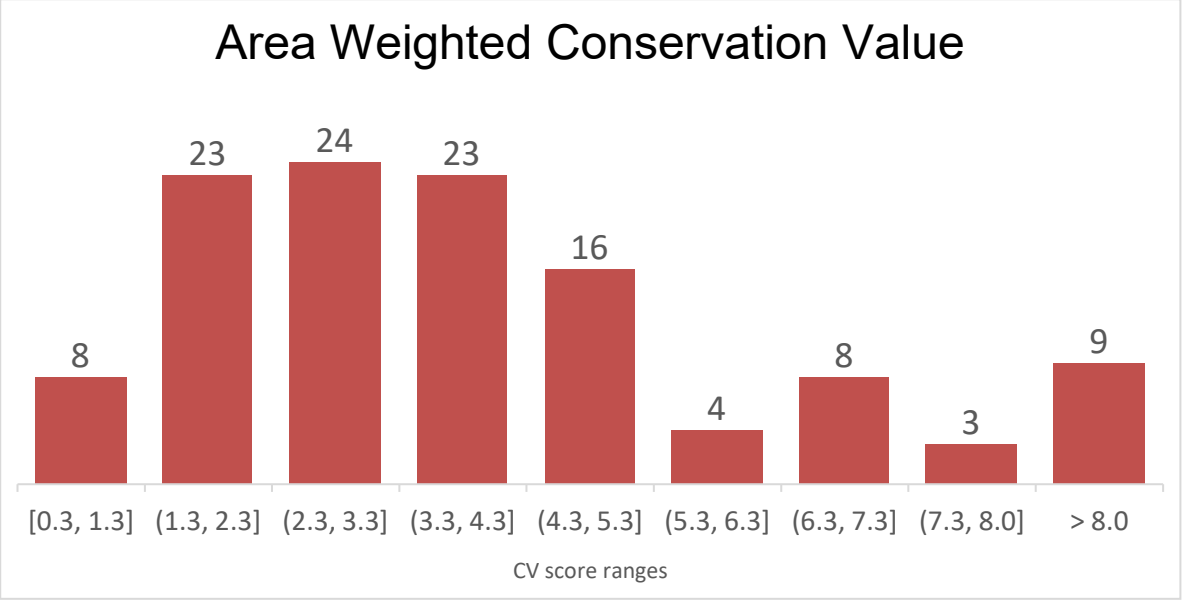

Figure 1. Histogram of area weighted conservation value scores for all Signpost demonstration farms (number of farms above each bar). Farms are placed in bins of CV values. So there are 8 farms with a CV score between 0.3 and 1.3 (bar furthest left) and these are the farms with lowest conservation value amongst the signpost demonstration farms.

The average score for each main system amongst the Signpost demonstration farm programme is shown in Table 1. Sheep farms have the highest CV values on average and tillage the lowest.

Table 1. Area Weighted Conservation Value (CV) scores for Signpost demonstration farms by type[1]

Type	Average Farm CV Score	Standard Deviation
Sheep	3.7	0.5
Suckler beef	3.6	1.0
Dairy beef	3.6	0.8
Dairy	3.5	0.7
Mixed	3.4	0.1

Tillage	2.5	0.3

[1]Note sheep and Tillage have less than 10 representatives

Carbon

The maps and lidar data are also used for the calculation of carbon stored in the woody biomass of the farm, hedgerows, woodland, forest, treelines, scrub and solo trees.

The estimation of carbon in hedgerows rely on a different approach, created over a number of projects in Teagasc over the last decade. The simple principle is to use the LIDAR data to create a 3D model of the volume of the hedgerow (Figure 2) and using figures devised in the Teagasc Farm Carbon project, convert this volume figure into carbon amounts for each hedgerow.

Figure 2: 3D digital model of a hedgerow on a Signpost demonstration farm

Using new methods developed as part of the Signpost Programme, the hedgerows are characterised into one of 4 types and the correct algorithm applied. The two most common types on Signpost demonstration farms are tightly cropped and less managed hedgerow types (See Figure 3).

