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Integrated Soil Quality Assessment Within two Contrasting Catchments of the Southern Ethiopian Rift Valley

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Abstract

This research focuses on two science-based soil quality assessments, i.e. visual soil assessment (VSA) and standard physico-chemical soil analyses. The VSA, especially when conducted by farmers, offers a cost-effective approach to study soil in extended study areas. However, little is known on the applicability of VSA in areas subjected to different degradation processes.

Our study takes place in the lowland, midland, and highland agro-ecological zones (AEZs) of the Shafe and Sile-Elgo catchments, in the Southern Ethiopian Rift Valley. It aims to contribute to the state-of-art knowledge on VSA by (1) a comparison of scores assigned by experts versus farmers and (2) their correlation to standard physico-chemical analyses. Our integrated soil quality assessment is furthermore applied to (3) develop a contextualized understanding of soil quality under different soil management levels in the AEZs within this region.

To that aim, 36 cropland fields, six within each AEZ of both catchments, were selected. Half of these fields were collected in cropland receiving soil and water conservation (SWC) strategies (“good management”), while no SWC (“poor management”) was applied in the others. On each field, the VSA was conducted by farmers and experts, followed by laboratory analyses of standard physico-chemical soil properties.

The overall VSA scores assigned by both groups were very strongly correlated ($r=0.905$, $p < 0.001$), albeit with higher correspondence in Shafe ($r=0.940$, $p < 0.001$) than in Sile-Elgo ($r=0.807$, $p < 0.001$). We observed differences between expert and farmer groups with respect to particular VSA indicators. The overall score of the farmers’ VSA proved very strongly negatively correlated ($r=-0.835$, $p < 0.001$) to bulk density, which is an important soil quality indicator in all three AEZs. Aggregate stability, organic carbon and nitrogen contents correlated strongly to the VSA overall score. Both the VSA and physico-chemical data revealed a higher soil quality under good management.

Integrating local knowledge with science-based, systematic approaches of soil quality can thus provide a platform to exchange experiences, foster an in-depth understanding of degradation processes, and promote sustainable agricultural use.

Keywords: Agro-ecology, chemical soil properties, physical soil properties, soil management, soil quality, visual soil assessment

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