World Food Security: Can Private Sector R&D Reach the Poor?
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Keynote Address

# World Food Security, Private Sector R&D and Small Farmers

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Mr Chairman,
Ladies and Gentlemen:

I am deeply honored to have been invited to address the prestigious venue of the Crawford Fund Annual Development Conference. Most of us in this auditorium know the Fund for what it is: a hotbed of dedication to the cause of international agricultural research. I would like to thank the organizers and Dr. Denis Blight, the Fund's Executive Director, for inviting me.

The Fund, its vision and ideals, and Sir John's legacy are unique parts of the tradition and the landscape of international agricultural research – a landscape that has been undergoing tectonic transformations in recent times as far as the relative investments, roles, and capabilities of public and private actors are concerned.

## Framing the problem

Broadly, what has been happening – and Professor Pardey will no doubt address this in his upcoming presentation – is that for many years now, public spending in R&D for basic food production has stagnated in many countries and in the world as a whole on average, at least when expressed as a share of agricultural GDP. In OECD countries, public spending classified as 'agricultural R&D' has tended to shift to new priorities different from plant breeding and 'production' narrowly defined (**EXHIBIT 1**).

Private spending in basic and applied crop science, on the other hand, has grown. It is concentrated in rich countries, where the business sector tends to outspend the public sector in crop-focused agricultural research.

The private sector in developed countries, as a result, has become a major source of innovation in global agriculture, helping to sustain yields in both developed and emerging markets.

Local companies and multinationals have deepened their presence in agriculture in those markets. Privately produced and marketed solutions are on the rise at a time when the supply of public agricultural research goods focused on production seems to be declining. Commercial agriculture takes advantage of these trends and benefits from them in both developed and emerging markets.

The questions that my presentation seeks to answer are:

- What about small farmers in emerging markets?
- To what extent does private sector R&D reach small farmers and deliver benefits to them?
- In what ways, specifically, can private sector R&D contribute to the reduction of yield gaps in lagging regions, noting that the first priority of private R&D is and must be business in the pursuit of profit?

As argued in Exhibit 1, the solidification of food security and the reduction of yield gaps now and going forward are challenges that call for action on many fronts, one of which is R&D.

Agricultural R&D involves a complex set of steps from research at different levels to ‘development’ or ‘bringing products to the market’. Bringing products to the market is what counts, of course, but the story doesn’t end there, since we must worry about the successful adoption of products by farmers, safe and effective use, and how to assist growers to enable them to make the best of their capabilities and resources through agricultural extension, for example, and by linking them to markets.

The thesis I would like to advance is that while many small farmers are being reached commercially on a daily basis in emerging markets as they buy crop protection products, seed and fertilizer, cell phones and machinery and tools, many more could and must be reached, and the way to do this is through partnerships.

The purpose of partnerships is twofold in our context (**EXHIBIT 2**): 1) to combine science skills according to comparative advantage in agricultural research, and 2) to kick-start markets (note that we are focusing exclusively on input markets here).

I will return to this, but first: Why markets? Answer: they are the only way to massively scale up. And massive scaling up is what I think and hope G8/G20 leaders had in mind when at L'Aquila and Pittsburgh recently they pledged to take 'decisive action to free mankind from poverty and hunger'.

It is, of course, possible to reach sizeable numbers of farmers through projects – hundreds of thousands of them in large projects, in fact, if things go well – but to reach the dozens and indeed hundreds of millions that must be reached to really make a difference in terms of yield, production and improved livelihoods, we need functioning markets.

Markets require infrastructure and other public goods to function, and a private sector keen on making contributions to develop the market along with others.

The private sector's business case (assuming companies have products and services on offer that respond to farmers' needs) is substantially affected by the presence or absence, and the quality, of national and local public goods, including (beyond infrastructure): governance and institutions, trade and price policies and an enabling business climate. This cannot be overemphasized.

So in framing the problem, what we are discovering is the need for the public and the private for-profit and not-for-profit sectors to work together in R&D and the development of markets, as suggested in Exhibit 2.

**Raise yields, sustainably**

Having framed the problem thus, let me define the task by first focusing on the 'target group' I have in mind, i.e., small farmers. The question of whether private sector R&D can reach small farmers is relevant because this group produces most of the food consumed in emerging markets – the part of the world where we are seeing the most intensive agricultural resource and food demands materializing in the years to 2050 and beyond.

Small farmers will remain pivotal for decades to come because of their sheer numbers (**EXHIBIT 3**), given that reshaping economic geography – a process that is well underway in the emerging markets – takes time.

Census data and other estimates suggest that there are at least 400 million small farms of up to 2 hectares in size in China, the Indian subcontinent and Africa combined. Most farm units in key countries are 'small', as indicated in EXHIBIT 3. As a category, small farmers operate under a great diversity of natural and man-made opportunities and limitations, but with some recurring themes: low crop yields, widespread poverty, and decaying natural resources.

