Monitoring framework for soil health and climate smartness in cacao agroecosystems.

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Background

To overcome multiple challenges related to supply chain sustainability (low productivity, soil degradation, poverty, carbon footprint, impacts of climate change) there is a demand for soil health indicator frameworks applicable to cacao production systems.

Those indicator frameworks should allow for:
a) assess and monitor different aspects of soil health
b) inform/ prioritize contextualized management interventions
c) trace supply chain compliance with sustainability targets

Objective

Provide a monitoring framework for gaining insight into the status and the changes of soil health and climate smartness in cacao agroecosystems as affected by soil management and that can be used together with farmers and supply chain actors. This framework is being developed and tested as part of the EU project ClimaLoca.

Framework

Based on the conceptual framework in Figure 1, we propose an approach to measure soil health in cacao agroecosystems linked to key production and environmental outcomes (performance objectives).

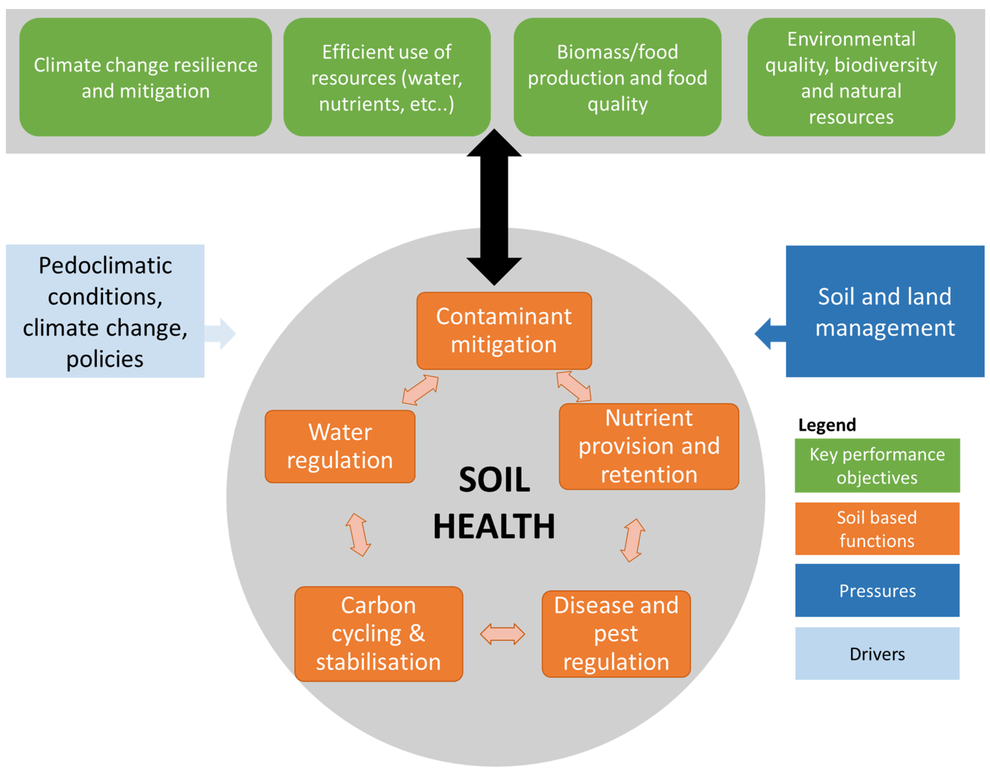

Figure 1. Conceptual framework for cacao agroecosystems. Pressures and drivers affect soil functions, which are depicted in the grey circle and are linked to broader key performance objectives of cacao agroecosystems.

The framework is tested and adapted in trials and farms in Ecuador, Colombia and Peru' (Figure 2). Soil functions will be monitored measuring multiple soil health indicators at different times, to capture changes, their synergies and trade-off. Ultimately, the steps in Figure 3 will be applied

Soil Health and soil health indicators

Soil health is defined as the capacity of a soil to perform multiple functions (Figure 1), which are underlined by different soil processes. Soil processes can be measured by a combination of chemical, physical and biological soil health indicators, e.g. carbon pools, nutrient availability, soil compaction, soil biota presence and activity.

Case studies for framework testing- Ecuador

Figure 2. Organic agroforestry farm in the Guayas province of Ecuador on the right, agroforestry long-term field experiment in the Ecuadorian Amazon (INIAP).

- **Organic amendments (OA) in organic cacao agroforestry farms in the Guayas province of Ecuador.**

5 types of OA consisting of combinations of bokashi, biochar and effective liquid microorganisms applied since 2020 in 5 organic agroforestry farms. Soil health indicators linked to nutrients, carbon cycling and Cd mitigation including chemical indicators and microbial activity are measured at different times after application.

- **Agroforestry long-term trial in the Ecuadorian Amazon (INIAP)**

5 agroforestry design (monoculture, fruit, timber, N-fixing and mix of timber and N-fixing) and conventional vs organic systems (with both low and high nutrient input) are applied since 2015. Soil health indicators linked to nutrient and C cycling including chemical, physical and biological indicators are measured.

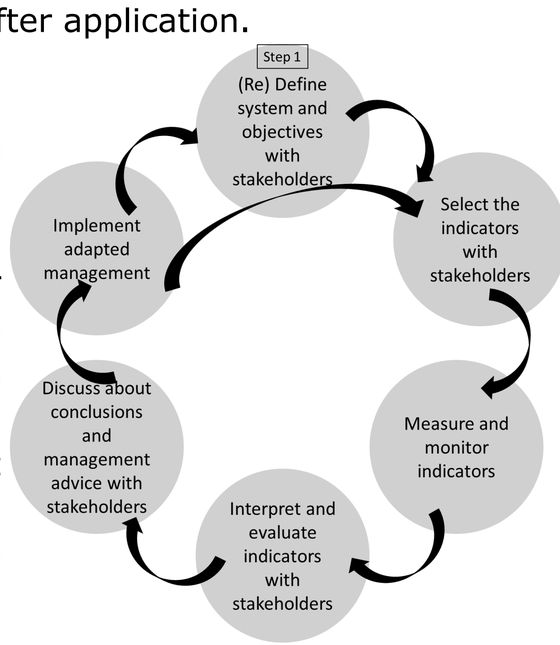

Figure 3. Steps in the participatory soil health and climate smartness monitoring schemes

Conclusions

The framework is a flexible decision support tool that multiple end-users can adapt and apply depending on the specific system's context, threats, needs and objectives. It will ultimately help in the creation of a sustainable cacao food system that sustain internal soil functioning, cope with climate stresses and therefore sustain and ensure cacao farmers' income.

Acknowledgements

We acknowledge Eduardo Francisco Chavez and the whole ESPOL Soil science team, INIAP, WUR MSc students involved in the project, Anna Visscher.

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International Symposium on Cocoa Research