PLANNING FOR SCALE BRIEF #2

SCALING DEMAND

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1 – Introduction

Scaling the adoption of improved varieties of seed among smallholder farmers in a way that is sustainable over time will require investments that make seed systems more demand-driven. We have seen many examples of supply-driven expansion, where public resources have been spent on the breeding, multiplication and distribution of varieties without commensurate impact at the farm level, or with impacts that do not last. Improving the responsiveness of a seed system to farmers' demands has two important benefits for public sector donors, practitioners and policy-makers. First, a seed system is more efficient when information about farmers' decision-making as customers is integrated backwards up the value chain through different stakeholders, all the way to plant breeding programs. This allows scarce resources are better targeted and have a higher likelihood of resulting in products that are adopted. Second, investments to make a system more demand-driven result in more clearly defined roles for private sector partners. Public money can then be a better catalyst, sparking changes that continue on, and grow, after the public investment has ended.

» A Malawian seed company mentions that the breeding priorities are set by the government, but that these priorities are different from the preferences of the farmer. The government prioritizes yield and disease tolerance whereas farmers prioritize hardness of grain and early maturity. «

CDI and IFDC Report, 2010

Ag Partner XChange

What does demand-driven mean?

Our use of the term 'demand-driven' describes a system in which the decision-making of the *farmer* drives research, development and deployment strategies for agricultural technologies; the system is driven by market demand. This term is based on a belief that farmers are the best arbiters of their own risks and returns. Demand-driven scaling builds toward a seed system that does not depend on small groups of experts to decide what a smallholder farmer 'should' be planting. Instead, while still valuing and integrating information from experts, its central tenet is to assume that the smallholder farmer knows best what to plant, given current prices, access to inputs (including fertilizer and credit), assessed risks, agro-ecological conditions, market access, local preferences, access to information and knowledge, and other determining factors.

Demand-driven work in international development typically '*challenges commonly held assumptions about the needs and wants of poor communities, integrates information from customers into the design and development of products and services, and calls for careful consideration of how to reach these underserved markets*' (Boettiger et al., 2013). Many options exist for investments to make seed systems more demand-driven, and we discuss a few of them in this brief.

Some parts of a seed system are already demand-driven. Companies, for instance, by definition respond to potential opportunities in the market. More broadly, private sector enterprises in both *formal* and *informal* parts of a seed system are inherently demand-driven, including: seed traders, agro-dealers, local seed producers, seed production companies, processors, producers' organizations and farmers.

Making a seed system more demand-driven requires progress in two main categories. First, there is a need to support the transition of public sector organizations to become more demand-driven, moving their programs and policies to become more responsive to the needs of their customers (smallholder farmers). Organizations working in the public interest, including NGOs, donors, governments and universities, are not by nature demand-driven and change can be difficult. Demand-driven change in public sector organizations might require, for example, re-thinking decision-making mechanisms, performance evaluations, and metrics.

Second, investments can be made that focus on private enterprises. There are opportunities to 'crowd-in' private sector activities and generally explore how their activities can better align with public interests. Alignment of private sector activities with public goals is only partial, but it can be expanded with smart, well-targeted investments. For example, much of the formal private sector interest in sub-Saharan Africa currently lies in hybrid maize, represent-

ing only one piece of a much larger set of needs across multiple crops, varieties and geographies. Demand-driven investments in this instance might be characterized by seeking to incentivize seed companies to expand target markets to reach more smallholder farmers, or perhaps to diversify production into other crops and varieties valued by smallholder farmers.

In the *Planning for Scale* project we tried to bring a practicality to the term 'demand-driven,' but it is by no means a new term. In 1989, for instance, Collinson wrote: '*The attributes of systems-based adaptive research, when well organized and managed, respond strongly to major shortcomings of the traditional top down research and extension process…small farmer involvement brings a demand driven research agenda*.'

If these are good ideas, and they have a central a role to play, why have they still not been taken up more broadly in international development? We begin with a discussion of this dilemma. We then move on to explore investments in four specific areas that create more demand-driven seed systems: (1) market intelligence; (2) seed trialing and product testing; (3) information and marketing; and (4) increasing the value a farmer gets from a seed.

2 – Our demand-driven past in seed systems

Participatory plant breeding (PPB) and participatory variety selection (PVS) have been a part of international development for many years. They focus on improving the research and development (R&D) processes of products (new varieties of crops) by integrating farmers' knowledge and preferences. There are differences, however, between these participatory approaches and our definition of demand-driven. We take this opportunity to discuss the differences, but first note two caveats. First, the underlying principle of listening to farmers is common to both, and all approaches recognize its merits. Second, there is no single definition of participatory approaches in agricultural development, and some versions of PPB or PVS will be much closer to our definition of 'demand-driven' than others.

