FONDATION POUR LES ÉTUDES ET RECHERCHES SUR LE DÉVELOPPEMENT INTERNATIONAL

LA FERDI EST UNE FONDATION RECONNUE D'UTILITÉ PUBLIQUE. ELLE MET EN ŒUVRE AVEC L'IDDRI L'INITIATIVE POUR LE DÉVELOPPEMENT ET LA GOUVERNANCE MONDIALE (IDGM). ELLE COORDONNE LE LABEX IDGM+ QUI L'ASSOCIE AU CERDI ET À L'IDDRI. CETTE PUBLICATION A BÉNÉFICIÉ D'UNE AIDE DE L'ÉTAT FRANÇAIS GÉRÉE PAR L'ANR AU TITRE DU PROGRAMME « INVESTISSEMENTS D'AVENIR » PORTANT LA RÉFÉRENCE « ANR-10-LABX-14-01 »

Adjusting extension models to the way farmers learn

Alain de Janvry
Elisabeth Sadoulet
Manaswini Rao

Alain de Janvry, Department of Agricultural and Resource Economics, University of California at Berkeley, Senior Fellow at Ferdi.

Elisabeth Sadoulet, Department of Agricultural and Resource Economics, University of California at Berkeley, Senior Fellow at Ferdi.

Manaswini Rao, Department of Agricultural and Resource Economics, University of California at Berkeley.

Abstract

Extension services play a key role in helping developing countries modernize their agriculture and grow. Yet, these services have almost universally performed below expectation. The hypothesis proposed here is that extension systems could perform better if they delivered services structured on the way farmers learn. To inform this hypothesis, we review critically existing extension systems, extract from learning models and empirical studies of adoption regularities about how farmers learn, and propose a set of reforms to existing extension services that match learning channels. Major reforms to extension would select contact farmers as entry points for diffusion according to the specific constraint to be addressed, organize head-to-head trials in farmers' fields under the jurisdiction of farmers themselves, use private agents in value chains as sources of information, and inform social networks about the existence of innovations using mass media to induce a demand-driven search for information from contact farmers.

policy brief 159 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.

The role of agricultural extension services for development

As was learned from the Solow growth accounting model, Total Factor Productivity (TFP) growth is an important source of aggregate economic growth. This is particularly true for agriculture. For that sector in all developing countries in 2000-07, 2/3 of agricultural growth is explained by productivity growth and 1/3 by factor deepening (Evenson and Fuglie, 2010; Gollin, 2010). Improving agricultural productivity is for that reason one of the key objectives for governments in most developing countries, not only from the perspective of growth, but also to achieve food security and improve the welfare of a large share of their populations that is engaged in agriculture.

Public investment in productivity enhancing public goods and technologies continues to be large (World Bank, 2006), even if there is a chronic under-investment in agricultural research (Alston, 2000). However, adoption of technological innovations is constrained by many factors (Jack, 2011). Prominent among them are the following that we address here:

– Low profitability of the innovation in a risk-return framework
– Lack of information about the availability of innovations
– Lack of information about how to use available innovations given heterogeneity of farmer circumstances

Agricultural extension services have a fundamental role to play in disseminating information about the availability of new technologies and the fit of innovations to individual conditions of use. This is particularly the case in developing countries where value chains are yet poorly developed, with missing agents such as agro-dealers and commercial agents that could be sources of information about new technologies.

Agricultural extension is one of the largest public institutions in developing countries, employing and training more than a million extension workers at a world scale (Anderson and Feder, 2007). According to the Neuchatel Initiative (Swanson and Davis, 2014), there are some 618,000 extension agents in China, 90,000 in India, 54,000 in Indonesia, 46,000 in Ethiopia, 35,000 in Vietnam, and 24,000 in Brazil.

The general observation, however, is that current extension systems have not lived up to expectations. Available technological innovations are often only scantly adopted. Large segments of the farming population do not know about the existence of these innovations, or do not know how to use them for maximum efficiency. There is, consequently, a large literature critical of current extension services. Dispersed attempts have been made to experiment with alternative designs to improve on current extension systems. The proposition behind this note is that the redesign of extension services must correspond to the way farmers learn in order to effectively induce adoption and productivity gains.

