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Can Private Sector R&D Reach Small Farms?

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Can Private-Sector R&D Reach Small Farms?

MARCO FERRONI^A

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Millions of small farmers are reached commercially every day as they buy seeds and crop protection products, fertiliser, cell phones, machinery and tools, taking advantage of the science and research embodied in these products. The market for agricultural inputs is large, and the role of the private sector as a purveyor of technology and services is growing. It is in the nature of the private sector to bring products to the market and deliver value, including to small farmers. But the private sector goes where there is a commercial incentive. Farmers who are too poor to purchase inputs are not helped, and the technologies they need may not get developed. This is a public policy and societal challenge that cannot be solved by the public or the private sector alone. The solution requires the creative complementarities of public-private cooperation that — in addition to the farm population — must include the ‘third’ or not-for-profit sector (foundations, NGOs, civil society). This pathway can develop and deliver solutions to large numbers of small farmers.

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Introduction

The theme of the Crawford Fund’s 2009 Annual Development Conference — *World Food Security: Can Private Sector R&D Feed the Poor?* — continues to be relevant and timely. World food security is a distant dream. Donors have reacted to the recent food price crisis by promising increased support to agriculture — notably in Sub-Saharan Africa and South Asia where crop yield shortfalls are pronounced. But ultimately it is the private sector that must deliver inputs to the farmers. Can private R&D and distribution channels reach small farmers, the group that produces most of the food consumed in less developed countries and emerging markets?

The answer is straightforward: millions of small farmers are reached commercially every day as they buy seeds and crop protection products, fertiliser, cell phones, machinery and tools, taking advantage of the science and research embodied in these products. The market for agricultural inputs is large, and the role of the private sector as a purveyor of technology and services is growing. It is in the nature of the private sector to bring products to the market and deliver value, including to small farmers. But the private sector goes where there is a commercial incentive and a business case where money can be made. Farmers who are too poor to purchase inputs are not helped, and the technologies they need may not get developed.

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This is a public policy and societal challenge that cannot be solved by the public or the private sector alone. It requires public–private cooperation that — in addition to the farm population — must include the ‘third’ or not-for profit sector (foundations, NGOs, civil society). Cooperation offers the prospect to overcome each sector’s limitations: the business sector’s inability to operate where there is no market; the not-for-profit sector’s tools and interventions that tend to take the form of projects that can reach only relatively small numbers of farmers; and the public sector’s limited ability to market research outputs.

Clearly, public agricultural research is important and there is a large literature on its impact. The benefits include spillovers that clear the road for private agricultural research. For example, the seed industry in India — which reaches millions of small farmers annually and makes major contributions to yield gains in the country’s smallholder-dominated agriculture (Gadwal 2003) — benefits from access to germplasm and breeding lines developed by the public sector. But public agricultural research has lost some of its dominance, luster and dynamic edge. Global public agricultural research spending is down when expressed as a share of agricultural GDP, whereas private spending is up, having grown significantly in the last two to three decades. Creative complementarities and cooperation between the public and the private sector are needed to develop and deliver solutions to large numbers of small farmers. This paper looks at how this can be done.

Impact of private agricultural research

The impact of private agricultural research is less well documented than that of public R&D, and the literature that exists does not have much to say about impacts by farm size. The literature has been reviewed by Pray *et al.* (2007), and it is from this source that this section borrows.

Private R&D fosters innovation and productivity gains in agriculture in both rich and poor countries. A number of studies attest for example to the positive impact of private agricultural research by Indian seed companies on crop yields and farm profits in that country. Econometric studies cited by Pray *et al.* demonstrate that:

- increases in the use of manufactured agricultural inputs developed and sold by the private sector added to average annual agricultural growth in Asia and Latin America, but not in Africa
- private research had the effect of increasing agricultural output by raising total factor productivity when the *quality* of inputs improved such as when breakthrough chemicals and varieties of seed or machinery were developed and diffused.

Assessments of total factor productivity in Indian agriculture that looked at the relative contributions of public and private agricultural research found positive private contributions, but they were smaller than those derived from public R&D.

