Harwig, L., & L. Ostenso. 2020. Case study.
Knowledge as catalyst: using knowledge exchange and learning
to commercialize a public agricultural research idea for Kenyan and Rwandan smallholder farmers.
Knowledge Management for Development Journal 15(2): 155-167.
km4djournal.org

CASE STUDY

Knowledge as catalyst: using knowledge exchange and learning to commercialize a public agricultural research idea for Kenyan and Rwandan smallholder farmers

Laura Harwig and Laura Ostenso

Actors involved in developing and scaling agricultural technologies in developing countries – specifically publicly funded research institutions and private sector businesses – operate according to different sets of motivations and perspectives. Their objectives, however, can be complementary and, with the right incentives, align to create synergies leading to innovative products and services for smallholder farmers. The exchange of knowledge among these actors plays a catalytic role in aligning motivations, perspectives, and objectives to advance innovations. Its role can aid in the initial stages of shaping public agricultural research priorities to the later stage of scaling-up a resulting product, service, or technology through commercialization. This case study illustrates this dynamic in a multi-year agricultural technology partnership between Feed the Future Partnering for Innovation, a United States Agency for International Development (USAID)-funded program implemented by Fintrac Inc., and Purdue University. The partnership aimed to scale use of an improved grain storage bag, known as PICS (Purdue Improved Crop Storage), to reduce postharvest loss among smallholder farmers in Kenya and Rwanda. The case study draws on lessons learned from this partnership, as well as from analysis conducted by Partnering for Innovation, notably Success Factors for Commercializing Agricultural Research: Lessons from Feed the Future Partnering for Innovation. The case presents a set of knowledge exchange touchpoints to facilitate collaboration between publicly funded research institutions and private sector businesses in successfully and sustainably scaling innovative agricultural technologies.

Keywords: knowledge exchange; learning; research institutions; private sector; small farmers; agricultural technology; scaling; postharvest losses; Kenya; Rwanda

Background

Publicly-funded research institutions and private sector businesses often supply innovative ideas and solutions to the numerous challenges smallholder farmers in developing countries must overcome on a daily basis. These ideas can evolve into practical solutions that help smallholder farmers plant, grow, harvest, process, and market their products. While publicly funded research institutions and private sector businesses operate according to distinct sets of perspectives, motivations, and objectives, these differences can be complementary and result in transformative outcomes.

The knowledge generated by publicly funded research institutions offers a critical starting point for many product breakthroughs addressing real-world challenges. These breakthroughs can provide an opening for the private sector to transform them into commercially viable and accessible products. Interaction between research institutions and the private sector in this way is frequently seen within the public health domain: researchers conduct studies for promising new treatments and medicines, which incentivize pharmaceutical companies to license, further invest in development, and sell them. Similarly, publicly funded agricultural research often results in scientific advances, such as improved plant varieties, that can transform the livelihoods of millions of smallholder farmers around the world. Once developed, they can be sold to and commercialized by private companies to reach farmers on a large-scale. In this way, research institutions develop the foundational scholarship for new products (many of which are designed to address a societal challenge), and businesses build from this work to create affordable and profitable products. Early collaboration among these actors is a key part of this process in order to achieve greater efficiency, lower cost, and more impact (Partnering for Innovation 2016a).

Within the context of international development, reaching vulnerable consumers at scale with needed products or services is a key objective. Driven by a heightened interest among donor agencies, researchers have adapted their strategies to demonstrate scaling results. Within the agricultural sector, research entities have responded in the following ways (Koerner 2019; Partnering for Innovation 2016a):

- Starting or strengthening technology transfer offices within their institutions.
- Partnering with multinational companies to scale research through supply chain interventions.
- Partnering locally in developing countries with nongovernmental organizations (NGOs) and private sector businesses to deliver research products directly to smallholder farmers.

A growing body of work, evident in paper topics and conference themes,[1] demonstrates a strong interest among researchers in identifying effective approaches for directly reaching smallholder farmers with research-based innovations. Likewise, private sector actors are shifting toward traditionally underserved markets, including rural agricultural settings, as potential growth areas.

Partnering for Innovation's efforts to scale agricultural technologies in emerging markets, since its inception as a program nearly a decade ago, illustrate that knowledge exchange among different actors serves as one of the most effective ways to bridge publicly funded agricultural research and commercial scaling of resulting technologies.