Traditional approaches to extension

Traditional approaches to extension include the Training and Visit and the Farmer Field School systems. They are based on Everett Rogers' (2003) model of diffusion of innovations where farmers will adopt an innovation once they are surrounded by a threshold of adopters. Both systems have been widely used and also widely criticized.

Training and Visit (T&V)

The World Bank promoted the "Training and Visit" system in over 40 developing countries in the 1970s and 1980s. This system introduces a cadre of trained agriculture extension workers operat-

ing under a single line of command, replacing (in India) the previous system of multipurpose village-level workers. At the lowest level of the T&V system are village extension workers who cover each about 800 farm families, 10% of which are chosen as "**contact farmers**" -- mostly larger, well-to-do farmers, who receive intensive training in communication from the agriculture extension workers and are expected to adopt the improved practices and disseminate them among other farmers in the community (Feder, 1986).

What has been the impact of the T&V extension system? This question is yet to be answered with rigorous impact evaluation techniques although there has been growing evidence accumulating over the years. Some of the early evaluations have been in the form of structural economic analyses of investment projects that estimate benefits to farmers and rates of return using an economic surplus approach (Anderson and Feder, 2007). Feder (1986) estimated no significant impact of T&V-type extension on rice production in India, while the return for wheat producing areas was estimated at 15% using simple differences between districts with and without the T&V system a few years after introduction of the extension system. While it is hard to attribute causality, as the author acknowledges citing lack of disaggregated panel data and identification options, these are the only early estimates available.

More recently, Gautam (2000) studied the impact of a revised extension system in Kenya based on T&V called the NEP-I and NEP-II projects. He found that the extension system was mis-targeted away from smallholder farmers. In addition, the system was not effective for beneficiaries. First, the content of services was not demand-driven: it was mainly focused on modern methods of maize production while many smallholder farmers require services on diversified cropping systems and less costly technology. Second, there was no notable change in quality and quantity of extension services from before the program. Third, adoption followed awareness that was limited to maize-related messaging and technology, which already had a high baseline level implying limited impact of the new program. Fourth, the system was targeted at districts that already had high baseline productivity, again, with limited potential for impact. Finally, productivity increased substantially in districts with low baseline productivity but since most of the program was targeted towards high productivity districts, data do not reveal a significant overall impact of extension services.

Anderson and Feder (2007) concluded their review of evidence on T&V by claiming that the system introduced a top-down hierarchical structure with no adjustment to farmers' demands for services, no accountability to farmers, no effective feedback mechanisms, a strict schedule of visits (with no flexibility and no adjustment to heterogeneity of farmer circumstances), and that it was too costly and excessively dependent on external funding, consequently failing to achieve financial sustainability. While the system was largely abandoned in its original form, it still forms the basis of most current existing extension services.

Farmer Field School (FFS)

Under the FFS approach, trained facilitators bring student-farmers to training schools to build skills using a discovery-based approach to learning, i.e., using experimental methods, typically with treatment and control plots managed by the student-farmers themselves under guidance of the trained facilitators. FFS is a participatory approach intended at developing a farmer's own understanding and decision-making capacity, rather than a top-down approach of transfer of information on what to do as in T&V. Student-farmers are trained to not only learn and decide, but also to communicate with others in the community. Results show that the approach can be effective in teaching farmers and helping them decide for themselves under their

own circumstances, especially for such issues as the implementation of Integrated Pest Management practices and seed selection (Waddington and White, 2014). The problem with the approach is that it is not cost-effective, and as a consequence is not scalable and sustainable. In addition, trained student-farmers have difficulty communicating to others what they have learned as it is too complex to be transmitted to un-trained farmers. Additionally, they are not equipped with demonstration tools (such as treatment and control plots as used at the FFS) in attempting to provide the information to others.

