Technology transfer

This note provides guidance to governments and investors on how best to support the development and transfer of technologies to local smallholders and communities.

New technology can help boost production and productivity in the agriculture sector and, given the growing global demand for food and fiber and the limits of natural resources, has the potential to substantially raise incomes for smallholders and rural communities. Improving mechanisms to increase the transmission and adoption of technologies is important for building technological capability in developing countries. The importation and adoption of productivity-enhancing technologies in part depends on investors’ support and training efforts but ultimately will fail if local smallholders acting as partners in the value chain do not achieve gains that warrant the embrace and use of technology.

WHAT DOES FIELD RESEARCH SHOW?

Introducing new technologies and encouraging their adoption by smallholders is not a straightforward process. It depends on engaging a variety of actors in the value chain, as well as creating the appropriate conditions to benefit from new technologies and practices. The field research identified several issues and challenges to consider in promoting the use of new technologies and practices:

Generating and transferring technology through collaboration. National and regional systems of innovation—ones in which nongovernmental organizations (NGOs), government, investors, and smallholder organizations cooperate—can generate the impetus to enhance adoption. In one country, a program of soya seed multiplication and dissemination through a cooperative network was bringing positive results. In a spin-off program, other technology transfers were occurring; for example, milling and blending dried vegetables with maize meal to enhance nutrition levels while maintaining acceptable consumption attributes.

Assessing the range of technology options. Smallholders connected with large investors through outgrower schemes can use or apply various categories of technology options in their production systems. They include production processes, techniques and systems, equipment and mechanization, irrigation, seeds and fertilizers, transportation, storage and communication.

Selecting appropriate technologies to suit local conditions. Agricultural production is greatly influenced by local economic, social, climatic, and soil conditions. The application of appropriate technology and management practices to suit local conditions (including cultural norms, geographic features, and climatic conditions) influences the adoption and success rates of new technologies.
Adjusting to extant local knowledge levels and skills gaps to shape adoption of new technology. When the information and skills gap in local communities is substantial, it limits the adoption of new technologies and management practices. Less experienced smallholders are more reluctant to adopt new methods. Whether smallholders have alternative sources of income is also important: households with more non-farm income are less willing to adopt new technology, especially if doing so requires significant investment in time and labor. Smallholders who are dependent on farm-generated income are more likely to adopt new technologies.

Innovating and adopting. Technological innovation that reduces the initial investment cost, eases access to productivity, reduces transaction costs, and improves financial returns greatly eases adoption. In one case an investor introduced a card-based digital monetary transaction system that facilitated smallholders’ sales of produce and purchases of inputs. This system was rapidly adopted because of the increased utility it offered.

Considering the extent to which farmers have access to technology. The use of foreign technology requires some initial level of exposure and development of familiarity with the technology, something that takes time for smallholders to acquire and that requires a capital outlay, which they are unlikely to be able to manage. As an example, one investor introduced center-pivot irrigation on the core estate; although local farmers could see and appreciate the benefit of irrigation they had no means of affording it. It was only when the investor rolled out the outgrower scheme and facilitated access to a mix of loan and concessionary funding that local farmers could benefit from the technology. In another case, the investor introduced the System of Rice Intensification for smallholder paddy rice producers through an integrated program of advice, demonstration, and a finance scheme so that local farmers could reap the reward from greatly improved production. Bilateral agreements between countries can also contribute to access to improved seed technology, as illustrated in box 1.

Evaluating appropriateness to local smallholders and their farming systems. An investor’s choice of technology may have no relevance and/or use to local smallholders. They are therefore less likely to adopt the technology being offered, although in the longer term they may find that there are new opportunities for income generation than they had previously considered. For instance, an investor producing biofuels from Jatropha grown on land leased from the government wanted to introduce agricultural technology that was of no immediate benefit to local smallholders. They preferred to produce crops they were accustomed to (especially food crops).

Creating incentives and providing assistance to investors to encourage the transfer of technology. Investors are often driven to achieve high levels of productivity and have set performance targets that should be achieved within the shortest possible time and within limited budgets. Technology transfer can be a time-consuming and resource-intensive undertaking, especially if large numbers of smallholders are involved. If investors have financial constraints, they rely on a few people undertaking all the technical work to improve the capacity of smallholders. Investors have few incentives to diffuse technology beyond what is necessary for them to operate. In one industry, the government allocated extension officers to work under the direction of the investor to disseminate production system technology to smallholders.

Justifying the investment through economic returns. Smallholders have limited financial resources, so if they cannot afford new technologies they are unlikely to adopt them. If they adopt new technologies but the ongoing costs remain more than they can afford, they may revert to older technologies or use alternatives. It is important for investors to fully understand both the incremental returns an investment in technology will generate and its level of affordability to smallholders, in terms of both time and money needed for adoption.

Elements of good practice for governments and investors

The good practices below point to a range of intervention options by various stakeholders that should yield more positive results than negative ones:

Role of government. Government and public policy play key roles in fostering more technological accumulation through foreign direct investment and better aligning foreign technologies with local needs and constraints. For example, public institutions can act as gatekeepers to screen for responsible investments that introduce desirable technologies that contribute to a country’s growth and development strategy. They can also support the adoption of new technology; for example, by establishing national and regional systems of innovation, involving government, NGOs, investors and smallholder representatives, and by funding (or subsidizing through patient capital loans) the initial procurement of new technologies needed, to reduce their initial cost and catalyze technological progress in the country.
**Collaboration between public and private sector.** Opportunities abound for appropriate collaboration between the public and private sectors. For instance, governments can second skilled officers to an industry body to provide enterprise- or crop-specific technical support to smallholders.