Figure 3. a. Tightly cropped hedge. b. Less managed hedge

The processing of the entire LIDAR catalogue for the Signpost demonstration farms is not complete, and new algorithms are being developed to maximise precision of estimates. However, a preliminary analysis of all Signpost demonstration farms using the hedgerow maps and figures form Farm Carbon can give the system breakdown of carbon stored in hedgerows. See figure 4.

The average amount of carbon stored in hedgerow biomass on Signpost demonstration farms is 4.1tonnes carbon per ha of farmland.

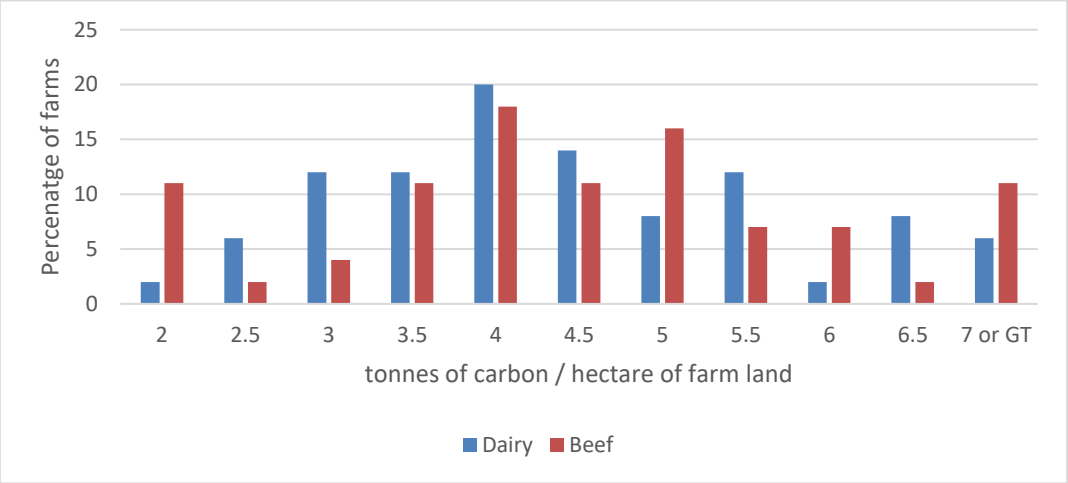

Figure 4: Histogram showing the range of values of tonnes of carbon stored in hedgerows per hectare of farmland for beef (n=45) and dairy (n=51)

Conclusion

The figure of 4.1tonnes of carbon per hectare is the amount of carbon stored in the hedgerows as a function of total farm area. For example, if it's a 100ha farm, there are 410 tonnes of carbon stored in the hedgerow. It is not annual carbon sequestration. It does not offset emissions on a year-by-year basis.

By allowing hedgerows to get wider, or taller or develop trees within the structure; move form Figure 3a to Figure 3b is the path to increase carbon stored and thus offset emissions.

The data collected in the Signpost Demonstration Farm Programme is supporting 2 current Walsh scholars. They are exploring two important areas: 1. How to better score a farm for its nature value- considering the whole farm and its landscape; 2. The second PhD is looking at how well these scoring systems detect change overtime and do they fully recognise all efforts at improving carbon stock and biodiversity.

The hedgerow detection algorithms are being refined to estimate the volume of a hedgerow from regular imagery and not require expensive LIDAR data. This will radically speed up and reduce the cost of monitoring for the next phase.

References

S. Ruas, J.A. Finn and D. Ó hUallacháin et al. Estimating conservation value and natural capital value of land cover classes in the Irish National Land Cover Map and application to a case study area. Irish Journal of Agricultural and Food Research. 2024. Vol. 63(1):27-42. DOI: https://doi.org/10.15212/ijafr-2023-0111