International Technical Webinar

Climate change and agriculture: Quantifying carbon stocks in soils and their evolution

Wednesday 14 April 2021

14:30 - 16:00 (Rome time)

Food and Agriculture Organization of the United Nations

agreenium

UNITED NATIONS ESCAP
Economic and Social Commission for Asia and the Pacific

FUTURE FOOD INSTITUTE

Climate change and agriculture: Quantifying carbon stocks in soils and their evolution

International Technical Webinar – Wednesday 14 April 2021

Tools and methods for quantifying soil carbon stocks in a climate change context

Martial Bernoux

Office of Climate Change, Biodiversity and Environment (OCB)

Food and Agriculture Organization of the United Nations

FAO elearning ACADEMY | agreenium | UNITED NATIONS ESCAP Economic and Social Commission for Asia and the Pacific | FUTURE FOOD INSTITUTE

Climate change and agriculture: Quantifying carbon stocks in soils and their evolution

International Technical Webinar – Wednesday 14 April 2021

Tools and methods for quantifying soil carbon stocks in a climate change context

Why soil carbon stocks are important for climate change?

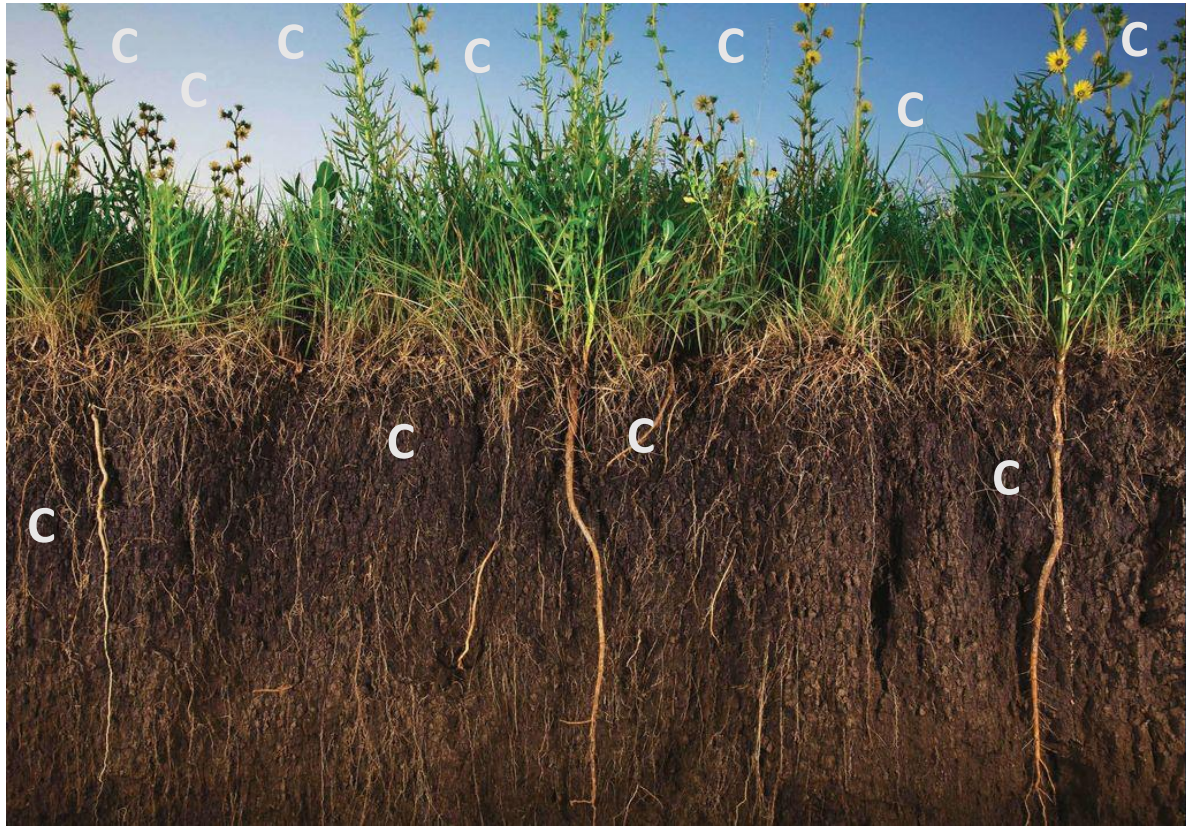
Are the soils considered by the UNFCCC?

United Nations Framework Convention on Climate Change

Do we have tools and methods for quantifying soil carbon stocks?

FAO elearning ACADEMY | agreenium | UNITED NATIONS ESCAP Economic and Social Commission for Asia and the Pacific | FUTURE FOOD INSTITUTE

Why soil carbon stocks are important for climate change?

