Negotiation-support toolkit for learning landscapes

Editors
MEINE VAN NOORDWIJK
BETHA LUSIANA
BERIA LEIMONA
SONYA DEWI
DIAH WULANDARI

WORLD AGROFORESTRY CENTRE
Southeast Asia Regional Program

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26 | Reducing emissions from peatlands (REPEAT)

Maswar, Meine van Noordwijk and Fahmuddin Agus

Reducing Emissions from Peatlands (REPEAT) is a methodological tool designed to fill the gaps in our knowledge about peatlands. REPEAT simplifies collecting data and the subsequent consideration of land-use options.

Introduction

Peatlands accumulate plant matter over hundreds of years because decomposition is slower than organic inputs owing to lack of oxygen, low nutrient content and types of organic matter that are biochemically resistant to decomposition. These lands can store greater amounts of carbon than the best-stocked rainforest.

Most agriculture on peatland requires drainage of the land and use of fertilizers, both of which increase microbial breakdown of the peat, resulting in large carbon dioxide (CO_2) emissions. When fire is used to clear peatland, emission of CO_2 can be greater than from old, dense rainforest and conversion to monoculture tree crops, such as oil palm, also creates large amounts of emissions. However, some modification of peat swamp-forests—to increase the numbers of trees that are valuable to humans—produces little, if any, emissions but data on such types of agroforestry are scarce. REPEAT is designed to make it easier to collect these data.

Objectives

Practical ways to sample an undisturbed peat profile, and assess its carbon stock and emissions owing to changing the land use of the natural peatland ecosystem to a mostly agricultural one.

Steps

1. Assess the carbon stock in peatland soils based on depth, density and carbon content

The most popular and simplest way to sample undisturbed peat profiles is to use a peat auger, that is, a plate fin and a rotating half-circular sampler with a cutting edge along one side. Having reached the desired sample depth, the user turns the entire sampler 180° clockwise. During turning, the fin remains in position as the sampler completes the circle thereby forming an enclosed core sample. Figure 26.1 shows the full procedure for collecting peat soil samples to determine bulk density calculated by dividing the mass of the oven-dried sample by the volume of the core sample, ash and carbon content measured by 1) loss-on-ignition (LOI method); and 2) hydrogen peroxide digestion (Walkley and Black method).

Figure 26.1. Soil-sampling procedure and analysis for both bulk density and ash content

Note: a, b and c = peat-soil sampling procedure; d and e = bulk density determination; f, g and h = ash content determined by LOI method

2. Quantify the annual rate of CO_2 loss by measuring subsidence and compaction

Land subsidence is a symptom of the collapse of peat layers above the water table, owing to oxidation. Usually, subsidence is associated with an increase in the bulk density of the remaining peat and a correction factor is needed before subsidence data can be used for CO_2 emission estimates. Peat subsidence can be measured with a metal rod or other marker inserted into the underlying mineral soil (Figure 26.2). The distance between the soil surface and measuring point is recorded at three-monthly or yearly intervals. Adjacent to the stick, samples for bulk density need to be made at the start and end of the measurement period.