Concept of knowledge exchange

The concept of knowledge exchange used in this paper pertains to the two-way flow of information and expertise among disparate actors engaged in introducing innovative new agricultural products to the commercial market. This approach is illustrated in the case study presented here, which describes the role of knowledge exchange in a multi-year agricultural technology partnership between Feed the Future Partnering for Innovation and Purdue University (Purdue).

Each actor played an essential role in the overall success of the partnership. Purdue possessed an innovative postharvest storage technology, and required a pathway from its laboratory to farmers' fields to launch it. On the other end of the spectrum, private sector distributors and retailers with deep knowledge of local markets identified the strong consumer interest and sales potential such a product offered. Partnering for Innovation provided the bridge to connect the two, recognizing each of these actors were critical for ensuring a new technology reached its intended beneficiaries in a strategic and sustainable way.

In the case study to follow, touchpoints are presented to illustrate specific instances of how the partners' use of knowledge exchange[2] contributed to the successful scaling, production, and marketing of a postharvest storage technology in Rwanda and Kenya. The article concludes with a presentation of key lessons learned for use by international development practitioners seeking to incorporate knowledge exchange into initiatives involving the scaling and commercialization of publicly funded agricultural research.

What is scaling?

The concept of scaling differs between international development and business. In international development, the concept of scaling, at its most basic, involves replicating donor-funded activities to reach more beneficiaries (scaling up) over a larger area (scaling out) (Hartmann 1997; Wigboldus 2016a). Such replication is intended to result in increased and improved benefits in developing countries. In business, on the other hand, the concept of scaling equates more simply with growth, regardless of who benefits or where those benefits are conferred (McLean 2019). The scaling up and out of donor-funded programs in developing countries is often defined as horizontal scaling, or increasing the number of people reached within a specific spatial element (e.g. national or regional levels). Vertical scaling includes activities that enable organizational and political landscapes to replicate development activities (e.g. government policy, rules, norms). Finally, functional scaling entails translating effective interventions across systems (e.g. from the health care sector to the agricultural sector) (Hartmann 2007). The common denominator across these scaling types is creating beneficial social impact.

In practice, local contexts and realities often shape how donor-funded development is scaled. These complexities, therefore, make it difficult to arrive at a common definition[3] for scaling in international development contexts, and an array of methods, pathways, and models have proliferated in its absence. Scholars of international development seek to account for these complexities by expanding the definition of scaling to reflect a systems perspective (Wigboldus 2016a; Wigboldus 2016b). This approach is of particular relevance for agriculture, especially in relation to scaling a technology, given the wide range of interactions that occur across production, marketing, and consumption systems; academic disciplines; and knowledge management and communications.

Other scaling concepts focus on the application of different tools and methods to manage such complexities. In the agricultural sector, inclusive business models drive scale by integrating smallholder farmers and other vulnerable market segments into a firm's supply chain, while innovation platforms[4] bring private and public actors together to develop multiple pathways for scaling a practice or technology across a population. These approaches share the goals of scaling technologies for broad development and profit-making (Wigboldus 2016a; Nelson 2020), and rely on strong and transparent knowledge exchanges to achieve successful outcomes.

Defining scaling is important when navigating the different motivations for achieving it. In the case study presented here, researchers are motivated by the prospect of providing farmers in Kenya and Rwanda with an important postharvest storage solution, and businesses are

incentivized by the commercial viability of that solution. In this context, the concept of scaling is set in relation to negotiating these different motivations on a continuous basis and through the effective use of knowledge exchange to ensure the technology reaches its intended recipients.

Project overview: Purdue Improved Crop Storage (PICS)

Grain production is a cornerstone of food and income security for millions of rural households in developing countries. Despite its importance, 50 to 60 percent of cereal grains are lost to pests and diseases each year due to inadequate storage (Kumar 2017). The impact of postharvest loss at this scale is far-reaching, ultimately reducing the amount of grain available for household consumption and preventing smallholder farmers from storing it to sell at potentially higher prices outside of harvest seasons. Shifting to new storage practices that reduce postharvest loss greatly strengthens farmer livelihoods and food security.

