



Soil Carbon: Measurement and Analysis

Types of soil carbon

Carbon in the soil exists in many forms, but for the purposes of measurement and analysis there are three main types: organic soil carbon, inorganic soil carbon and charcoal.

Soil organic matter (SOM) originates from biological material such as leaves, roots, microbes, fungi and animals, and plays an essential role in soil structure and its ability to hold water and air. It is a valuable form of carbon and is readily increased; however, it is also the least stable form of carbon in soils.

Soil organic carbon (SOC) refers specifically to the carbon component of soil organic matter, so laboratories measure and report on SOC. SOC is an indicator of healthy, productive soils and agricultural practices that retain and increase the amount of SOC, also improve productivity and sequester atmospheric carbon. The soil methods offered by the ACCU Scheme (formerly the ERF) measure the changes in SOC.

Soil organic carbon measurement methods

The most accurate and reliable way to measure soil organic carbon is careful, repeated direct field sampling followed by laboratory analysis using a dry combustion analysis and bulk density measurement. Direct sampling and dry combustion analysis is required to calibrate and validate modelling and high-tech field methods, such as spectroscopy, to reduce the volume of direct samples required in sampling rounds after the baseline is established and therefore reduces project costs.

Soil carbon projects registered with the Clean Energy Regulator (CER) must meet the requirements of the Estimating soil organic carbon sequestration using measurement and models method, which provides direction on sampling design, sampling techniques, sample preparation and analysis. Results are audited before carbon credits are issued.

Soil sampling needs to be conducted by an experienced soil technician who has not prepared the project Land Management Strategy or Carbon Farming Plan and has no financial interest in the project (i.e., interest in ACCU generation).

Field sampling

Collection of soil samples for soil organic carbon requires specific equipment, and experience with and knowledge of core sampling techniques.

Dry combustion

The most accurate standard laboratory test for soil carbon is dry combustion using an elemental analyser. These instruments heat a small sample (less than a gram) of soil to 900°C then measure the carbon dioxide released. The results are expressed as the percentage of carbon in the sample (%/g).

Bulk density

Density of soils can vary widely. Organic matter is lighter than most mineral matter, so if organic matter decreases in a soil, the density will likely increase. The measurement for bulk density usually requires collection of intact soil samples using a core cylinder (of known volume). Bulk density is the dry weight in grams divided by the volume in cubic centimetres (g/cc) and provides useful information about the porosity of the soil.

Spectroscopy

Uses a device that directs known spectra of Near Infrared light onto a sample and detects the modification of the light as it is reflected or transmitted through the sample. The spectral modification of the light is converted to information regarding the composition of the sample.

Sample analysis

Analysis of soil organic carbon needs to be undertaken by a laboratory certified by the Australasian Soil and Plant Analysis Council (ASPAC) for organic carbon analysis by dry combustion and be accredited by the National Association of Testing Authorities (NATA).

DPIRD recommends using a WA-based laboratory which provides the option for Colwell P, Phosphorus Buffering Index (PBI) and Nitrogen analyses. Other soil analyses such as EM38 assessments for electrical conductivity (EC), cation exchange capacity (CEC), pH and soil respiration are always useful and support the improved understanding of the “soil story” when assessing soil carbon.

Resources

DPIRD

- [Service Provider Directory](#) includes local soil technicians and laboratories
- [What is soil organic carbon?](#)
- [Simple guide to describing soils](#)

Clean Energy Regulator (CER)

- [Soil Carbon Projects](#)
- [Understanding your soil carbon - Simple method guide - provides a step-by-step guide on how to register, run and report on a soil carbon project.](#)
- [Soil carbon sampling guidance](#)
- [Soil carbon land management strategy guidance](#)

Important Disclaimer

The Chief Executive Officer of the Department of Primary Industries and Regional Development and the State of Western Australia accept no liability whatsoever by reason of negligence or otherwise arising from the use or release of this information or any part of it.

Copyright © State of Western Australia (Department of Primary Industries and Regional Development), 2024.