SEARCH

Summary
Agricultural development programmes have a long history of working toward the adoption of improved crop cultivars among poor farmers.

The potential food security impacts of adopting improved cultivars are well documented and critical advances have been delivered by public plant breeding research over the decades.

Adoption rates, however, still remain low and there is increasing interest in understanding why so few improved cultivars have been adopted at scale, by large numbers of farmers.

The international development community has begun to explore these issues of scaling up in greater depth, considering how to successfully expand policies, programmes, or projects to impact many more people.

This paper contributes to a growing literature that builds on scholarship in technology adoption theory but focuses particularly on how to scale up technology adoption, moving from hundreds of farmers to reach millions.

The paper presents a simple framework for analyzing the wide range of challenges inherent in scaling up the adoption of a product or service among low-income communities in developing and emerging market countries.

The potential use of the framework is illustrated with a discussion of the challenges present in seed systems when seeking to scale the adoption of improved cultivars.

Glossary

Bottom of the Pyramid: socio-economic description of the 4-5 billion people who live primarily in developing and emerging market countries and who are "unserved or underserved by the large organized private sector (1)." The term also defines the field of business strategy focusing on reaching this population as a market for products and services. Bottom of the Pyramid is mostly associated with the work of C K Prahalad and Stuart Hart (2).

Cultivar: form of a plant species or crop plant in cultivation (excluding naturally occurring varieties) which needs to be propagated either by seed or vegetatively. The word 'variety' is sometimes used to describe these forms, particularly in the technology adoption literature where there terms like 'modern variety' and 'high-yielding variety' are widely used.

Impact investing: practice of investing in companies, NGOs, programs, projects, and funds with the explicit intention of generating both financial returns on the investment as well as social and environmental impacts.

Shared value: business concept describing how a company's strategy to address social and environmental problems can simultaneously add value to the company. The shared value framework identifies opportunities for companies, civil society organizations, and governments to employ of market-based competition to address social and environmental issues (3).

1. Introduction

Agricultural development programmes have a long history of working toward the widespread adoption of improved crop cultivars among poor farmers in developing and emerging market countries.

Empirical evidence finds that the adoption of improved cultivars significantly impacts a wide range of household poverty indicators. Particularly in staple crops, many studies have examined the relationship between poverty reduction and the use of improved cultivars (4, 5).
Promoting the adoption of high-yielding cultivars, as well as those with traits conferring resistance to abiotic and biotic stresses, remains a central goal for agricultural development policies, programmes and projects.

Despite demonstrated benefits and decades of innovative plant breeding to create cultivars that serve the needs of the poor, those cultivars that have achieved widespread adoption are few and far between.

The most well-known successes are the wheat and rice cultivars of the Green Revolution. More recently, the Pan African Bean Research Alliance (PABRA) has reached 18.3 million households in a decade with good quality bean seed (6)1.

In Bangladesh and India the flood tolerance gene (SUB1A) has been introduced into a range of 'mega-rice' cultivars and there is good reason to expect scaling up (7).

Maize, more than other crops, often exhibits higher adoption rates and Thailand's Suwan-1 is an excellent example of widespread adoption (8).

n some African countries, adoption of modern maize cultivars has soared. In Kenya an estimated 70% of land under maize is planted to improved cultivars (9).

There are many more technology adoption success stories that have not been documented, but there are also many failures where improved cultivars have not been adopted as broadly as we hoped, or there has been low adoption, particularly in food insecure regions, where modern cultivars are most needed.

After decades of innovative plant breeding and efforts by extension services to get better seed to poor farmers, the lack of adoption is disconcerting.

2010 World Bank data in Tanzania showed less than 17% of farming households were using improved seeds (10). Among a surveyed set of sorghum farmers in Eastern Ethiopia, only 8% of land was planted to modern cultivars (11).

In Cambodia, modern rice cultivars were planted on 41% of rice-growing land, but adoption was concentrated in regions where hydrological conditions were more favorable (12).

