Encouraging Technology Adoption in Agriculture through Recommendations and In-Kind Transfers to Smallholder Farmers in Mexico

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Sector(s): Agriculture

J-PAL office: J-PAL Latin America and the Caribbean

Fieldwork: Que Funciona para el Desarrollo

Sample: 678 farmers

Target group: Farmers

Outcome of interest: Technology adoption Productivity Profits/revenues

Intervention type: Extension services Fertilizer and agricultural inputs Information In-kind transfers

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Partner organization(s): Que Funciona para el Desarrollo, Fertilab, Agropecuaria de Amozoc, Ipampa S.C., International Initiative for Impact Evaluation (3ie), BASIS Research Program on Poverty, Inequality and Development, World Bank, Independent Science and Partnership Council's Standing Panel on Impact Assessment (ISPC-SPIA)

Despite substantial improvements in agricultural technologies and practices since the Green Revolution, farmers' technology adoption and use have been inconsistent, and yields for smallholder farmers in many low- and middle-income countries often remain low. In Mexico, researchers conducted a randomized evaluation to test the effect of providing plot-specific or general soil quality analyses and input recommendations, agricultural extension services, and flexible or inflexible in-kind grants on smallholder farmers' adoption and knowledge of improved practices and fertilizer combinations, yields, profits, and attitudes toward innovation. In the short run, they did not find differences on farmers' fertilizer adoption when comparing specific and general input recommendations, nor when comparing flexible and inflexible in-kind grants. However, farmers with greater grant spending flexibility had substantially higher adoption of improved practices two years after the intervention ended.

Policy issue

Increasing agricultural productivity plays an important role in poverty reduction. Although research and development efforts—mainly channeled through the Green Revolution—introduced many new, science-based agricultural practices to low- and middle-income countries, traditional farming practices remain widespread and yields for smallholder farmers in many of those countries remain low. This low take-up of improved technologies can be explained by a variety of reasons, like limited information on best practices, credit constraints, risk, poor input quality, or behavioral biases.

Previous studies have tested the effect of providing recommendations to farmers on fertilizer use and of providing in-kind transfers on technology adoption. However, more research is needed to understand the role of autonomy in decision-making and specificity in information transfer. Can more specific information on fertilizer application and flexible in-kind grants increase agricultural productivity and farmers' attitudes toward innovation?

Context of the evaluation

In Mexico, about 25 percent of the population lives in rural areas but accounts for approximately two-thirds of those experiencing extreme poverty.[1], In nearly half of 2,424 Mexican municipalities, the average farmland per household is often less than 5 hectares, thus heightening the need to boost productivity per hectare.[2] Additionally, almost 90 percent of farmers in the country rely on rain to water their plots, making farmers particularly vulnerable to climate change and weather shocks. Although nearly three-fourths of farmers in the country use inorganic fertilizers, there can be considerable differences in soil quality across localities and plots within the same locality. Therefore, the mix of fertilizers farmers use may not be ideal for their given plot, suggesting that choosing the right combination and quantity of fertilizer could boost productivity.

Participating farmers from thirteen municipalities in the state of Tlaxcala, Mexico, were 18–70 years old, cultivated maize in 1–15 hectares of owned or rented land, and earned low incomes by Mexican standards (US$2,200 approximately). Farms were predominantly rainfed and, maize yields were relatively low (on average 2.01 tons per hectare). About 97 percent of the farmers declared using inorganic fertilizers, and only 10 percent of participants had access to extension services.



Farmers ploughing field using tools in Mexico.

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Details of the intervention

In partnership with the NGO Qué funciona para el Desarrollo (QFD), the private extension company Ipampa S.C., and the commercial fertilizer dealer Agropecuaria Amozoc, researchers conducted a randomized evaluation to test the impact of a program providing soil analysis and tailored input recommendations, agricultural extension services, and in-kind grants on smallholder farmers' adoption and knowledge of improved practices and fertilizer combinations, yields, profits, and attitudes toward innovation. To determine the importance of specificity in fertilizer recommendations, researchers designed individualized and general input recommendations (e.g., specific fertilizers, herbicides, and tools) based on soil samples collected from each farmer. Shared with participating farmers in a written report, these recommendations were intuitive and did not exceed the total cost of fertilizer investment made by farmers in the previous year.