The first difference to note between participatory approaches in plant science and our definition of demand-driven is that demand-driven scaling solutions engage the smallholder farmer as a *customer*, not necessarily as a *participant* in product development. This may be a subtle point, but it is an important one. We argue that customer and market information can inform product development without engaging the customer directly in the process. Human-centered design[1] initiatives that engage end-users in product development are clearly valuable, but they can be prohibitively expensive

1 We refer to human-centered design (HCD) as a larger class of participatory design approaches. This has similar characteristics, but also brings together many different approaches under one umbrella, so the term is equally hard to define.

and difficult to scale when they rely on the direct participation of the end-user, particularly when dealing with very heterogeneous populations in rural developing country markets. Demand-driven approaches acknowledge that sometimes the only way to get good information is to engage farmers *directly*, while other times good information can be gained by leveraging *intermediaries* (for example, local non-profits or seed traders with local knowledge of markets can be excellent sources of information).

This last point leads to a second major difference between historical participatory approaches and demand-driven scaling solutions. Demand-driven approaches pay keen attention to cost-effectiveness and seek to find lower-cost ways to understand the decision-making processes and the needs of smallholder farmers. There is an appreciation in demand-driven methods that information is always limited and imperfect; the balance between the cost of the information, and the value it delivers, is critical. This is characteristic of demand-driven approaches to scaling. Many PPB and PVS programs have not been designed to integrate the balance between the cost and value of information that is necessary to achieve scale.

A third difference between the history of PPB or PVS programs in seed systems and demand-driven approaches is that the latter are focused on a much wider set of processes within the seed system. Beyond variety selection and plant breeding, there are opportunities to use demand-driven approaches to improve distribution channels of seed, choices of business models for scaling, post-harvest solutions, foundation seed systems, and much more.

3 – Market intelligence

In the big picture, sustainably scaling seed systems means: (1) improving existing channels of delivery; (2) having a pipeline of varieties that farmers value and will adopt; and (3) expanding markets by reaching out to more farmers and farmers in new localities. In each of these endeavors, success depends on understanding in detail new market opportunities, the demographics of farmers, their seed purchasing power, factors that drive their buying and selling decisions about seed for planting and crops for sale, and the availability of input supplies. In addition to investments to collect this information, smart scaling strategies require re-engineering the decision-making processes within seed systems to make use of market intelligence.

Given the pace of change in information and communication technologies (ICTs), the penetration of mobile phones among smallholder farmers, advances in remote sensing and the availability of image recognition and geo-referencing software, we have opportunities to gain much greater insight into how smallholder farmers make choices as customers. Rural market intelligence has already been pioneered in many parts of the world

where commercial interests exist. Those who work on market intelligence in rural markets know that, even more than in advanced markets, creative combinations of multiple sources of information are needed, including geo-referenced data and customer data often obtained by mobile phone.

What kind of data do we need?

Market intelligence data ideally provide information about both market characteristics and adoption considerations. Advocating the use of accurate, high quality market data to drive decision-making seems straightforward, but in markets comprised of smallholder farmers this kind of data is expensive and difficult to scale. Generally, market intelligence data for rural markets present more challenges than in advanced seed systems, where demand is more homogeneous. The agro-ecological diversity of the market alone makes it challenging, but there are many other factors of heterogeneity. Badstue et al. (2012), for example, stress the complex mix of traits on which a farmer bases the decision to adopt a new variety.

Market characteristics. Information about market characteristics allows planning for decisions about logistics, marketing, market expansion and other down-stream activities. But market characteristics information can also inform the development of new varieties.

By 'market characteristics,' we mean the answers to questions like these: *How many farmers live within reasonable walking distance to a potential new distribution point? What percentage of farmers in an identified potential market own cattle? How many farmers purchase seed from a local market? What percentage of farmers is regularly exposed to what media (for example, radio)? How many farmers have access to storage on-farm or off? How many households have access to mobile banking services?*

Another important set of data to gather relates to the size of markets within common agro-ecological zones. This data can define the potential for scaling of particular varieties. The answers to these questions can sometimes be derived from the results of pilot programs, but the information is difficult to collect with sufficient scale and reasonable accuracy.

Adoption information. Information about adoption decisions overlaps with the *market characteristics* category of information above, and includes data on farmers' access to inputs, access to financial services and access to markets. It also includes more product- or household-specific information that can require different data collection strategies. By 'adoption information,' we mean the answers to questions like this: *What variety traits are valued by farmers? In what ways are women engaged in decision-making and how are activities split among genders? How do processing characteristics or taste and color impact preferences for seed adoption?*

Building from existing data

Market information is not absent in rural markets; we are not starting from scratch. Data are now collected at every turn in international development by non-profits, foundations, aid agencies and governments. Companies also have valuable, albeit proprietary, intelligence about rural markets in Africa. Where public data are of sufficient quality, various sources can be combined to understand fairly local differences, and can be complemented by targeted additional data. For instance, the MICA Indian Marketing Intelligence resource launched in 2013 combines datasets from: the National Census, Planning Commission, Ministry of Agriculture, Department of Animal Husbandry, Fertilizer Association of India, Agricultural Marketing Information System Network, and others to calculate the Market Potential Index (MPI) for more than 630 districts (MICA, 2013).