Figure 1 shows 2012-2013 figures for the percentage of maize and wheat land planted under improved cultivars across a range of sub-Saharan African countries (13).2

Despite poor adoption figures, significant public resources continue to be invested in research to improve crops for the global poor, through organisations like the CGIAR Consortium (for which the annual budget reached $1 billion in 2013) (14).

The large number of cultivars produced by the research system that do not achieve widespread adoption can be seen as an indicator of missed opportunities for increasing the effectiveness of public investments directed to food security and poverty reduction.., For example 41% of the maize area Ghana was planted under one old and popular open-pollinated cultivar, Obatanpa.

A further 10% was planted under cultivars released before Obatanpa (i.e. before 1992) and only 1% of maize-growing land was planted to the many improved cultivars released since the early 1990s (15).

Evidence of the lack of widespread adoption demands better investigation into the mechanisms not just of technology adoption among the poor, but in the scaling up of adoption.

Defining Successful Scaling

To explore the issues of scaling up the adoption of new cultivars it would be useful to define specifically what constitutes success.

Should we, for instance, view the Ghanaian Obatanpa maize cultivar as a success? One out of twenty-seven improved cultivars released since the 1960s took twenty years to reach 41% of the land area (16).

Who is to say, however, that this success rate, return on investment and time frame are not reasonable, given the context in which the uptake was achieved? This paper argues for the need to develop a more precise definition of scaling up.

A good definition, however, must be built on a broader foundation of evidence than currently exists. Once we have documentation and analysis of a greater number of examples of scale in recent history, we can begin to understand successful scaling and the factors that contribute to it.

The term 'scale' will always be used by the international development community as a general way of referencing 'significant growth.'

For example, a working World Bank definition of scaling up cited in Hartmann and Linn (17) reads:
"Scaling up means expanding, adapting and sustaining successful policies, programmes, or projects in different places and over time to reach a greater number of people."

This definition has many merits. For instance, it notes that successful scaling will require not just expansion, but also the means to adapt polices, programmes and projects. It also limits scale to that which is sustainable over time.

Many examples exist of supply-driven expansion of technology adoption, where public resources have been spent on design, development, manufacturing and distribution of product only to see the use of the product plummet once the public sector steps back.

Sustainable scale implies a more demand-driven scaling that not only will reach a greater number of people but will also deliver value to them. These are important distinctions that distinguish the new literature on scaling up adoption from the old technology adoption and extension services literature.

Underneath the umbrella of this broad definition, however, we need critical analysis of what scale means in the adoption of technologies among the poor, and then with even more specificity, what defines successful scaling in an individual class of technologies.

This paper illustrates the importance of defining and analyzing scale differently for different classes of technologies by examining scaling up the seed of improved cultivars.

2. Diagnosing Failures to Scale

In addition to a rich body of literature in economics and international development on technology adoption, new explorations of scaling up rely heavily on business literature.

Much has been written on the intersection between social impact and the commercial potential within low-income developing country markets. From CK Prahalad's enthusiastic endorsement of opportunities at the 'bottom of the pyramid' (18) we have come to more nuanced views of the role of the private sector in poverty reduction (19).

At the same time, in the last decade, we have seen the rise of impact investing (20), the exponential growth of multinationals based in emerging market economies (21), and broad interest in Porter and Kramer's 'shared value' model (22).

These and other trends have produced a wealth of scholarship about market-driven solutions in international development, some of which discuss key issues related to scaling up the adoption of agricultural technologies.

Common business models for reaching rural markets have been explored (23), for example, and the discipline of rural marketing is coming into its own, particularly based on experience in India, but with broader applications for the international development field (24).

A practical understanding of how to scale technology adoption demands, however, that we move beyond common business models and marketing strategies.

The contributions from business are invaluable, but they must be combined with rigorous empirical knowledge of technology adoption, extension models, and development economics.

Additionally, progress in learning how to scale the adoption of technologies among the poor will require disaggregation; we will need to consider specific individual classes of technologies.

Scaling the use of vaccines, for instance, requires entirely different strategies to scaling the adoption of irrigation pumps. Paying attention to these differences can critically inform potential opportunities for the international development community in their efforts to catalyze scale.