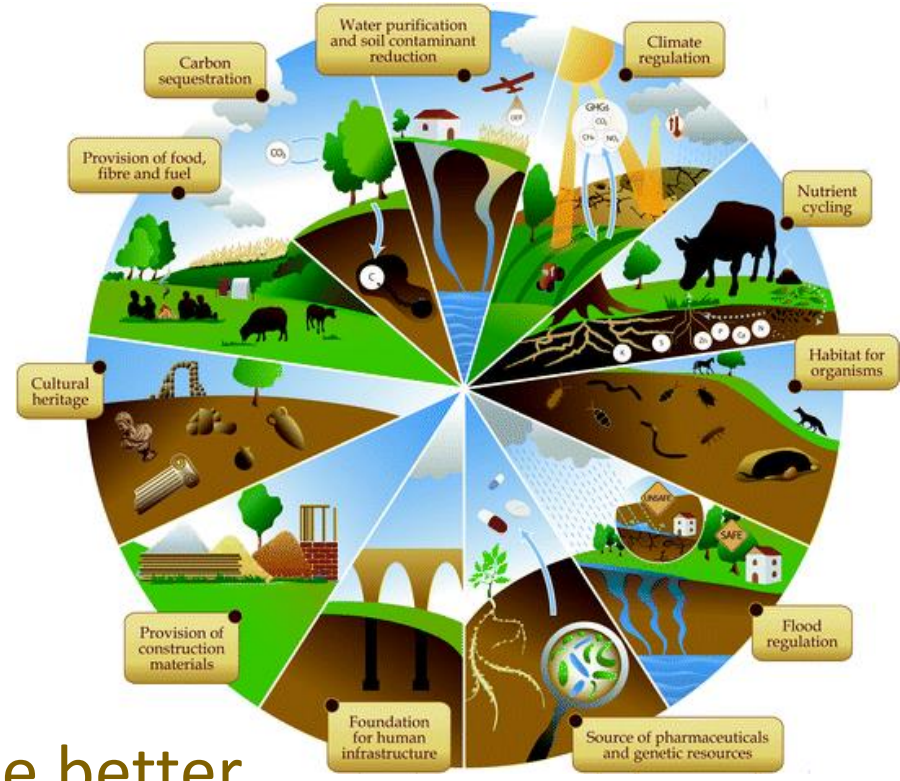


The less, the better

CO_2

Organic Matter

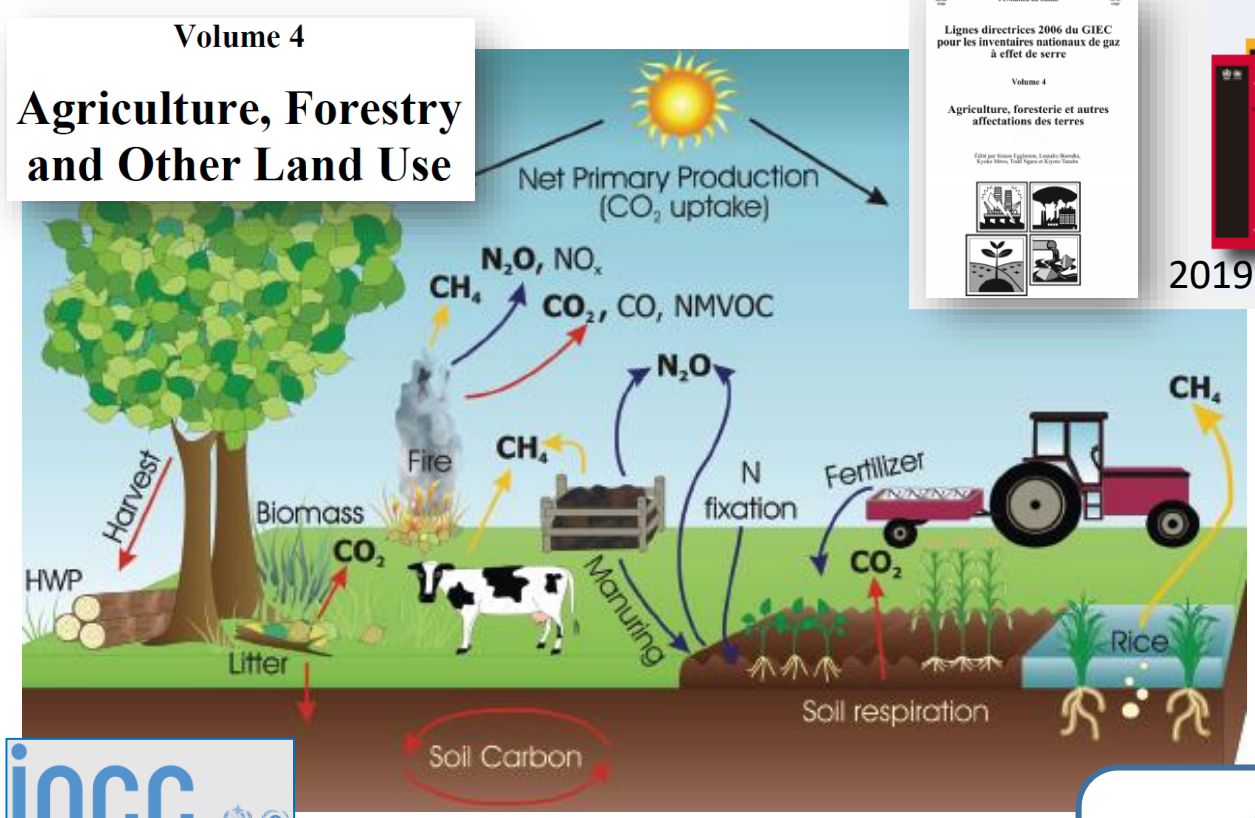
The more, the better

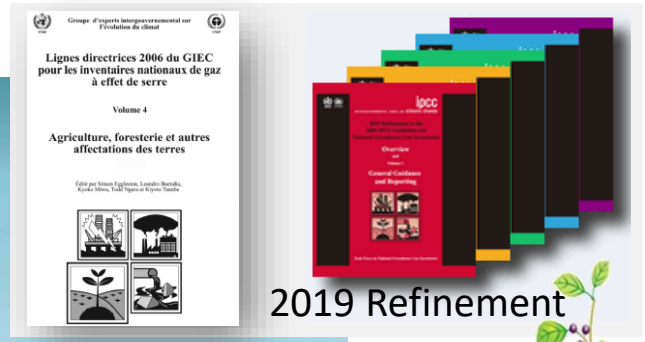


Are the soils considered by the UNFCCC?

United Nations
Framework Convention on
Climate Change

- Soils are considered in the reporting (national communication of GHG emissions, etc)

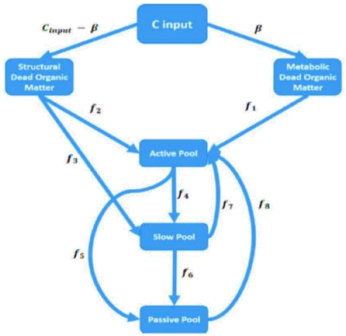




A set of different methods and defaults figures (reference values, scaling factors for management and for inputs, simplified modelling approach, etc)

TABLE 2.3 (UPDATED)
DEFAULT REFERENCE CONDITION SOIL ORGANIC CARBON STOCKS (SOC_{REF}) FOR MINERAL SOILS (TONNES C HA^{-1} IN 0-30 CM DEPTH) [1,2]

IPCC Climate Zone [5]	IPCC soil class [6]		
	High activity clay soils (HAC) [7]	Low activity clay soils (LAC) [8]	Sandy soils (SAN) [9]
Polar Moist/Dry (Px - undiff)[13]	59 ± 41% (24)	NA	27 ± 67% (18)
Boreal Moist/Dry (Bx - undiff)[13]	63 ± 18% (35)	NA	10 ± 90% [4]
Cool temperate dry (C2)	43 ± 8% (177)	33 ± 90% [3]	13 ± 33% (10)
Cool temperate moist (C1)	81 ± 5% (334)	76 ± 51% (6)	51 ± 13% (126)