Leveraging existing sources of information can be challenging, though. Access to private data, and even public data, can pose hurdles. Quality can sometimes be poor or highly variable, and the integration of very diverse sets of data is sometimes impossible. These challenges should not be underestimated, but this field has moved quickly in recent years and our capacity to build central deposits of data from diverse sources has improved.

In addition to agricultural data, many other sources of data exist. Public health provides a rich set of data that also has implications for market intelligence in scaling agricultural technologies. Young (2012), for example, uses the USAID-funded MEASURE data from Demographic and Health Surveys (DHS) to understand ownership of durables, quality of housing, and education of children. Information from other sectors outside agriculture can provide proxies for some variables of interest in market intelligence for agricultural technologies.

Long-running, farm-level, time series datasets, like the many years high frequency longitudinal household data in the Village Level Studies dataset from the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), have brought critical insights into our understanding of technology adoption. But market intelligence is different. Data covering large areas are required; the data need to be fairly recent and, ideally, geo-referenced. Data with these characteristics serve different purposes than those of more common data collection methods of the public sector, which often entail small-scale and expensive studies that seek in-depth academic understanding. The distinction between data used in an academic setting, and data used in a scaling strategy requires clarity in planning.

Market intelligence data, especially about customers and their preferences, can be an expensive research investment, but it is undertaken because the data can be used to obtain a significant competitive advantage. Therefore,

usually companies are unwilling to share these types of data. It is possible, however, that public-private partnerships (PPPs) can be structured to share market intelligence data from companies. There are a number of models in which companies share proprietary data in PPPs. This area is not without challenges. In addition to access issues, company data are often specific to internal needs and not necessarily suited to broader use. If, however, there is an overlap with public interest goals, sharing data can prove to be a catalyst for scaling.

Spatial mapping and geo-referencing

There are many unexplored uses of *existing* technology to improve intelligence about rural markets in Africa, but the changes in remote sensing in the next decade could offer even greater opportunities. Since the 1970s, researchers have been mapping nighttime images of the earth's city lights from the US Defense Meteorological Satellite Program (DMSP), and using them in social sciences, particularly to estimate population (Levin, 2011). By calibrating the type of light in communities, it is possible to estimate the population densities of areas. Rough estimates are beginning to give information that could inform choices for distribution channels or new market entry. The images are comparatively low resolution (2.7km), and medium- to high-resolution imagery has been scarce (Levin, 2011). This is changing, however, with innovations in 'micro-satellites' from companies like Planet Labs. Planet Labs, a company with dual commercial and social missions, is launching a flock of small satellites that will map the planet around the clock, providing frequent images at high resolution (Eisenberg, 2013).

More comprehensive and higher quality data that can give information about the distance from farming household to market, will have a large impact on scaling strategies for the adoption of agricultural technologies. We know that distance to market is a major determinant in technology adoption among smallholder farmers (Buckmaster, 2012). Adejobi and Kassali (2013), for example, confirm that use of improved seed among 270 farming households in the Osun State of Nigeria is significantly influenced by distance to market. We also know that distance impacts men and women very differently in rural communities. Montgomery (2008) for instance, reports on gender differences in access to agricultural inputs and technology adoption among Ugandan women farmers in a community where the operation of bicycles or motorbikes by women is culturally prohibited. Understanding the time-distance component of access to seed and other inputs, as well as markets for farmers' outputs, will improve decision-making as we seek to scale the adoption of agricultural technologies.

In addition to changing technologies in the remote sensing field, the falling cost of mobile phones offers large opportunities for geo-referenced market intelligence for the coming decade. Smartphones with GPS capabilities are

dropping in price and their sales are skyrocketing. In the second quarter of 2013, sales were up 46.5% compared to the same period the previous year and surpassed those of feature phones (Reisinger, 2013). But the more likely impact among smallholder farmers will be in the 'feature phone' sector of the market. These phones lie between basic, very cheap handsets and smart phones, but they can be programmed for geo-location and web access capabilities. Feature phone markets in India and China are up to about a billion subscribers each and the market for feature phones in Africa has grown from 87 million in 2005 to 434 million (Piotrowski, 2013). The ability to use mobile phones to collect data, for instance by survey, and include geo-referencing, would transform our knowledge of market intelligence in sub-Saharan Africa.