Studies that examined the impact of private research on productivity changes in particular commodities, especially hybrid maize and poultry, found significant effects on maize yield from research conducted by multinational seed companies and from seed imports. Pray *et al.* note that hybrid seed technology can be transferred directly among temperate countries through seed imports, while adaptive research is required to move technology from temperate to tropical regions. The authors report that private pearl millet and sorghum breeding for the semi-arid tropics made important contributions to farmers’ income and welfare in India by increasing yields by means of hybrids that were both high-yielding and resistant to diseases to which public hybrids were susceptible.

Micro-level studies of the impact of private research show similarly strong effects. The CIMMYT¹ impact study of modern maize varieties estimated that by 2000, maize breeding by international, national and private-sector researchers collectively had added about 1 t ha⁻¹, on average, to the 58.8 million ha in developing countries where modern maize varieties had been adopted (Morris 2002, cited from Pray *et al.*).

Private research is undertaken by domestic and multinational companies. The relative effects of each on yields, farm profits and agricultural growth are difficult to disentangle because of the presence of spillovers of private research from

¹ CIMMYT: the Spanish acronym of the International Maize and Wheat Improvement Centre.

rich to poor countries, such as when multinational companies engage in cross-border technology partnerships.

The impact of private agricultural research is easier to demonstrate for certain regions and products than for others. It has visible impact in Latin America, South Africa, Eastern Europe and Asia. In Asia private R&D benefits small farmers almost by definition, because there are few farms there that are not small. There is less impact in Sub-Saharan Africa so far because economic conditions there have long been relatively depressed, seed markets barely exist (see below), and there is a relative disincentive to private research that stems from the region's large number of different crops each with relatively small markets.

Private-sector innovations are dominant in some important product categories: agricultural chemicals, seed treatment, plant growth regulation, fertiliser, machinery, many hybrid varieties and genetically engineered crops. Therefore, where products from these categories are sold and used, impacts of private R&D come into view. In China, genetically modified crops and a significant share of hybrid seeds for key crops are developed by the public sector, but partnerships with private firms are growing. The adoption of products from these categories differs widely across countries and world regions; the reader is referred to Pray *et al.* for data. An aspect that the products have in common, except for some types of mechanisation, is their scale-neutrality and thus their applicability irrespective of farm size, at least in principle.

What then are the factors limiting adoption? 'Farm capability', a concept introduced in the next section, is one such factor. Others include:

- the absence of extension services
- the absence of remunerative links to markets
- the absence of technology that works, either because the research to develop the technology has not been done or because the regulatory framework in the country precludes farmers from accessing it.

The price of purchased inputs, and considerations such as patents, hybrids, oligopolistic conditions in the international crop science industry, and whether or not 'biotechnology' is involved have little or no bearing:

- The price of seed — and crop protection products for that matter — 'is not considered a constraint in usage by the farmers, if the seed (or product) ensures higher return through higher productivity and other value added traits' (Gadwal 2003). This is the inescapable conclusion from data on the growth of the Indian seed market between 1990–1991 and 1998–1999 that show steady increases in (i) area planted to bought seed — including open pollinated varieties — and (ii) proprietary hybrids at the expense of public hybrids even as the average price of proprietary hybrids rose.
- Plant breeders' rights and patents on mechanical, chemical and biological products and processes are a means of promoting and protecting investment in R&D and innovation. Rather than making small farmers in developing countries dependent on expensive inputs, as some tend to argue, these tools of intellectual property lead to the development of technology that would otherwise not become available and that farmers can choose to use or not to use. Hybrid varieties — which provide appropriability without patents — are sought out by farmers because of the yield advantages and other traits that they convey.
- Does industrial concentration or for some reason the evolution of science and 'agricultural biotechnology' create conditions that hinder the adoption of technology by small farmers? Hardly. Some level of concentration is a reality in many economic sectors for many reasons nowadays. It does not mean that there is not competition or that innovation is neglected, as a glance at the information and communications technology sector, automobiles, pharmaceuticals and other industries reveals. The literature on the distribution of benefits from improved varieties — both conventional hybrids and transgenics — among farmers and seed companies dispels the myth of monopoly profits accruing to the industry. Pray *et al.* cite the case of hybrid sorghum in one period in India where seed companies captured less than one-fifth of total benefits, while more than four-fifths went to farmers. Gouse *et al.* (2004) found that during the 2000–2001 cropping season in South Africa, 33% of the benefits from introducing Bt

cotton went to the seed company and its distributors and 67% to domestic farmers.