To overcome such grain loss among East African smallholder farmers, Purdue developed PICS (Purdue Improved Crop Storage) bags.[5] The triple-lined plastic bags are a small-scale hermetic grain storage solution. At a cost of approximately $2.50 each, the bags provide farmers with an affordable, reliable, and easily adoptable way to store up to 90 kilograms (kg) of grain on their farms over multiple seasons without the need for pesticides or training. Purdue originally developed the bags for cowpea storage in the 1980s. After additional research showed the bags were able to deliver similar benefits for maize and other grains, the university began to license the bags to West African manufacturers and distributors for sale across the region. Success was fast, with more than 2 million bags sold through 12 licensed local manufacturers and distributors between 2007 and 2013. The success of the PICS bags in West Africa offered strong potential to benefit significant numbers of smallholder farmers in other key grain-producing countries across the continent. Equipped with this proven technology, Purdue sought financial support and commercialization expertise to help scale the bags into East Africa. The team submitted a proposal to Partnering for Innovation in 2013 to introduce PICS bags in Kenya and Rwanda.

Partnering for Innovation, in keeping with its mission to expand commercial access of transformational technologies to smallholder farmers, selected Purdue and two local private sector businesses as partners on a multi-year effort to introduce and scale the PICS bags in Rwanda and Kenya. Since Partnering for Innovation's launch in 2012, the program has served as a bridge between research institutions and the private sector in transitioning innovative agricultural technologies into new markets. The partnership with Purdue is one of the program's

63 partnerships in 24 countries that have directly led to the commercialization of 124 technologies and management practices (Partnering for Innovation 2020).

In Kenya, Purdue introduced PICS bag in partnership with Bell Industries Ltd. (Bell Industries), a local private company, that led local market access and adoption of the technology over the long-term. The partnership aimed to increase access and adoption of 17,500 PICS bags by smallholder grain producers across the country. As of 2016, Bell Industries had sold 835,161 PICS bags (Partnering for Innovation 2014) benefiting 208,804 farmers (Partnering for Innovation 2016b). Similarly, Purdue partnered with EcoPlastics, a local private sector partner in Rwanda, to lead market access and adoption of 15,000 PICS bags by smallholder grain producers. As of 2016, Purdue and EcoPlastics had sold 116,545 PICS bags, benefiting 58,259 smallholder farmers. (Partnering for Innovation 2016b).

Under its partnership with Partnering for Innovation, Purdue lifted its royalty fee to incentivize distributors in Kenya and Rwanda, enabling distributors to test the product's market viability. By the end of the partnership, distributors began paying royalties; Bell Industries and EcoPlastics became self-sufficient in manufacturing, marketing, and selling the PICS bags; and smallholder farmers in both countries benefitted significantly.

Exchanging knowledge: three key touchpoints

Knowledge exchange[6]—described as touchpoints in this article—facilitated interaction among Partnering for Innovation, Purdue, and private sector distributors and retailers in co-creating efforts to scale the PICS bags. Identifying and utilizing the tacit knowledge and motivation of each partner were critical aspects of this process. As detailed below, a set of key touchpoints provided a guiding structure to these efforts.

Touchpoint 1: Co-creation through due diligence

Due diligence provided Partnering for Innovation with an opportunity to co-create a plan with the potential partner, combining assurance that donor compliance requirements are met while working collaboratively to discuss, negotiate, and refine funding details. Importantly, this process included Partnering for Innovation staff visits with potential partners in Rwanda and Kenya to clarify gaps regarding the proposed product/service and business model.

During these interactions, product pricing, intellectual property, manufacturing, distribution, organizational capabilities, and potential timelines for breaking-even on the proposed product

(see the due diligence survey here) were investigated. These criteria were made explicit with all potential partners to ensure commercialization strategy objectives and targets were clear at the outset. Ambiguities were discussed immediately to address any strategy gaps.

In the case of PICS, Purdue researchers used this process to identify potential manufacturing and distribution challenges before local companies were signed as partners. In Kenya, the original distributor lacked sufficient experience in the agricultural sector and an established distribution network, which ultimately impacted the timeframe for introducing and scaling PICS bags. Partnering with this company would have required Purdue to establish additional partners during the course of the partnership at additional cost. As a result, Partnering for Innovation asked Purdue to identify an alternative distributor more suited to help accelerate PICS commercialization in Kenya.