UNICEF Crowdsourcing

In March 2013, a UNICEF network of 190,000 volunteers across Uganda was sent a message on their mobile phones: *'Do you know any farmers whose banana plantations or crops are infected with banana bacterial wilt disease? YES or NO.'* Twenty-four hours later, 35,000 responses from the Ureport network enabled a mapping of the area of the country impacted by disease. Those who responded positively were sent the critical piece of information for containing the disease: *'To control, avoid moving infected plant, break male bud, cut infected plants, clean cutting tools using jik or flame. (1 JIK: in 5 water.) Tell someone you know.'* This network of crowdsourcing information and disseminating data cost 3 US cents per person. Lyudmila Bujoreanu (2013) at the World Bank notes: *'What Ureport made possible was not only information dissemination or data gathering, but a nationwide conversation focused on a critical issue for Ugandans.'*

Mobile phones and data collection

New data for market intelligence is expensive, but mobile phones offer smart and efficient opportunities for the public sector to build adoption information and market intelligence. Firms like mSurvey in Kenya are reaching out to rural customers and gathering data. Mobile surveys offer significant cost savings compared to traditional face-to-face surveys, but a direct comparison is somewhat spurious, as they form quite a different data collection tool altogether.

The public health field was at the forefront of pioneering efficiencies for survey personnel who could upload data during face-to-face interviews through personal digital assistants (PDAs), but relatively little has been published in the field of international development on the use of solely mobile phone-based household survey instruments in low income communities. Through the mobile phone, smallholder farmers can be directly approached to provide a wide variety of information. Responses can be sent back

through voice or SMS. A World Bank study of more than 1,000 households in South Sudan, somewhat counter-intuitively, found that participants were disproportionately female, and that the incentives offered for survey completion (a 10 SDG top-up payment) were negatively correlated with responses (Demombynes et al., 2013). In many countries, SMS spam is common, and lessons from early mobile health initiatives have focused on building trust so that messages get through, and get answered (Aarons-Mele, 2013). Clearly, there is much to learn in using mobile phones to gather market intelligence about technology adoption among smallholder farmers.

Crowd-sourcing, now a well-accepted low-cost method of gathering data,[2] overlaps with mobile-phone based surveys, but there are differences. In most cases, crowd-sourcing is less structured and often unplanned; individuals contribute ad-hoc to a larger network or platform. Crowd-mapping is a common example that will be increasingly useful in agricultural development and in scaling technology adoption. Unlike mobile phone-based surveys, crowd-sourcing has the potential to use data sensed directly, as well as data resulting from users answering questions (Hirth et al., 2013). An example from outside agriculture is the crowd-sourced radiation map made by Japanese citizens after the Fukushima nuclear accident. A citizens' network, armed with Geiger counters, set out to provide a people's map of the radiation. Thousands of radiation readings were collected, color-coded, and released on the web by the not-for-profit Safecast (Scientific American, 2011). Managing crowd-sourced data presents challenges to analysts (for example, observer variability and sampling bias), but the field has benefited from recent advances in computational approaches to managing large datasets.

Ultimately, market intelligence is a balance between breadth and depth. Crowd-sourcing will evolve as only one among many tools for gaining a better understanding of the decision-making processes at the household level among smallholder farmers. Here, as in other areas where we are applying information and communication technologies to bring about efficiencies in rural developing economies, we have much to learn.

Many challenges

Gathering market intelligence in rural areas requires navigating obvious challenges. Market research in rural markets is typically more expensive than when conducted in urban, densely populated locations with more homogeneous markets. This can be due to: accessibility issues; literacy and local language issues; the need for face-to-face consultations with smallholder farmers, and other costs. As noted, there are always decisions to be made in the balance between the value of market intelligence and its accuracy

2 The term crowd-sourcing now has broader commercial meanings that embrace the sourcing of labor (e.g. micro-work projects) as well as finances in crowd-funding. Here we use the limited sense of the term to refer only to crowdsourcing data and information.

and cost. Decisions about accuracy vs. cost are not always second nature for public sector, science-based organizations whose mission is based on research. Mapping fertilizer use patterns for academic research purposes, for example, may entail very different standards of accuracy and therefore different costs than a company might accept in gathering market intelligence.

Another challenge in scaling market intelligence relates to a naiveté about information and communication technologies (ICTs). Too often, ICTs are employed without serious consideration of their known limitations. Certainly this includes technical limitations as they are deployed in rural markets, but the larger limitations in the 'ICT for development' field have always been related to the poor implementation of business strategies for ICT solutions, and social considerations in how customers interact with the technologies. While the authors of this brief are perhaps some of the more enthusiastic proponents of mobile technology changing the landscape of development, we believe there are good reasons for caution in designing new scaling strategies based on ICTs.

Ownership and access

Scaling strategies will need to consider how best to navigate the public-private interface in terms of ownership and access to market intelligence data. A company's market data is proprietary; firms are willing to pay for it so they can improve their own decision-making capabilities and have a competitive advantage. If public sector organizations begin to invest in either generating market intelligence or aggregating existing data to be used in market intelligence, there will be a need to revisit the discussion about optimal publication of the data that has previously slowed public-private interactions in international development.

