Biodiversity and Stored Carbon

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Two of the goals for signpost participants is to protect and enhance carbon storage and biodiversity on the farm. Biodiversity on the farms is assessed by the quantity and quality of habitats and Carbon is stored on the farm in the soil and in the plants growing on the farm; the biomass. Soil carbon can only be assessed through soil sampling as discussed earlier in this report. Carbon stored in biomass and the distribution of on farm habitats are suitable to be assessed using remote sensing technology.

In the winters of 2022/2023 and 2023/24 a total of 92 signpost farms were surveyed using drone mounted cameras and LIDAR. The colour imagery taken by the drone gives a snapshot of the farm land 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 (similar to RADAR), allowing a 3D picture of the farm to be built up of millions of points. This is the reason for flying in the winter, as it is more likely for a laser point to strike the ground beneath a tree, or a hedgerow, helping us get a fuller 3D picture.

The LIDAR points are converted into a Digital Surface Model, or DSM. This DSM is a representation, at very high detail, of the height of the surface of the farm (imagine a blanket thrown over the farm – the DSM is all the lumps and bumps visible). The DSM is combined with the drone images and other images from the national aerial survey. The drone pictures, captured in the winter, do not have as much information as data captured in the summer, so we use these earlier images to help interpretation.

This collection of data is then interpreted by a geospatial specialist to digitise by hand a high resolution biodiversity map. The classes mapped are based on the National Land Cover Map classes but adapted for signpost. The maps give a wall to wall hybrid land cover / habitat map for each block in each signpost farm. 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 treeline (field boundaries largely made up of bushes/trees greater than 10m). Individual trees are also mapped. The habitats as a percentage of the total area are calculated and displayed as a bar chart and as a bar chart and

as a total percentage (this is not the same calculation as space for nature). Values range from 3% of the farm to more than 15%.

These maps provide a baseline for the farmer and advisor – they show the structure of the habitat assets on the farm and help direct discussion about where and how to improve. For example showing where a short length of new hedgerow could go that would improve the overall connectivity of the farm habitats whilst also helping potentially to reduce run-off into water curses.

The maps 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 habitat maps allow us to extract LIDAR data for all these targets to calculate the biomass present. Each target has to be treated differently. For mature trees (woodland, treelines etc.) a technique known as automatic crown detection is used. Using the LIDARs ability to see through the canopy to the ground a new data set can be created called the Digital Terrain Model, DTM. This is sometimes called the bare earth model as it represents what the ground would look like with all the vegetation stripped away. Taking the values of the DTM away from the DSM, gives us a final product the Digital Canopy Model, DCM. The DCM is a 3D picture of the forests or trees and from this we can identify every individual tree and measure its exact height and width of its crown. With these two measurement we can estimate the biomass and thus the carbon in each tree.

The hedgerows rely on a different approach, created over a number of projects in Teagasc over the last decade. Using the DCM and map we can calculate the exact volume of a hedgerow and using equations developed in Teagasc convert that volume into biomass and thus tonnes of carbon.

It is important to think of volume when assessing how much carbon a hedgerow contains not its length. A short, tightly managed hedgerow will contain much less carbon (maybe as little as a 10th) than the same length of a wider, taller hedgerow that has also trees within it. The signpost farms assessed so far have stored within the woody biomass 100's tons of carbon. But it's important to note that this is carbon stored over the life of the farm-it is not the carbon sequestered annually by the farm biomass.
By the end of the year every farm flown will have a report containing a map and statistics of the farm habitat and carbon. Work has begun within two Teagasc Walsh Scholar PhD projects using this drone data to improve estimates of habitat quality (not just quantity) and to assess how best to reflect the small but important changes that farmers make on the farm that so far are not captured or valued.

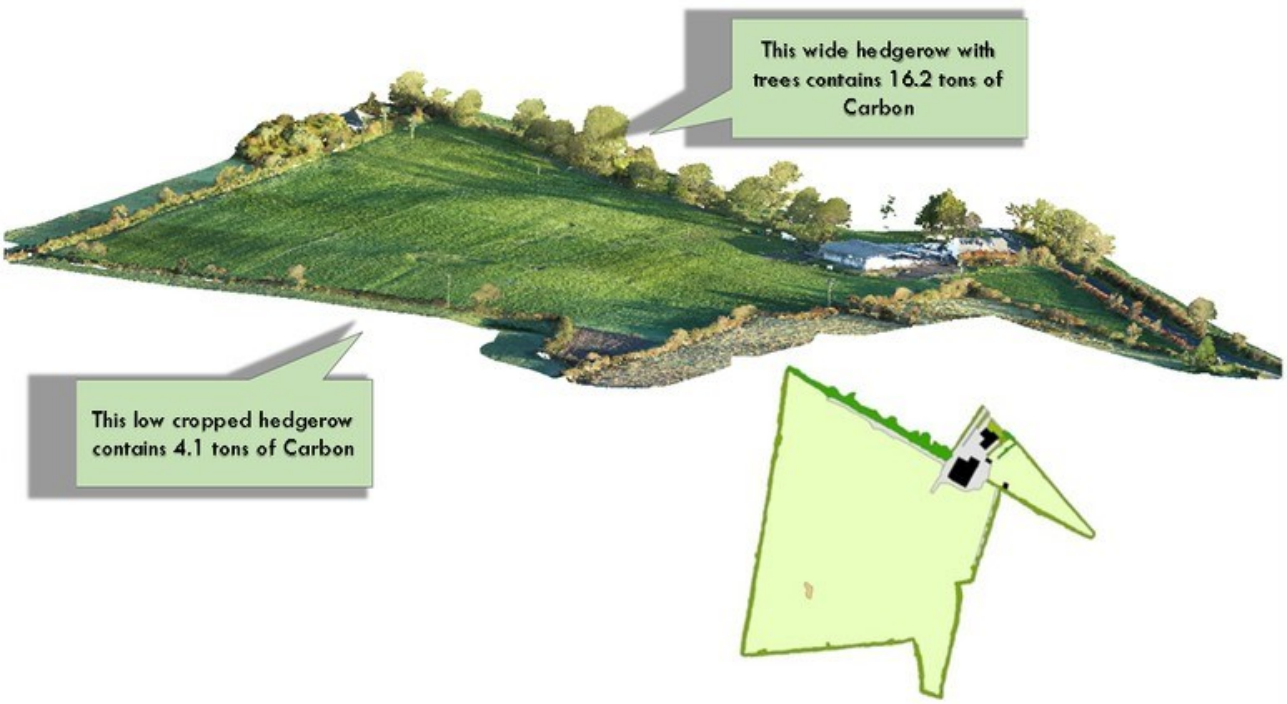

Figure 1. A 3D model of a signpost farm block, with accompanying habitat map. The figure shown is actual above ground carbon estimates for those two hedgerows (both the same length).