In addition to considering classes of technologies, it is useful to disaggregate further by dividing scaling issues into three main categories.

These categories are derived from technology adoption theory and are sometimes used to diagnose why adoption failed. Examining scaling issues for a product or service requires examination of the technology across these three categories.

In order to illustrate how such a simple matrix of scaling analysis can be used, this section concludes with an overview of these three categories as they relate to scaling the seed of improved cultivars.3

Then, Section 3 considers six fundamental differences in seed as a class of products and, using the scaling analysis framework, explores implications for scaling up adoption.

Category 1: Value
The product did not provide value to a large number of customers.

Perhaps the greatest failure in scaling the adoption of technologies across any sub-field of international development lies in the fact that we are almost always trying to scale the wrong product.

Products in international development are too often developed without attention to the customers' needs and desires. This is as true in the development of new cultivars as it is for other products.

Among the improved cultivars that are produced in public plant breeding systems, there are many documented mismatches between the value farmers assign to traits and the value plant breeders do.

Formal breeding programmes may focus on one trait (e.g. yield) rather than a balance of traits that are valuable to the farmer. A farmer's determination of the value of new cultivar might include, for instance, a balance between yield, the stability of yield, early maturity and perhaps heat tolerance.

In addition to valuing the degree to which the cultivar lends itself to local production conditions and techniques, a farmer's valuation also depends on consumer traits that are often overlooked by plant breeding programmes (25). Adoption of sweet potato with higher vitamin A, for example, depends on the cultivar's taste, 'mouth-feel', aroma, and color when fried (26).

The valuation of traits among farmers is also diverse and dependent on a wide range of factors. In Uganda, for example, men valued banana cultivars that made better beer and women valued those that that had better cooking quality (27).

Public plant breeding programmes have recognized and made advances in this area, but much more work is needed. Successful scaling strategies will include significantly improving the channels through which farmers' needs can inform decision-making in public plant breeding programmes (28).

Another failure in attempts to scale improved cultivars relates to the assumption that value for the farmer is limited to the seed's genetics.

In fact, the quality of the seed can be as important, or more important to a farmer. Tackling quality issues is a key to increasing adoption of all improved cultivars, but it can be especially important in attempts for open pollinated varieties (OPVs) and vegetatively propagated crops. Availability of high quality seed can make all the difference in a farmer's decision to adopt.

Category 2: Information and Knowledge
The spread of information and knowledge related to the product was insufficient.

A second major category of failure in scaling the adoption of improved cultivars lies in the information and knowledge systems that run parallel to the supply chain.

Where marketing, extension and education services do not reach farmers, even good cultivars will fail to be adopted. Some parts of these information and knowledge systems relate to raising awareness among farmers about new cultivars, including demonstrations of the value of the improved cultivar.

Other parts involve dissemination of knowledge that, ultimately, increases the value of the cultivar to the farmer. Performance often varies dramatically with timing of planting, fertilizer use, irrigation and other factors.

The gene-environment interplay is a pillar of value creation in cropping systems, and scaling up a new cultivar depends upon how these benefits are communicated to farmers.

While there is deserved focus by those working in technology adoption on both the product and underlying business model, scaling will fail without this parallel system of information and knowledge.

Category 3: Access
There were problems in access to the product.

The third category, where failures may occur relates to a farmer's access to the improved cultivar. Typically, this includes failures across a wide range of issues such as distribution networks of the seed, which may not bring the product to the farmer.

Dynamic market effects across both formal and informal seed systems may be poorly understood and incorrectly forecasted. The timing of the availability of the seed is sometimes wrong, as farmers often have a narrow window for planting.

Problems in the supply chain may cause degradation in the seed which reduces quality. Supplies of essential complementary inputs may also fail.

Credit is often seen as a complementary input and also brings issues of affordability to this category . These are examples of issues which can contribute to failure in scaling because they inhibit the customer's access to the product.