Warm temperate dry (W2)	24 ± 5% (781)	19 ± 16% (41)	10 ± 5% (338)
Warm temperate moist (W1)	64 ± 5% (489)	55 ± 8% (183)	36 ± 23% (39)
Tropical dry (T4)	21 ± 5% (554)	19 ± 10% (135)	9 ± 9% (164)
Tropical moist (T3)	40 ± 7% (226)	38 ± 5% (326)	27 ± 12% (76)
Tropical wet (T2)	60 ± 8% (137)	52 ± 6% (271)	46 ± 20% (43)
Tropical montane (T1)	51 ± 10% (114)	44 ± 11% (84)	52 ± 34% (11)
	Spodic soils (POD) [10]	Volcanic soils (VOL) [11]	Wetland soils (WET) [12]
Polar Moist/Dry (Px - undiff)[13]	NO	NA	NA
Boreal Moist/Dry (Bx - undiff)[13]	117 ± 90% [3]	20 ± 90% [4]	116 ± 65% (6)
Cool temperate dry (C2)	NO	20 ± 90% [4]	87 ± 90% [3]
Cool temperate moist (C1)	128 ± 14% (45)	136 ± 14% (28)	128 ± 13% (42)
Warm temperate dry (W2)	NO	84 ± 65% (10)	74 ± 17% (49)
Warm temperate moist (W1)	143 ± 30% (9)	138 ± 12% (42)	135 ± 28% (28)
Tropical dry (T4)	NA	50 ± 90% [4]	22 ± 17% (32)
Tropical moist (T3)	NA	70 ± 90% [4]	68 ± 17% (55)
Tropical wet (T2)	NA	77 ± 27% (14)	49 ± 19% (33)
Tropical montane (T1)	NA	96 ± 31% (10)	82 ± 50% (12)



FAO elearning ACADEMY

Preparing a greenhouse gas inventory under the Enhanced Transparency Framework
OCTOBER 2020 1 h 30 m