Yield increases brought about sustainably are therefore an important part of what is needed – but efforts in this sense must be part of macro-level change that includes growth enhancers and the provision of the means to effectively tap demand. That is how the Brazilian *Cerrado* and Thailand's North East developed, the latter the domain of smallholders to this day.

The yield gap to be closed may be defined as the difference between potential yield and the yield attainable in farmers' fields. **EXHIBIT 4** points to yield gaps in a different sense in that it displays the trends in average grain yield between world regions, identifying Africa and (at a different level) South Asia as the lagging pair relative to Latin America and the rest of the world. No surprises here.

The implication is: raise yields, sustainably, in lagging regions (**EXHIBIT 5**), both to ensure the supply of food in a world in which income growth combines with population growth as drivers of the demand for food, <u>and</u> to reduce poverty. The World Development Report 2008 has shown convincingly the link between crop yields and poverty dynamics where livelihoods depend on agriculture.

**'Horses for courses'**

To become agents in closing yield gaps, small farmers need (and my experience in the field tells me that they are craving for) access to technology and services (**Exhibit 6**).

'Technology' and 'services' are linked to the two blocks of 'Research' and 'Development' in Exhibit 6, which must go hand in hand, the first attempting to generate solutions in genetic improvement, crop protection, fertilizer efficiency and soil and water management, to mention but the key domains, the second ('development') referring to product introduction and uptake, which spans the gamut of components from field trials to regulatory approvals and the 'supporting infrastructure' of input markets, connectivity, extension, financial services and so on.

The private sector in its many forms – from small-scale agro-dealers to national seed and fertilizer companies to multinationals – has a stake in all of this. But the private sector goes where there is a business case, and this is limited where conditions are deficient and poverty abounds.

Incentive problems need to be addressed, therefore, to deal with what is possible and needed at different stages of 'farm capability'.

**EXHIBIT 7** suggests a way of thinking about raising yields from 'enhanced basics' at the cash- and endowment-strapped subsistence level to successively more professional levels of inputs and technology as capability expands.

At the low end of the spectrum, improved agronomy (and thus competent extension services) and seeds (typically of the farmer saved kind) are the priority. At higher levels, there is scope for additions to the basics, which farmers can afford if there are links to markets. These additions include hybrids, GM traits and stacks, modern crop protection, crop enhancement chemistry, nutritional content, precision agriculture, and so on, hopefully combined with low tillage farming and other methods to preserve water and take care of soils.

However, there isn't only movement to the right in the diagram shown in Exhibit 7, but also movement up. Farmers can improve farming within their category ('horses for courses') as the widespread adoption of Bt cotton by smallholders in India shows. Even at the simplest level of farming, which is essentially 'organic', improvements in yield and land management can be achieved. 'Return on investment' is the decision paradigm that <u>all</u> farmers apply.

As seen in **EXHIBIT 8**, the 'natural' supporting actors in this model differ depending on the point in the progression: Not-for-profit stakeholders (foundations, NGOs, governments and donors) are vital at the lower end. The for-profit sector (fertilizer, agrochemical and seed companies and their distributors) can be expected to come in as capability improves. <u>Farmers, even very modest ones, will buy inputs if they see scope for realizing a return</u>.

## Agricultural technology as a form of risk management

Against this background, let me now turn to 'technology' and let me suggest that, when all is said and done, agricultural technology is perhaps best viewed as a form of risk management.

Yield potential is at the heart of the matter, expressed in the germplasm that the farmer plants (**Exhibit 9**). Everything else is insurance to help protect that yield potential and realize a return on investment: traits (including GM traits), seed treatment, sprays, fertilizer, and agronomy, where water and nutrient management and postharvest technology are of great importance. Ultimately, too, a healthy farmer is a pre-requisite to effective risk management.

How to enhance yield? Molecular breeding is the route, building on the genomics revolution of the last decade (please see **EXHIBIT 10**, where the photo, taken last month, shows field trials at IARI, the Indian Agricultural Research Institute, in New Delhi).

Interestingly, molecular breeding offers significant opportunities for partnerships between the public and the private sector (for example, centers of the CGIAR system and national programs, on the one hand, and crop science companies, on the other).

A distribution of comparative advantages in the phenotyping and genotyping space can often be detected and could be exploited to improve germplasm resources of crops that are of interest to small farmers in emerging markets. Opportunities for partnerships arise when private companies and public organizations lack the resources or incentives to fully develop products or exploit their assets independently.

In our experience at Syngenta Foundation, this occurs quite frequently, and we have recently been able to broker some research partnerships that may come up in the discussion later in the day, which is why I will not refer to them now.

