FONDATION POUR LES ÉTUDES ET RECHERCHES SUR LE DÉVELOPPEMENT INTERNATIONAL

Learning-by-doing and learning-from-others: evidence from agronomical trials in Kenya

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Abstract

This research analyzes the dynamic processes underlying farmers' learning about heterogeneous returns to new inputs. A RCT was designed to provide an exogenous increase in the farmers' information on input quality and suitability through agronomical trials on their own farm. We study the dynamic impacts of farmers' experimentation with multiple products over three seasons and test whether this leads to an increase in the use of high quality and suitable inputs and yields. Preliminary results show that farmers' learning is slow but matches well the agronomic findings of the trials. After several seasons many identify which inputs worked best and increase the demand for those specific inputs. The increased willingness to purchase the inputs is however only partially translated into purchase, suggesting important remaining constraints on the supply side. Evidence further suggests that farmers participating in the trial are learning from each other, but learning by non-participating neighboring farmers appears more limited.

policy brief
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September
2016
note brève

Policy brief prepared for the Ferdi and SPIA workshop Learning for adopting: Technology adoption in developing country agriculture, held in Clermont-Ferrand (France), June 1 and 2, 2016.

1. Motivation

Information barriers can be an important constraint preventing adoption of a profitable technology. Whether such information constraints exist and persist likely depends on farmers' ability to learn about the use of, and the returns to new technologies, through learning-by-doing or through learning-from-others. However farmers' experimentation and learning does not always happen, which can be puzzling given that in many cases the cost to experiment a technology may seem relatively small compared to the long-term benefits of technology adoption. This research explores a number of reasons that can explain this puzzle.

First, farmers do not consider one input in isolation, but a large number of inputs and input combinations. If a large share of possible input combinations has low returns it may become too costly to experiment with enough products to identify the few good ones. Second, because the return to each input combination is a function of soil and other farm characteristics, each farmer may need to find the one that is most suitable to their own farm, thus reducing the potential for learning-from-others. Third, learning about the return of an input combination can be a challenging dynamic process because yields can be affected by multiple observed and unobserved factors. Identifying the right signal about returns can hence be complex and might well take multiple seasons, and farmers are likely to differ in their willingness and ability to do so. Finally, imperfect communication within the household, and the fact that the person exposed to new information is not necessarily the one who can use it adds to the household's difficulty to use its experience to make the right decisions about technology adoption.

This research hence focuses on the dynamic processes underlying farmers' learning about heterogeneous returns to new inputs. As numerous interventions aim at increasing technology adoption through learning, a better understanding of how these different factors affect farmers' learning arguably is key for effective policy design. We provide strong causal evidence on the impact of providing information on the returns to specific combination of inputs that rely on experimentation on the farmer's own land. We pay special attention to the heterogeneity in returns and learning due to local soil conditions and differences in skill levels of farmers. Beyond providing unique evidence on learning-by-doing regarding input quality and suitability, the research also contributes by analyzing learning-from-others. First of all, we analyze learning within the household, building on a rich baseline datasets with individual skill measures for the two main farmers in the household. Second, we analyze learning by other farmers in the village, and how differences between neighbors and participating farmers affect the learning process. As such, the research will provide evidence on potential hidden constraints to information dissemination within and across households.

2. Setting for the research

The research builds on the findings of COMPRO I, a BMG funded project, which analyzed the cost-effectiveness of 100 commercial inputs in Kenya, Nigeria and Ethiopia, through lab-analysis of the content for active ingredients, trials in research stations and on-farm trials. Only a small proportion of tested inputs were found to have sufficiently high benefit-costs ratios to unambiguously warrant adoption by smallholder farmers. Agronomic research results further show that the returns to inputs can vary a lot depending on soil conditions, the use of complementary inputs, farming practices and weather conditions, implying there can be low returns to many inputs for a large share of farmers. With a high likelihood of low returns, farmers' own experimentation with many products will often turn out to be a costly mistake, and anticipation of such costs might well entirely prevent such experimentation. This can lead to low demand, and in turn low supply of new products, including of the few high return ones.

We analyze these potential constraints to learning in the context of COMPRO II, a program implemented by IITA (the International Institute for Tropical Agriculture, one of the CGIAR centers) in 6 sub-Saharan African countries. Within this context, IITA and PSE set up an agronomical research RCT in Siaya (Western Kenya), where smallholder farmers were invited to participate in an agronomical trial on one of their plots that lasted for three seasons. While the study is set up as a proof-of-concept study, encouraging experimentation by farmers is at the core of the technology dissemination approach of Compro II and many other extension programs. The insights of the study hence aim to contribute to the literature on extension, where rigorous evidence on scalable cost-effective interventions remains scarce.

