African Journal of Agricultural and Resource Economics Volume 11 Number 1 pages 1-7

New experiments in agriculture

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1. Introduction

Until about two decades ago, experimentation in agriculture was primarily focused on crop trials at research stations and model farms. Studies in the field, involving actors along the value chain, tended to focus on cross-sectional data, or relied on panel data and the inclusion of control variables to tease out causal effects. More recently, however, the number of field studies involving experiments has exploded. The 2015 International Conference of Agricultural Economists devoted a lot of attention to experiments, and several keynote speakers noted that an experimental *revolution* is under way in agricultural, development and natural resource economics. Throughout the (developing) world, experiments are now being used, both as a measurement tool to assess preferences and behaviour and as a method to separate cause and effect.

Harrison and List (2004) provide a useful classification of experiments, covering the full spectrum from the laboratory to the field. At one extreme are standard laboratory experiments, typically conducted at universities and involving students as study subjects (see Falk and Heckman (2009) for a review). Moving one step into the field are artefactual field experiments, or so-called "lab-in-the-field" experiments. These are (perhaps slightly modified) laboratory games, played with a non-standard population of subjects – typically drawn from the population of interest (for example farmers or agricultural policy makers). Next, framed field experiments introduce additional context to the experimental dilemma that is being studied. For example, experimental choices involve seedlings rather than experimental tokens, and realistic management decisions rather than context-free allocation decisions. For example, building on Binswanger's (1981) seminal work on the risk preferences of farmers in India, researchers have started to use a suite of laboratory experiments to measure social risk and time preferences (amongst others). The contributions are too many to mention and have emerged as the sub-disciplines behavioural environmental economics (see Shogren 2003) and behavioural development economics (see Cardenas and Carpenter 2008).

One lively field comprises social dilemmas around common pool resources (see Ostrom *et al*. 1994; Janssen *et al*. 2010). One recent study looked at the role of social preferences for participatory forest management in Ethiopia (Rustagi *et al*. 2010). They found that groups with a higher proportion of conditional co-operator types are more successful in forest management. Pfaff *et al*. (2015) looked at water scarcity and collective action using a framed field experiment. They found that higher scarcity can erode the basis for collective action. In a different experiment, Prediger *et al*. (2014) found evidence that resource scarcity induced antisocial behaviour.

One specific type of framed field experiments is auctions used to test bed policies or products. Nystad Handberg and Angelsen (2015) looked at various policies to reduce deforestation. Cardenas *et al*. (2013) looked at policies governing forest, water and fishery dilemmas. Auctions represent one well-studied allocation method. For example, Cummings *et al*. (2004) reported on a series of auctions used to pay farmers to suspend irrigation in drought years (see also Anderies *et al*. 2016). Narloch *et al*. (2013) looked at payments for ecosystem services. Other examples concern studies on the demand for new food products. In 2008, for example, the Africa Rice Center (AfricaRice) initiated a programme of framed field experiments based on auction markets to generate empirical evidence for supporting rice value chain upgrading in Africa. Demont *et al*. (2013) developed an experimental treatment for assessing the impact of learning through social cognition on individual consumer valuation and teased out the determinants of opinion leadership. The findings suggest that African rice can compete against imported rice if its extrinsic and intrinsic quality attributes are upgraded to the standards of imported rice. Follow-up work showed that word-of-mouth communication is a critical factor in the acceptance and value of upgraded rice products in African markets (Demont & Ndour 2015).

Finally, at the other extreme of the laboratory-to-field spectrum are field experiments, in which participants operate in their natural surroundings and typically are not aware they are part of an experiment. RCTs are part of this family of experiments and are now being implemented across the globe. Without trying to be complete, we discuss several promising developments in experimental research.