The national greenhouse gas inventory for agriculture
NOVEMBER 2020 5 h 30 m

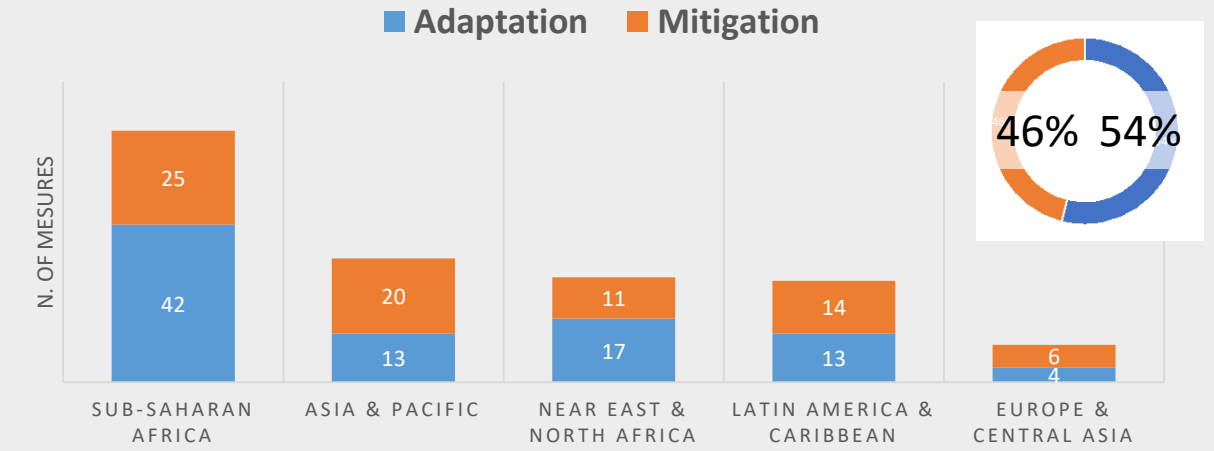
The national greenhouse gas inventory for land use
MARCH 2019 17 h

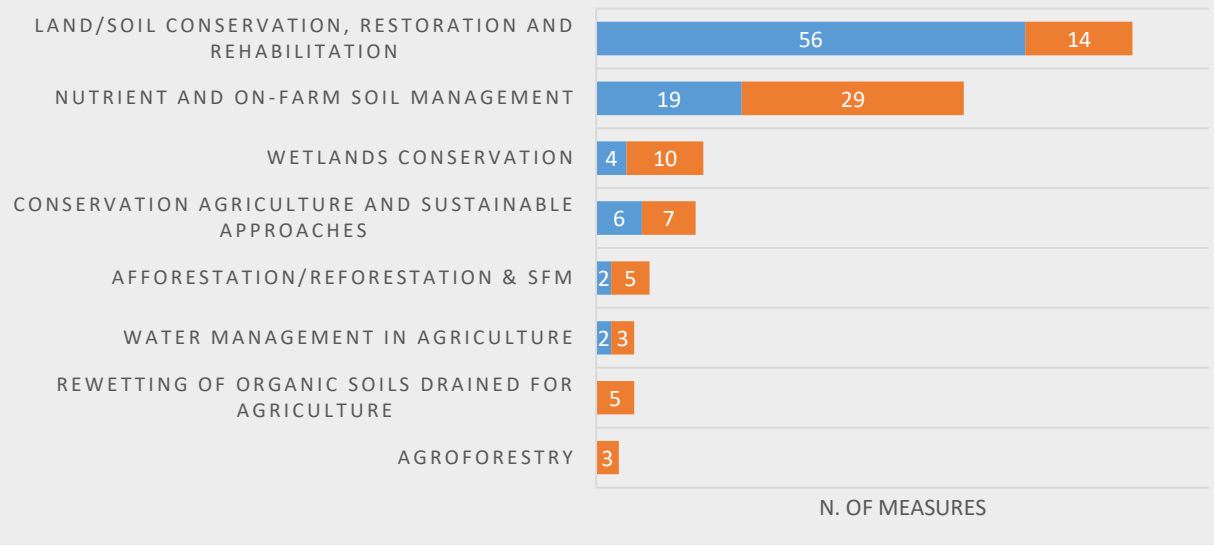
Are the soils considered by the UNFCCC?

United Nations
Framework Convention on
Climate Change

- Soils are referenced in adaptation/mitigation policies (NDCs under the Paris Agreement)

- **Almost half of all NDCs reference soils** as part of their mitigation and/or adaptation priorities – **the majority in SSA and Asia-Pacific**
- **Agricultural soils, wetlands and organic soils are the prominent focus** of soil-related adaptation and mitigation measures in the NDCs.
- **Adaptation efforts focus on** conserving, restoring and rehabilitating agricultural soils and managing on-farm nutrients.
- **Mitigation efforts focus on** reducing emissions from agricultural soils, enhancing soil organic carbon in natural and managed landscapes, including wetlands and organic soils, as well as protecting and restoring forest land.





Are the soils considered by the UNFCCC?

United Nations Framework Convention on Climate Change

- Soils are one of the topic discussed by the Koronivia Joint Work on Agriculture

Decision 4/CP.23

Koronivia joint work on agriculture

COP23 FIJI UN CLIMATE CHANGE CONFERENCE BONN 2017-18

The Conference of the Parties,

Recalling decision 2/CP.17, particularly paragraphs 75–77,

Having considered the reports to the Subsidiary Body for Scientific and Technological Advice on the five in-session workshops on issues related to agriculture,[1]

1. *Requests* the Subsidiary Body for Scientific and Technological Advice and the Subsidiary Body for Implementation to jointly address issues related to agriculture, including through workshops and expert meetings, working with constituted bodies under the Convention and taking into consideration the vulnerabilities of agriculture to climate change and approaches to addressing food security;

2. *Invites* Parties and observers to submit,[2] by 31 March 2018, their views on elements to be included in the work referred to in paragraph 1 above for consideration at the forty-eighth session of the subsidiary bodies (April–May 2018), starting with but not limited to the following:

