Food and Agriculture Organization of the United Nations

MEASURING AND MODELLING SOIL CARBON STOCKS AND STOCK CHANGES IN LIVESTOCK PRODUCTION SYSTEMS

SUMMARY OF THE GUIDELINES FOR ASSESSMENT

OVERVIEW

Grazed livestock production systems are an integral part of the cultural, social and economic identity of many nations worldwide. Key agricultural commodities such as milk and meat come from ruminant (cud-chewing) animals, predominantly cows, goats and sheep.

Soil properties, particular soil organic matter (SOM) content, may be affected directly when livestock graze on grassland; pastures and/or rangelands or indirectly when land is used for feed crop production. SOM content is measured as density of soil organic carbon (SOC). Indeed, there is a strong negative correlation between land use intensity and SOC.

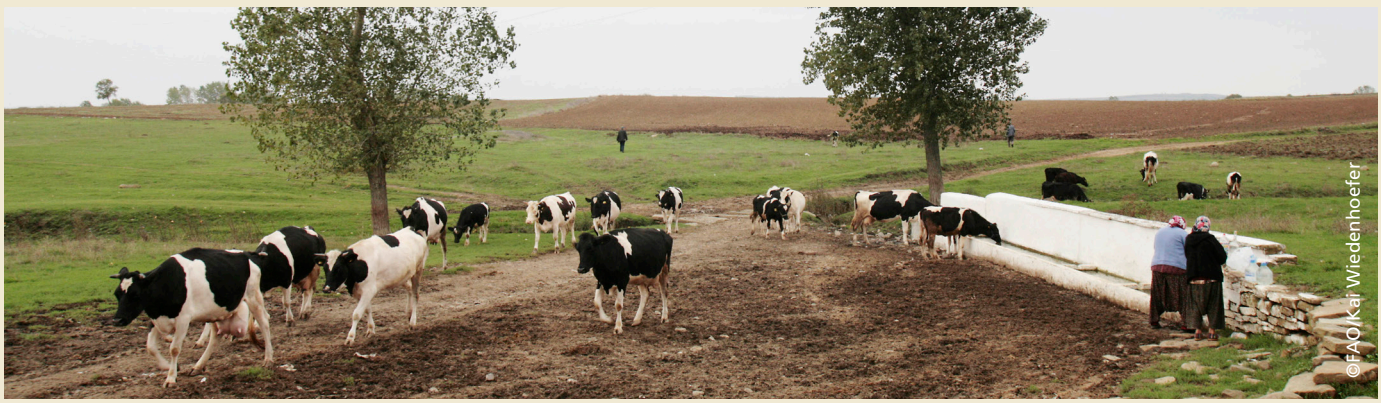
The focus of these guidelines is on measuring and modelling SOC stocks, as well as monitoring SOC changes in response to management practices in grasslands and rangelands. The methodology strives to increase understanding of carbon sequestration and to facilitate improvement of livestock systems' environmental performance.

The intended uses of these guidelines for assessment are wide. A set of methods and approaches are recommended to be used by individual farmers, pastoralist, or land managers, or by those undertaking life cycle assessment studies, policy makers or regulators at local, regional or national scales.

CHALLENGES AND SOLUTIONS

Despite the attention given to SOC, knowledge about SOC stock baselines and its changes under different land management is still limited. Accurate baselines are still missing for many countries and estimates of SOC within the global carbon cycle are still associated with large uncertainties. Global SOC estimates exist, but there is high variability in reported values among authors, caused by the diversity of data sources and methodologies. SOC measurements are highly variable in space, while changes over time depend on a multitude of factors, for which detailed information and understanding is not always available. There is a need to estimate benchmarks and potential changes, which, depending on the purpose, will require different levels of data precision.

In these guidelines a decision-tree is presented to help the user identify and align the available data and intended use with a measuring or modelling method. The recommended methods provided in this document aim to align with the intended use and available data. Thus, uncertainty levels depend on the method and the intended use.



