Land and Soil Experimental Research (LaSER): Methodological Validation in Ethiopia

By Sydney Gourlay

The Global Strategy to Improve Agricultural and Rural Statistics has identified improving the measurement of crop productivity as its top priority. Because agricultural statistics are often marred by controversy over methods and overall quality, stringent validation of the available measurement methodologies is essential. With financial support from the Bill and Melinda Gates Foundation, the Living Standards Measurement Study (LSMS) team of the World Bank is supporting the Central Statistical Agency of Ethiopia (CSA) in the design and implementation of the Ethiopia Rural Socioeconomic Survey. As part of this partnership and under a grant from UK Aid, the LSMS team collaborated with the CSA and the World Agroforestry Centre (ICRAF) to conduct a research project to validate methodologies used in yield estimation and to improve our understanding of productivity estimates.

Objectives

The Land and Soil Experimental Research project (LaSER) aims to test the various methodological options in collecting agricultural data and assess the feasibility of implementing each method in large household surveys in order to improve the timeliness and quality of data collected. The objectives include: (1) validating the data quality associated with each method, (2) determining costs and benefits of each method, (3) benchmarking existing and future yield estimates with respect to “gold standard” methods, and (4) mainstreaming findings into future national-level data collection efforts. Following this survey and the replication of such a survey in a second country, the LSMS team will also document best practices in data collection methods with respect to agricultural production.

Methodologies

The LaSER study revolves around three components: land area, soil fertility, and maize production measurement. For each component, two or more methodologies were implemented:

**Land Area:**
Each selected field was measured using a handheld GPS device, the traditional compass and rope (or ‘traversing’) method (largely considered to be the ‘gold standard’), and farmer self-reported area estimation.

Preliminary results reveal highly correlated GPS and compass and rope measurements (sample average areas for GPS and traversing 0.383 acres and 0.377 acres, respectively). The significantly weaker relationship observed between traversing and farmer self-reported area estimates is illustrated in the scatterplots below. On average, GPS measurement required about 14 minutes while traversing required 57 minutes.
Maize production:
Crop-cutting was conducted on pure stand maize fields in addition to the collection of farmer estimates of plot-level production. Crop-cutting activities were executed on a 4 meter by 4 meter subplot on each selected field. The 4x4m subplot was separated into 2x2m quadrants, for which the harvest was measured separately. Additionally, all production from the subplot was weighed using both analog and digital scales. Planned analysis includes comparison of yield estimation using a 4x4m versus a 2x2m subplot for extrapolation as well as analysis of the variation observed within the 4x4m subplot.

Soil Fertility:
Subjective farmer assessment of soil quality, the most common soil fertility gauge employed in household surveys, was complemented by conventional and spectral soil analysis. Field teams were trained by ICRAF in soil sample collection methods. From each selected field, a composite 0-20cm depth sample and a 20-50cm depth sample were collected by field teams, processed in local laboratories, and shipped to ICRAF Nairobi for analysis. Additionally, for fields with pure stand maize, a third sample was collected representative of the 4x4m crop-cutting area. All samples were subject to spectral analysis while a subset were subject to conventional analysis. On average, soil sampling required 38 minutes per plot. The conventional and spectral soil testing has been completed by ICRAF Nairobi and analysis, conducted jointly between LSMS and ICRAF, is underway.

Sample
Three administrative zones of the Oromia region of Ethiopia – East Wellega, West Arsi, and Borena – were selected based primarily on agroecology and geographic diversity. Secondary consideration was made for the availability of local soil research centers which could be used for soil processing. The allocation of enumeration areas (EAs) was determined largely by the proportion of EAs across agroecological zones within each administrative zone.

Using the CSA’s Agricultural Sample Survey (AgSS) as the sampling frame, a total of 85 EAs were selected. Within each EA, 12 households were randomly selected from the AgSS household listing completed September 2013. Households selected for the AgSS were ineligible for selection in this project. Up to two fields were measured per household. First, if any fields contained pure stand maize, one was randomly selected. Subsequently, a second field was randomly selected from the remaining cultivated fields irrespective of crop type. If no fields contained pure stand maize, two fields were randomly selected. Only those fields with pure stand maize were subject to crop cutting.

Timeline
Five mobile teams were deployed across the three selected zones for the duration of fieldwork, which included three waves of data collection. The post-planting fieldwork, which included a household questionnaire, in-field measurements, and soil collection, began in September 2013. Crop-cutting activities were conducted at various dates depending on the harvest time at each site. Post-planting and crop-cutting activities continued through December 2013. The post-harvest wave, which involved a household questionnaire on farmer estimates of production, ran from January to March 2014.

This brief is intended as a descriptive piece to share the ongoing efforts of the LSMS team. Stay tuned for analytical work related to the LASER project, including a sourcebook on land area measurement in household surveys and an article comparing the results of various soils testing methodologies.

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