Article title	Modeling Spatial Variability across Farms to Estimate the Error in Experiments Replicated across Numerous Farms.
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Abstract	Balanced crop nutrition and soil fertility research toward ensuring food security for Subsaharan Africa requires conduction of experiments in small-holder farms. These experiments can be intrusive and compete for the land used by producers to support their families and derive income. The burden for the farmers can be reduced conducting experiments in which the set of treatments is applied only once in each of numerous farms located across entire regions. The wide spatial variability, mainly due to soil characteristics, is reduced grouping farms with the use of a combination of multivariate factor and cluster analysis, and the error term for testing hypotheses about treatments is obtained from modeling the spatial variability across farms within each cluster. The effect of three fertilization treatments, three farm clusters and the interaction of treatment*cluster on bean yields in Burundi were tested with a Generalized Linear Mixed Model (GLIMMIX), the R-side covariance error structure was modeled with a Spatial Exponential structure along the latitude and altitude coordinates. Running the experiments in many farms covering entire regions enhances the scope of the research, clustering the farms allows to develop specific fertilization recommendations for the specific environmental characteristics of each cluster, modeling the covariance error structure across farms results in an analysis of variance (ANOVA) model of higher fitness and power than an ANOVA model that assumes error term independence across farms. The Akaike Information Criteria were 245.21 and 528.85, and the error variances were 0.0937 and 0.1286 for the ANOVA models with spatial exponential covariance error structure and with assumed error independence respectively. A significant interaction Treatment*Cluster is critical to make specific fertilization recommendations to farm clusters, the ANOVA model including the error covariance modeling was able to detect such a significance while the ANOVA model assuming independence of errors failed to detect the interaction significance.
Publication date	2017
Citation	Sanabria, J., J. Wendt, and O. Nduwimana. 2017. “Modeling Spatial Variability across Farms to Estimate the Error in Experiments Replicated across Numerous Farms,” Presented at the ASA, CSSA and SSA 2017 Annual Meeting, Tampa, FL, USA.
Link to the actual article	https://scisoc.confex.com/crops/2017am/webprogram/Paper104876.html