- As to ‘biotechnology’ in its various dimensions, including genetic modification, this is a blessing, not a curse — for farmers and farm profitability, consumers and the environment. Agricultural biotechnology helps improve crop plants by providing built-in protection against diseases and insects, and by conveying herbicide tolerance. This creates opportunities to produce more food in sustainable ways.

Pray *et al.* note that the overall importance of private agricultural research to agricultural development has been increasing over time. They also note that private agricultural research is uneven in that it favors certain types of technologies and inputs. (Actually, it is not different from public agricultural research in this respect.) The footprint of private agricultural research in Sub-Saharan Africa is weak. Important questions are what public policy can do to stimulate private research in the full range of challenges that demand solutions, and how private and public research capability can be pooled for the benefit of small farmers. These are addressed below.

The small farm challenge

Census data indicate that there are about 450 million small farms with up to 2 ha of land in non-OECD countries today, mostly in China, the Indian sub-continent and Africa. Assuming an average farm household size of five, the corresponding agricultural population is about 2.3 billion people, a third of mankind. Not surprisingly, the farms operate under a wide range of natural and man-made opportunities and limitations. At the lower end of the spectrum, farms are not viable as economic units in average years. At the upper end, farmers have access to productivity-enhancing technology and are commercial, buying inputs such as seed and fertiliser and selling produce. Agro-dealers (and thus the private sector) are a key source of technology and externally supplied agronomic knowledge and expertise for this group. If one assumes for the sake of an indicative calculation that 40% of the total number of small farms (450 million) run commercial operations — not an implausible figure — one gets a universe of some 270 million small farms in developing and emerging market

countries that are ‘pre-commercial’, practicing what some call ‘subsistence farming’, a potentially misleading term, among other reasons because it suggests ‘autarchy’ at the family or community level when in reality nobody can live without money and trade. The yields and profitability of these farms are low, and emigration out of agriculture may be the best option to the extent that there are off-farm jobs domestically or abroad to which farmers in this category can aspire. However, off-farm employment is scarce. The reshaping of economic geography, a process that is massively underway these days, takes time, and farming, therefore, remains the default form of employment for many ‘pre-commercial’ farmers in the short and medium run.

The private and social pay-off for improving productivity, sustainability and profitability through links to markets of ‘pre-commercial’ farming is high in this situation. How to get there on the required scale is the break-through question that exercises the professional community that is active in this field. Two phenomena bode well: technology (in the broadest sense of the term) is advancing in leaps and bounds, and markets for agricultural commodities — including high-value products for human consumption such as vegetables and fruit — are growing as never before because of rapid income and continued population growth. The opportunity for transformational change in small-scale farming is there.

Smallness is not an economic condemnation. Small farms can be viable, and many that are not could be with the help of technology and links to markets. Michael Lipton has demonstrated that there is an inverse relationship between farm size and land productivity in labour-abundant developing countries across most conceivable conditions: ‘small farms produce more, per hectare per year, than large farms’ (Lipton 2009).

As small farmers apply family and community labour that is cheap in relation to capital in developing countries, they face low transaction costs per unit of output associated with labour, the main contributor to output other than land. So investing in small farms by developing technology and making it accessible to them is not ‘backward’ or a ‘lost cause from the outset’ as some might have it: it can be a winning proposition, quite apart from being necessary and irreplaceable as a route to food security and poverty reduction in countries

where the rural population is large and most farms are small, as in all of Asia and much of Africa. Paths to food security and poverty reduction that are based on the intensification of smallholder agriculture on a large scale will remain relevant for several decades to come — until spatial demographic realities change and the urban and rural non-agricultural economy lastingly absorbs a large share of agricultural labour.

