



# Methodological Evaluation of Smallholder Farm Systems in Ghana: Randomized Field Trial for System Reliability Assessment

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## Abstract

Smallholder farms in Ghana face diverse challenges related to sustainable agricultural productivity. A randomized controlled trial was conducted on 120 randomly selected plots of land, divided into four treatment groups. Each group received different management practices (e.g., organic fertilizer versus chemical fertilizers). Soil quality, crop yield, and water use efficiency were measured over two growing seasons. In the first season, there was a significant increase in soil organic matter content by 15% in plots treated with organic fertilizers compared to those using chemical fertilizers ( $p < 0.05$ ). The randomized trial demonstrated that organic fertilizer management significantly improved soil quality and crop yield. Farmers should be encouraged to adopt organic farming practices, which are more sustainable and effective in enhancing soil health and productivity. Smallholder farms, Randomized field trial, Soil quality, Crop yield, Water use efficiency The empirical specification follows  $Y = \beta_{0+\beta} p X + \text{varepsilon}$ , and inference is reported with uncertainty-aware statistical criteria.

**Keywords:** *African geographics, smallholder systems, randomized trials, agricultural productivity, sustainability assessment, econometrics, participatory approaches*

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