FACTSHEET

Carbon sequestration in woody vegetation

September 2021

What is woody vegetation?

Woody vegetation is land cover types dominated by woody plants such as trees (forests) and scrub or shrubs (scrub/shrubland).

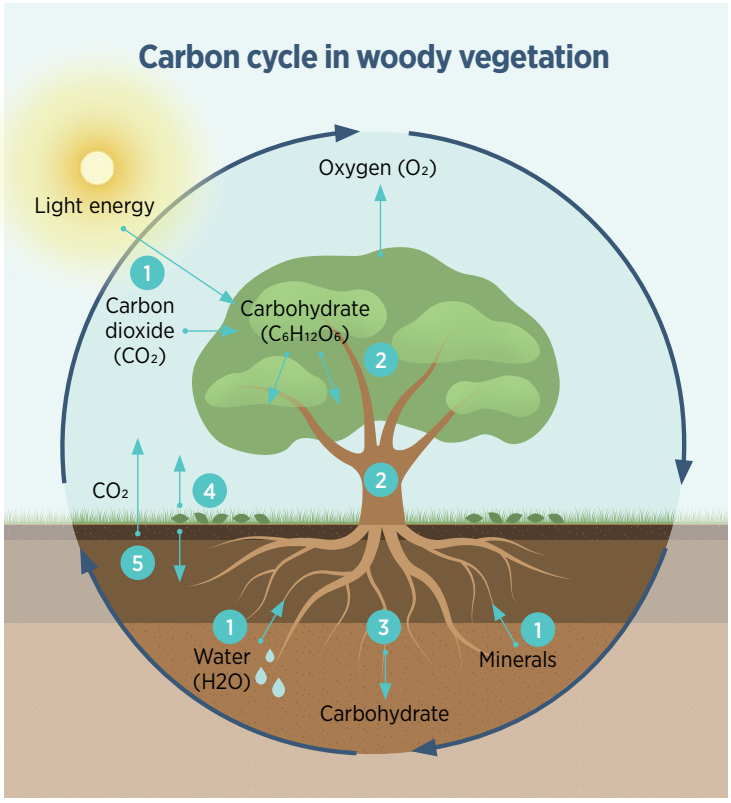
What is woody vegetation carbon sequestration?

Carbon sequestration is the process of a plant absorbing carbon dioxide during photosynthesis and then storing that carbon dioxide as carbon in the trunk, branches, foliage and roots (these together are known as biomass). Around 50% of a forest's biomass is carbon.

There are two different figures that can be calculated. The first is the total amount of carbon stored in the plant or forest at any one point in time. The second is to calculate the changes in the amount of stored carbon over a period in time (if done over a 1 year timeframe this provides an annual amount of sequestration that can be used to off-set annual GHG emissions).

What is accounted for in the calculation of total carbon stored?

1. Above-ground live biomass (leaves, stem, branches, needles)
2. Below-ground live biomass (roots)
3. Above ground woody debris (large branches and woody material on the ground)
4. Fine litter on the ground (leaves, small branches and twigs).



1. Plants draw carbon dioxide (CO_2) from the air and water (H_2O) from the soil (using light energy from the sun and minerals from the soil) to produce carbohydrates. This is known as photosynthesis.
2. Carbon is stored in foliage, branches, trunk and roots.
3. Excess carbohydrates are exuded by the roots to feed soil organisms.
4. Carbon released into the soil and atmosphere as plant material decomposes.
5. Soil organisms release carbon dioxide (CO_2) back into the atmosphere

A forest continues to increase its carbon stores as long as the sequestration is greater than the release of carbon from dead and decaying matter as it decomposes and releases carbon dioxide. Often once a forest reaches maturity the system is in balance and is no longer sequestering more carbon than it releases, so net sequestration is zero. If a forest is harvested then it becomes a source of carbon dioxide emissions from the logs removed and also from the rotting material left behind. The logs harvested become an emission in the year of harvest (regardless of the end use of the wood) and then the rotting material that remains (both above and below ground) becomes a source of emissions for a number of years.

What is in the calculation of total carbon sequestered?

The amount of carbon sequestered for an individual tree/shrub in any particular year depends on:

- Plant species or vegetation type
- Age of plant or stage of growth
- Climate (rainfall, temperature)
- Soil type

MPI produced some lookup tables designed to calculate carbon stocks for the Emissions Trading Scheme (ETS) and they require the following data to estimate the sequestration of a forest block:

- Plant species (or dominant species in a mixed species forest)
- Geographic region the forest is located
- Canopy cover – (more than 30% tree crown coverage per hectare)
- Age of forest
- Whether the forest is second or subsequent post-1989 forest (including the forest type in previous rotations)
- Width of tree block (must be more than 30 m wide)
- Trees species but reach at least 5 m at mature height.