Agricultural extension system and National Food Security Mission (NFSM) in India

Dedicated agricultural extension services in India, like most around the world, started with the top-down public T&V approach promoted by the World Bank during the Green Revolution period. Over time, this system has evolved to address some of the criticisms of limited reach and inadequacy of adaptation of content to local context. The current public extension system involves the Department of Agriculture at the national and state levels, with district and block level officers in charge of implementation. In recent years, under the current 12th five-year plan (2012-17), a decentralized agency known as the Agricultural Technology Management Agency (ATMA) has become the main coordinating body in charge of implementation. ATMA is a multi-stakeholder agency involving farmer interest groups, NGOs, the private sector, and public officials from different line departments within the agricultural sector. The link between research and extension is mainly overseen at the national level by the Indian Council of Agricultural Research (ICAR) and at the state level by State Agricultural Universities (SAUs). Krishi Vigyan Kendras (KVK), established at the district level, are experimental stations of SAUs where new technologies are tested on experimental plots and extension officers are trained for dissemination.

Recent years have seen a rise in private sector involvement in agricultural extension on a modest scale, including public-private partnerships (PPP), following liberalization and changes in agricultural policies in favor of increasing private sector roles. Some of the PPP initiatives are under the form of agri-clinics and agri-business centers covering parts of the country. These initiatives focus on providing agricultural advisory services and sale of inputs through a cadre of trained agricultural graduates. Private sector players such as ITC Limited, the Tata Group, and the Godrej Group among others have engaged in contract farming as part of vertical integration of their agro-based industries. They have provided extension services by establishing a network of agri-business centers and information kiosks (such as e-choupal by ITC and Tata Kisan Sansar by Tata Chemicals) that provide marketing and price information to farmers.

In addition, many NGOs provide the last mile connectivity between the extension system and farmers through self-help groups (SHGs) and farmer-based organizations (FBOs). BASIX, PRADAN, and BAIF are large national level NGOs engaged in farmer welfare and increasing agricultural productivity, concentrated in the southern Indian states.

Mass media have always been used both by public extension system and more recently by NGOs. Specialized programs on TV, Radio (Krishi channels), and newspapers are among important avenues through which farmers get information. More recently, the government has set up "Kisan call centers" to address demand-driven information requests. Non-profit technology firms like Digital Green provide video-based extension services that have been shown to have better impact than traditional systems.

Glendenning *et al.* (2010) and Ferroni and

Zhou (2012) evaluated the Indian extension system, finding many inefficiencies and they call for greater synergies between private and public sectors. The public extension system continues to focus on wealthier progressive farmers and few other farmers report having accessed the extension service. Most small and marginal farmers get information and advice from input dealers and broadcast media; this is particularly salient for fertilizer and animal feed. The authors criticize weak links between extension and research, saying that only few farmers attend demonstrations at SAUs and KVKs. While PPP and private sectors models have been able to address some of the gaps, credit constraints and licensing requirements have prevented them from reaching scale. The private sector provides more context specific services on both production and post-harvest management; however, they tend to service larger contract farmers who are part of their vertical supply chains.

Under the 12th Five-Year Plan, the Government of India introduced the National Food Security Mission (NFSM) in 2007 with a focus on increasing productivity of core cereal crops (NFSM-Rice and NFSM-Wheat) and pulses (NFSM-Pulses). The policy specifies that small, marginal, and women farmers should comprise at least 33 % of contact farmers in the extension system. NFSM provides detailed guidelines on the expected intensity of demonstrations, stating that demonstrations should be held on 0.4 ha of land for every 100 cultivated ha, by dividing contiguous plots into experimental plots for new techniques and other plots for existing practices in order to visually show the impact to farmers by difference between treatment and controls. Extension officers are required to provide sufficient advance information before demonstrations and display boards on demonstration plots. Additional field days are required during the reproductive phase to ensure follow-up and address concerns during the entire farming cycle.