3. Diagnosing Failures in Scaling the Adoption of Improved Cultivars
This section illustrates the importance of disaggregating technologies into classes when considering scaling strategies and provides examples of how to use the diagnostic framework described in Section 2. Seed, as product, has fundamental differences in production, distribution, and adoption that set it apart from other technologies.

An understanding of these differences offers critical insight for the future potential to scale up adoption of improved cultivars.

In advanced markets, tools to support the seed business have developed over time to accommodate the idiosyncrasies of the seed market.

From credit and insurance instruments, to intellectual property rights, to technologies facilitating transportation
and storage, the seed business in developed countries benefits from enabling laws, policies, technologies and business practices tailored particularly to the industry. In developing countries, however, many of these tools are the targets of intervention by the international development community.

These tools can be seen as the enablers of scale. Interventions to catalyze scale, however, cannot be generalized across products. By summarizing six important differences in the production, distribution, and adoption of seed, the intention is that this paper will remind donors, impact investors, policymakers and practitioners that scaling strategies differ radically across classes of products.

In access to finance, support for technological innovation, the championing of business models, changes to the underlying policy framework and many more areas, different interventions are needed to address issues of scale in the adoption of different types of technologies.

A. Production lags and uncertain demand
Unlike many products, seed production is characterized by a combination of long delays and uncertain demand.

The time required for multiplying seed (from breeder's seed to foundation seed to marketed seed) varies from two to as many as six seasons. This production lag creates a multiplier effect for uncertainty; production problems in any one of the seasons will impact the final volume available for the market.

The lag additionally highlights demand forecasting as a critical element in scaling up the production of seed. Supply decisions today are based on the forecasted demand for cultivars and quantities made several years before.

Also, the production lag has implications for scaling that relate to inventory costs. Crops with long production times larger stocks of seed kept for longer so more money is tied up. Business implications for inventory turnover ratios in the seed industry vary across crops according to bulk rates and perishability.

Vegetable seed inventory, of course, is less costly to hold than potato seed inventory. For industries with low inventory turnover ratios, scaling strategies may demand interventions focused on financing needs accommodating long-term cash flow.

When inventories are held over long periods of time, companies may react more strongly to changes in the cost of capital. These, among many others, are important clues for the international development community seeking to scale up the production and distribution of the seed of improved cultivars.

Thoughtful application of the framework for diagnosing failures in scale described in Section 2 of this paper can provide guidance on policy development, creation of financial tools for seed industry enterprises or provision of support for better demand forecasting.

B. Perishability
This is a second defining characteristic with critical implications for scaling.

Businesses producing, storing, transporting and delivering perishable goods are, of course, dependent on good transportation links and cold storage facilities. Investments in infrastructure and storage technologies may have especially high returns if they reduce quality losses.

Production and distribution of seed also derives high value from access to modern supply chain technology (like traceability, sensor, or packaging technologies).

Scaling up strategies can also be informed by the impact perishability can have on pricing strategies for seed producers. Firstly, financing opportunities for businesses selling perishable products may differ from others. Secondly, production and distribution of perishable products may involve costs of compliance with wide-ranging regulations.

Market dynamics in perishable goods can be affected by the implications of perishability and policies developed to support the industry.

In developing countries, for instance, policies governing the export cut flowers may affect industry constraints. Seed industries that are not export-led may not benefit from similar policies, and the introduction of these types of policy changes could be a potential area for catalyzing scale.

C. Counter-cyclical effect
Unlike many products, seed production suffers from an unusual counter-cyclical effect that sometimes sends demand and supply in opposite directions (29).

This occurs because producers and consumers are affected differently by the same risks. For example, in a year when maize yields are low seed production (for future sales) is reduced and farmers' have also produced less.

Scarcity increases market prices for farmers selling their maize and they decide, based on high prices, to increase the land they plant under maize for the next season.

Demand for maize seed rises at a time when supply of maize seed has fallen. Conversely, if there is a bumper harvest in a good year maize floods the market, farmers may plant less maize for the next season, lowering demand in the seed market.

Those same favorable conditions leave seed producers entering the next year with a higher inventory, but lower market demand.
Understanding this characteristic of seed as a product should inform interventions for scaling in several areas.