For example: *If a seed company receives a loan or grant to improve capacity in market intelligence, will the data remain exclusively available to the company? Are there ways to incentivize private sector organizations in agribusiness to collectively fund the generation of market intelligence data and make some of it publicly available? If partnerships can be made with market intelligence firms or companies that already have valuable data, are public sector organizations prepared to comply with some negotiated data use restrictions?*

The 'big data' revolution has brought together a wide range of models that are already in use, which relate to data ownership and access in public-private partnerships. These can be explored to inform a strategy that will support public interest goals of getting better seed to farmers. These can include, for example, divisions in timeliness (for example, data is proprietary for a year, but public after that), granularity (data are made public in more

aggregate forms that are still useful, but the specifics are kept proprietary), and content (information core to a company's market is kept proprietary, but there might be an agreement to make certain information broadly accessible, such as farmer's distance to market, or credit availability).

Potential scaling investments in market intelligence

The following represents a preliminary list of potential investments in market intelligence that could contribute to either individual, tailored scaling strategies or to our broader ability to scale agricultural technology adoption among smallholder farmers.

Figure 1 – Potential scaling investment in market intelligence.

SCALING GOAL

Increase the amount and quality of market intelligence data available

HOW TO DO IT

- ➔ Invest in existing market intelligence firms that serve public and/or private sectors.
- ➔ Expand or fund new programs and projects within public sector organizations that have a primary goal of collecting and aggregating seed market data, farmer demographics, input market data, assets data, financial services and more.
- ➔ Approach companies to explore the potential for public-private partnerships, including access to aspects of market intelligence data.
- ➔ Invest in platforms for crowd-sourcing market intelligence about smallholder farmer markets.
- ➔ Add market intelligence aspects to new or existing grants that are not focused on information and data.
- ➔ Fund data warehousing, aggregation and standardization initiatives.
- ➔ Incentivize development of apps for making data accessible for market intelligence uses.
- ➔ Build market research capability within R&D institutions to be able to define and oversee market research data gathering by market intelligence firms.
- ➔ Support improvements in mobile phone-based survey intelligence.

4 – Variety testing

In this section, we add to a discussion that began many years ago in the literature on participatory breeding. Arguments in favor of participatory breeding noted the inefficiencies of formal breeding programs that did not seek information from the farm level early on in the breeding process. This is

true of seed as well as other products in international development. Products are often developed without close attention to the needs of the market, and then resources are employed *ex post* to try to push an increase in adoption. Of course, the successful development of new products (in this case varieties of seed) requires a combination of *pull* from the market, as well as *push,* to demonstrate the value to smallholder farmers (we discuss marketing new varieties of seed in Section 5 below).

As we have stressed, scaling seed systems requires much better information about the needs and preferences of smallholder farmers, their families and other buyers and consumers in the value chain, in informing the design and testing of new varieties. In addition to this information on preferences, however, technical information about the performance of a variety in different agro-ecologies and under different input combinations will inform scaling strategies in plant breeding, seed production and delivery. We also note in this section the very central role of regulatory frameworks that govern variety testing.

Scaling strategies related to variety testing, as elsewhere, include a central focus on cost-effectiveness. *How can we find cost-effective ways to integrate better information from the farm-level into decision-making processes up and down the seed value chain?* Scaling strategies also include a specific focus on reducing the time needed for variety testing so as to get better varieties to farmers faster. Setimela et al. (2009) note, for example, that on-farm trials often increase time to market because they are performed sequentially, after multi-environment trials (METs).

Performance testing by and for customers

Product evaluation by farmers and other stakeholders in the value chain needs to be maintained throughout the life-cycle of breeding activities and seed scale-up as an iterative process; not just at the beginning or at the end when varietal lines are fixed. Walker (2007) provides a good recent history of participatory approaches in plant breeding. The testing techniques used in participatory breeding have improved and evolved over the last twelve years, but there are still mixed views on how to generate reliable, meaningful data and the merits of independent unsupervised smallholder farmer involvement remain a point of discussion.

In the introduction to this brief, we noted a particularly relevant criticism of the participatory breeding and variety selection approaches: cost. Thomas Miethbauer, for instance, calculated that participatory variety selection trials in Peru cost an average of $725 per farmer participant. Other estimates have been lower, but it is important that demand-driven scaling strategies identify low-cost ways to integrate information about farmers' preferences. Newer ideas involve applying crowd-sourcing techniques that involve large

numbers of farmer participants in seed assessments. Crowd-sourcing has the potential to dramatically change the scale of performance testing and involvement of farmers from many agro-ecological zones. It could involve, for example, the wide distribution of very small packets of seeds, and feedback using SMS on mobile phones (Van Etten, 2011). In India, 800 farmers are in the process of testing wheat varieties as part of a seeds for needs program, looking at genetic diversity for climate change (Van Etten, 2013). Each farmer received 120g of seed and ranked the performance of three agronomic characteristics: early vigor, yield and grain quality. Crowd-sourcing is worth considering as a next generation, low cost tool for variety testing that can connect and involve farmers and consumers as potential customers to test and select new varieties.