However, the kinds of partnerships that I am talking about, with symmetry as far as the distribution of burdens and advantages is concerned and clarity when it comes to the objectives, the business plan and accountability for deliverables, are not necessarily easy to bring about.

**EXHIBIT 11** suggests why: The platforms that are required can be demanding, particularly when it comes to protecting and agreeing on how to deal with IP and defining the freedom to exploit processes or products in the ‘poor’ and ‘rich’ geographies that are of interest to the public and the private partners, respectively. Ultimately, ‘win-win’ has to be quite carefully explored to ensure that the mandates of each partner are fulfilled.

As some of you know, Syngenta Foundation will be hosting a CGIAR workshop in Zurich two weeks from now, precisely to discuss the crafting of partnerships in R&D and securing win-wins in the context of research strategies.

Safeguarding the investment is the item to be addressed next (**EXHIBIT 12**).

There are non-GM and GM traits, and the latter, shown here, have had great impact in some important crops and settings, including at the smallholder level, where (as mentioned) there have been benefits from Bt cotton. However, the point to make is: few traits, few crops.

In the interest of expanding the range of traits and crops for the benefit of small farmers, we need to consider some of the issues arising in the context of different technologies (turn to **EXHIBIT 13**).

Marker-assisted breeding (MAB) is generic and transferable to crops amenable to the approach, but requires investment in capacity building and in genetic and statistical/bioinformatics tools.

This is an underfunded area in Sub-Saharan Africa. Syngenta Foundation, for this reason, is supporting Beca, the Biosciences Hub for Eastern and Central Africa in the hope that in the coming years Beca will strengthen its position as a premier institution in the region attracting projects in upstream genetics from national programs and universities with a view to developing products that can then be used as resources for plant breeding and livestock improvement at the local level.

GM technology, on the other hand, is more complicated, not because of the aspect of intellectual property or IP as this can be negotiated, but because of stewardship, environmental management, and the liability concerns that come with GM traits, even after those traits have jumped the hurdles of regulatory approval.

Biosafety, therefore, is an important aspect to address as countries buying into the technologies develop the legislative and regulatory frameworks that are needed. Africa is now clearly making progress in this area. Syngenta Foundation is supporting a project managed by FARA, the Federation for Agricultural Research in Africa, to build biosafety management capacity in 6 countries, and this is coordinated with efforts funded by others in this field.

Crop protection is what I would like to turn to next in this discussion of agricultural technology as a form of risk management. To introduce the topic, **EXHIBIT 14** illustrates the global complexity of maize pests, presented here as an example.

As you know, there are many kinds of maize pests in addition to the lepidopteran stemborers referred to in this picture. Given the reigning complexity, a single approach is unlikely to be feasible in managing the range of pests, diseases and weeds that threaten maize and, indeed, most crops. Integrated systems of management are called for.

Look at the circled figures in **EXHIBIT 15**. They show that the emerging markets are much less well served than, for example, farmers in the EU when it comes to the number of registered active ingredients.

The current registration of crop protection chemicals in the EU numbers 240 – down from a much higher level some years ago as a result of a rigorous process of review and re-registration to phase out older compounds and make way for modern, low-presence, 'efficient' chemicals.

In Nigeria, registered compounds number 38, in Ethiopia 90 (many of them used in the production of flowers), and in Bangladesh 124, including chemicals for rice not registered in Europe. Of the compounds registered in Ethiopia, 20% are also registered in the EU, 80%, therefore, are old compounds.

For their food security and to support farmers' efforts, the emerging markets need the most effective crop protection agents with the greatest operator safety profiles, not old and often out-moded technology. This raises two issues: the costs of registering new products in small markets, and IP protection in those markets that would incentivize investments by the private sector. As you know, it is extremely expensive to develop and introduce new compounds, which is why one sees only large firms engaged in this business.

Does the market power that comes with industrial concentration, and does IP, preclude the flow of benefits of private R&D to small farmers in poor countries? 'No', is the answer.

The real blocker is the lack of capability in poor countries to do the needed science, most of which is unpatented. Another blocker is the difficulty of crafting research partnerships, as discussed, and in the case of GM technology, stewardship. These are the issues that we must address.

If you think that the presence of IP (which I regard as necessary to stimulate investment) automatically translates into monopoly profits on the part of patent holders, please look at **EXHIBIT 16**. The table in Exhibit 16 summarizes literature on the distribution of benefits of patented biotech inventions between patent holders, farmers and consumers. The table reveals interesting data and results, as one might expect. But it does not bear out the theory of all-out monopoly profits. All seem to be gaining from the innovations: inventors, farmers and consumers.

## Partnerships for input markets

I now turn to the last section of my presentation, on services and partnerships for input markets in four areas: seed markets, fertilizer distribution, agricultural extension, and financial services, in this case, agricultural insurance.