High returns may come from interventions that enable seed companies to have access to technologies that improve control of their production environment, for example, or access better storage facilities.

This characteristic of seed markets also has implications for the financing needs of seed producers to ensure their long-term survival and growth of their enterprises.

D. Responses to disasters
A fourth characteristic of seed production and distribution relates to how governments and markets respond to disasters.

Seed supply and demand are critically affected by disasters and similarly essential to the recovery. In times of disaster and insecurity (for example, when civil unrest ensues, crops are wiped out by a pest or disease, or there is a prolonged drought) farmers may use their seed as grain, using up stocks that had been saved for planting in the next season.4

In addition, disasters impact the seed market when seed is moved through non-market channels to alleviate the impacts of the disaster.

How, where and over what period of time emergency seed is distributed, therefore, affect the seed markets. Scaling strategies need to recognize the dynamics of how nascent seed industries are impacted by various responses to disasters and, where possible, use this analysis to inform both emergency relief efforts as well as explore options for building more resilience in the seed industry.

E. Information asymmetries
A fifth characteristic of seed as a product relates to information availability.

It may be difficult to identify the true value of the product and therefore, for example, the seller may have more information than the buyer.

In some products this is relatively easily resolved. For example, demonstration of an irrigation pump or a solar lamp resolves some elements of the information asymmetry. In other products it is much more difficult. The value of a livestock vaccine, for instance, may only be demonstrated a long time after sale of the product when a disease kills non-vaccinated animals.

It may take time to demonstrate the value of the new cultivar, but it is reasonably easy so to do. This characteristic primarily informs scaling strategies in category two of the diagnostic tool presented in this paper, focusing on interventions in marketing, extension and education, but it also indicates the critical dependency between marketing (for example large-scale demonstrations of new cultivars) and production.

Additionally, for some products brands become all-important. Strategies for scaling production, distribution, and adoption of technologies with information asymmetries offer opportunities for innovations to improve branding (for example packaging or anti-counterfeiting) and marketing strategies become paramount.

F. Easily reproducible goods and informal seed systems

The last characteristic of seed considered here relates to its reproducibility.

Markets for some cultivars of seed are defined by the fact that they are easily reproducible. This is not true for hybrids and some crops where viability is lost in continued multiplication.

For many crops important for food security, however, seed for next year can be produced from this year’s harvest. Scaling strategies for easily reproducible goods differ fundamentally from those that are difficult to reproduce. Some policies become commercially important (such as intellectual property rights) and marketing strategies fundamentally shift.

For easily reproducible goods like non-hybrid cultivars , production, distribution and marketing decisions are based around the farmer’s decision to purchase, rather than save, seed.

For many cultivars (including many OPVs), scaling the adoption of seed means understanding that the farmer’s decision to adopt includes consideration of factors beyond the relative gain brought by the genetics, including central issues of quality. For the farmer, the value that spurs adoption might be, for example, seed viability or disease resistance.

For reproducible goods that are not bought each year, there are also timing issues that inform scaling strategies. Forecasting requires assessments of how many seasons farmers might save seed before purchasing new.

Other issues that inform scaling strategies include branding, convenience, quality, price elasticities, aftermarket support services and planned timing for the introduction of the next generation of improved cultivars. All of these provide guidance for interventions that can scale up the adoption of the seed of improved cultivars.

Perhaps the biggest implication of the replicability of seed, though, in scaling up adoption lies in the fact that scaling strategies must approach both formal and informal aspects of a seed system (30). In the ‘informal’ seed system, farmers save seed, cross it with local strains or landraces and produce it for themselves and for sale.

Interventions by the international development community to scale the adoption of improved cultivars must address the seed system from an integrated perspective, understanding how new cultivars flow from formal to informal systems and how they move within the informal system.

Conclusions

This paper has contributed to a growing literature on scaling up the adoption of technologies by presenting a simple framework for analysis that can be used across a wide variety of products and services to understand critical issues.

