L'apprentissage des pratiques agricoles et de la qualité des intrants à travers l'expérimentation, au Kenya

Researchers:

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Sector(s): Agriculture

Fieldwork: Innovations for Poverty Action (IPA)

Location: l'ouest du Kenya

Sample: 900 agriculteurs dans 96 villages

Target group: Farmers

Outcome of interest: Technology adoption Productivity Profits/revenues

Intervention type: Extension services Fertilizer and agricultural inputs Information

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Research Papers: Measuring Skills in Developing Countries, The Complexity of Multidimensional Learning in Agriculture, Reconciling Yield Gains in Agronomic Trials with Returns under African Smallhol...

Partner organization(s): International Institute of Tropical Agriculture (IITA), The Institut National de la Recherche Agronomique (INRAE), Economic and Social Research Council (ESRC), World Bank, CGIAR, Agence Nationale de la Recherche, Centre pour la recherche économique et ses applications (CEPREMAP)

Policy issue

Small-scale farmers in low- and middle-income countries face many challenges to adopting new technologies to improve their productivity and profitability. One such challenge is access to tailored and timely information about how to best use different combinations of inputs and practices. It can be difficult for farmers to predict production outcomes due to complicated and unknown interactions between unfamiliar inputs. Making multiple decisions regarding various combinations of inputs and practices is a complex learning process because agricultural technologies may have different levels of risk and reward depending on local plot characteristics, making it difficult for farmers to predict production outcomes on their own plots.

Past research has focused on improving agricultural information and extension services by leveraging tools like farmer field days and demonstration plots to teach small-scale farmers about the improved performance of new, profitable technologies or practices. Generally, this research has focused on encouraging farmers to adopt one specific input or practice at a time. However, less is known about how to support farmers to experiment and learn about different input combinations across multiple seasons and real-life production experiences, like using a specific fertilizer in combination with an improved seed. Can farmers' participation in agronomic trials encourage their experimentation with different input combinations, increase their adoption of inputs, and ultimately increase their yields and profits? Furthermore, does a farmer's original agricultural skill level impact their learning and subsequent adoption of new technologies?

Context of the evaluation

In Siaya, Western Kenya, households rely on farming as the main source of income, typically farming maize. Due to low agricultural productivity, among other factors, the poverty rate in the region was 38.2 percent in 2016, the time of the study's conclusion. Three quarters of farmers in the region used mineral fertilizer, a widely available input, to support their productivity. However, mineral fertilizers like Calcium Ammonium Nitrate (CAN) and Diammonium Phosphate (DAP) can increase soil acidity over time with exclusive use, impacting farmers' soil quality. Agronomists at the International Institute for Tropical Agriculture (IITA) test more sustainable intensification packages, like combinations of mineral and organic fertilizers with new improved seeds. For example, integrated soil fertility management (ISFM), a set of agricultural practices adapted to local conditions, is designed to maximize the efficiency of nutrient and water use while improving agricultural productivity.

At the time, knowledge of these practices was low among farmers and varied by farmers' technical, cognitive, and non-cognitive skills. Researchers grouped farmers into two groups, low-skilled and high-skilled, based on farmers' technical, cognitive, and non-cognitive skills explained below. Twenty-six percent of low-skilled farmers used any type of soil conservation practice prior to the evaluation compared to 31 percent of high-skilled farmers. Compared to low-skilled farmers who had on average four years of education and five family members, high-skilled farmers had eight years of education and six family members. Most farmers owned at least some cattle and worked on average three plots of land, totaling .27 log hectares, on average.

A farmer in a field in Kenya.

Photo: Thomas Chupein | J-PAL/IPA

Details of the intervention

In partnership with Innovations for Poverty Action and IITA agronomists, researchers conducted a randomized evaluation to assess how farmers' participation in agronomic trials comparing different combinations of inputs impacted their learning and affected their subsequent use of high-quality inputs, yields, adoption of new crops, and profitability. Researchers randomly assigned 96 villages in Siaya County into three groups. In each village, researchers randomly selected five farmers to participate in agronomic trials on their own farmland. Farmers of different starting skill levels were equally included to understand how farmers' pre-existing education and agricultural knowledge affected their outcomes after participating in the trials. Community members selected an additional five farmers to participate in the trials during a village meeting for a total of ten participants per village.

Researchers assigned the farmers to participate in either a maize, soya, or a maize and soya intercropped trial over three agricultural seasons between 2013–2015 to observe different combinations of inputs over multiple weather realizations. Both high- and low-skilled farmers had little knowledge of soya cultivation prior to the study. IITA agronomists instructed participating farmers to divide their plots into six subplots to test combinations of biofertilizers, composting, weed-resistant seeds, and mineral fertilizers, based on the principles of ISFM. The groups are summarized below:

1. *Short rain agronomic trials (24 villages; 240 farmers):* Farmers in these villages were invited to begin the trials during the short rains of 2013 and received three visits per season from an agronomist, a one-page description of the inputs included in the trials, and signs to indicate which combination of inputs corresponded to which subplot. In addition, these farmers participated in a field day to visit other trial plots in their village and were invited to a group discussion session toward the end of the third season with other participants to exchange learnings.
2. *Long rain agronomic trials (24 villages; 240 farmers*): Farmers in these villages were invited to begin the trials during the long rains of 2014 and received the same information, field day, and discussion session as in group one.
3. *Comparison (48 villages; 480 farmers):* Farmers in these villages were not offered participation in the agronomic trials.

To measure the impact of participation in the agronomic trials, researchers conducted surveys with farmers before the trials, and five subsequent times (once a season) to understand the effects over time. Researchers collected information on farmers' skills, understanding of new inputs and practices, decisions to use inputs beyond the test-plots, crops grown, yields, and profitability.