In each instance, my objective is to demonstrate how PPPs of different kinds have helped, or are in the process of helping, markets to emerge and function.

### Seed markets

**EXHIBIT 17**, on area share of maize seed types, shows the position of different countries in the landscape of proprietary, publicly supplied and farmer saved seed. Not surprisingly, as you can see, the private sector's presence measured in area shares is much higher in the selected Asian cases than in Africa, with the significant exception of South Africa.

We know that seed markets and seed systems are in rudimentary stages of development in Sub-Saharan Africa: seed markets reach few farmers; improved varieties bred in public programs require many years to make it into farmers' fields; some never make it.

The reasons are set out quite clearly in a recent study on maize seed deployment in East Africa by CIMMYT. Summarized in **EXHIBIT 18**, the study identifies 4 blocks of problems surrounding:

- the establishment of seed companies in what is an uncertain, high cost, and over- and ill-regulated environment
- the production of seed, which is plagued by problems that include access to germplasm and credit
- the marketing of seed, where poor infrastructure is a big constraint, and
- the demand for seed at the farm level, which is very low because of the absence of supporting services, including agricultural extension, as well as the parlous state of grain markets.

The good news is that a lot of work is now being undertaken to address this in Sub-Saharan Africa. While silver bullets do not exist, there is a model that can guide this work: India (**EXHIBIT 19**).

India is a success story in seed market development and a remarkable example of public-private cooperation over four decades for the benefit of the country's agriculture sector and small farmers.

The seed business took off with the advent of private seed companies in India, but private seed companies were able to emerge because they could rely on two resources:

- public germplasm
- a pro-active, pro-business attitude on the part of both the national agricultural research system and international partners that include the legendary early role of the Rockefeller Foundation and the CGIAR, in particular (to this day) ICRISAT.

EXHIBIT 19 shows how seed markets became increasingly private over time, whereas in the early period, starting in 1960 in this picture, they were wholly public. In India, the private sector does reach small farmers, and this goes a long way toward explaining the difference in average grain yields between Africa and South Asia that we saw in Exhibit 4.

### Fertilizer distribution

Fertilizer distribution, too, is a task that is unlikely to happen without the private sector. But how to bring the private sector in and start the market up? **EXHIBIT 20** reports on a successful recent effort in Rwanda.

Under its Crop Intensification Program, Rwanda three years ago started a PPP-based model of fertilizer distribution whereby the government imports fertilizer and auctions it off to private distributors who then distribute it (sometimes in package deals with seed) to communities and farmers at the local level.

The impact in terms of metric tons of fertilizer moved and maize yields has been significant, with maize yields rising, on average, from 0.7 t/ha in 2007 to 1.1 t/ha in 2008 and 1.7 t/ha in 2009. This would not have been achievable without cooperation between the public sector and private distributors of fertilizer.

### Agricultural extension

On agricultural extension, the point I would like to stress is that making knowledge available to growers that cannot get it by themselves is essential if the goal is to raise yields: please see **EXHIBIT 21**.

Agricultural extension has a long and burdened history in emerging market countries, much of it disappointing for reasons I don't have time to tell. But things are happening in agricultural extension, perhaps more so in India with its dynamic agricultural markets than in Africa at the moment.

EXHIBIT 21 reports on the results of a survey of farmers in India who were invited to rank their sources of information about improved farming practices and inputs.

The private sector (specifically, the input industry, directly or indirectly via lead farmers) came out on top – which leads me to postulate the model of extension described in **EXHIBIT 22**, driven by the input industry and agro-dealers, where necessary in cooperation with NGOs and others, including the public extension service where it exists.

Naturally, the model in Exhibit 22 can only work for farmers that are in the market as buyers of inputs. Those at lower levels of capability initially need solutions driven by the not-for-profit sector.

### Agricultural insurance

Finally, agricultural (or crop) insurance – a fashionable topic these days, as many of you know. I am pleased to be able to report something new and concrete in this area, if you would turn your attention to **Exhibit 23**.

The pictures in the EXHIBIT summarize the workings of a weather-indexed-based drought insurance product for small farmers developed by Syngenta Foundation in cooperation with UAP insurance company in Kenya, internationally renowned re-insurers, the Kenya Meteorological Service, input companies, and stockists (agro-dealers). The product insures farmers' expenditure on purchased inputs.

The product was field tested during the 2009 agricultural year in the area of Nanyuki, Kenya. The drought experienced in that part of the country in 2009 led to an insurance pay-out recently, to significant media coverage in Kenya and beyond last week.

The partners developing the product are currently preparing a much larger second-round field test for 2010, on the basis of which I hope that it will be possible to launch the product commercially.