Better, cheaper farmer feedback is not the whole answer, though. Scaling up trialing and product testing also requires looking ahead toward critical trends that may not be accurately reflected in current farmer feedback. Plant breeding is a long process and future demands have to be anticipated. As an example, consider the trend toward an increasing share of off-farm work income for smallholder farmers in sub-Saharan Africa. Decision-makers seeking to scale seed systems may need to look ahead at trends like this to anticipate how the changing value that farmers attach to varieties of seed as they increasingly split their time across off-farm as well as on-farm work. These pressures may, for example, play out in farmers attaching higher values to crops that require less labor. Mathenge et al. (2013) provide a thoughtful examination of the competition of resources between off-farm and on-farm work. They note implications regarding labor-intensity and also note a need to better understand changing gender roles. Adoption of new varieties will depend on who in the household has the decision-making power over off-farm and on-farm incomes. These issues and others related to the shift toward off-farm income may have significant impacts on the types of varieties that will be demanded in the near future.

Performance evaluation by national variety release committees

National government approval is a pre-requisite for new varieties to be released for sale in most countries and this requires varietal performance data from official trials. Setimela et al. (2010) reviewed the requirements for registration of new maize varieties in fourteen African countries. There are two types of varietal testing and release procedures required to satisfy national variety release committees: standardized tests for distinctness, uniformity and stability (DUS); and demonstration of value for cultivation and use (VCU). In South Africa, only data for DUS are required, with assessment of value for cultivation being left to market forces. Ghana, on the other hand, has 36 additional agronomic trait assessments required for compliance with its VCU regulation; this results in costly duplication. Testing by breeders to

identify the best lines for progression and then again in national government variety trials, often over multiple years. The variety performance equation for plant breeding programs, farmer participation and value chain beneficiaries vs. government requirements and investment costs is a critical one needing consideration. Progress is being made by the Common Market for Eastern and Southern Africa/Southern African Development Community (COMESA/SADC), with proposals on harmonization of regulatory requirements and mutual recognition of varietal testing data to encourage seed trade between countries. Piloting is expected soon in Zambia, Zimbabwe, Malawi and Swaziland (ISSD, 2013). Facilitating advocacy and migration of these core principles to other economic regions in sub-Saharan Africa is an important scaling investment.

Potential scaling investments in variety testing

The following represents a preliminary list of potential investments in variety testing that could contribute to either individual, tailored scaling strategies or to our broader ability to scale agricultural technology adoption among smallholder farmers.

Figure 2 – Potential scaling investments in variety testing.

SCALING GOAL — **Improve the availability and quality of variety release data**

HOW TO DO IT

- ➔ Support initiatives to improve multi-country variety release data for regulatory purposes.
- ➔ Invest in initiatives to share variety testing data outside the regulatory processes.
- ➔ Support the further development of agro-ecological geo-referenced data for more varieties, indicating performance across common agro-ecological zones.

SCALING GOAL — **Create more direct connections between variety release and the market**

HOW TO DO IT

- ➔ Support initiatives to reduce the time and investment needed to release new varieties.

SCALING GOAL — **Improve analysis of data and advocacy for better data and more demand-driven variety release processes**

HOW TO DO IT

- ➔ Predict performance and geographical scope for demand for new varieties by linking location of performance trials and farmer responses with mobile phone geospatial data and agro-ecological zones.
- ➔ Support initiatives to assess the balance between the public benefits of crop trials and their costs in slowing the delivery of new varieties to smallholder farmers.

5 – Marketing and extension

Adoption is highly influenced by farmers' perceptions of benefits vs. costs, and potential risks or uncertainties arising from changing from current practices to trying new seeds. An important part of a new variety's marketing and promotion campaign includes communicating the benefits of a new variety. The basic and well-accepted methodology in rural seed markets involves a combination of field days, demonstration plots and other localized investments to satisfy the farmer's need for 'seeing is believing.' Other lower-cost marketing channels also deserve attention, but it is hard to get past the need to *show* a farmer the benefits of a new variety. Scaling strategies in marketing and extension examine how to reduce the cost of these marketing mechanisms, how to structure them to reach more farmers, and how to make their impact most effective in facilitating adoption.

Scaling demonstrations

The challenge of scaling marketing and extension for smallholder farmers has been another long-running goal toward which we have so far made little progress. Our research confirms that, unlike the collection of information *from* the farm-level (Section 3), the conveyance of information *to* farmers is much less likely to be transformed by the revolution in ICTs. Certainly, other forms of media are being employed to bring information to farmers about new technologies, including video, film, plays, TV, radio and others. Their effectiveness has been underwhelming, with only limited success in finding more cost-effective ways to deliver information to farmers in rural markets. Digital Green in India is one exception. By videoing local farmers who use innovative technologies or methods of farming, and then screening those videos in surrounding villages, Digital Green amplifies the usual channels of information exchange and enables good ideas to have a much broader impact. Their data suggest that the method is ten times more effective per dollar spent than the older extension system known as Training and Visitation. Overall, however, a widespread review of recent evidence on extension and rural marketing reveals few bright spots. Even without new, low-cost, effective methods for convincing farmers of the value of new varieties of seed, there are a number of existing scaling strategies that focus on creating more coordinated, cost-effective demonstrations.

