



The degradation of soil health from agricultural activities in lowland tropical rainforest, Peru

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1. Introduction

Soil health is the 'continued capacity of a specific kind of soil to function as a vital living system'. This purpose of this project was to use soil health as an indicator to look at the short and long term implications of intensive crop production on tropical soils.

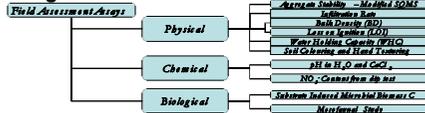
2. Objectives

- Establish the health of the soil used by migrant farmers on tropical river terraces in the Amazon basin, incorporating the site history and current land management techniques.
- Compile a chronosequence of different sites over 30 months and study the changes in specific soil health, from different methods of agricultural management.

3. Material and Methods

There were two motivations behind the choice of assays were used during the data collection (Diagram 1). One, the techniques had to be reliable in the field and synergise with the equipment based in the field laboratory. Two the techniques had to be transferable to the local counterparts involved in the project so they were able to analyse the quality of their own soils (Figure 1 – example of modified SQMS technique).

Diagram 1



4. Study site



Figure 2. Image showing the site locations of the three farms used within the project. Sites are located on alluvial plains along the Alto Madre de Dios River, Peru. The MLC pin marks the base station.

5. Results

Over the 14 days after a burn event the soil environment fluctuates rapidly. After 4 days the soil available nitrate content has increased, and continues to increase up until 14 days. A similar pattern occurs with the soil microorganisms as they multiply due to the huge increase in substrate. These early increases are not sustained and are mainly due to the comparatively large organic inputs from the burning. All soil characteristics showed similar rates of increase post-burn and all showed declines after around 12 months reflecting the unsustainable nature of the soil

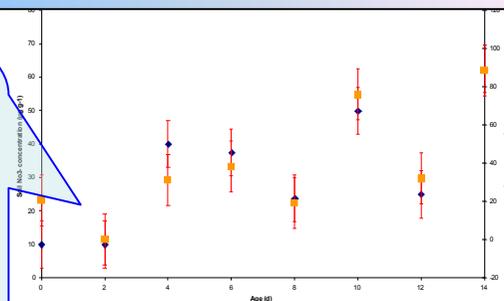


Figure 3. The effect of deforestation, burning and cultivation on soil available NO₃⁻ concentrations and soil microbial biomass along a 14 day agricultural land use chronosequence converted from secondary forest. Time 0 represents non-cleared forest. The symbol ■ signifies Microbial respiration and the symbol ◆ signifies Soil Available NO₃⁻.

5. Results (continued...)

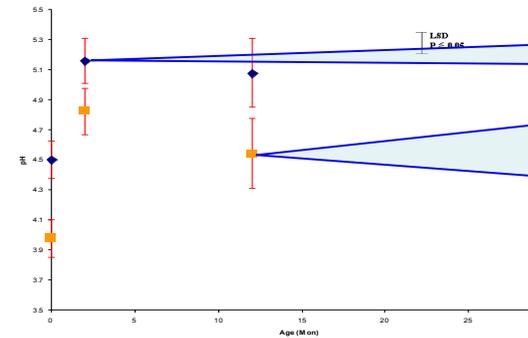


Figure 4. The effect of deforestation, burning and cultivation on soil pH along a 30 month agricultural land use chronosequence converted from secondary forest. Time 0 represents non-cleared forest. The symbol ■ signifies pH measured in a CaCl₂ solution and the symbol ◆ signifies pH measured in a H₂O solution.

The month after clearing and burning the pH acidity decreases rapidly as the carbonate (ash) is leached into the soil.

As leaching continues the first crop (usually maize) is harvested in under a year and Yucca and banana are planted. Within this 'cover deficient window' the soil is exposed to extreme temperature flux, no inputs of organic matter, compaction from rain, extremely high leaching rates and a decomposition of the majority of the remaining organic matter.

After the Yucca has been harvested (~2 yrs) the soils productivity declines rapidly due to the negative feedbacks within the carbon cycling leading to a soil that is significantly less healthy than the soil under forest cover in less than 3 yrs.

6. Summary

- Highest pH peak is reached within 14-56 days after burning. Then declines steadily. (P<0.05)
- Soil microbial biomass can decrease by 75% within 12 months (P<0.05)
- Complete soil structure collapse can occur within 30 months without correct soil conservation (P<0.05)
- Organic Matter is the most limiting factor for soil health

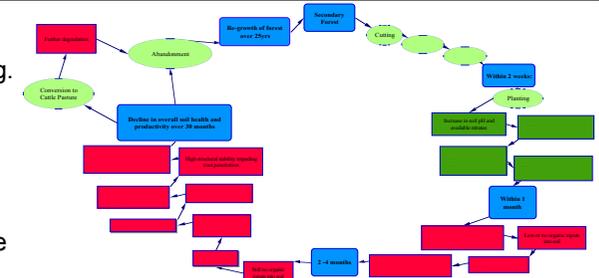


Diagram 2. Represents the cycle of land use established within the project. Bright green boxes indicate a positive change is soil health and red indicate a negative change. Blue ovals are represent the timescale and pale green are human actions on the soil.

7. Future work

Future research should aim to incorporate more replication within the area on sites at specific ages in order to fill up the chronosequence gaps. Within the local site area, there is a great need for examples of workable soil conservation techniques, so I would recommend the establishment of a model farm within the area, demonstrating efficient farming methods such as fertiliser/pesticide application and organic matter conservation and reintroduction.