Two elements of disaggregation are advised. First, potential failures can be diagnosed across three interrelated categories. Failures to scale may have occurred in the past because: [1] the product did not provide value to a large number of customers; [2] the spread of information and knowledge related to the product was insufficient among customers; [3] there were problems in customers' access to the product.

Second, there is a need for caution in adopting generalized business models and interventions for scale that are common in the current literature on scaling. Instead, this paper has illustrated the benefits of disaggregating technologies into classes to examine tailored scaling strategies.

Using the scaling diagnostic framework in this paper to examine the adoption of seed of improved cultivars as a class of products, it is possible to derive practical and actionable issues that deserve the attention of donors, impact investors, policymakers and practitioners.

Seed has intrinsic characteristics that, in advanced commercial markets, have led to the development of certain policies, financial services and technologies that allow the industry to function. These same tools can provide guidance for supporting growth in less advanced seed systems, ultimately improving the capacity to deliver improved cultivars to smallholder farmers.

Scaling up has been a buzzword in international development for many years, languishing in ambiguity and for the most part escaping empirical analysis. The development of more precise definitions of scale in international development is necessary before real progress can be made, but this relies on a foundation of detailed analysis of past successes and failures in scaling that does not yet exist.

Priority investments can be made by the international development community both in a more rigorous understanding of scaling up adoption as well as at programme-specific levels using existing diagnostic frameworks.

References

1. Prahalad, CK (2009) The Fortune At the Bottom of the Pyramid, Revised and Updated 5th Anniversary Edition: Eradicating Poverty Through Profits. FT Press.

2. Hart, S & Prahalad, CK (2002) The Fortune At the Bottom of the Pyramid. Strategy+ Business, 26, 54-67.

3. Porter, M E & Kramer, MR (2011) Creating Shared Value. Harvard business review, 89 (1/2), 62-77.

4. Kassie, M, Shiferaw, B & Muricho, G (2011) Agricultural technology, crop income, and poverty alleviation in Uganda. World Development, 39 (10) 1784-1795.

5. Asfaw, S, Kassie, M, Simtowe, F & Lipper, L (2012) Poverty reduction effects of agricultural technology adoption: A micro-evidence from rural Tanzania. Journal of Development Studies, 48 (9) 1288-1305.

6. Sperling, L, Buruchara, R, Rubyogog, JC, Boettiger, S (2013) Getting New Varieties Out to Millions: PABRA & the Power of Partnerships. AgPartnerXChange Case Study.

7. Singh, US, Dar, MH, Sudhanshu S, Zaidi, NW, Bari, MA, Mackill, DJ, Collard, BCY, Singh, VN, Singh, JP, Reddy, JN, Singh, RK, Ismail, AM (2013) Field performance, dissemination, impact and tracking of submergence tolerant (Sub1) rice varieties in South Asia. SABRAO Journal of Breeding and Genetics, 45 (1) 112-131.

8. Le Page, L, Boettiger, S (2013) Lessons for Africa's Emerging Seed Sector from Scaling Maize in Thailand. AgPartnerXChange Case Study.

9. Mbata, J (2013) Agribusiness Indicators: Kenya. The World Bank.

10. Thapa, S (2012) Agribusiness Indicators: Tanzania. The World Bank.

11. Cavatassia, R, Lipperb, L & Narlochc, U (2011) Modern variety adoption and risk management in drought prone areas: insights from the sorghum farmers of eastern Ethiopia. Agricultural Economics 42 (2011) 279–292.

12. Wang, H, Pandey, S, Verlarde, O & Hardy B, eds (2012) Patterns of Varietal Adoption and Economics of Rice Production in Asia. IRRI.

13. World Bank (forthcoming) Agribusiness Indicators: Synthesis Report for sub-Saharan Africa.

14. Stokstad, E (2014) Global research network raises $1 billion for its centers. Science 3, 343 (6166) 17.

15. Ragasa, C, Dankyi, A, Acheampong, P, Nimo Wiredu, AN, Chapo-to, A, Asamoah, M & Tripp, R (2013) Patterns of Adoption of Improved Maize Technologies in Ghana. IFPRI Working Paper, No 36.