As indicated in the pictorial, the stylized workings of the insurance process are as follows:

- 1) farmers learn about the insurance through group training sessions
- 2) farmers buy maize seed and other inputs from agro-dealers; they register the insurance by filling out the corresponding card
- 3) registration is completed by sending an SMS to the insurance company where the needed information is recorded in a data base
- 4) a local weather station records rainfall and sends the data to the insurance company
- 5) with the rainfall data, the insurer calculates a pay-out that can range from 0 to 100 based on an agronomic model
- 6) at the end of the season, the farmer receives an SMS informing her of a pay-out if there is one; if so, the farmer can pick up inputs for the pay-out value at the agro-dealer shop.

**Conclusion**

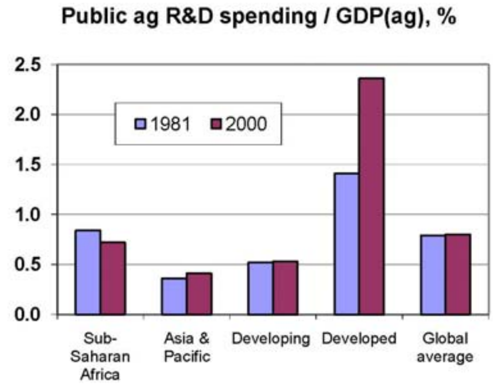
Mr Chairman, Ladies and Gentlemen: I know that I am now out of time. May I ask that you please look at the concluding slide, **EXHIBIT 24,** as we wrap up.

My conclusions are: Private R&D can reach large numbers of small farmers, if we get organized for the purpose and act through markets; IP is not the issue, tech partnerships are; in thinking about the right kinds of technology at given levels of farm capability, 'horses for courses' helps; and, partnerships are needed to kick-start input markets.

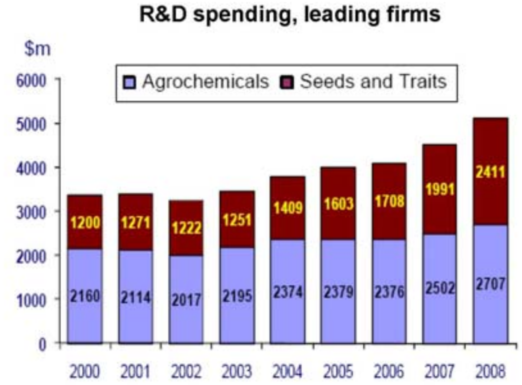
Thank you for your attention.

## Framing the problem

- Food security now and going forward: many needs emerge, R&D one of the keys
- The leading edge of R&D capability is shifting from the public to the private sector
- Question: Can private sector R&D reach small farmers?
- Answer: In emerging markets, millions of small farmers are reached commercially. More could be reached, with 'kick-starts' that rest on partnerships




Source: ASTI/IFPRI




Source: Phillips McDougal , 2009

**EXHIBIT 1**

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## Partnerships and public goods

- Reaching small farmers and solving 'food security' calls for a confluence of contributions
- Role of:
  - Public sector: public goods
  - Private sector: value-adding technology and services
  - Farmers: part of the private sector – production and livelihoods
  - Foundations, 'third sector': patient money; early-stage; provide common platforms to governments, NGOs, private-public groups
  - Partnerships: 1) Synergies in R&D; 2) Tweak markets into existence
- Markets the only way to massively scale up. Projects can reach 100s of thousands of farmers, if things go well, not the 100s of millions that must be reached

**EXHIBIT 2**

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## Smallholders the right focus …