These tables have been used as the basis by which to calculate carbon stocks and sequestration on-farm. You can find a link to these tables at www.beeflambnz.com/farmplan Go to the Farm Plan – Environment Module resource links and open the section for 'Chapter 4: Responding to a changing climate' resources.

Note: B+LNZ is advocating for more research on the sequestration rates, particularly regenerating and mature native vegetation, as we believe the rates in the MPI tables underestimate how much is happening. The main focus of research to date in New Zealand has been on the sequestration rates from exotic trees.

Note: this document is not going to list the on-farm woody vegetation that is eligible to use as an off-set for on-farm GHG emissions as this is yet to be determined through He Waka Eke Noa. B+LNZ is advocating for farmers to be able to get credit for as much woody vegetation that is genuinely sequestering carbon as possible, particularly pre-1989 native forest. We recommend that you record larger tree blocks (greater than 1 ha) and regenerating forest areas. Any other tree areas (e.g. shelter belts, riparian areas) you wish to record may be useful data to have in the future.

How do I calculate sequestration?

The calculation of stored carbon and annual sequestration can be difficult to measure directly and requires specialist knowledge. At an individual farm level, however, it can be done more simply by using figures that have come from research and are provided in the Carbon MPI look-up tables for forestry and the Emissions Trading Scheme. It is important to remember that the look up tables give you a value of tonnes of carbon dioxide per hectare.

You can do this yourself following the criteria in the MPI look-up table document (using tables for your particular region and tree species) or you can use tools such as OverseerFM, Farmax8 or the B+LNZ GHG calculator to calculate the annual sequestration for you.

It is important to remember to add the deforestation of trees as a source of carbon dioxide emissions in the year that the forest is harvested.

Why is carbon sequestration important to me?

Currently forests that are in the Emissions Trading Scheme (ETS) are not eligible to off-set GHG emissions at a farm level. However, the work in He Waka Eke Noa (see B+LNZ Factsheet 'Contributing to meeting our climate change commitments through He Waka Eke Noa' for more information) is still trying to determine what forests and other tree plantings on-farm may be eligible to offset farm GHG emissions. In the interim we are recommending that farmers record areas of forest on their properties with the following information (see B+LNZ Farm Plan: Environment Module for more details).

Current Areas of Woody Vegetation

CC2 **Example**

Vegetated area type and description (native, exotic, shrubland)	Approx age or year of planting	Area (ha) Pre-1990	Area (ha) Post-1989	Approx canopy cover (%)	Annual sequestration if known (kg CO_2 provided from some calculators)	ETS eligible? Y/N	State (declining, static, improving)
Planted pine plantation-exotic	*19 years (planted 2002)*		*18*	*100%*		*Y*	*Improving*
Regenerating manuka in step south facing middle country- native	*25*		*20*	*70%*	*114*		*Improving*
Old growth Kahikatea-native	*100+*	*35*				*N*	*Static*
Shelter belts	*15 years*		*3.4*	*80%*		*N*	*Improving*
TOTAL		*35*	*41.4*		*114*		

The MPI Look-Up tables cover five different forest types so if you can split your forest areas into those specific forest types then the sequestration rates are more accurate. The types are:

- Pinus radiata
- Douglas fir
- Exotic softwoods
- Exotic hardwoods
- Indigenous forest

B+LNZ adds a 6th category of scrubland, however the sequestration for that comes from the indigenous forest lookup table of the appropriate age and region.

Options to increase sequestration

You may have options on your farm to sequester carbon through additional areas of woody vegetation – exotics or natives, permanent forest or plantation forestry. See the table below for examples. This can also enhance biodiversity outcomes for your farm and depending on location, also support healthy freshwater outcomes by reducing erosion risk or providing riparian habitat.

Areas for consideration	Some suggested actions on-farm to achieve the list on the left. These are not exhaustive and are for guidance only
Increased sequestration	• Retiring less productive areas (where applicable) and planting in natives or exotic forestry • Planting shelter belts for improved animal production and sequestration • Collaborate with neighbours and council to form catchment groups for a cohesive catchment approach to planning riparian plantings or other areas such as eco-corridors • Planting of riparian areas and retiring critical source areas for dual sequestration and water quality outcomes • Control pests, diseases, and weeds in planted areas to maximise survival and sequestration of planted areas

Further information can be found here:

B+LNZ Factsheets: Find these Factsheets on the B+LNZ Knowledge Hub www.knowledgehub.co.nz

- Contributing to meeting our climate change commitments through He Waka Eke Noa

B+LNZ Farm Plan: Environment Module

- You can download the Farm Plan, with the 'Responding to a changing climate' chapter at www.beeflambnz.com/farmplan
- You can find MPI's 'lookup tables' for carbon sequestration at www.beeflambnz.com/farmplan - in the Farm Plan - Environment Module resource links, under Chapter 4 'Responding to a changing climate'

Websites

- https://www.nzfoa.org.nz/plantation-forestry/carbon-sequestration
- https://www.agmatters.nz/topics/on-farm-forestry/