The International Rice Research Institute (IRRI) has held cluster demonstrations under NFSM-Rice for stress tolerant rice varieties (STRV) on 9,700 ha of land across 51 districts. Apart from disseminating information on modern STRV rice among farmers, the demonstrations have helped multiply seeds to meet increasing demand from farmers. A critique of this cluster approach is that it demonstrates the new technology under the cultivation conditions advocated by the extension agent and not as practiced by the farmer. The farmer may not be able to replicate the treatment the year after when he has to buy inputs and pursues his own objective function. What is being demonstrated to other farmers similarly does not correspond to what a peer farmer would be doing. For this reason, this approach has been criticized as broadly ineffective in helping farmers learning and deciding to adopt.

The Neuchatel Initiative on Agricultural Extension and Advisory Services (EAS)

The Global Forum for Rural Advisory Services (Swanson and Davis, 2014) is a platform for member organizations (especially producer organizations) where information is exchanged about best approaches and methods for the provision of rural advisory services in different country situations. It is also referred to as the Neuchatel Initiative and is supported by a coalition of donors including the Bill and Melinda Gates Foundation, the European Commission, and USAID. Based on the comparative analysis of extension services, it has evolved a set of recommendations about the desirable features of extension and advisory services (EAS) that include the following:

- It should be **demand-driven**, responding to farmers' demands for advice, in part through producer organizations (POs)
- It should recognize **diversity** and **heteroge-**

neity of conditions and needs across farmers

- It should be **participatory** of farmers, in particular through POs
- It should **diversify advice** beyond technology adoption to such issues of concern to farmers as household income, gender roles, empowerment, access to credit and insurance, marketing of produce, risk management, environmental protection, and links to the agricultural innovation systems
- EAS should include farmer **training**, with capacity development at the individual and organizational levels
- It should be **pluralistic**, with roles for the public, private, NGO, and PO sectors in the corresponding value chain. This requires the partial privatization, decentralization, and coordination of advisory services
- It should link extension to **research** as part of an Agricultural Innovation System, with feedbacks between the two
- It should be **financially sustainable**, with cofinancing of services

These broad principles derived from comparative experiences are useful in identifying desirable features for the design of extension services.

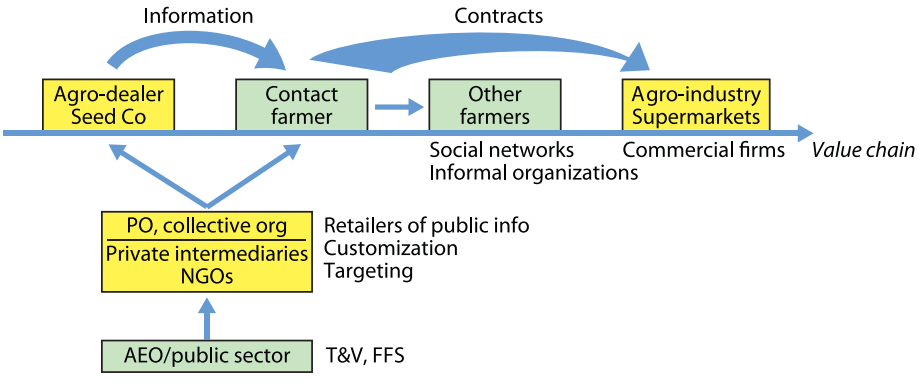
Figure 1 shows the variety of potential sources of information in a value chain framework. The traditional approach (T&V, FFS) involves the Agricultural Extension Officer in the public sector connecting to contact farmers who in turn diffuse information to other farmers in social networks and through informal organizations. The more pluralistic approach recognizes roles for agro-dealers and seed companies, agroindustry and supermarkets, POs and collective organizations, and private intermediaries and NGOs. The latter two categories of organizations act as retailers of public information, with an important role in recognizing heterogeneity of conditions and customizing and targeting information to relevant clienteles.

