Simulation of the impacts of restoration techniques on soil organic carbon content and structure in West Africa

Jérôme YAMEOGO[1], Sotiria Panakoulia[2], Manolis Kotronakis[2], Irénée SOMDA[1], Nikolaos Nikolaidis[2], Anne Lykke[3], and Jørgen Axelsen[4]

[1]Nazi Boni University
[2]Technical University of Crete
[3]Aarhus University, Vejlsøvej 25, DK-8600 Silkeborg
[4]Aarhus Universitet

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Abstract

The main objective of this study was to evaluate two restoration techniques, "stone rows" and "stone rows + tree planting" on soil organic carbon (SOC) sequestration and structure in terms of water stable aggregates as well as the time required to restore soil fertility. The Carbon, Aggregate and Structure Turnover (CAST) model was used to model the changes of SOC content and water stable aggregate formation under the two restoration techniques. Field experiments used for calibration of the model were conducted using a randomized block design. Soil samples were class fractionated followed by a micro-aggregate isolation procedure. The two restoration techniques contributed significantly to improving soil total carbon content. By running five year simulation of the "stone rows", the estimated total carbon input was 27 Mg ha-1 of which 6.1 Mg ha-1 were sequestered in the soil and 20.7 Mg ha-1 were released as CO2. In "stone rows + planting", the total SOC content after five years was estimated to be 22.96 Mg ha-1, which was broken down to 15.43 Mg ha-1 aggregated carbon and 26.60 Mg ha-1 CO2. Fifty-year simulations showed a SOC increase to 54.8 Mg ha-1 in "stone rows", and to 86.0 Mg ha-1 in "stone rows + planting". This means that natural grassland vegetation slowly improves soil carbon content and soil quality, but with trees behind stone rows, the result will be about 50% higher.

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