To disentangle the effect of autonomy and choice in making input decisions, researchers compared the effects of providing participating farmers with either flexible or inflexible in-kind grants worth MXN 2,000 (approximately US$150 at the time) to cover approximately half of the average per-hectare total input costs. Specifically, some farmers were offered the option to spend the grants on the agricultural input of their choice (flexible), while others were offered only recommended items to purchase with their grant (inflexible).

QFD advertised the program in selected municipalities and interested farmers registered to participate. Researchers then divided the 678 eligible farmers into 26 localities based on their location and farms' agro-climatic conditions and randomly allocated them to one of the following groups:

1. *Individual recommendations + inflexible grant*: The farmers in this group received plot-specific soil analysis and input recommendations, access to extension services with Ipama S.C., and an inflexible in-kind grant.
2. *General recommendations + inflexible grant*: The farmers in this group received general soil analysis and input recommendations, extension services with Ipama S.C., and an inflexible in-kind grant.
3. *General recommendations + flexible grant*: The farmers in this group received general soil analysis and input recommendations, extension services with Ipama S.C., and a flexible in-kind grant.
4. *General recommendations + no grant*: The farmers in this group received general soil analysis and input recommendations, and extension services with Ipama S.C.
5. *Comparison*: The farmers in the comparison group did not participate in the intervention. However, they received general soil analysis and recommendations the year after the intervention ended (early 2016).

The research team collected information on several occasions: A baseline survey in February-March 2015, two midline surveys in August and September 2015, and end-line surveys in January and June 2016 to gather data on farmers' yields and input sales. In May 2017, the researchers did a follow-up survey to assess the program in a longer time frame. They asked the farmers about their personal characteristics, farming practices (such as the use of fertilizers, precision drills, pesticides, etc.), yields, and income. From this data, researchers assessed farmers' compliance with the recommendations, any changes in productivity in the short run, and the persistence of technology adoption.

Results and policy lessons

Researchers found that farmers adopted the recommendations, especially when they were accompanied by in-kind grants. While neither the degree of recommendation specificity nor the extent of autonomy (defined as the ability to choose how the in-kind grant was spent) had any effect on adoption during the intervention, the adoption of recommendations persisted among those with autonomy.

Adoption of improved practices: Farmers who received the recommendations and extension services adopted some recommended practices, but those that also received the in-kind grants implemented considerably more practices. Out of nine possible recommendations, farmers who were offered just the recommendations and extension adopted 2.34 practices or inputs, and those that also received grants adopted roughly twice as many. Farmers in the comparison group spent roughly the same amount on fertilizers as those that received a grant, suggesting that the grants allowed farmers to experiment with new technologies and practices rather than financing expenditures that were not previously incurred. Farmers with flexible grants adopted new practices at the same rate as those with inflexible grants. The researchers found no evidence that the level of recommendation specificity (general versus specific to the plot) affected farmers' decision to adopt improved inputs and practices, suggesting that it might be better to give general recommendations since they are less expensive to generate.

Productivity: The impacts on productivity were in line with the adoption of improved practices. Average yields and profits for farmers that only received the soil analysis, recommendations, and extension services were not statistically different from those in the comparison group. In contrast, researchers found substantial effects of also providing the in-kind grant: Yields for farmers that received a grant were 0.2–0.4 tons/hectare higher relative to those for comparison farmers, corresponding to an increase of approximately 12–17 percent. Nevertheless, there was no meaningful increase in profits for farmers, and neither specificity nor autonomy affected yields or profits.

Persistence of adoption: Combining recommendations with extension services had modest but persistent effects on agricultural practices two years later (0.24 more practices than the comparison group). Farmers who received the flexible in-kind grants were more likely to maintain the new practices two years later relative to farmers with the inflexible in-kind grant (an increase of 0.45 new practices) or farmers in the comparison group (an increase of 0.7869 new practices). Researchers suggested that this could be due to farmers with autonomy being more likely to remember the recommendations, trust project partners and their expertise, and have a more positive attitude towards experimentation.

In light of these findings, researchers call for more research to better identify the role of autonomy in agricultural technology adoption.

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1. International Fund for Agricultural Development (IFAD). 2012. "President's report: Proposed financing to the United Mexican States for the Rural Development Project in the Mixteca
Region and the Mazahua Zone" Executive Board — 105th Session. https://webapps.ifad.org/members/eb/105/docs/EB-2012-105-R-22-Rev-1.pdf

2. LaFevor, Matthew C., and Nicholas R. Magliocca. 2020. "Farmland size, chemical fertilizers, and irrigation management effects on maize and wheat yield in Mexico." Journal of Land Use Science 15, no. 4: 532-546.