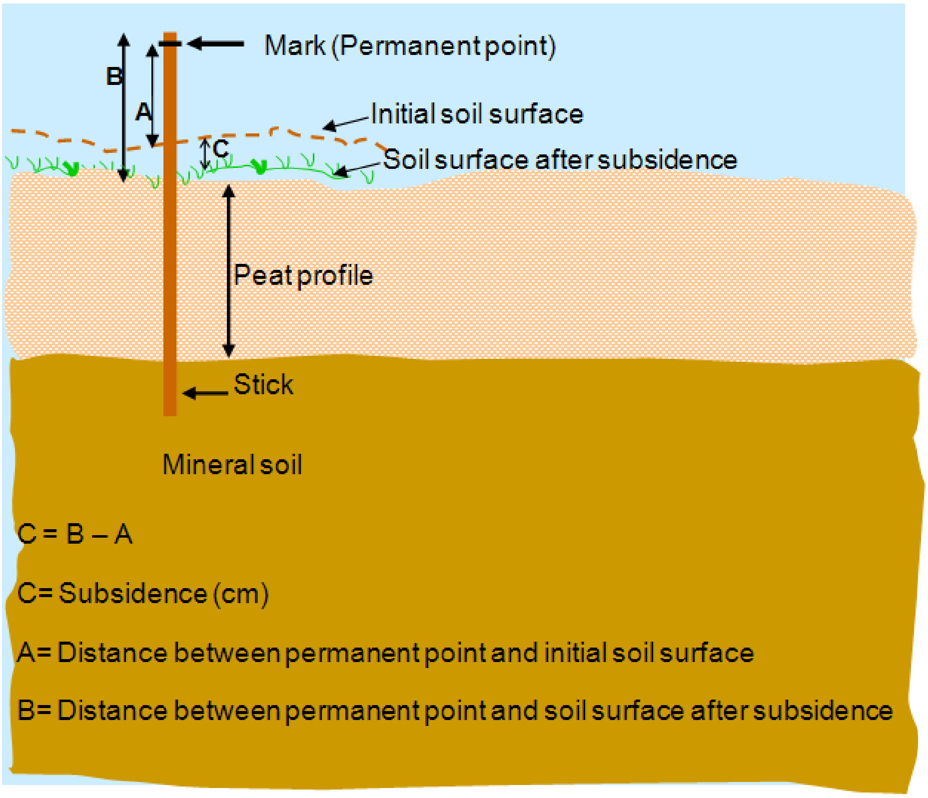

Figure 26.2. Conventional (field) method for measurement of peatland subsidence

3. Extrapolate to a broader spatial context through the use of ash content as internal tracer

In theory, carbon loss from peatland can be estimated from the progressive increase in mineral (ash) content after drainage, burning and/or a combination of both. This type of loss of the organic matter in the peat material sees the mineral fraction become more concentrated on the surface of peatland (Grønlund et al 2008, Turetsky and Wieder 2001, Maswar 2010). Carbon loss from the surface of peatland can be estimated based on the increase in ash concentration on the oxidation profile of peat soils.

4. Relate CO_2 loss to drainage, fertilisation and other aspects of agriculture or agroforestry

Carbon loss from the surface of peatland owing to fertiliser application can be quantified from the increase in ash concentration. By measuring subsidence and compaction in transects perpendicular to the drains and monitoring the groundwater table at measurement locations, emissions can be related to the deepest groundwater depth in a season or year. Carbon loss from peatland burning can be quantified based on the difference in ash concentration in the surface layers of burned and unburned peatland.

5.Identify 'best practice' and options for further improvement of low-emission peatland use

Maintaining peatland implies maintaining the conditions for low peat oxidation: wet and nutrient poor.

Example of application

Studies show that sites with a maximum depth of groundwater table of 20–40 cm have the lowest overall greenhouse gas emission rates, as shallower groundwater leads to methane emissions (Handayani 2009). In practice, the horizontal distance between drains is closely related to the depth of water table in the drain required to achieve sufficient drainage for all trees. A finely distributed network of shallow drains can allow good tree growth at low net emission rates.

Rubber trees on peatland can be grown without high fertiliser application rates, as the latex removed from the field has low nitrogen content, in contrast to oil palm, which has high fertiliser requirements. Rubber agroforests on peat in Aceh Barat were found to have low CO_2 emission rates. Other agroforestry systems, such as those with *Dyera* species ('jelutung'), have properties similar to *Hevea brasiliensis* (rubber) and returned similar results. Native fruit trees on peatland tend to be restricted to nutrient-enriched zones close to rivers.

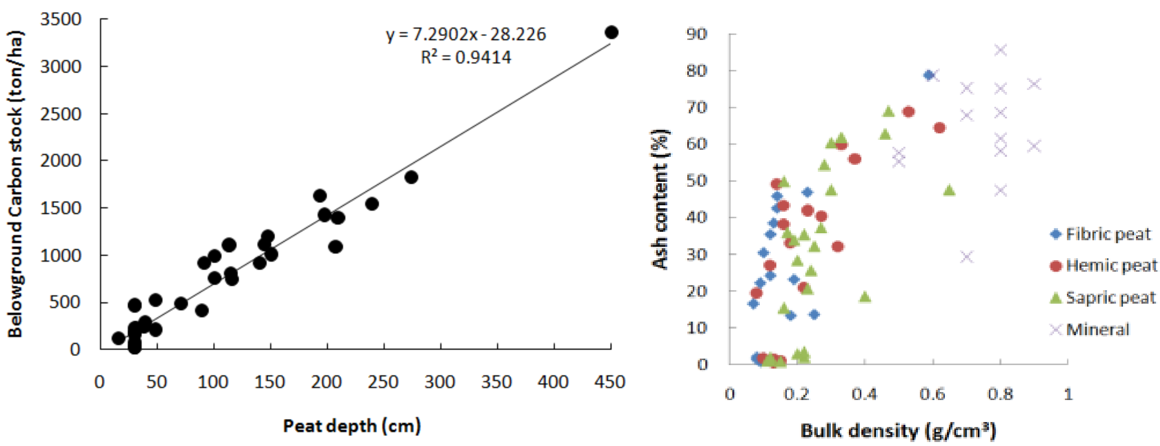

Figure 26.3. Example of the relationship between peat depth and total belowground carbon stock and the relationship between bulk density and ash content in samples from Lamandau, Central Kalimantan, Indonesia