(a) Modalities for implementation of the outcomes of the five in-session workshops on issues related to agriculture and other future topics that may arise from this work;

(b) Methods and approaches for assessing adaptation, adaptation co-benefits and resilience;

(c) Improved soil carbon, soil health and soil fertility under grassland and cropland as well as integrated systems, including water management;

(d) Improved nutrient use and manure management towards sustainable and resilient agricultural systems;

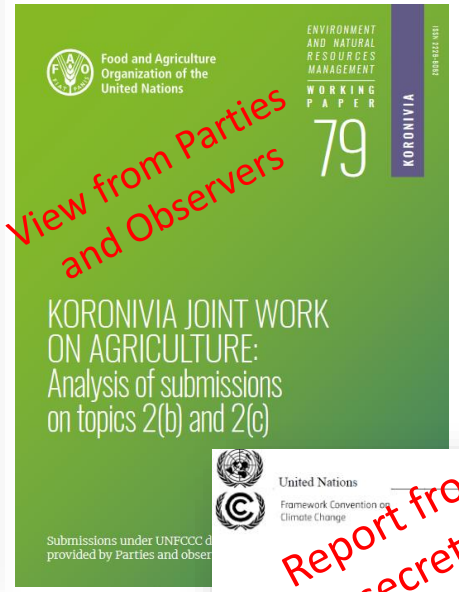
(e) Improved livestock management systems;

(f) Socioeconomic and food security dimensions of climate change in the agricultural sector.

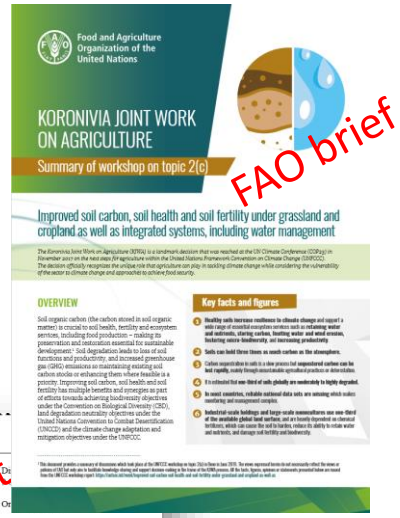
3. *Requests* that any actions of the secretariat resulting from the provisions in paragraph 1 above be undertaken subject to the availability of financial resources;

4. *Also requests* the subsidiary bodies to report to the Conference of the Parties on the progress and outcomes of the work referred to in paragraph 1 above at its twenty-sixth session (November 2020).

(2c) Improved soil carbon, soil health and soil fertility under grassland and cropland as well as integrated systems, including water management



View from Parties and Observers



FAO brief

Report from the secretariat

http://www.fao.org/climate-change/our-work/what-we-do/koronivia/en/

The narrative is evolving from "Soil Carbon sequestration" to "heathy soil"

We have never been so close to have a conclusion at next COP that would be a game-changer

A clear signal supporting more investments for healthy soils

GREEN CLIMATE FUND gef

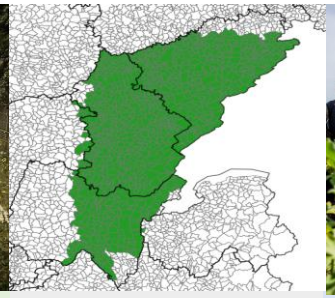
Research, modalities, pilot phases, scaling up....

Soils fully considered in NDC / national policies

Do we have tools and methods for quantifying soil carbon stocks?

Need to consider different scales

Field plots and farm



National and sub-national

Project (including for voluntary markets)

frontiers in Environmental Science

REVIEW
published: 12 July 2017
doi: 10.3389/fenvs.2017.00041

Accounting for Carbon Stocks in Soils and Measuring GHGs Emission Fluxes from Soils: Do We Have the Necessary Standards?

Antonio Bispo[1], Lizzi Andersen[2], Denis A. Angers[3], Martial Bernoux[4], Michel Brossard[5], Lauric Cécillon[6], Rob N. J. Comans[7], Joop Harmsen[8], Knut Jonassen[9], Frank Lamé[10], Caroline Lhuillery[11], Stanislav Maly[12], Edith Martin[1], Angus E. Mcelnea[13], Hiro Sakai[14], Yoichi Watabe[15] and Thomas K. Eglin[1]*