SUMMARY OF THE DECISION FRAMEWORK

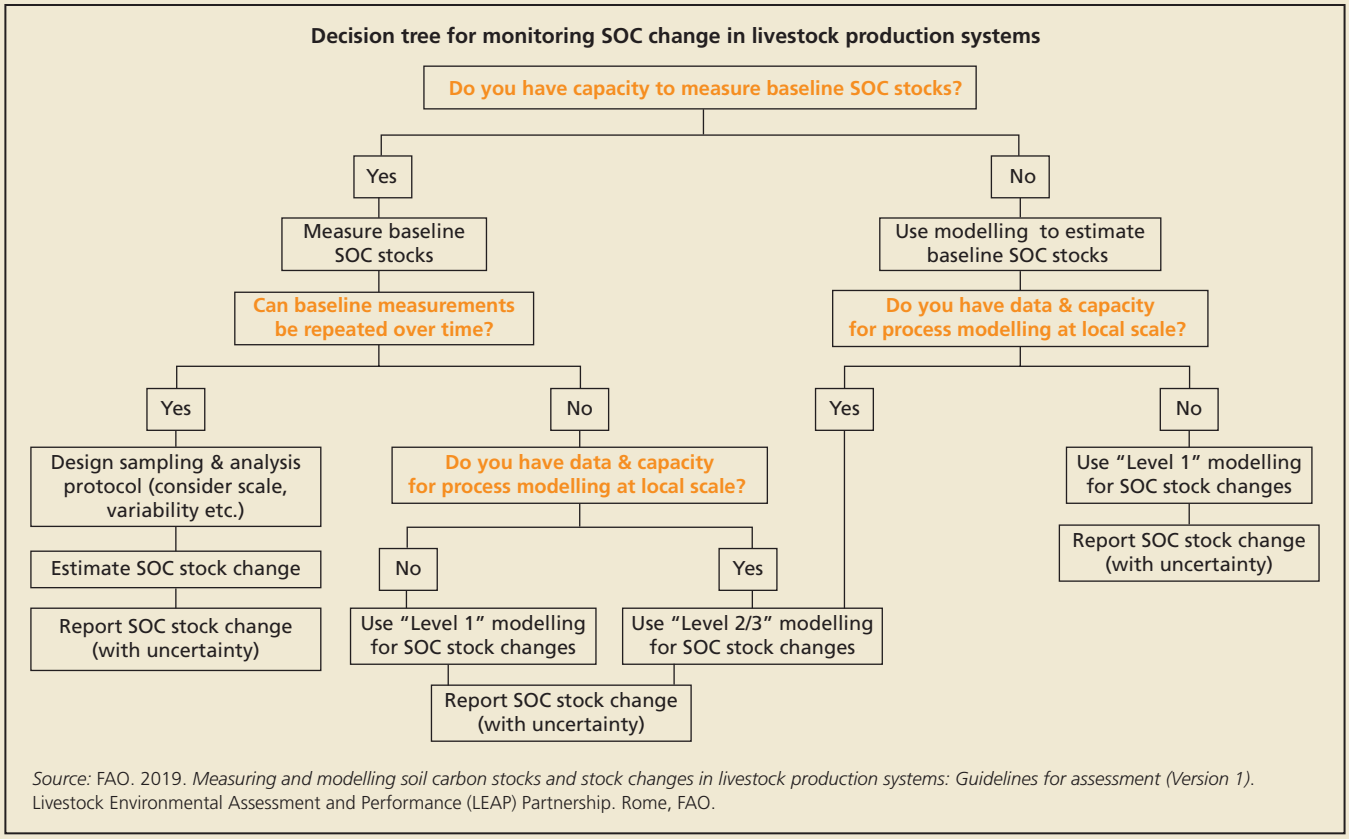
The document describes a range of methods to assess SOC stocks and changes. It follows a "bottom-up" approach, from soil sampling at field scale to spatial modelling, giving detailed instruction on procedures, quantification of uncertainties and implementations.

Selecting the method to monitor SOC stock and/or changes should consider the purpose of the investigation and the skills, capacity and budget available to the project. There are a range of objectives and scales possible for a study on SOC stocks and changes study, for example:

- global, regional or national accounting for greenhouse gas emissions and removals from the livestock sector as a component of climate change accounting;
- monitoring, reporting and verification (MRV) obligations for the United Nations Framework Convention on Climate Change (UNFCCC);
- analysis of the carbon footprint of livestock products;
- evaluation of the environmental impacts of grazing land management for animal agriculture;
- assessment of the mitigation potential of agricultural practices at a pastoralist, industry, region or farm scale;
- implementing mitigation options in an emissions trading or other market mechanism, where payments for SOC sequestration depend on accurate and verifiable quantification;
- research into biochemical processes affecting SOC stocks and dynamics; and
- linking SOC, soil biodiversity and resilience of systems for adaptation to climate change and food security.

A decision framework is valuable to guide systematic decisions on the monitoring approach and requirements to achieve accuracy and consistency levels aligned to the goals of the study. Figure below depicts one such decision tree to guide the development of a sampling and measurement, or modelling plan. It is to notice that this framework, and monitoring approach, can be applicable not only on livestock systems, but on feed crop production as well.

The document provides thirty-three recommendations to guide the decision process. Eleven case studies are also reported to show concrete examples of SOC assessment through measurements and modelling methods. They cover a wide range of livestock systems, geographical areas and methods.



Source: FAO. 2019. *Measuring and modelling soil carbon stocks and stock changes in livestock production systems: Guidelines for assessment (Version 1).* Livestock Environmental Assessment and Performance (LEAP) Partnership. Rome, FAO.

Figure: *A decision tree to guide the selection of a SOC stock change monitoring approach. Level 1 refers to simple "empirical" models; Level 2, to "soil" models; and Level 3, to "ecosystem" models, with model complexity and data demand increasing from Levels 1 to 3.*

LIVESTOCK ENVIRONMENTAL ASSESSMENT AND PERFORMANCE (LEAP) PARTNERSHIP

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