In response, Purdue proposed a new company – Bell Industries, a regional distributor of agricultural products with headquarters in Kenya. The company already managed an extensive distribution network in the country and had the internal capacity (i.e. people, processes, and technologies) to effectively reach smallholder farmers. Bell Industries was also a trusted name in rural areas of Kenya, with marketing capabilities and knowledge of integrating training about the bags with NGOs, farmer-based organizations (FBOs), women's groups, and local business service providers. Alignment with Bell Industries, an established business with a good reputation, enabled Purdue to establish an accurate price point for the PICS bags. This meant that the partners did not need to use valuable time testing distribution and marketing models to determine an appropriate price, and could therefore hit-the-ground-running with a targeted marketing effort at the start the grant. The PICS bags were ultimately sold by Bell Industries to agrodealers for $1.52 per bag and retailed to farmers for $2.34 per bag.

By viewing due diligence as an opportunity, Purdue was able to reassess its initial distribution and marketing plan, and identify Bell Industries as the right distribution partner. Such well-fitting distribution partners are uncommon, making it vital in commercial scaling processes to thoroughly assess the market system first or plan to commit time and resources to build a distribution network. Finally, the due diligence process also enabled Purdue to hire a local manager in Kenya to direct expanding commercial availability of PICS bags from West Africa to Kenya.

Touchpoint 2: Co-creation through technical inputs

To introduce the PICS bag to consumers in Kenya, and in keeping with a Partnering for Innovation social impact goal to improve gender outcomes, Purdue and Bell Industries

conducted a market assessment focused on identifying constraints facing potential female customers. Drawing on market assessment findings regarding women's role in household decision making, Purdue and Bell Industries developed and implemented a marketing campaign that advanced scaling efforts of PICS bags in the country while also reaching women in smallholder communities.

The market assessment also helped the team identify specific tactics that would be most impactful. For example, the marketing campaign was implemented through village demonstrations using farmers' personal grain supply. This was a powerful way to introduce the utility of the PICS bags directly to farmers, and over the one-year partnership, 100 market demonstrations reached 5,674 participants. The team introduced bag opening ceremonies at which PICS service providers filled PICS bags, sealed them, and three months later opened them to the public. The opened bags provided visual proof to potential customers, the majority of whom were illiterate, that grains stored in the bags emerged free of pests and diseases. Additionally, Purdue and Bell Industries targeted commercial distribution and retail networks to equip them with materials and messages for potential end-consumers. This involved visiting shops to train employees, distributing educational materials on how to use the bags, and advising on smart display placement of the bags. All of these elements raised the profile of the PICS bags in Kenya.

Touchpoint 3: Ongoing co-creation through frequent dialogue

Structured, regular dialogue among partners served as a major knowledge exchange touchpoint during the partnership. Monthly partner management calls, in particular, provided established times for all partners to come together in a transparent way to discuss progress, setbacks, and successes. These calls set the stage, and continually reinforced, a collaborative, team-focused culture among team members as they co-created scaling strategies, processes, and implementation. The management calls provided three concrete ways in which knowledge exchange generated results: 1) troubleshooting issues; 2) forging new collaborations and resources; and 3) forecasting or generating creative solutions to driving costs down to achieve maximum commercial results.

Troubleshooting

A clear example of how knowledge exchange engendered a forward-focused, team-centered approach to problem solving occurred early on in commercializing PICS bags in Kenya. Bell Industries encountered a cash flow problem because its manufacturer was unable to extend credit as originally anticipated. The company invested its own cash reserves to purchase and distribute the bags across its agrodealer network, a risk compounded by the agrodealers refusal to purchase

the bags outright as they preferred to push the risk to Bell Industries and pay for the bags once they were successfully sold to smallholder farmers. This further restricted Bell Industries' cash flow. Partnering for Innovation, anticipating such business setbacks in the initial design of its grant model, was able to work with the partners to find a solution to ease the cash flow issues as PICS sales increased. As a result, Purdue and Bell Industries began to explore new options for manufacturing the product, with Bell Industries opting to make significant investments in its manufacturing capacity and began purchasing the PICS bags directly.

The ongoing management calls allowed early identification of the problem so that all partners could pivot quickly, and in tandem. Such calls also prepared Partnering for Innovation team members for troubleshooting issues during their yearly site visits. These visits allowed partners to discuss issues more in-depth, particularly as the partnership entered the commercialization phase of the PICS bags. For example, in working with retailers during a site visit, Partnering for Innovation managers were able to talk to shop keepers to change bag placement to more favorable shelving locations.