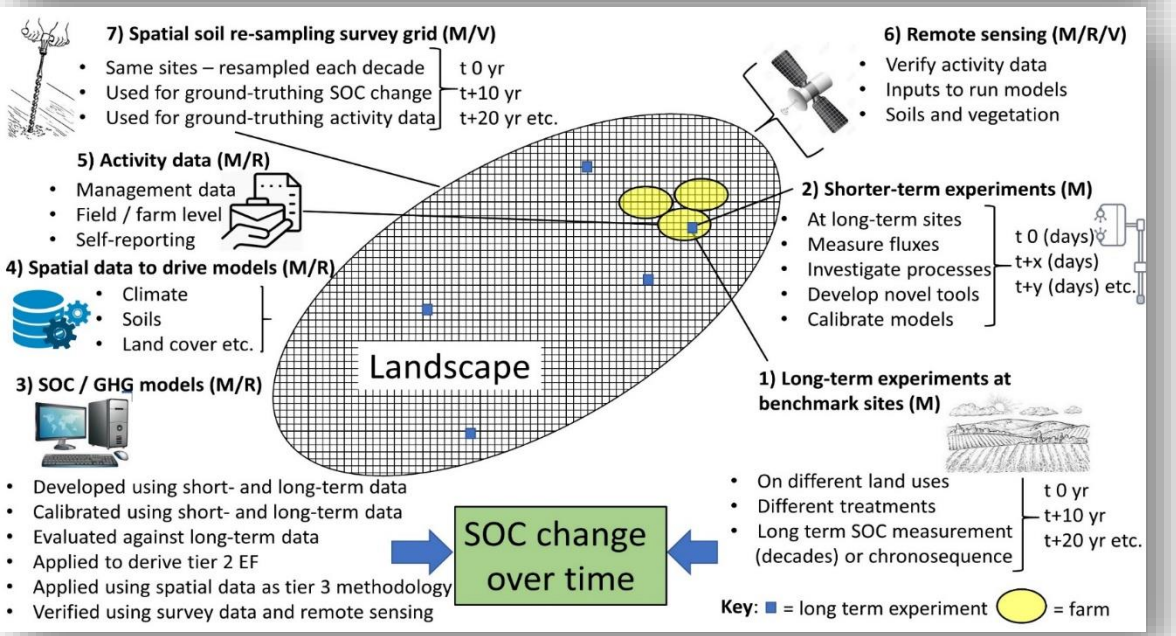
https://doi.org/10.3389/fenvs.2017.00041

Received: 13 July 2019 | Accepted: 22 August 2019
DOI: 10.1111/gcb.14815

INVITED RESEARCH REVIEW

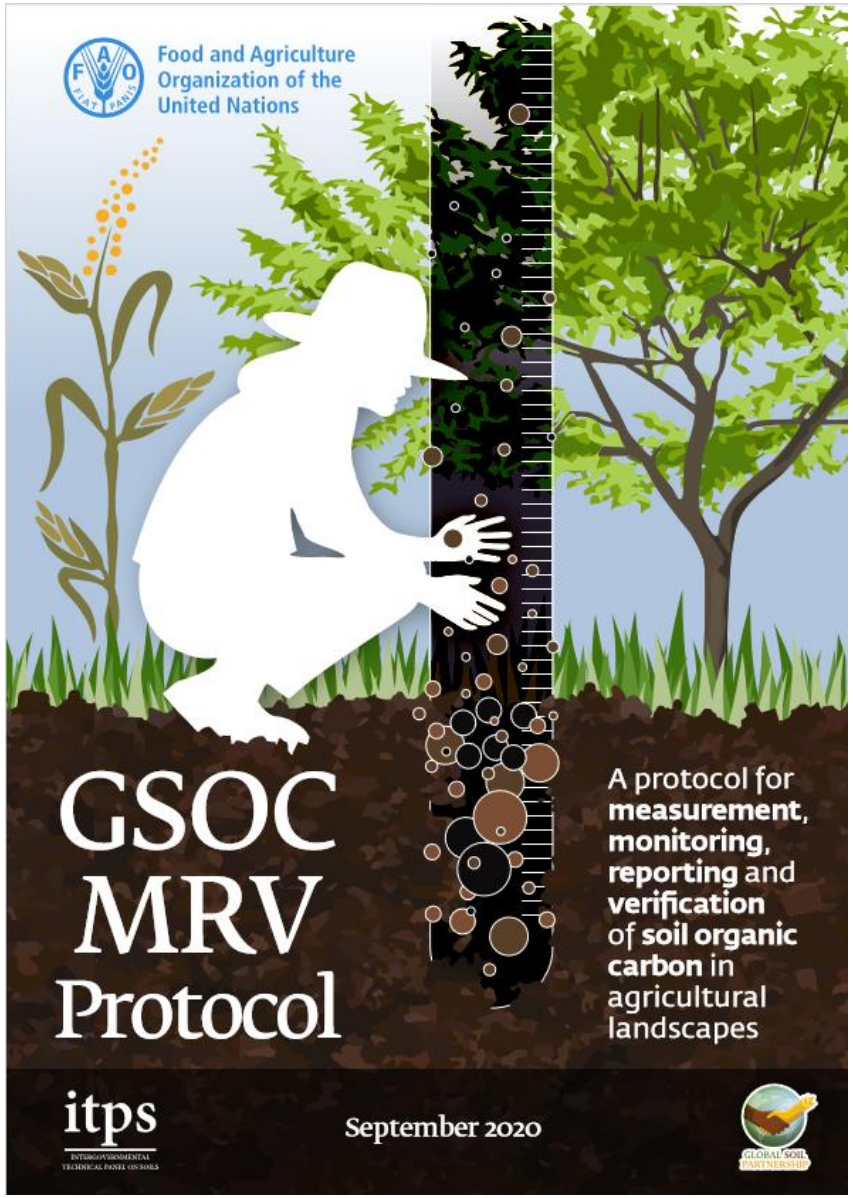
Global Change Biology WILEY

How to measure, report and verify soil carbon change to realize the potential of soil carbon sequestration for atmospheric greenhouse gas removal



https://doi.org/10.1111/gcb.14815

Do we have tools and methods for quantifying soil carbon stocks?