**Collaboration between investors and research institutions and NGOs.** Linking research institutions such as CGIAR and NGOs involved in technology development and dissemination with investors can leverage the efforts of all parties for the benefit of smallholders.

**Community participation in decision-making processes.** Investors should consult with communities to identify appropriate technologies or determine how a technology might be tailored to local smallholders’ situations and needs (box 2). Technologies that might perform well in one environment may produce little added value or may have negative effects in a different environment. Large irrigation schemes are an example. They are often designed without consideration of the needs of smallholders. In one case, an irrigation scheme was designed to serve a large area divided into 10-hectare blocks allocated to smallholder households. However, the smallholders were required to live far from their lands, and no provision was made for night storage of water to enable them to irrigate to suit their own timing and crop choice or for availability of water when the system was shut down for maintenance or repair. This resulted in crop losses and lack of management supervision by smallholders and—coupled with other institutional design deficiencies—the failure of most smallholders and thus an investment which was not economically sound.

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**Box 2. Case study: Introduction of production technology to smallholders**

An investor in rice identified a possibility for local smallholders, producing under a traditional paddy rice system with low yields, to adopt the SRI\(^1\) to improve yields and incomes. The company identified the important smallholder constraints as lack of knowledge, lack of finance, and difficulty accessing a market that paid fair prices.

The investor appointed field officers, who facilitated the establishment of grower groups, supported by a demonstration plot, and helped to transfer knowledge. The company also started trials to assess the best local varieties. The investor addressed smallholders’ lack of finance by working with an aid organization and local financial institutions (both microfinance and commercial banks) to start offering finance.

This was initially successful, and smallholders produced yields of up to 8 tons per hectare. The investor offered to buy the rice produced at a price that was higher than the local price at the peak harvest season (which tended to be low due to the large supply available locally). Challenges experienced were the occurrence of a drought, coupled with the activity of a local agitator, who advised farmers that “it was their constitutional right not to have to repay loans.” These challenges (combined with the use of other loan redemption avoidance tactics of side-selling to opportunistic traders) resulted in a near-collapse of the available finance, but gradually smallholders learned to be financially responsible and there has been a recovery.

Another challenge arose when the government, bowing to pressure from traders, reduced import tariffs, thereby flooding the market with imported rice and forcing down prices received by all producers. Producers decided that they needed to band together to form a rice growers association to lobby government for fair treatment.

Source: UNCTAD-World Bank Responsible Agricultural Investment Database.

\(^1\) The System of Rice Intensification (SRI) was developed in Madagascar in 1983 by Father Henri de Laulanié. It aims to increase yield by using low amounts of water but is labor intensive, using available household labor to hand plant young seedlings in a grid and hand weed the land.

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**Consideration of the socioeconomic needs and constraints of smallholder producers.** Investors that rely on smallholders need to understand their socioeconomic situation and the barriers or constraints they face in adopting improved technology, and then develop strategies to mitigate them. To better understand decision drivers and to impart knowledge, investors should have an open dialogue with smallholders, which requires setting up formal and informal communication channels. The types of issues likely to be identified through such channels are issues of food security, inadequate storage, road infrastructure, education backlogs (literacy and numeracy challenges), and limited skills.

**A successful local track record for a specific technology.** For technologies to be adopted widely they need to be proven under local conditions, with repeated positive results over an extended period. Reliable evidence of the potential of a technology under similar geographic conditions needs to be developed through the conduct of field or plot demonstrations and pilots and the development of a set of early adopters or innovators in the community willing to try the technology and share the results with others. In addition, to incentivize adoption and reduce risks of failure, investors and government need to understand and put in place other supportive adoption “enablers,” such as finance, service support, and the securing of markets for the resultant increased outputs. This requires the investor to have a proven track record of building strong relationships with communities because for smallholders to adopt new technology they need to have a high level of trust in the advisor or organization promoting the concepts. This requires the investor to

- Have a clear outreach strategy for how it intends to collaborate with local smallholders to make the transfer of technology successful. Such a strategy incorporates in its design on-the-ground knowledge of the socioeconomic constraints that smallholders face. Two methods work best: training well-known local smallholders to demonstrate and share the results of applying the technology and establishing field schools to demonstrate the application and results of the technology relative to existing practices.
Collaborate closely with local producers and communities to facilitate the exchange of knowledge to adapt the desired technology to local conditions (box 3).

Be committed to developing its operation in a way that goes beyond the simple extraction or use of local natural resources, but with the intention to build the local capacity to produce.

**Box 3. Case study: Aligning support staff incentives to engage smallholders**

An investor developed its outgrower model around a small group of field technicians who were trained to perform all the technical fieldwork of grafting improved material onto traditional rootstock to develop a supply base of fruit to suit their processing requirements. Technicians lived close to the communities they served. Each was assigned specific smallholders so that the company could achieve the desired level of production to serve the market. Driven by targets, technicians undertook most of the work themselves, rather than in collaboration with the smallholders. The smallholders had few responsibilities, other than watering the trees and protecting them from being eaten by animals. Under this scheme, they had very limited exposure to the grafting techniques and options for different varieties, impeding their ability to learn and eventually emulate. The investor did not consciously try to prevent the transfer of technology, but its focus on efficiency and time constraints prevented learning by smallholders.

Source: UNCTAD–World Bank Responsible Agricultural Investment Database.

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**REFERENCES AND RESOURCES**

This Note is complementary to the literature and guidance documents to which many organizations have contributed, a selection of which is provided below. Further resources are provided in Note 2: Additional resources.


**Country examples:**

