Collecting the Dirt on Soils: Advancements in Plot-Level Soil Testing and Implications for Agricultural Statistics

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Improving agricultural productivity to meet food security needs in developing countries requires firm understanding soil fertility constraints, lending to the UN declaration of 2015 as the International Year of Soil. Using a unique plot-level dataset consisting of subjective indicators of quality and results from both conventional and spectral soil tests collected through a methodological validation study in Ethiopia, this paper analyzes intra-farm variation in soil properties, the use of lower resolution but potentially more cost effective digital soil maps in lieu of plot-level soil data, and the impacts of relying on subjective farmer estimates of soil quality. “Noting that soils constitute the foundation for agricultural development, essential ecosystem functions and food security and hence are key to sustaining life on Earth…” the UN General Assembly declared 2015 the International Year of Soils (A/RES/68/232). The recent increased attention afforded to soil is for naught, however, if soil health measurements are inaccurate or of inadequate resolution. Much of the current analysis on agricultural productivity is hampered by the lack of consistent, high quality data on soil health and how it is changing under past and current management. This is
especially critical in the face of increased variability in weather conditions brought on by climate change. Renewed interest in increasing agricultural productivity to meet food security needs and increasing resilience of agricultural systems in developing countries, especially in sub-Saharan Africa, makes understanding soil fertility constraints and trends ever more important. Historically, plot-level soil statistics derived from household surveys have relied on subjective farmer assessments of soil quality or on linking with soil raster data (when plots are geo-referenced). Direct systematic measurement of soil fertility as part of household level data collection has rarely been attempted due to the high costs of soil sampling and analysis. Recently developed rapid low cost technology for assessing soil characteristics using infrared spectroscopy, however, has increased the potential for direct soil fertility characterization in large studies.
In a recent methodological study completed by the Living Standards Measurement Study of the World Bank in collaboration with the World Agroforestry Centre (ICRAF) and the Central Statistical Agency of Ethiopia, objective conventional and spectral soil testing was conducted alongside subjective measurements allowing for validation of previously relied-upon farmer assessment. Geo-referencing of the direct plot-level measurements also allows for validation of national soil maps and remotesensing sources.
The unique plot-level dataset consists of subjective indicators of soil health as well as a suite of properties measured through conventional and spectral soil tests. Both top- and sub-soil samples were collected and analyzed from approximately 1800 plots in three zones of Ethiopia’s Oromia region, resulting in a rich dataset which includes soil organic carbon levels, pH, salinity, and texture, among others. ICRAF’s Soil-Plant Diagnostics Laboratory in Nairobi, where all samples were tested, is also the primary analytical center for the Africa Soil Information Service (africasoils.net) lending to the comparability of soil testing protocols and results. Using this purposely collected plot-level data we
are able to capture intra-farm variation in soil properties, validate (or not) the use of lower resolution but more cost effective digital soil maps in lieu of plot-level soil data, and analyze the impacts of relying on subjective farmer estimates of soil quality.
Keywords: Land productivity; householder survey; soil spectroscopy; soil fertility**.**