Advanced extension systems: Lessons from the US Agricultural Information System (Wolf, Just, and Zilberman, 2001)

In the context of agriculture extension in the United States, value chains as well as private and social provision of information are well developed. Issues of contracts and incentives become key to performance. Lessons learned from analyzing these emerging forms of extension services are the following:

- **Agents in value chains** are important sources of information. This includes agro-dealers, private service providers, and commercial partners (agro-industry, supermarkets). These private agents may not compensate for the

Figure 1. Sources of information for learning in value chains



decline in public extension services, especially for smallholder farmers

- **Private providers** deal with heterogeneity: they can customize public information to the demands of specific subsets of the farmer population.
- There is chronic private under-investment in information due to externalities and public goods effects, leaving a role for government intervention. This includes subsidies to adoption and direct provision of public services to targeted segments of the farmer population.
- **Less educated** farmers, and hence typically smallholder farmers, tend to use:
  – More processed information and less raw data for own analysis and use
  – More commercial intermediaries and NGOs as providers of information
  – More informal sources of information such as social networks and local organizations
  – Adoption can be motivated by the need to adapt, for example to climate shocks. Adoption then occurs in a discontinuous fashion. It is induced by crisis response and triggers, creating lags and recency bias

How farmers learn: Alternative channels

We use here the review paper prepared by Sadoulet (2016)[1] for this workshop that presents a number of models conceptualizing the channels through which farmers learn about innovations. We use them to identify the corresponding dimensions that extension services should have if they are to correspond to the way farmers learn. These dimensions are the following:

- **Private learning (learning-by-doing) by Bayesian updating.** This channel consists of direct learning from own individual actions over time. Prior knowledge about a stochastic phenomenon is updated based on information generated in the latest period (Besley and Case; Bardhan and Udry; Wang).
- **Social learning (learning from others) with Bayesian updating and aggregation of observations** collected from others according to a chosen pattern of weights. Learning from social networks is thus an important complement to direct learning from extension services (Chandrasekhar; Mobius; Ben Yishay and Mobarak).
- **Learning by acquiring knowledge from others.** Learning from others in deciding for oneself could be through the transmission of knowledge or of information about the behavior of others that can be imitated. Empirical results show that the transmission of knowledge may be more prevalent in social networks than the transmission of information on actions. This may be because information on actions is not willingly transmitted for reasons of liability and reputational risk, when transmission of knowledge has no implications for eventual adverse outcomes (Tjernström; Cai el al.; Udry and Goldstein).
- **Learning from others under heterogeneity of circumstances.** Heterogeneity of conditions (e.g., soil types, farmer skills) reduces learning from others in social networks (Tjernström). In India, there is less learning from others in rice (with more heterogeneous production conditions) than in wheat farming (more homogenous conditions) (Munshi). More unobserved differential characteristics of others decreases learning from others and induces more private learning. With heterogeneity, farmers learn more from peer farmers (people more similar to them) than from lead (best) farmers. They perhaps require more complex contagion to decide on adoption (information from more than one peer farmer) (Beaman, Magruder, *et al.*).
- **Learning by trusting.** If trust is important in deciding to imitate or use transmitted knowledge, farmers will learn more from large/lead farmers with a well-established social reputa-

1. See references in this section in the Sadoulet (2016) paper.

tion. Farmers will also rely on individuals in social networks where trust prevails, such as women Self-Help Groups (SHG), members of the same caste, community members, and members of a voluntary organization (Ben Yishak and Mobarak).

- **Learning by comparing and differencing.** This is the central learning approach in impact analysis, where fixed effects (farmer and plot characteristics, weather events) are subtracted away by measuring impact as the difference between observed outcomes in treatment and control plots. At the individual level, with only one plot, this is done with zero degrees of freedom in a particular year, requiring Bayesian updating of prior knowledge. At the social level, with large samples, this is done by differencing average outcomes between treatment and control plots. In this case, learning can happen through statistical inference without relying on priors (Banerjee, Chassang, and Snowberg, 2016).
- **Learning by communicating and deliberating.** Farmer field days serve for demonstrating, training, and confirming/interpreting information received. They can be very influential on adoption (Emerick *et al.*, 2016).
- **Learning through noticing.** Farmers can fail to notice important features in the information available to them. By failing to notice some of the determinants of outcomes, omitted variable biases are created in learning. Helping notice can reduce biases in making use of available information (Schwartzstein; Hanna *et al.*).
- **Learning from incomplete and noisy evidence.** Decision-making in agriculture is complex as it concerns use of many inputs under variable conditions and with unobservable returns. If evidence is incomplete about the value of an innovation, farmers will rely more on opinion leaders. Under these conditions, best users (serving as opinion leaders) give more precise signals about an underlying causal relation than what farmers can obtain for themselves. Self-selection through bidding or willingness-to-pay (WTP) may help reveal who are the best (most eager) and hence potentially most informative users (Chassang; Dupas; Miller and Mobarak).
- **Learning strategically.** Experimenting by early adopters (people with lower discount rates) creates positive externalities on others. Farmers with higher discount rates may delay adoption to learn more from others (Besley).