16. Ibid.

17. Hartmann, A & Linn, JF (2008) Scaling up: A framework and lessons for development effectiveness from literature and practice. In: Wolfensohn Center for Development at Brookings: Working Paper 5, USA, 8.

18. Prahalad, CK (2009) The Fortune At the Bottom of the Pyramid, Revised and Updated 5th Anniversary Edition: Eradicating Poverty Through Profits. FT Press.

19. Simanis, E (2012) Reality Check At the Bottom of the Pyramid. Harvard Business Review 90 (6), 120-25.

20. Goldman, P (2 December 2013) Impact Investing: Harnessing the Power of Business for Social Good. The Guardian.

21. Gaur, Ajai S, Vikas Kumar, and Deeksha Singh (2014) Institutions, Resources, and Internationalization of Emerging Economy Firms. Journal of World Business 49 (1), 12-20.

22. Porter, M E & Kramer, MR (2011) Creating Shared Value. Harvard business review, 89 (1/2), 62-77.

23. Accenture (2013) Masters of rural markets: Profitably selling to India's rural consumers. www.accenture.com/sitecollectiondocuments accessed 22 April 2014.

24. Modi, P (2009) Rural Marketing: Its definition and development perspective. International Journal of Rural Management 5 (1) 91-104.

25. Almekinders, C J M, Louwaars, N P & de Buijn, G H (1994) Local seed systems and their importance for an improved seed supply in developing countries. Euphytica, 78, 207-216.

26. Afuape, S O, Nwankwo, I I M, Omodamiro, R M, Echendu, T N C & Toure A (2014) Studies on some important consumer and processing traits for breeding sweet potato for varied end-uses. American Journal of Experimental Agriculture, 4 (1), 114-124.

27. Edmeades, S, Smale, M, Renkow, M & Phaneuf, D (2004) EPTD discussion paper no. 125: Variety demand within the framework of an agricultural household model with attributes: The case of bananas in Uganda. Environment and Protection Technology Division, International Food Policy Research Institute, USA.

28. Boettiger, S & Anthony V (2013) Planning for scale brief #2: Scaling demand. Ag Partner XChange: http://media.wix.com/ugd/ad2c36_f53dd2f8d7e9472e88235ebd160c1b80.pdf accessed 22 April 2014.

29. Louwaars N.P. & De Boef W.S. 2012. Integrated Seed Sector Development in Africa: a Conceptual Framework for Creating Coherence Between Practices, Programs, and Policies. Journal of Crop Improvement 26: 39-59.

30. Sperling, L, Boettiger, S & Barker, I (2013) Planning for scale brief #3: Integrating seed systems. Ag Partner Xchange: http://media.wix.com/ugd/ad2c36_b4d1abdff9894
33092daa54a6e0fbd06.pdf accessed 22 April 2014.

1. Discussion of 'improved cultivars' or 'improved varieties' implicitly limit the discussion to improvements in genetics and not seed quality. In fact, improvements in seed quality, particularly for open pollinated varieties (OPVs), may have larger impacts on successful scaling of adoption. Seed quality is discussed in several sections of the paper, but is acknowledged here as an essential component of strategies for scaling up the adoption of improved cultivars.