Agricultural intensification requires technology and also services by which inputs are delivered and farmers can be linked to markets. Exhibit 1 lists some of the products and practices that this entails: varieties, chemicals, mechanical tools, to mention but some of the components of ‘technology’. Key services include seed and other input systems, agricultural extension, connectivity, market and weather data, financial services such as credit and agricultural insurance, infrastructure, ‘conducive’ agricultural and trade policies, and market access for the farmer.

Needs for technology and the capacity to productively absorb external inputs vary with the ‘capability’ of farms. Exhibit 2 suggests a way of thinking about agricultural intensification from ‘enhanced basics’ at the cash- and endowment-strapped bottom to successively more professional levels of inputs and technology as capability expands. It is an additive progression: basic elements of technology need to be present at each successive step.

At the low end of the spectrum, improved agronomy (and thus competent extension services, privately or publicly supplied, or offered through mixed partnerships), seeds (typically of the farmer-saved kind), and basic soil nutrients are the priority. At higher levels, there is scope for additions to the basics that farmers can afford if there are links to markets. These additions include hybrids, possibly transgenic traits and stacks, modern crop protection, crop enhancement chemistry, nutritional content enhancement through biofortification, precision agriculture and so on, all ideally combined with low-tillage farming and other methods to preserve water and take care of

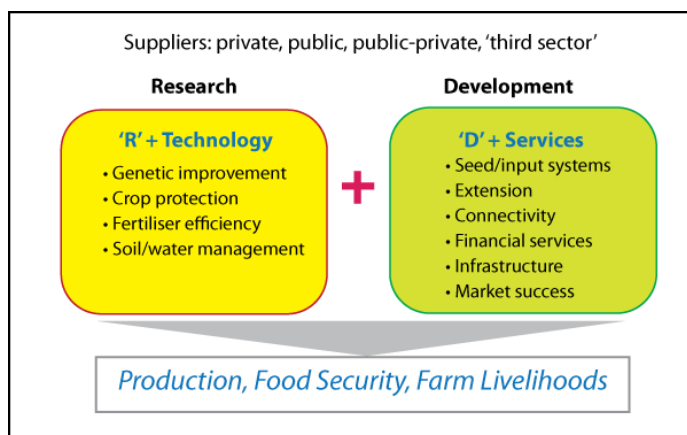


Exhibit 1. Technology and services
Syngenta Foundation for Sustainable Agriculture

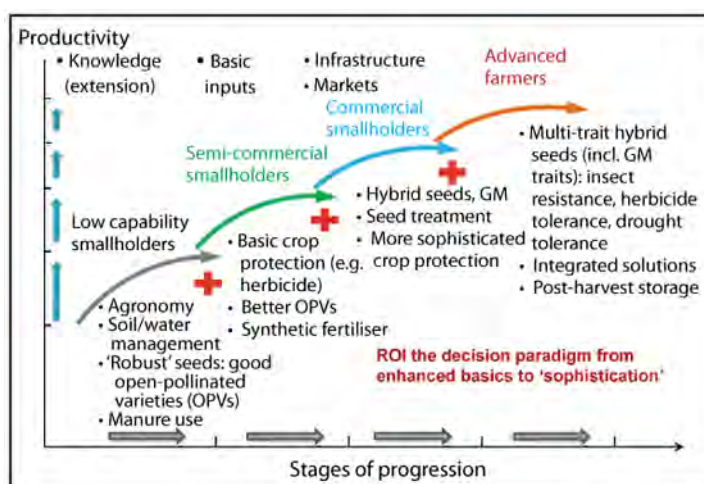


Exhibit 2. Farm capability as an additive progression
(ROI = return on investment) Syngenta Foundation for Sustainable Agriculture

soils. ‘Return on investment’ (‘ROI’ in Exhibit 2) is the decision paradigm.

Note at the same time that there is not only movement to the right in the progression, but also movement up. Farmers can improve farming within their capability (‘horses for courses’) as the widespread adoption of Bt cotton by smallholders in India suggests. Even at the simplest and essentially ‘organic’ level of farming, improvements in land management and yield can be achieved.