Adapt new approaches to extension to the way farmers learn

Each of these learning mechanisms has implications for the design of extension services if these services are to be adapted to the way farmers learn for adopting. Specifically:

- **Private learning by Bayesian updating.** A longer time series of data on one's own plot increases expected returns from adoption as it makes input decisions more precise. Keeping formal records (IT based) on past practices (actions), weather (events), and outcomes would help farmers make the updating process more precise.
- **Social learning (learning from others) with updating and aggregation.** Panel data with a larger cross-sectional base of identical farmers allow more precise updating in social learning. Exchange of information across farmers – perhaps at PO/local cooperative/village level - with information on actions and weather events enhances social learning. Incentives can be given to peer farmers to induce adoption by themselves and for them to communicate lessons learned to others. Information on others (household and plot characteristics) would help determine who are your own peers. Demonstrations can be organized for clusters of peer farmers. Keeping formal records (IT based) on others will help updating and aggregation in social learning.

- **Learning by comparing and differencing.** As opposed to cluster head-to-head (H2H) demonstrations, H2H plots can be managed by farmers under their own farming conditions. Farmer field days and visits for training are organized using the farmer-managed H2H plots.
- **Learning by acquiring knowledge from others.** If social networks do not convey information on decisions to adopt, information can be provided separately on decisions made by others. Public postings of names of adopters can be made in the name of transparency when subsidies to adoption have been used.
- **Learning from others under heterogeneity of circumstances.** Peer farmers can be used as injection points and communicators. Demonstrating farmers can be let to choose their control practices to reveal their type to other farmers. Dimensions of heterogeneity can be revealed to help others identify their own peer farmers from among demonstrators. Demonstrations can be run with clusters of similar farmers.
- **Learning by trusting.** Survey questions can be used to find out who are the most trusted farmers in the community. They may be larger/lead farmers. Voluntary organizations can be used for self-selection into trusted groups, such as women SHG, producer organizations, and castes. Mutual insurance networks help reveal relations of trust.
- **Learning by communicating and deliberating.** Farmer field days can be organized with multiple visits to allow heterogeneity and peer farmer recognition. Organizations where psychological security exists (e.g., SHG) facilitate communication. Dealer demonstrations can achieve financial sustainability and scalability, but may need local monopoly to create incentives to invest in the generation of public knowledge. Dealer demonstrations may also be distorted by incentives to sell innovations that may not be the best fit for farmers.
- **Learning through noticing.** Information can be provided on relationships in the data to reduce omitted variable effects. Summaries of relevant relationships in the data can be made available to farmers to help them notice what matters.
- **Learning from incomplete and noisy evidence.** Lead farmers can be used as entry points when information is very incomplete. Self-selection of best users can be induced through auctions and WTP. This will create a trade-off between relevance (peer farmer) and completeness (lead farmer) of information.
- **Learning strategically.** In poor populations with high discount rates, subsidies can be given to induce the emergence of early adopters. Cooperation in experimentation can help internalize learning externalities. This gives a role to producer organizations in managing experimentation for collective learning, as done by the Regional Consortia for Agricultural Experimentation (CREA) in France and Argentina.