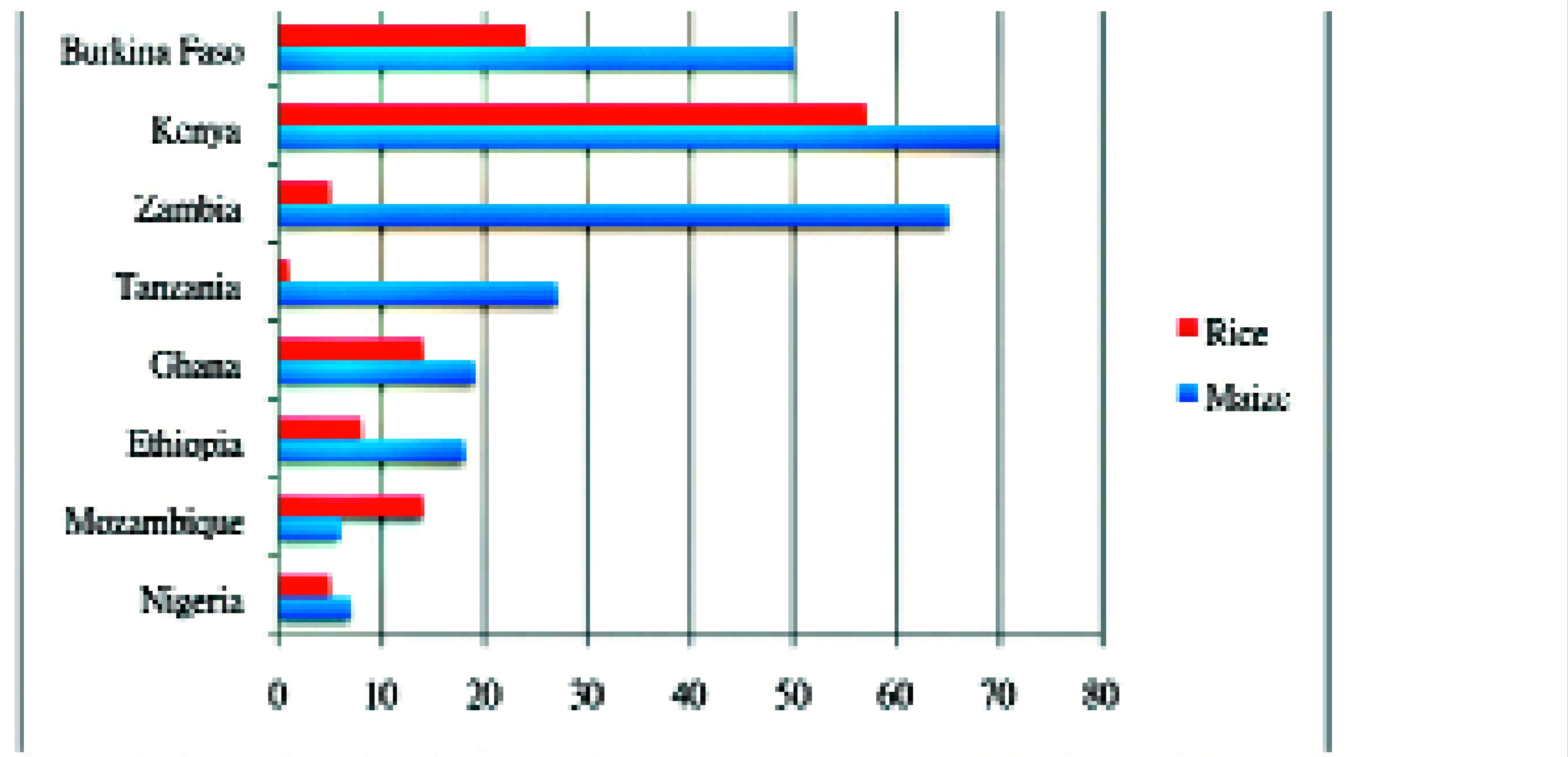
2. In presenting cultivar adoption data, it is important to note that these data are difficult to collect and often differ considerably across sources. For example, in Ghana (15) 61% of maize land was planted to improved cultivars, considerably more than the 19% estimate in Figure 1 derived from national government data during a similar period.

3. Vegetatively propagated crops, such as sweetpotato and cassava, play a central role in poverty reduction. Their scaling issues, however, are significantly different. Scaling the multiplication, transportation, extension, and marketing for vegetatively

propagated crops, for instance, deserve separate analysis that lies outside the remit of this paper.

4. Authors, however, are divided on the extent to which this occurs.

Figures



Source: National Ministries of Agriculture and Central Offices of Statistics, as cited in World Bank (forthcoming).

Figure 1.

Figure 1. Percent of Land Under Maize and Rice Planted With Improved Cultivars.

1423

Dr Sara Boettiger

1st December 2014

Comments