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

by

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Policy brief

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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, the new technologies, through learning-by-doing or through learning-from-others (Besley and Case 1994; Foster and Rosenzweig 1995; Conley and Udry 2010). Given the low fixed cost of many technologies, the cost of experimenting may seem relatively small compared to the long-term benefits of the technology adoption, but farmers' own experimentation with new products does not always seem to happen. We hypothesize that this is because farmers are not considering one input in isolation, but a large number of inputs with unobservable and variable returns, and learning about each input combination is a lengthy process. If experimentation is costly, and a large share of possible input combinations have returns that are not worth their adoptions, either because they are low quality or because of their non-suitability to the farmers conditions, then it may become too costly to experiment with enough products to identify the good ones, leading to a lemons problem (Akerlof, 1970). To the best of our knowledge, little is known about whether variation in the returns of different available agricultural technologies, and the high frequency of low-return ones, are important constraints to adoption. If they are, farmers' learning experiences about such variation can enhance adoption of the high return technologies, and encouraging farmers to experiment with high quality and suitable products might hence increase adoption.

This paper focuses on the role of heterogeneous input returns, the dynamic processes underlying farmers' learning and their appreciation about new inputs. 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 male and female farmers. Beyond providing unique evidence on learning-by-doing regarding input quality and suitability, the research also contributes by analyzing learning-from-others along a number of innovative channels. 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. Among the 100 products tested, only 3 of them were found to have sufficiently high benefit-costs ratios to unambiguously warrant adoption by smallholder farmers. Given such high frequency of low quality products, 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 such products, including of the few high quality ones. These problems in turn can be reinforced if returns to inputs further depend on complementary inputs, the farmer's skills set, soil and/or weather conditions.

We analyze this potential constraint to adoption 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

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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 (Anderson and Feder, 2007).

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. Adoption 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 are riskier.

The protocol was designed so that the agronomist working with the farmers does 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 quality of 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 random 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. Indeed, 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 much more limited. In contrast, we find significant learning spillovers within the participating households.