Forging new partnerships and resources

The management calls provided an opportunity to tap into each partners' networks to help advance the partnership. Bell Industries was able to leverage its agrodealer network to jump-start distribution, while Purdue drew on its West African network to support its new efforts in East Africa. Partnering for Innovation was able to leverage its extensive field presence in Kenya to expand the reach of the partnership, such as by connecting the PICS team in Kenya with the USAID-funded Kenya Agricultural Value Chain Enterprises (KAVES) project.

Implemented by Fintrac Inc., KAVES had a significant presence across Kenya's maize value chain and joined with Bell Industries to test the use of PICS bags under various field conditions and directly with farmers. KAVES purchased 2,500 bags from Bell Industries and used them for demonstrations in 22 target counties, dramatically expanding the marketing footprint for the bags. KAVES also organized PICS bag trials in collaboration with even more partners, such as local agribusinesses, the Ministry of Agriculture, farmer groups, small-scale traders, and local NGOs. PICS bags became increasingly known among farmers and were tested for cost effectiveness, efficiency, and impact at the household level.

The extensive testing provided evidence that PICS bags prevented insect damage at a 98 percent success rate. These findings drove KAVES to partner more closely with Bell Industries on promotional activities such as field days, radio advertisements, and market demonstrations to further raise awareness of the technology. The regular partner management calls played a major

role in connecting the two entities, and is cited as a major reason for PICS scaling success in Kenya (Foy and Martin Wafula 2016).

Forecasting

Monthly management calls prioritized next steps to help partners identify and manage future needs. This aspect of the calls was of particular value for Purdue and Bell Industries in developing a sustainable commercial scaling plan given the significant growth resulting from alignment with the KAVES project. The calls also provided the necessary space for partners to determine that the existing distribution model for PICS bags needed to be transitioned to a more cost-effective one that would be capable of distributing the bags to private sector agrodealers throughout the country. As a result, new ways to piggyback off existing donor-funded programs and commercial distribution models were explored as a final step in the year-long partnership.

Conclusion

Knowledge exchange plays a critical role in scaling publicly funded agriculture research. When embedded as a core component of the process, knowledge exchange can unlock solutions that are compatible with the distinct motivations of different actors – researchers, private sector actors, and donors –while also advancing the overall objectives of the partnership. By establishing pre-determined touchpoints, actors are better positioned to maximize co-creation opportunities for troubleshooting, leveraging unique knowledge and resources, and forecasting potential future challenges and opportunities.

The success of scaling PICS into East Africa was built on its proven performance in West Africa, and augmented through purposeful knowledge exchange between and among partners in Rwanda and Kenya. It illustrates larger lessons studied from across similar partnerships developed under Partnering for Innovation. Practitioners can draw from these lessons to replicate similar success for scaling technologies in developing countries. Specifically, integrating at least three knowledge exchange touchpoints – initial due diligence, technical inputs, and regular, ongoing interactions – offer a sound structure to support the successful and sustainable scaling of innovative agricultural technologies.

Limitations

This case study represents the experience of Partnering for Innovation. The goal is to support other practitioners to embed knowledge exchange activities into efforts that scale publicly funded agricultural technologies through commercial means. From the experience of Partnering for

Innovation, such exchange is an integral part of successfully scaling publicly funded research, as well as in any development initiative. As discussed above, there are also numerous definitions, motivations, drivers, and pathways for scaling that can be drawn on for customizing strategies to unique contexts and pathways; there is no single solution or recipe for success. It is important to note that not all research is suitable for commercialization, and the public sector can, and often does, play an important role in supporting basic research that may be far removed from commercial application.

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[1] See, for example, Piñeiro, M (2007); Sartas, M. (2019); Koerner, J. (2018).
[2] See all Partnering for Innovation tools in the program's Practitioner Guide here: https://www.partneringforinnovation.org/practitionersguide.
[3] For a full discussion about the definition of scaling in international development, see Wigboldus (2014) and Frake (2017).
[4] Innovation platforms are designed to bring multi-stakeholder groups together for achieving development impacts at scale, see Totino, E. (2020).
[5] The case background information is taken from Partnering for Innovation grant documents, articles written during the partnership, and past interviews.
[6] See all Partnering for Innovation tools in the program's Practitioner Guide here: https://www.partneringforinnovation.org/practitionersguide.