Suggestions for the design of new approaches to extension in a changing context

This critical review of existing approaches to agricultural extension, together with lessons from theory as to how farmers learn and empirical results from recent experiments, suggest ideas for the design of new approaches to extension. Some key results are the following:

- Critical reviews of the **T&V system** suggest that contact (lead) farmers are not always the most effective disseminators of new technologies. Peer farmers may be more convincing, because they use the technology in a more relevant fashion for learning. When there is heterogeneity, selection of peer farmers from whom to learn may become essential.
- Reviews of the **Farmer Field School** approach tell us that student-farmers benefit from the training received, but are not in a position to in turn transmit their knowledge to other farm-

ers in helping them decide. When decisions are complex, deciding by imitating may dominate over deciding by acquiring knowledge. Selection (incl. self-selection) of best farmers as demonstrators may then be the most effective source of information for social learning.

- Choice of contact farmers (entry points) as intermediaries between extension agents and social networks depends on the problem to be addressed. In particular, one would want to select as entry points into social networks: (1) **peer** farmers for similarity to others in a context of heterogeneity and for a concern with equity (such as gender), (2) **lead** farmers as role models when information is incomplete, (3) **best** farmers (self-selected for example on the basis of bids in auctions or WTP to acquire the technology) as demonstrators of the inherent value of an innovation, (4) most **central** farmers for the diffusion of information following a contagion model, (5) farmers with most **social capital** (members of PO and SHG; farmers designated by community voting) for trust in adopting or to provide assistance to others, (6) **largest** farmers for seed multiplication and biggest market effects on others (for example employment effect on landless farm workers), and (7) **cooperating** farmers (e.g., members of CREA groups) for internalization of learning externalities.
- **Head-to-head** cluster demonstration plots as practiced by ATMA and NFSM may not be effective because they do not demonstrate the technology according to farmers' objective functions and under farmers' own circumstances. Delegating to farmers the management of these H-to-H trials may be a better option.
- Choice of **control practices** by farmers in H2H trials is important to reveal their type and conditions, especially under heterogeneity. This helps other farmers in the community identify who among demonstrators approximates most for them the status of peer farmer. A multiplicity of trials serves to document the performance of the innovation under heterogeneity.
- **Farmer field days** are useful for training and deliberating. If trust is important in deciding, managing demonstrations through farmer organizations (such as SHG) is important, as recommended by the Neuchatel Initiative.
- Because **updating** is an essential approach to learning, giving information to others on farmer type, conditions of plot, actions taken, and weather events is important. This allows both better private and social learning from the information available. Multiple visits to demonstration plots allow better updating by helping give more weight to peer farmers.
- The **Neuchatel** recommendation of seeking financial sustainability calls on making use of the private sector for the provision of information at the same time as it captures market share for the sale of inputs. Competition among dealers may create disincentives to experiment with public goods information. Interlinked transactions with commercial partners can logically contain information on innovations that the partner would like to see the contracted farmers adopt.
- Increasing privatization of sources of information for learning in value chains redefines the **role of the state** in extension from a direct provider of information to a coordinator and regulator, with in particular targeted services to the social categories and the types of innovations not attended to by the private sector.
- If **strategic learning** under conditions of high discount rates postpones adoption and individual experimentation, use of producer organizations to organize experimentation helps internalize externalities and reduce under-investment in learning.
- Social networks may act more effectively for diffusion on the demand-side of **knowledge** than on the supply-side of **information** (contagion). Yet, traditional use of social networks for diffusion has been on the supply side, with contact-farmers under T&V and student-farmers under FFS serving as contagion points. These contact and student farmers can

be made more pro-active with performance-based incentives rewarding diffusion efforts. Yet, a **demand-driven** approach to social learning may be more effective, especially if contact farmers do not have incentives to pro-actively seek to promote adoption. For this, **demand** for knowledge about innovations must be created in social networks, using in particular mass media, to induce the farmer population to actively search for knowledge from contact- and student-farmers.