**Share of farms <2 ha (% of total, selected countries)**

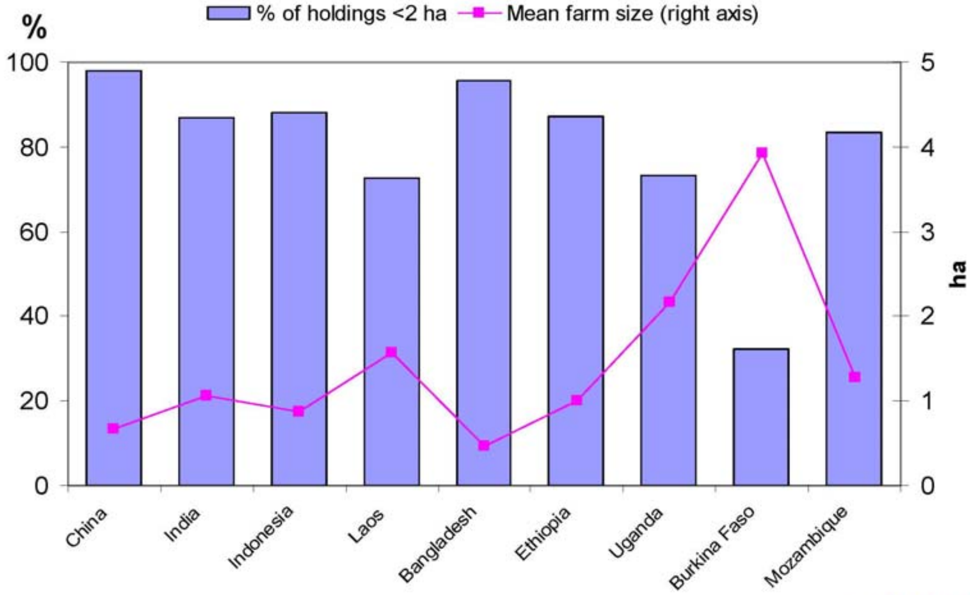


**EXHIBIT 3**

Sources: World Census of Agriculture (FAO); Nagayets (2005)

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## … as yield gaps widen …

- Grain yield growth rate declining
- Small farmers not contributing to food security as they might

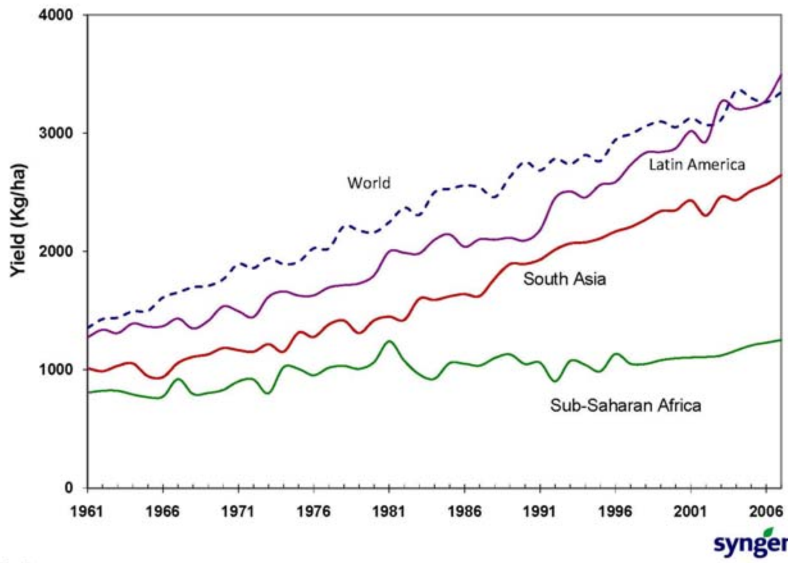


**EXHIBIT 4**

Source: FAOSTAT 2008

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## … and the task in agriculture, once again, is clear

- Raise productivity (Borlaug's challenge)
- Especially of smallholders, where the gap is greatest
- Use land and water wisely
- Intensify sustainably

**EXHIBIT 5**

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## Needed: technology and services …

Suppliers: private, public, public-private, 'third sector'

**Research**

**'R' + Technology**

- Genetic improvement
- Crop protection
- Fertilizer efficiency
- Soil/water management

+

**Development**

**'D' + Services**

- Seed/input systems
- Ag. extension
- Connectivity
- Financial services
- Infrastructure
- Market access

***Production, Food Security, Farm Livelihoods***

**EXHIBIT 6**

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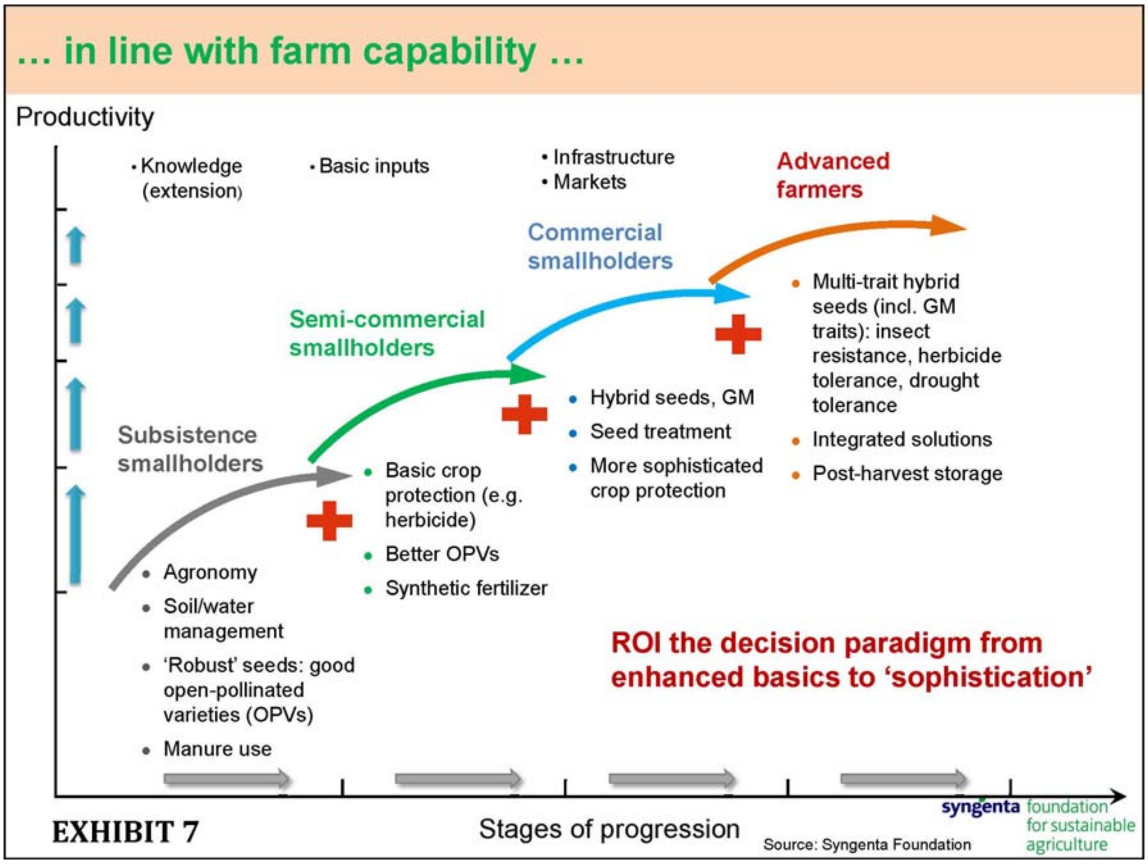