3. Methodology

The RCT was designed to provide an exogenous increase in the farmers' information on input quality and suitability. We study the dynamic impacts of farmers' experimentation with multiple products over three seasons and test whether this leads to an increase in the use of high quality and suitable inputs and yields. Prior to the long rain season 2014, we identified ten farmers per village in 96 villages and the plots that they would dedicate to the research trials. Half of the villages were randomly selected to the control group, and in the other half all identified farmers were selected to apply the research trials during three seasons. In the first (random) 24 villages, trials started in the long rain season 2014, in the second batch of 24 villages trials started in the short rain season 2014. Within each village, we sampled 5 random farmers, as well as 5 farmers specifically selected as promising farmers for the trials, so lessons can be drawn for both average and highly skilled or motivated farmers. Following standard agronomical protocols, agronomical scientists from IITA then worked with each farmer in the treatment group to implement an agronomical trial. Each plot was randomly divided into a control sub-plot without inputs and 5 treatment sub-plots where different combinations of inputs were tested. Inputs were selected to ensure variation in the quality and suitability of the inputs tested by each farmer, ranging from inputs of known stable high returns to inputs with more uncertain quality signals. The inputs were varied randomly by farmer, but each farmer tested a set of inputs that satisfy the same function.

The trials tested different combinations of seeds and fertilizer packages, for soya and maize. The packages were selected based on insights from the ISFM (integrated soil fertility management) literature. The returns to the different packages are further illustrated through the agronomical trials, with important heterogeneity across locations (subdivisions) and farmers in Siaya county. The packages include both some inputs with which farmers were familiar, as well as fertilizer more recently introduced in the market. The use of these inputs at baseline was low. When using an optimal fertilizer package, maize yields increased between 30-200%, with important heterogeneity between locations and maize varieties; yield gains in soya varied between 50-150%. These yield gains were calculated based on comparison of control and treatment subplots of the same farmers, and the results for different subplots allows disentangling the importance of different inputs. The trial yield data also illustrated important heterogeneity across farmers within the same village. Overall compliance with the randomized design was good, though some farmers did not complete all three seasons. In general take-up was good during the long-rain seasons (~90%) but lower (~ 80%) during the short-rain seasons, when weather conditions increase the risk of crop failure.

The protocol was designed so that the

agronomist working with the farmers did not provide any signals about which input is expected to perform better. As a result, a significantly higher use of the high quality inputs in the treatment villages should indicate that farmers learned about the return to inputs from observations of the trials. Indeed, the design of the RCT is based on an assumption that, due to possible heterogeneity in soil and farmer characteristics, dissemination of information on input quality through experimentation may be more credible than merely telling farmers which inputs to use. In particular, the research trials offer a rare occasion to analyze learning from observation and yield comparison of farmer's own experimentation, in absence of any behavioral marketing. To do so we collected data at baseline and after each season of the agricultural trials. This intensive data collection during and after the implementation of the RCTs allows the analysis of the dynamic learning and adoption decisions. The data collected after the end of the trial allows studying the sustainability of the adoption patterns, as well as any potential dis-adoption. Attrition was kept to a minimum, at less than 5% in each of the follow-up rounds.

We also surveyed the second farmer in the household after 3 seasons on their agricultural knowledge, perceptions about the new technologies, and their related investments and decisions, after their spouses have participated three seasons in the agricultural trials. This allows testing for intra-household learning. To further shed light on the relative importance of own experimentation for learning, we organized field days in the last season of the trials in the treatment villages, where the results and experiences of the trails were discussed among participating farmers and presented to other interested farmers in the village. We subsequently study spillovers in the wider village population by surveying non-participating farmers randomly selected from the village population. Further evidence on learning-from-others comes from studying changes in soya input use and practices among farmers that were randomly assigned to maize treatment, and vice versa.

4. Preliminary results

The findings show that experimentation on farmers' own plots results in clear learning gains. Farmers' learning is slow but it matches well the agronomic findings and after several seasons many identify which inputs worked best and increase the demand for those specific inputs. Community selected farmers learn faster and more, but differences with randomly farmers decrease over time. And learning is not limited to specific inputs, but farmers' also grasp wider lessons regarding optimal agronomical practices, and apply those on their own plots. Learning increased the willingness to purchase the inputs, but only partially translates into purchase, pointing to important remaining constraints, in particular on the supply side.

Learning-by-doing is to a certain extent accompanied by learning from others. Indeed learning is strong across treatments: farmers with maize trials learn about soya and vice versa, suggesting high communication among participating farmers in the village. We find that participation in the trials increases the communication among the participating farmers, and this increases over time. Yet learning of neighboring farmers that themselves did not participate in any trials appears more limited. In contrast, we find significant learning spillovers within the participating households. Future work will deepen the analysis of returns and learning, conditional on soil characteristics and on the skills of farmers, measured at baseline. The analysis will also aim to derive lessons for the design of extension interventions.

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n° ISSN : 2275-5055