The ‘natural’ supporting actors in this model differ depending on the point in the progression (cf. Exhibit 3). Not-for-profit actors — foundations and NGOs professionally specialised in agriculture, and the public sector — are vital at the lower end. For-profit sector companies (and their distributors) selling fertilisers, machinery, agro-chemicals and seeds can be expected to

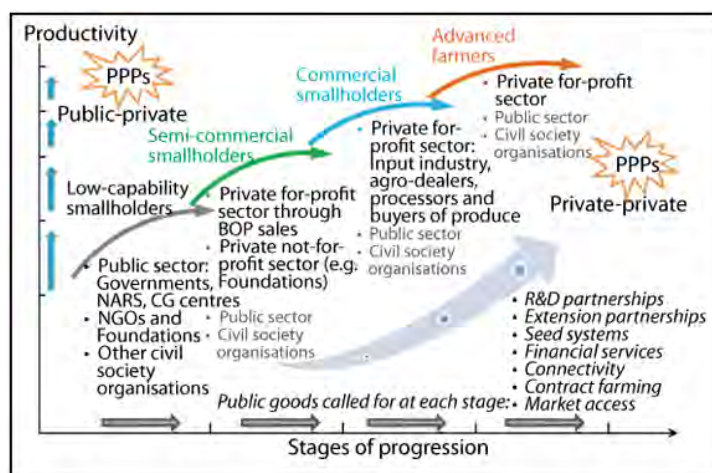


Exhibit 3. Stakeholders and the additive progression
 Syngenta Foundation for Sustainable Agriculture

come in as capability expands. This can create movement to the right or vertically as a result of good agricultural extension or in response to relevant technologies that spread by themselves as in the case of Bt cotton in some countries. Farmers, even very modest ones, will buy inputs if they detect an opportunity to realise returns.

The R&D challenge in smallholder agriculture is to develop the right kinds of products for different farm capabilities and agro-ecological conditions and then take them to market and the farmer. This may sound easy, but it is not. Partnerships can help in two respects: to bring out synergy between private and public entities in agricultural research and to develop — or ‘kick-start’ — input markets where they do not exist.

Business partnerships in agricultural research

Agricultural technology is in essence about realising yield potential. The seed that the farmer plants holds yield potential that must be protected in the face of risk. This is achieved with the help of inputs and management that include traits (derived conventionally or through genetic modification), seed treatment, sprays, fertiliser and ‘agronomy’, where particular attention is paid to water and nutrient management and postharvest technology. Ultimately, too, a healthy farmer is a pre-requisite for effective risk management and the achievement of yield potential.

How to enhance the yield potential that is embodied in the seed? Molecular breeding building on the genomics revolution of the past decade is the key. Transgenic approaches can also offer some specific scope.

It turns out that molecular breeding presents ‘natural’ opportunities for partnerships between the public and the private sector such as centres of the Consultative Group for International Agricultural Research (CGIAR) and national programs, on the one hand, and crop science companies on the other. This is so because of the distribution of comparative advantages in phenotyping and genotyping, both of which are needed to develop varieties and traits that are of interest to farmers.

The public sector, with its germplasm resources and knowledge derived from *in situ* field trials, has particular strengths in phenotyping and breeding, whereas the private sector, with its high-throughput genomic and bioinformatics capabilities, is well resourced to contribute knowledge and capability on gene sequencing and genotyping. Opportunities and needs for partnerships arise when private companies and public organisations lack the resources or incentives to fully develop products or exploit their assets independently — an almost everyday occurrence where research for ‘pre-commercial’ agriculture is concerned.

Unfortunately, the types of partnerships that are desirable — with symmetry as far as the distribution of burdens and benefits is concerned and clarity as to the objectives, the business plan, the protection of (and agreement on how to exploit) intellectual property, and accountability for deliverables — are not necessarily easy to bring about. Deals must be negotiated, and there is little to go by in the form of precedent and guidance. Public-private partnerships in international agricultural research are slowly growing in number, but each deal is generic — which does not mean it cannot be part of a publicly announced, consistent strategy. The examples in Table 1 are vital aspects of plans by individual international agricultural research centers to gain relevance through products using advanced genomics, molecular biology and breeding methods.