EXHIBIT 7

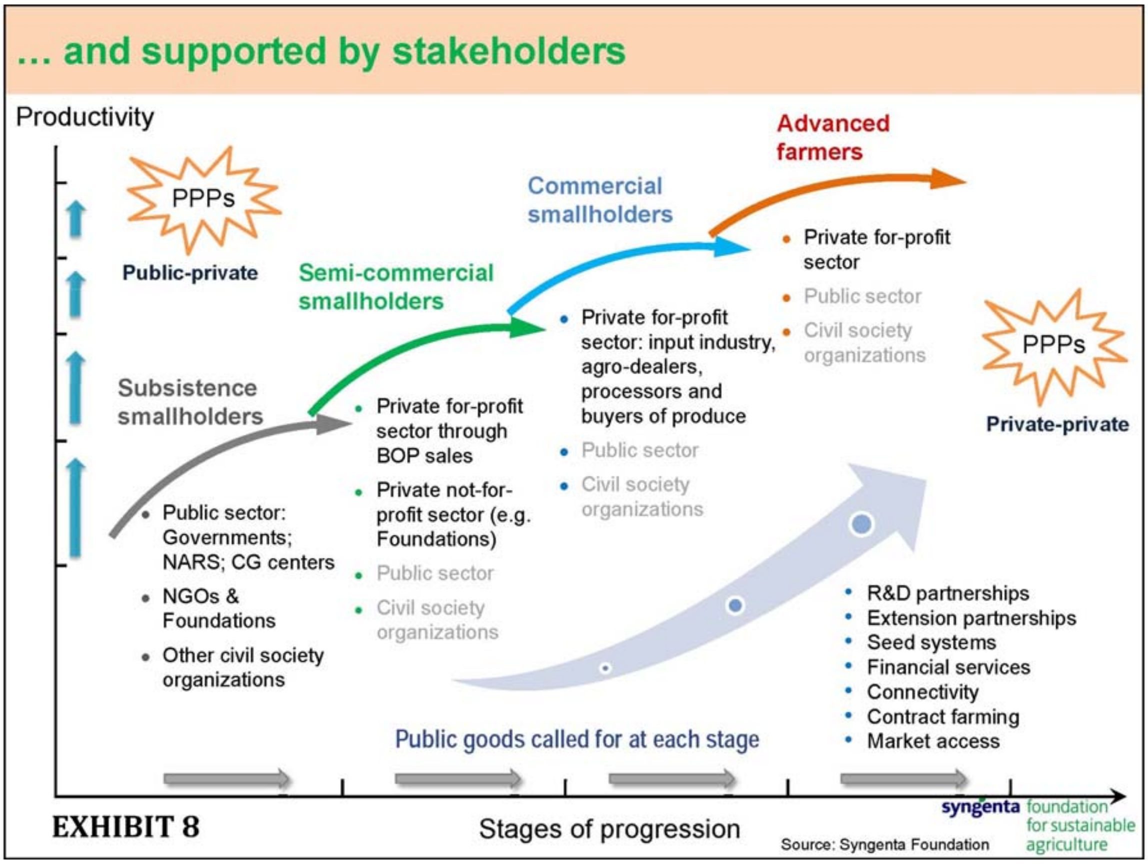
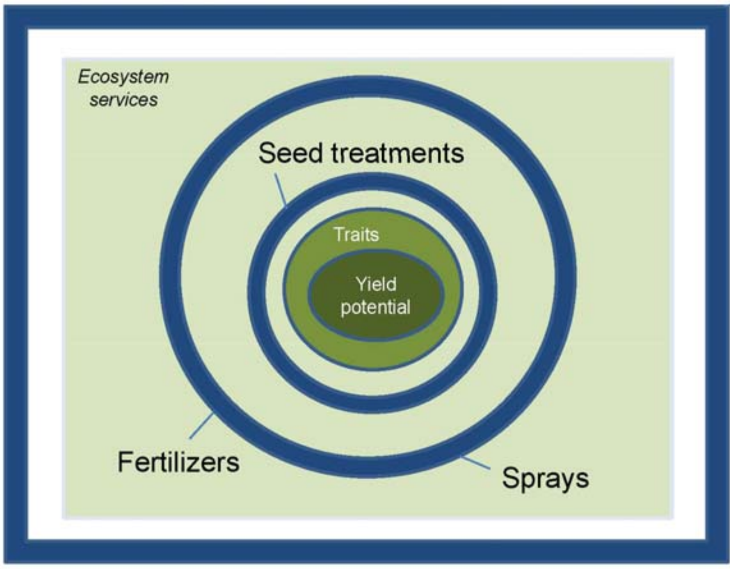