2. Technology adoption

A key challenge facing farmers and policy makers concerns technology adoption. While new technologies are available (for example fertiliser, improved seeds or new farm techniques), and appear to have high returns, farmers are not adopting them. For example, Dar *et al*. (2013) looked at the introduction of Swarna-Sub1, a submergence-tolerant rice variety, and found it reduces rice yield variability and increases yields in submerged rice fields by about 45%. Duflo *et al*. (2008) found that, when applied adequately, fertiliser input can increase average yields by 36% in a season. Farmers, however, face numerous constraints that preclude adoption, such as access to savings and credit. Researchers have thus turned to looking at the role of grants and subsidies, often with large impacts. For example, Beaman *et al*. (2013) looked at the role of giving fertiliser grants to female rice farmers in Mali. They found that it not only increased fertiliser use, but also stimulated (crowded in) the use of complementary inputs such as herbicides and hired labour. Carter *et al*. (2013) used a fertiliser subsidy programme for maize and rice crops and observed the uptake of fertiliser by farmers. They found that uptake of the treatments was low (50%), but that those farmers who purchased subsidised fertiliser had higher incomes.

3. Access to finance

Several studies have looked at the role of access to financial services. In one seminal study, Duflo *et al*. (2011) highlighted the low take-up of fertiliser. This was explained by farmers facing liquidity constraints due to apparent poor inter-temporal planning caused by procrastination and time inconsistencies. Brune *et al*. (2016) facilitated access to formal savings for agricultural inputs. Treated farmers were offered the option to directly deposit crop income in bank accounts. Compared to farmers paid in cash after harvest, farmers in the treatment group had higher savings and increased agricultural input use, sales and expenditures.

4. Social learning and networks

There also are various non-pecuniary constraints to the adoption and diffusion of technologies. A lively new field looks at the role of social networks. Magnan *et al*. (2015) investigated how social learning affects the demand for a resource-conserving technology (land levelling) in India. Using a combination between an experimental auction and a randomised control trail (RCT), they show that having an adopter in one's network increases demand by over 50%. BenYishay and Mobarak (2013) looked at the role of social learning in technology adoption. Using a large-scale RCT in Malawi, they show that incentives matter, as they increase the willingness to learn about a technology. In addition, they show that the identity of the person communicating about the technology matters. In particular, using peer farmers rather than extension agents or lead farmers increases learning and adoption by maize farmers. In follow-up work, Beaman *et al*. (2015) looked at the network determinants of technology adoption. Using network data, they determined the theoretically optimal lead farmers in a village for an agricultural technique (pit planting and crop residue management). They showed that social network-based targeting improved technology adoption in the villages. Relatedly, Hofman *et al*. (2016) show that selecting lead farmers with low centrality increased the speed of technology diffusion for a sample of farmers in DRC.

5. Value chains

A suite of papers has looked at treatments that measure changes in the value chain. Ashraf *et al*. (2009) report on a RCT implemented in Kenya that aims to help farmers adopt and bring to market export crops. Farmer self-help groups were randomly assigned to no export facilitation, a treatment involving intermediary services (information, liaison with exporters) and a group receiving additional access to credit. The short-term results were positive: export orientation went up and transaction costs went down. In the longer run, however, the intermediary collapsed as the exporters learnt that products did not meet minimum standards, resulting in changes in the value chain and loan defaulting. Casaburi and Reed (2014) looked at how changes in the value chain are passed through by cocoa traders in Sierra Leone. A group of traders was paid a bonus for delivering quality cocoa to wholesalers. They found that the pass-through to farmers in terms of prices was small, but that there were substantial changes in terms of credit outlay.

6. Migration

Another strand of work looks at the impact of seasonal migration. Bryan *et al*. (2014) looked at temporary migration for employment to nearby urban areas during the agricultural lean season in Bangladesh. They randomly assigned potential migrants to small cash or credit incentives and found strong economic returns for migrants over the short and medium term. They argue that temporarily offsetting the costs of migration lowers the associated risk of failing to find employment for subsistence households.

7. Access to insurance

Finally, several papers have looked at the role of insurance against climatic risks. Comparing access to credit and insurance, Karlan *et al*. (2014) found large impacts of insurance on farm investments. In a set of experiments, farmers were randomly allocated to receive a cash transfer, the opportunity to buy rainfall insurance, or both. These authors found large impacts on the take up of insurance and its subsequent impact on agricultural investments and crop choice. When insured, farmers were able to overcome climatic risk and free up resources for farm investments. Giné and Yang (2009) implemented a field experiment to see if insurance induces farmers to take out loans to adopt a new crop technology. Half of the farmers were offered a credit package to purchase high-yielding hybrid

seeds, while the other half also had to purchase weather insurance for when crops would fail. Contrary to expectations, they found treatment take up to be lower among the group with insurance, suggesting that farmers already had an implicit insurance from the limited liability clause in the loan contract.