Table 1. Recent examples of public–private partnerships in international agricultural research.

Source: Private sector and AATF websites Syngenta Foundation for Sustainable Agriculture

Partner / partnership	Date announced	Partners	Objectives
Rice science exchange and collaboration programme	December 2009	Bayer CropScience, International Rice Research Centre (IRRI)	To strengthen rice productivity by utilising rice genetic diversity, development of diagnostic tools for seed-borne bacterial leaf blight, monitoring greenhouse gas emissions from growing systems, and capacity building for young rice scientists.
Wheat rust resistance research partnership	August 2009	Syngenta, International Maize and Wheat Improvement Centre (CIMMYT)	To rapidly identify and map genetic markers to support wheat resistance breeding against Ug99 stem rust (<i>Puccinia graminis</i>). This fungus is causing devastating crop losses and spreading across Africa, Asia and the Middle East.
Boosting rice yields — science exchange program	March 2009	DuPont, International Rice Research Centre (IRRI)	To strengthen and accelerate breeding efforts and commercialisation of higher-yielding hybrids with added resistance to brown plant hopper. To boost the quality and diversity of hybrid rice in Asia. Doctorate scholarship programme for rice scientists for Asia.
Water-Efficient Maize for Africa (WEMA) (A multilateral consortium led by AATF)	March 2008	Monsanto, International Maize and Wheat Improvement Centre (CIMMYT); African Agricultural Technology Foundation (AATF); National Agricultural Research Systems (NARS) in five African countries	To use marker-assisted breeding and biotechnology to develop African maize varieties with the long-term goal of making drought-tolerant maize available royalty-free to African small-scale farmers.

As an example, the Syngenta Foundation for Sustainable Agriculture brokered an agreement between Syngenta (the Corporation) and CIMMYT in 2009 to cooperate on breeding for resistance to Ug99, the new, virulent strain of stem rust (a fungal disease) that threatens the global wheat harvest and requires stepped-up research to find sources of resistance and to breed varieties that can cope.

The two-year project seeks to rapidly identify and map genetic markers for use in wheat resistance breeding. Funded by the Foundation, the project combines Syngenta’s genetic profiling expertise with the strengths of CIMMYT’s extensive field research to develop a genetic map of wheat stem rust resistance. This will culminate in the development of wheat varieties that have better tolerance to the disease.

The results from this project will contribute directly to the global effort to combat stem rust, which is coordinated by the Borlaug Global Rust

Initiative. The marker data arising from the research will be published. Pre-breeding information developed by the project will thus be in the public domain for others to use without restriction — a standard to which public–private partnerships in international agricultural research should rise. In turn, the breeding products that are expected to be developed by CIMMYT and Syngenta, respectively, will be marketed by each in its geographies and markets.

A CGIAR *Workshop on Public Private Partnerships and Associated Needs for Product Stewardship and Liability* was hosted by the Syngenta Foundation in November 2009. The workshop concluded that ‘PPPs (public private partnerships) should be seen as a valuable and effective vehicle ... to capitalise on the complementarities that exist between the CGIAR and the private sector’s R&D value-creation process’.²

² <http://www.cgiar.org/PSC/index.html>

Participants noted the need to bring R&D closer together with product dissemination and deployment to generate impact where it matters, that is in farmers' fields. They recognised strengths of the private sector that go beyond breeding, transgenics and pre-breeding — for example, in project management and how to organise a research process with a development mindset to bring products to the market and to farmers in good time. Likewise, they recognised the private sector's assets of know-how and expertise in stewardship management. High quality stewardship management capacity is a pre-condition for the introduction of transgenic events anywhere. The Syngenta Foundation is funding a project in biosafety and stewardship management in Africa and is partnering with the Forum of Agricultural Research for Africa (FARA) to catalyse sharing of best practice in stewardship between private- and public-sector R&D and seed communities.