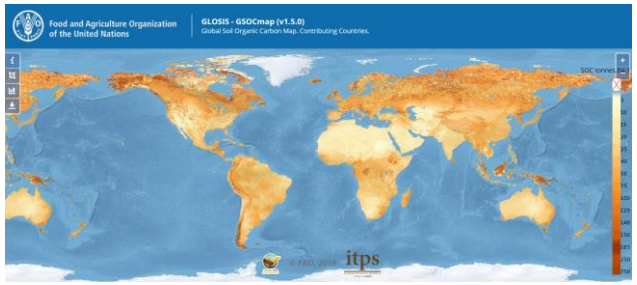


https://doi.org/10.4060/cb0509en

A framework and standard methodologies for the measuring, monitoring, reporting and verifying changes in SOC stocks and GHG emission removals from agricultural projects that adopt Sustainable Soil Management Practices at the farm level.

This protocol is part of a GSP "Carbon Toolkit"

- Global Soil Organic Carbon Map (GSOC map).



- Voluntary Guidelines for Sustainable Soil Management (VGSSM).
- Cookbook on Soil Organic Carbon mapping
- and much more: see the GSP website and its 5 pillars of actions:

1- Soil management
2- Awareness raising
3- Research
4- Information & data
5- Harmonization

Do we have tools and methods for quantifying soil carbon stocks?

At project level different tools and guidance are available to support users

Selection of appropriate calculators for landscape-scale greenhouse gas assessment for agriculture and forestry

Received 13 January 2013
Accepted for publication 18 February 2013
Published 7 March 2013
Online at stacks.iop.org/ERL/8/015029

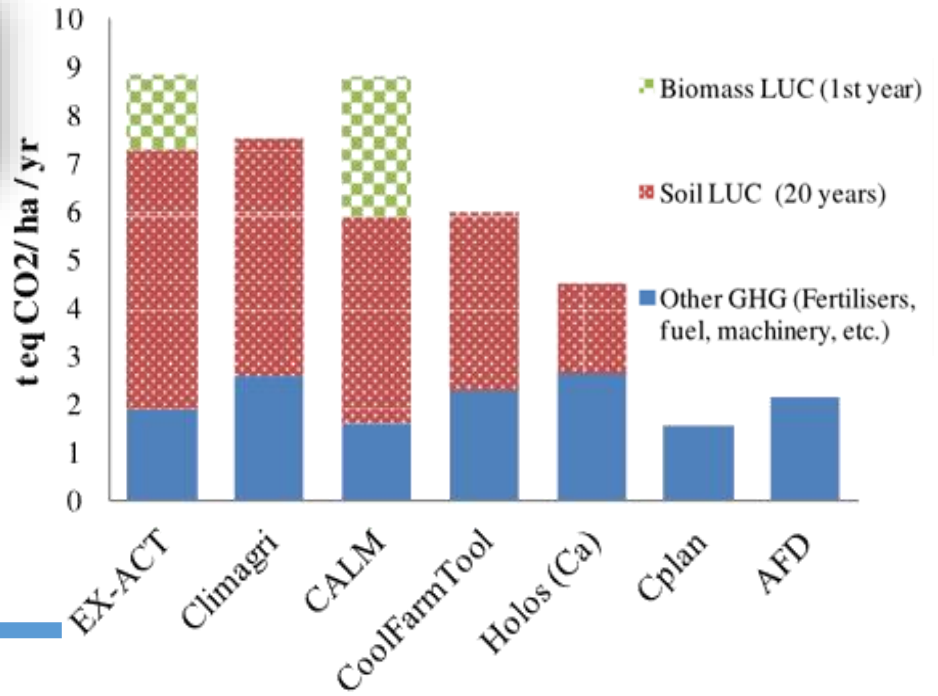
Abstract

This letter is intended to help potential users select the most appropriate calculator for a landscape scale greenhouse gas (GHG) assessment of activities for agriculture and forestry. Eighteen calculators were assessed. These calculators were designed for different aims and to be used in different geographical areas and they use slightly different accounting methodologies. The classification proposed is based on the main aim of the assessment: raising awareness, reporting, project evaluation or product assessment. When the aims have been clearly formulated, the most suitable calculator can be selected from the comparison tables, taking account of the geographical area and the scope of the calculation as well as the time and skills required for the calculation. The main issues for interpreting GHG assessments are discussed, highlighting the difficulty of comparing the results obtained from different calculators, mainly owing to differences in scope, calculation methods and reporting units. A major problem is the poor accounting for land use change; the calculators are usually able to account satisfactorily for other emission sources. One of the main challenges at landscape-scale level is to produce a realistic assessment of the various production systems as the uncertainty levels are very high. The results should always give some indication of the link between GHG emissions and the productivity of the area, although no single indicator is able to encompass all the services produced by agriculture and forestry (e.g. food, goods, landscape value and revenue).