This special issue

Below we introduce the studies included in this special issue. They cover the full range of the laboratory to field spectrum on a wide range of topics.

Akoa Etoa *et al*. (2016) used a framed field experiment to understand consumer demand for technology upgrading in rice parboiling (a processing technique that improves the quality of rice). Using an experimental auction in a central market in Cameroon, they presented participants with a benchmark quality of rice and invited them to upgrade to an improved rice type by bidding in a Vickrey second-price auction. The available improved type was either non-parboiled rice with manually improved quality, parboiled rice using the traditional technology, or rice parboiled through the improved technology. The authors found that perceptions matter for consumer demand. Consumers were more likely to buy quality rice if they believed it was imported rather than locally produced.

Torero and Viceisza (2016) used trust games with contract dairy farmers and firm owners in Vietnam to assess the degree of trust and the impact of auditing, and to study potential collusion between firms and third-party auditors. Using a within-subject study design, the participants were exposed to each of the treatments in random order. The authors found that the presence of a third party increased trust substantially. Surprisingly, the potential for collusion did not erode this. The authors discuss the external validity of their findings.

In a laboratory experiment, Iskander *et al*. (2016) used a sample of Indonesian university students to study compliance with environmental taxes. The authors start by developing a model in which reported emissions by companies are a function of tax rates, audits, financial incentives and bribes. Students act as firm decision makers to make choices over how much of a stock (taxable earnings) they voluntarily report to authorities, given a probability of being audited. Study treatments vary the introduction of financial rewards and the possibility to bribe auditors. The study shows that tax compliance increases with financial rewards, but is diminished by the presence of bribes.

Moving to the field, Holden and Bruvik Westberg (2016) used a series of risk experiments involving agricultural smallholders in Ethiopia. They correlated experimental choices on risk to changes in rainfall and fertiliser use. Using data from over 500 cereal growers, they found that fertiliser use is correlated to risk aversion, rainfall levels and variation. In addition, in a choice experiment they found that demand for fertiliser responded to price and average rainfall levels and variability.

The final set of papers used field experiments involving people in their natural environment.

Thunström *et al*. (2016) used a randomised control trial to study the impact of the composition of restaurant menus on the demand for meals. They experimentally included a healthy food label on the menu to test the hypothesis that this may attract new customers and change the consumption patterns of existing clients. Comparing sales before and after the introduction, they found that introducing a healthy food label does not increase restaurant sales.

Finally, Nillesen (2016) used a natural field experiment, the civil war in Burundi, to look at the impacts of exposure to violence on agricultural choices (planting cash crops). Most of the violence in the civil war was exogenous to individual behaviour. Comparing victims to non-victims, the author

showed a direct relationship between conflict exposure and cash crop production, even several years after the war ended. This suggests a legacy of violence in agricultural production.

The various articles covered in this special issue highlight the fruitful contribution that experimental research can make to an improved understanding of key topics in agriculture, development and natural resource economics throughout the world.

Looking ahead, we have identified three encouraging trends in recent experimental studies. First, experiments are moving beyond (simply) empirically testing an interesting question towards designs that seek to test theoretical predictions. Second, a promising development is to look beyond local average effects, and to assess spill-overs to communities as a whole and, in turn, the impact of social learning on individual behaviour. Modelling and simulations offer a useful tool to look at how whole economies respond to treatments (see Taylor and Filipski 2014). Third, with the widespread use of smartphones and tablets, experimental tools are increasingly becoming dynamic and interactive, offering new possibilities for eliciting preferences and behaviour from stakeholders directly in the field in agriculture and food value chains.

Acknowledgements

We thank the NWO for financial support through grant # 453-10-001.

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