All told, a new reality was recognised: given the lay of incentives and comparative advantage, partnerships (or perhaps a form of joint ventures) between the public and the private for-profit and not-for-profit sectors are needed to reach large numbers of small farmers. The list of implementation issues is non-trivial, however, and must be dealt with. It includes the need for agreement on the sharing of germplasm, open access to data, implementable approaches to market segmentation, arrangements to deal with stewardship and liability in the case of transgenic crops, market analysis, and performing routes to market and the farmer.

Business partnerships to kick-start input markets

Routes to market and the farmer are as important as advanced chemistry and genomics, if the objective is to achieve change on the ground. Markets are needed to help the millions of small farmers that must be reached in the effort to bring technology to every acre farmed. Some rural markets clearly work, reaching customers on a massive scale: think of soap, certain drinks and mobile phones. For agricultural input products and services this is not the case, at least not to the same extent, because of demand- and supply-side constraints that need to be addressed.

On the demand side, for farmers to buy inputs and services they must have access to markets for their products (a vital topic not specifically discussed in this paper because of space limitations) or a

source of income such as cash entitlements or off-farm employment. Well administered and effective intermediate solutions — typically partnership-based, such as when governments or NGOs buy and distribute seed and fertiliser at subsidised rates — can help ease the demand constraint in subsequent years if they engender income growth. The question is whether and to what extent they do.

On the supply side, the first aspect to note is that selling to different farm capabilities at the bottom of the pyramid is well-known as a method in the input and crop-science industry and practised by agro-dealers all over the developing world. But in agriculture special considerations apply: the first is the fact that for best results and safe and effective use, inputs must be marketed along with knowledge, the delivery of which must be provided for in farmer-interactive ways that foster learning. This can complicate the task. The second consideration refers to regulation. Inputs such as seed and crop protection products are regulated, and regulation, if it is not well designed and properly administered, can have the unintended effect of withholding safe and needed products from the market.

Thus, for seeds, unrealistic quality standards are sometimes encountered that inhibit the emergence of a seed industry. Where national markets are small, as in Africa, the lack of harmonisation of seed laws across countries (such as related to varietal release, phyto-sanitary standards and plant variety protection) hampers the emergence of seed companies and markets by inhibiting cross-border trade.

In crop protection, farmers need access to the most effective agents with the greatest operator and environmental safety profiles, rather than the old and outmoded generic technology that one frequently encounters in developing countries and emerging markets. Regulatory systems often fail to provide for this. Cross-border regulatory harmonisation, too, would help because of the high cost of registering new products and the resulting disincentive to take them to small markets.

So for input markets to begin to function, and for products to become available to farmers, certain conditions need to be fulfilled, particularly as related to regulation and stewardship capacity as discussed in the previous section. Partnerships can then play productive roles, as shown forthwith with reference to seeds and fertiliser. Exhibit 4 on area shares of maize seed types displays the

position of selected countries in the landscape of proprietary, publicly supplied and unimproved farmer-saved seed. Not surprisingly, the private sector's presence measured in area shares is much higher in the selected Asian cases with their relatively well-developed seed markets and seed distribution systems than in Africa, except for South Africa.

Seed markets and seed systems are in rudimentary stages of development in much of Africa. It can take years for improved varieties to find their way to farmers' fields — some never make it — for reasons having to do with four sets of challenges:

- the *establishment of seed companies* in what are uncertain, high-cost, and over- and ill-regulated environments
- the *production of seed*, which is plagued by the lack of access to germplasm and credit, among other factors
- the *marketing of seed*, where poor infrastructure is a constraint
- the *demand for seed* at the farm level, which is low because of the absence of supporting services and problems with grain marketing on the output side (Langyintuo *et al.* 2008).

In India, the seed business took off decades ago with the advent of private seed companies that operated in close partnership with the public sector and benefitted from public germplasm, pragmatic regulation with the 1964 Seeds Act and the New Seed Policy of 1986 as milestones, and support from the Rockefeller Foundation in the early days and to this day from the national agricultural research system and the CGIAR.