Data source: Joshi et al 2010

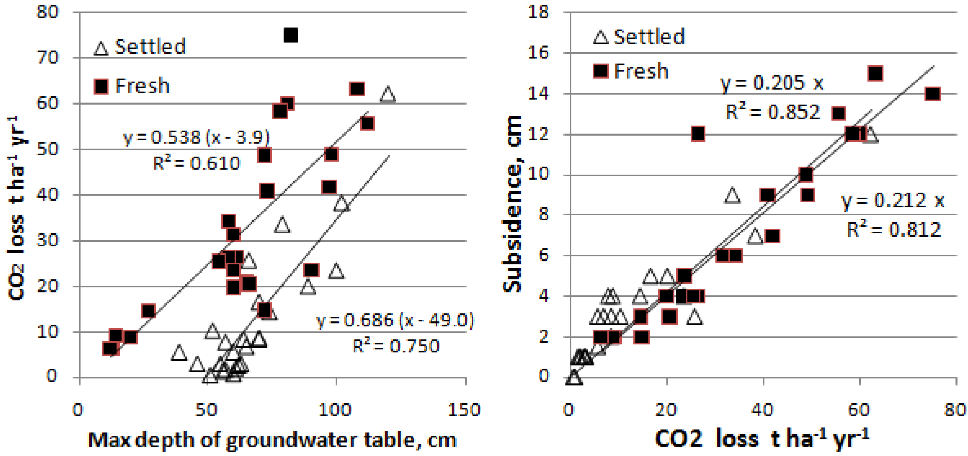

Figure 26.4. Example of the relationships between maximum depth of groundwater table and the calculated annual rate of CO2 loss owing to peatland decomposition

Note: For 'fresh' sites with recent (last two years) change in their drainage condition and 'settled' sites where drain depth was increased further in the past

Data source: Maswar 2010

Open questions

Because of the importance of reliable CO_2 emission estimates and the uncertainties in each of the methods, a triangulation approach that uses multiple methods is advisable. There are several important questions to consider.

- How variable are estimates of carbon loss or CO_2 emission when different tools and methods are used?
- How can point data be extrapolated to field and landscape scales by understanding the drainage and fertilisation patterns on top of the inherent variability of peat domes?
- What low-emission agroforestry practices can be further developed for supporting low-carbon-emission livelihoods options in peatlands?

Key references

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Maswar. 2011. *Kajian cadangan karbon pada lahan gambut tropika yang didrainase untuk tanaman tahunan*. Assessment of carbon stocks in tropical peatlands drained for annual crops. PhD Thesis. Bogor, Indonesia: Program Studi Ilmu Tanah, Sekolah Pascasarjana, Institut Pertanian Bogor.

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The landscape scale is a meeting point for bottom–up local initiatives to secure and improve livelihoods from agriculture, agroforestry and forest management, and top–down concerns and incentives related to planetary boundaries to human resource use.

Sustainable development goals require a substantial change of direction from the past when economic growth was usually accompanied by environmental degradation, with the increase of atmospheric greenhouse gasses as a symptom, but also as an issue that needs to be managed as such.

In landscapes around the world, active learning takes place with experiments that involve changes in technology, farming systems, value chains, livelihoods' strategies and institutions. An overarching hypothesis that is being tested is:

> Investment in institutionalising rewards for the environmental services that are provided by multifunctional landscapes with trees is a cost-effective and fair way to reduce vulnerability of rural livelihoods to climate change and to avoid larger costs of specific 'adaptation' while enhancing carbon stocks in the landscape.

Such changes can't come overnight. A complex process of negotiations among stakeholders is usually needed. The divergence of knowledge and claims to knowledge is a major hurdle in the negotiation process.

The collection of tools—methods, approaches and computer models—presented here was shaped by over a decade of involvement in supporting such negotiations in landscapes where a lot is at stake. The tools are meant to support further learning and effectively sharing experience towards smarter landscape management.

World Agroforestry Centre

ASB Partnership for the Tropical Forest Margins

AARD

Federal Ministry for Economic Cooperation and Development

Norad

IFAD Enabling poor rural people to overcome poverty

CGIAR Research Program on Forests, Trees, and Agroforestry