Scaling up our capacity to demonstrate new seeds to farmers will also likely require complementary investments to ensure the demonstrations can make an impact on the adoption of new varieties. Alemu et al. (2008), for instance, cite a basic mismatch between demonstration plots and the supply of seed. Even when farmers were swayed by the information conveyed in the demonstration, they were not able to access the seed.

Building brand equity

Branding seed with trademarks, identifiable packaging and logos builds awareness, conveys reputational information about the product and facilitates recognition by farmers, extension advisors, seed suppliers and retailors. Branding is a powerful seed-marketing tool in many countries and it is no less powerful in sub-Saharan Africa.

We have already mentioned several times in these briefs the rising concerns over counterfeit seed in sub-Saharan Africa. The presence of fake seed in markets erodes trust and can have disproportionate reputational impacts for seed producers relative to the actual amount found in the market. In 2012, the Alliance for Seed Industry in Eastern and Southern Africa was launched to address the counterfeit seed issue. Counterfeit operations can be sophisticated and large-scale. For example, some use discarded bags from a seed company, refilling them with counterfeit seed, stitching them closed and marketing them (Wamalwa, 2013). Strategies to address counterfeit seed are critical to scaling. These will include innovations in packaging, technologies, reporting coordination and incentives, improved prosecution rates, heavier penalties and more.

Potential scaling investments in marketing and extension

The following represents a preliminary list of potential investments in marketing and extension that could contribute to either individual, tailored scaling strategies, or to our broader ability to scale agricultural technology adoption among smallholder farmers.

Figure 3 – Potential scaling investments in marketing and extension.

SCALING GOAL — **Explore lower-cost ways to scale up information getting to farmers about new varieties**

HOW TO DO IT

- ➔ Support, evaluate and scale programs designed to assess the impact of low-cost, large-scale demonstrations, including models to incentivize local farmers.
- ➔ Support partnerships between formal sector seed producers and informal sector marketing entrepreneurs.

SCALING GOAL — **Improve packaging and labeling**

HOW TO DO IT

- ➔ Invest in leveraging advances in the packaging and labeling field to change seed packaging and labeling.
- ➔ Invest in advocacy for packaging and labeling policies constraining scale.

SCALING GOAL

Strengthen the incentives of brand equity

HOW TO DO IT

- ➔ Support innovations in anti-counterfeit seed mechanisms using technical, practical and legal methods.
- ➔ Explore alternative strategies for achieving brand loyalty for seed varieties by smallholder farmers in rural areas.

6 – Changing value for the farmer

In this brief we have explored a range of options for progress toward more demand-driven seed systems:

- ➔ creating a pipeline of genetic resources based on what farmers value
- ➔ developing logistics so more farmers have access to improved varieties
- ➔ enhancing information and marketing so more farmers have knowledge of the benefits of the new varieties
- ➔ reducing barriers that constrain farmers from adopting a new variety

In this penultimate section we discuss how to catalyze demand-driven scaling of a seed system by changing the value the farmer derives from an improved variety of seed. What if, in addition to working on the channels that get seed to the farmer, you also looked at market access? The way in which smallholder farmers are connected to markets changes the *derived* demand for seed. For example, we know that a farmer growing a crop for household consumption only is much less likely to take the risk of adopting a new variety than a farmer connected to a market. Connecting farmers to markets shifts the value proposition, and farmers may invest in new inputs and better agronomy in anticipation of returns on their investment. Zavale (2005) writes that if we are to scale the diffusion of improved technologies we '*should ensure an environment in which it is profitable not only for seed companies to produce and sell high-yielding varieties, but also for farmers to adopt these varieties*.' The resulting pull towards adoption, which derives from the farmer's profitability, has enormous power to *accelerate* scale. These value-changing strategies are the *turbo-drive* of demand-driven scaling.

The potential to influence derived demand is not just about connecting farmers to markets. Because a farmer's demand for a trait is deeply influenced by market preferences, there are multiple opportunities to influence demand for seed varieties. We are familiar with marketing campaigns, for instance, to increase demand for orange-fleshed sweetpotatoes (HarvestPlus, 2012). But many other shifts in demand can occur. Complementary technologies, for instance, access to finance, insurance services and more can be used strategically in engineering changes in the derived demand for new varieties of seed.

There are numerous options that deliver this accelerant effect to scaling a seed system; some have been priorities on the desks of donors for years. We argue, however, that their potential impact is often underestimated and that the value of the secondary and tertiary effects that the pull creates in seed systems, input markets, the application of agronomic knowledge, and much else is often omitted. Recognizing that this field is very wide, we briefly explore three examples of interventions targeted to shift the value of seed for farmers: storage, coordination of transportation, and branding in urban markets.