References

- **Alston, J.**, **Wyatt, T.J.**, **Pardey, P.**, **Marra, M.**, and **Chan-Kang, C.** (2000) *A meta-analysis of rates of return to agricultural R&D*. Washington D.C.: IFPRI Research Report.
- **Anderson, J.** and **Feder, G.** (2007) "Agricultural extension." In R.E. Evenson and P. Pingali (eds.), Handbook of Agricultural Economics, Chapter 44, Volume 3, *Agricultural Development: Farmers, Farm Production, and Farm Markets*. Amsterdam: Elsevier.
- **Anderson, J.**, **Feder, G.**, and **Ganguly, S.** (2006) "The Rise and Fall of Training and Visit Extension: An Asian Mini-drama with an African Epilogue." World Bank Policy Research Working Paper 3928, Agriculture and Rural Development Department, the World Bank.
- **Banerjee, A.**, **Chassang, S.** and **Snowberg, E.** (2016) "Decision theoretic approaches to experiment design and external validity." *Handbook of Field Experiments, forthcoming* (J-PAL website).
- **Emerick, K.**, *et al.* (2016) "Identifying early adopters, enhancing learning, and the diffusion of agricultural technology." Working paper, Economics Department, Tufts University.
- **Feder, G.** (1986) "The impact of agricultural extension: The training and visit system in India." *The World Bank Research Observer* 1(2): 139–161.
- **Evenson, R.** and **Fuglie K.** (2010) "Technology capital: The price of admission to the growth club." *Journal of Productivity Analysis* 33(3): 173-190.
- **Ferroni, M.** and **Zhou Y.** (2012) "Achievements and challenges in agricultural extension in India." *Global Journal of Emerging Market Economies*, pages 319-346.
- **Gautam, M.** (2000) "Agricultural Extension: The Kenya Experience: An Impact Evaluation." Commodity Working Papers. World Bank.
- **Glendenning, C.J.**, **Babu, S.** and **Asenso-Okyere K.** (2010) "Review of agricultural extension in India: Are farmers' needs being met?" Report 01048, IFPRI.
- **Gollin, D.** (2010) "Agricultural productivity and economic growth." *Handbook of Agricultural Economics* 4(73): 3825-3866. http://www.g-fras.org/en/about-us/vision-mission.html
- **Jack, K.** (2011) "Constraints on the adoption of agricultural technologies in developing countries." White paper, Agricultural Technology Adoption Initiative, J-PAL (MIT) and CEGA (UC Berkeley).
- **Lagakos, D.** and **Waugh, M.** (2013) "Selection, Agriculture and Cross-Country Productivity Differences." *American Economic Review* 103 (2): 948-980.
- **Restuccia, D.**, **Tao Yang, D.** and **Zhu, X.** (2008) "Agriculture and aggregate productivity: A quantitative cross-country analysis." *Journal of Monetary Economics* 55 (2): 234-250
- **Rogers, E.** (2003) *Diffusion of Innovations*. New York: Simon and Schuster.
- **Sadoulet, E.** (2016) "Learning models." FERDI workshop on Learning for Adopting.
- **Swanson, B.** and **Davis, K.** (2014) "Status of agricultural extension and rural advisory services worldwide." Global Forum for Rural Advisory Services (GFRAS), Lindau, Switzerland.
- **Waddington, H.** and **White, H.** (2014) "Farmer field schools: From agricultural extension to adult education." 3ie Systematic Review Summary 1. London: International Initiative for Impact Evaluation (3ie).

- **World Bank**. (2006) *Agriculture for Development: World Development Report 2007*. Washington D.C.: The World Bank.
- **Wolf, S.**, **Just D.** and **Zilberman D.** (2001) "Between data and decisions: The organization of agricultural economic information systems." *Research Policy* 30: 121–141.
- **Rogers, E.** (2003) *Diffusion of Innovations*. New York: Simon and Schuster.

FERDI

Created in 2003 , the **Fondation pour les études et recherches sur le développement international** aims to promote a fuller understanding of international economic development and the factors that influence it.

Contact

www.ferdi.fr

contact@ferdi.fr

+33 (0)4 73 17 75 30

n° ISSN : 2275-5055

policy brief 159 September 2016 note brève