To better understand which factors increased learning, researchers conducted their analysis conditional on farmers' initial skill level. Prior to beginning the agronomic trials, researchers classified half of the farmers in the sample as low-skilled farmers (LSFs) and the other half as high-skilled farmers (HSFs) based on the average results from three different surveys[1]:

1. *Cognitive skills:* Researchers conducted five tests to measure farmers' reading skills, math skills (with and without relation to agriculture), visual processing, analytical reasoning, short-term memory, and executive functioning.
2. *Non-cognitive skills:* Researchers asked farmers the level to which they agreed or disagreed with general statements about themselves to measure non-cognitive skills, such as agency, self-esteem, perceptions about the causes of poverty, attitudes towards change, organization, tenacity, meta-cognitive ability, optimism, openness to learning, and self-control.
3. *Technical skills:* Researchers developed a module with a mix of open and multiple-choice questions to measure farmers technical abilities, like their knowledge of how to use inputs and agricultural practices.

The evaluation helped researchers formulate a theoretical model to understand farmers' dynamic learning process.

Results and policy lessons

Farmers exposed to new information about various input combinations during agronomic trials were more likely to experiment on their own farms. Particularly high-skilled farmers (HSFs) were quicker to learn and adopt different combinations of inputs and practices than participating low-skilled farmers (LSFs). However, increased experimentation was costly. HSFs' average profits decreased over the five agricultural seasons, whereas LSFs' profits increased to reach the average profits of HSFs by the fifth season. Researchers suggest that HSFs' willingness to experiment with different input combinations hurt their profits in the short term but supported LSFs' learning.

Agricultural knowledge: On average, all farmers who participated in the trials increased their knowledge about optimizing combinations of inputs and practices over the five agricultural seasons compared to those who did not participate. Despite having more knowledge than LSFs before the trials began, HSFs increased their agricultural knowledge by 0.57 standard deviations on average by the third season, learning more and faster than LSFs, who increased their know-how by 0.39 standard deviations in the same time period. Both HSFs and LSFs who participated in the trials increased their likelihood of discussing practices, particularly during the seasons the trials took place, suggesting learning may not only come from exposure to one' own trials but also from discussing with others.

Use of inputs and practices: Both participating LSFs and HSFs increased their use of inputs and practices from the trials over time. However, HSFs were quicker to adopt new inputs and practices. Specifically, participating HSFs were 14 percentage points more likely to adopt any input by the fourth agricultural season compared to HSFs not included in the trials, whereas participating LSFs were 5 percentage points more likely to adopt, compared to LSFs in the comparison group (on average around 10 percent adoption in both HSF and LSF comparison groups). By the fifth season, participating LSFs caught up to HSFs in the likelihood of adopting inputs.

That said, HSFs were more likely than LSFs to learn subtle and complex lessons, like choosing between two inputs or learning about effective combinations of inputs. For example, HSFs who participated in the trials were 23 percent more likely to correctly adapt inputs to their conditions (according to agronomists) compared to HSFs in the comparison group, while LSFs were 10 percent more likely to correctly adapt their inputs, compared to LSFs in the comparison group.

Adopting a new crop (soya): Both participating HSFs and LSFs increased their likelihood to grow soya over the course of the five agricultural seasons, demonstrating how participation in the multi-input trials increased their willingness to experiment with multiple new practices and inputs at once. However, HSFs adopted soya more quickly, reaching 27 percent adoption just after the trials ended, between the third and fourth agricultural seasons, while LSFs adopted at a lower rate, reaching a 21 percent adoption rate only in the fifth season, demonstrating HSFs' ability to more quickly learn and adapt a new combination of inputs and practices.

Yields: On average, farmers yield increments—the difference between yields in farmers' non-trial plot and yields measured in the trial plot with the input package—were positive at 950 kg/acre for maize and 283 kg/acre for soya. About 85 and 47 percent of farmers who cultivated maize and soya respectively in the trials realized yield increments that offset the cost of using new inputs (not including the cost of labor).

Profits: Both participating LSF and HSFs maintained positive profits, however, profits decreased by KES 949 (US$9.40) and KES 861 (US$8.52) for participating HSFs and LSFs, respectively, in the first agricultural season, compared to average baseline profits of KES 8500 (US$84.15) and KES 6000 (US$59.40) in the respective comparison groups. By the fifth agricultural season, profits for LSFs increased to be in line with the post-experimentation profits of HSFs, whose profits decreased over the five agricultural seasons. Researchers posit that the average decrease in profits for HSFs was due to their willingness to explore new combinations of more costly inputs and practices. For example, using a new seed or fertilizer could require re-optimizing other inputs and practices, which could increase the likelihood of committing costly mistakes.

HSFs' continued use of new inputs despite a decrease in profitability is a signal of their dedication to experimentation and learning. LSFs, although less likely to experiment themselves, also benefited from HSFs experimentation as they were able to increase their profits by the fifth agricultural season to match HSFs' average profits of about KES 5000 (US$49.50).

Overall, researchers highlighted how exposure to agronomic trials can encourage farmers, particularly HSFs to experiment on their own farms, however, modifying input decisions and practices can be costly and result in reduced profits in the short-term, despite increased learning. As such, researchers point to a need to find ways to lower the cost of experimentation to encourage farmer experimentation with more productive combinations of inputs and practices.

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1. For more information on the skills classification, see Laajaj, Rachid and Karen Macours. 2021. “Measuring Skills in Developing Countries,” *The Journal of Human Resources* 56, no.4 (October): 1254-1295. doi: https://jhr.uwpress.org/content/56/4/1254.