Keywords: landscape, carbon calculators, greenhouse gases, GHG emissions, AFOLU, mitigation

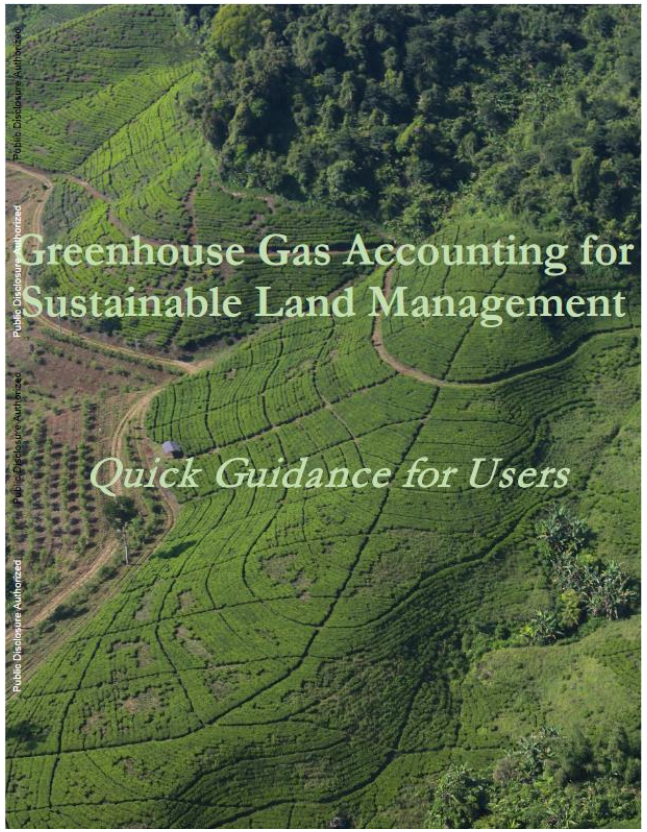
1. Introduction

https://iopscience.iop.org/article/10.1088/1748-9326/8/1/015029



http://www.fao.org/in-action/epic/ex-act-tool/overview/en/

Most are based on IPCC guidelines and default values, but results change according to the completeness and scope of the tools.



https://openknowledge.worldbank.org/handle/10986/31063

Do we have tools and methods for quantifying soil carbon stocks?

At national level (targeting NDC enhancement)

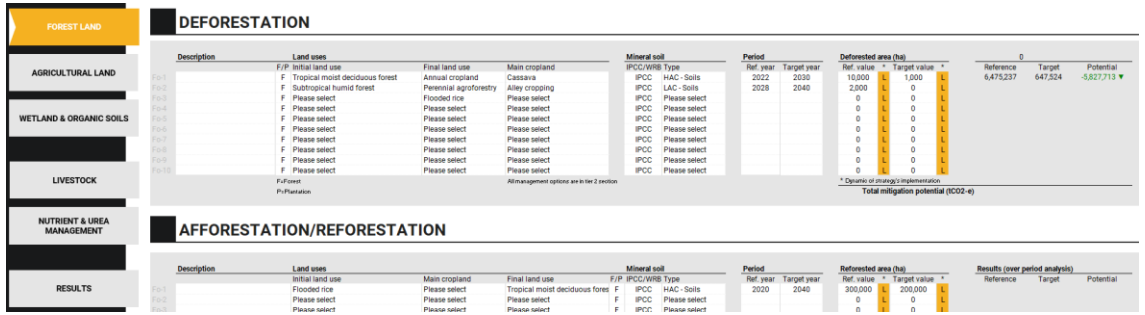
N.EX.T.

NDC EXpert Tool
FAO tool to target GHG emissions reductions commitments in the NDCs

Internationally approved methodologies
Based on IPCC standards (2006, 2013 Wetlands supplement and 2019 Refinement) developed for AFOLU and aligning with the Enhanced Transparency Framework

Estimates national climate mitigation commitments
Provides annual GHG emissions reduction and mitigation potential of implemented and planned policies

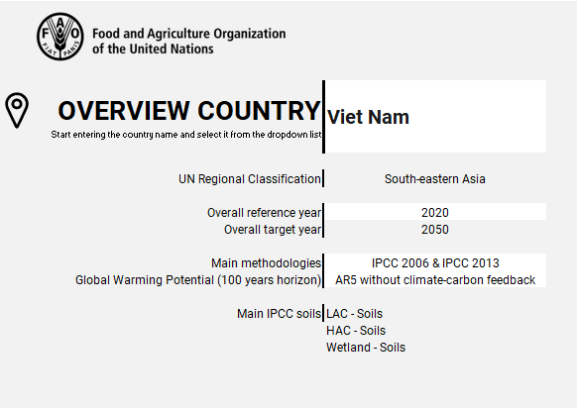
Helps
Governments and companies improve their strategies, pointing them toward net zero GHG emissions in the AFOLU sector.



Simplified

Country-tailored

Climate, soil, agro-ecological zones, crops, livestock, etc



Allow to analyze climate commitments of **different implementation periods** & different **agro-ecological zones**

Include **direct and indirect GHG emissions**

Track and monitor GHG emissions reductions

Climate change and agriculture: Quantifying carbon stocks in soils and their evolution

International Technical Webinar – Wednesday 14 April 2021

www.freepik.com

FAO elearning ACADEMY | agreenium | UNITED NATIONS ESCAP Economic and Social Commission for Asia and the Pacific | FUTURE FOOD INSTITUTE