Storage

Temporal and spatial marketing margins in many African countries remain high and there are enormous opportunities for smallholder farmers to obtain higher profits through improved storage and transportation. Storage investments range from on-farm solutions, to solutions for local aggregators and beyond. They include innovations in facilities themselves, as well as access to storage chemicals (Jones et al., 2002), drying technologies, and financial innovations that might support, for instance, better warehouse receipts systems.

Links between improvements in storage and the subsequent adoption of new varieties are based on the benefits accrued to the farmer in increased income and reduced risk. Storage allows farmers to not only reduce post-harvest losses, but also to time the selling of their harvest to take advantage of higher prices. Gains produced by improving storage in one link of the value chain will not, of course, translate fully to the smallholder farmer, and donors considering the landscape of potential storage investments are cognizant of the likely changes in marketing margins resulting from providing storage options to, for instance, local aggregators or wholesalers. But the bottom line is that there is under-investment in opportunities to improve storage.

Coordination of transportation

Transportation remains another critical hurdle to market access for smallholder farmers. Investments addressing transportation have a dual impact on scaling seed systems. They work to improve the supplies of inputs reaching farmers, but they also improve access to market for farmers and therefore play the role of 'accelerant' in a demand-driven system. As ever, there are many investment opportunities. While there is no substitute for infrastructure projects that result in better transportation, there are likely some smaller gains related to mobile phone use. We know producers reduce search costs related to marketing by checking prices (Aker, 2010). Overa (2006) finds that informal traders in Ghana are more efficient because of their use of mobile phones to match suppliers with sales opportunities, and to coordinate multiple collections, reducing their transportation needs.

Aker and Fafchamps (2013) offer recent analyses of the connection between spatial marketing margins and mobile phones. They find lower spatial dispersion of producer prices for cowpea crops in Niger due to improved information flow through mobile phones. They find no impact on the average price of producers (except among peanut farmers), but a reduction in price risk throughout the year. They also highlight the interconnectedness between transport and storage issues, finding that the reduction in price dispersion apparent in cowpeas did not exist in less perishable millet and sorghum. This study offers insights into some potentially important scaling strategies for seed systems by highlighting non-infrastructure investments as alternatives for improving transportation challenges.

Meeting demand in urban markets

The World Bank's estimates of growth in the African food market are startling. In less than two decades, markets could treble, creating a US$1 trillion food market (Byerlee et al., 2013). This has been translated by some as directly implying strong growth opportunities for African agribusiness. If this materializes, it will provide a powerful accelerant in demand-driven scaling of seed systems. An important caveat, however, lies in the preferences of urban consumers for locally grown produce compared to imports. Currently, urban African markets show a strong preference for imported food. Powerful scaling investments could be made to try to turn those urban markets toward locally grown agricultural products. This will require a focus on the consistent supply of high quality, locally produced crops that can compete with imports, but there are also important investments to be made in improving the branding of locally-grown food. Without these investments, the promising opportunities of growing urban markets may deliver value largely for foreign countries.

Potential scaling investments in changing value for the farmer

The list of strategies to shift the derived demand for smallholder farmers is an entire field unto itself. Here, we note only that the technology adoption components of these strategies need to be brought to the forefront as perhaps the largest of any factor in scaling seed systems in sub-Saharan Africa.

7 – Conclusion

There have been long-running discussions in agricultural development about the power of market 'pull', and value chains driving product supply, services and development. Demand-driven approaches have been funded over the decades, taking many shapes and forms. We have argued here, within the context of scaling seed systems for smallholder farmers in developing coun-

tries, that further emphasis is required in order to integrate the needs and preferences of farmers and other stakeholders in their value chains into the development and supply of new varieties and products.

It is clear that market intelligence has a pivotal role to play, and that the landscape of ICT is changing to open up new ways for dialogue between farmer customers, seed companies and market research organizations that specialize in providing data from rural communities. Connections to customers using crowd-sourcing techniques for market information and variety testing has arrived in the last five years. Exploration and development of practical uses of ICTs could transform not just farmer engagement in market intelligence but also the arena of testing and assurance of product performance and farmer extension services. Another key challenge is defining the benefits of new varieties for smallholder farmers in heterogeneous rural locations at an acceptable cost. New technologies are bringing lower-cost options that have not been possible before, and therefore opening up new avenues for scaling. They will require careful evaluation and there is still some way to go before we understand how to implement and integrate them effectively, however.

Despite our strong advocacy that scale requires improvements to the private sector capacity to develop and deliver goods and services to smallholder farmers, we also advise through the *Planning for Scale* briefs that the role of the public sector, even in very advanced seed systems, remains central. Particularly in this brief on demand-driven scaling, it is important to focus on the path ahead for public sector organizations in becoming more demand-driven. The public sector remains powerfully determinant in the ability to scale seed systems in most African countries. If we can bring more demand-driven practices to national seed production systems, plant breeding programs, variety registration and agricultural extension services, enabling these organizations to be more responsive to the needs of smallholder farmers, we will succeed in fostering scale.

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