Partnerships of this kind are needed in Africa to give rise to an entrepreneurial class in the seed sector — managers and business owners who understand plant breeding and the intricacies of seed production, the challenges of seed promotion, marketing and pricing, and the need for seed companies to provide advice linked to their products on all aspects of cultivation: land selection and preparation, fertiliser application, irrigation and moisture management, pest, weed and disease control, and harvesting and postharvest technology.

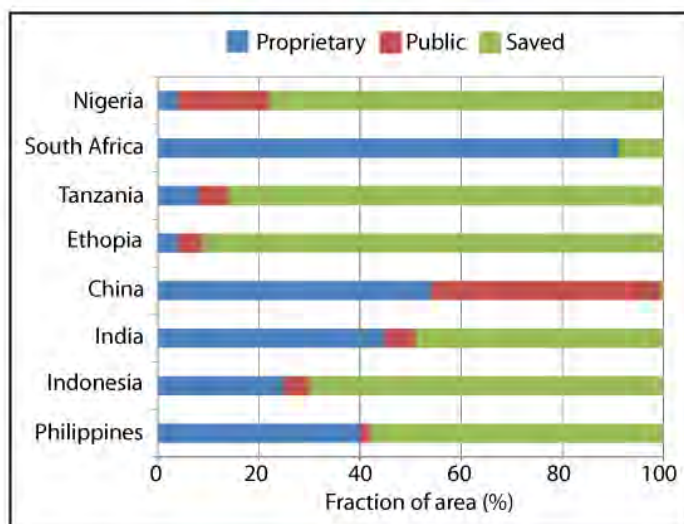


Exhibit 4. Area share of maize seed types, selected countries
Source: Global Seed Market Database, 2009.
Syngenta Foundation for Sustainable Agriculture

Fortunately, a number of partnerships and efforts are underway at the national and sub-regional level in Africa to drive seed policy reform, link public-sector breeding efforts and emerging private actors, create conditions for commercial investments in R&D, and establish seed consortia to bring together different types of implementing partners to address seed sector development in a coordinated way. Vitaly important 'work in progress', clearly, where governments, donors, the Alliance for a Green Revolution for Africa (AGRA) and programs by some of the centres of the CGIAR are working in tandem with emerging local firms that themselves are getting organised in national seed trade associations. An African Seed Trade Association was formed in 2000 to represent the African private seed sector to promote production, marketing and the use of improved seed.

Public-private partnerships are also at work in fertiliser distribution. Under the Rwandan Government's Crop Intensification Program, for example, an apparently effective public-private partnership to develop a market for fertiliser and distribute fertiliser to small farmers has been underway since the 2007 main cropping season. The partnership takes the form of an auction for fertiliser: the government imports fertiliser and auctions it off to private distributors who then transport and sell it to communities and farmers at the local level, sometimes in package deals with seed. The effects on the quantities of fertiliser

moved and maize yields have been significant, aided by adequate rains, with maize yields rising, on average, from 0.7 t ha⁻¹ in 2007 to 1.1 t ha⁻¹ in 2008 and 1.7 t ha⁻¹ in 2009 according to crop assessment data of the Ministry of Agriculture.

Versions of Rwanda's model of public-private partnership for agricultural inputs are in effect in many African countries today; Kenya's National Accelerated Agricultural Inputs Program is an example with a unique feature that links farmers to credit from Equity Bank. The challenges of design and implementation of these programs, which must have an exit strategy, are significant, of course, but so are the benefits, potentially, in the form of improved productivity of small farms, farm income, and as a contribution to the development of input markets. This contribution can be expected to be the more 'productive', the better organised and stronger markets are on the output side. The World Food Programme's local food procurement program 'Purchase for Progress' can play a role in this respect by helping to develop secure markets for farmers' harvests.

Conclusion

The answer to the question posed in the title of this paper is 'yes, private-sector R&D can reach 'pre-commercial' small farmers at low levels of capability, provided the public and the private for-profit and not-for-profit sector work in partnership along the full value chain from 'R' (i.e., research) to 'D' (i.e., product development and introduction), supported by functioning markets on the

output side'. The generic functions that must be combined include helpful policies and regulation from the public sector; products and investments to develop the market from the business sector; and a role of 'tipping the scales' for foundations and not-for-profits.

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