EXHIBIT 8

## Agricultural technology is risk management to protect yield




Agronomy & Extension:

Soil protection
- low/no-till Cons. Ag.
- carbon markets "incentivisation"

Water management
- irrigation technology
- novel growing systems

Nutrient management
- re-cycling, balance
- NUE
- cover crops

Post harvest management

Source: Syngenta Foundation

Healthy farm population

**EXHIBIT 9**

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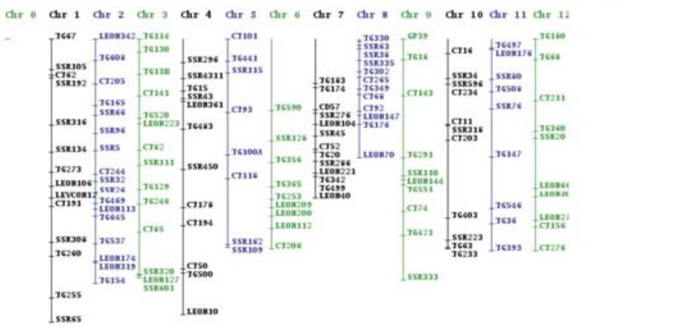
## Molecular breeding, the route to yield enhancement


Photo from IARI, New Delhi



Opportunities for partnerships – PPPs – arise when private companies and public organizations lack the resources or incentives to fully develop products or exploit their assets independently

**EXHIBIT 10**

Genetics, data >> a private strength

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## Fundamentals of good PPPs

- Productive PPPs require the formation of platforms on which to
  - assemble relevant partners
  - identify incentive compatibility
  - agree on mutual objectives
  - assign roles and responsibilities
  - protect and agree on how to exploit IP
  - partners benefit in a win-win situation

**EXHIBIT 11**

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## Safeguarding the investment: proprietary GM traits

- A few crops
- A few traits
- Smallholders benefit from GM crops (Bt cotton in India)

| Company | Corn | Soybean | Cotton | Canola | Others |
|---|---|---|---|---|---|
| BASF | DT | | DT | DT | **HT** Sunflower, Rice, Wheat |
| Bayer | HT | **HT**, IR | HT | **HT**, Oil | Quality, Stress |
| Dow | **IR**, HT | HT | **IR** | Oil | Quality |
| Dupont | HT, DR, IR, DT, Yield | HT, DR, IR, NR, Yield, Oil | | HT, Yield, Oil, Protein | HT, IR, HT |
| Monsanto | **HT**, **IR**, DT, NUE, Quality | **HT**, IR, NR, DR | **HT**, **IR**, DT | **HT** | **HT** SBeet, Alfalfa IR, HT Cane |
| Syngenta | **HT**, **IR**, DT, NUE, Quality | NR, HT, IR, DR | IR | | |

Notes: Red and bold traits already commercialised

Source: Phillips McDougall, Syngenta, 2009

**EXHIBIT 12**

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## Expanding the range of crops and traits

- MAB generic, transferable to crops amenable to the approach; requires investment in genetic and statistical tools
- GM extension to orphan crops – feasible, but complicated:
  - Stewardship
  - Trade routes
  - Liability
  - Environmental management
  - Regulatory issues
- To reach poor farmers, arrangements need to be agreed with the private sector's support which include royalty-free licenses or contracts that take into account the full landscape of issues and considerations

**EXHIBIT 13**

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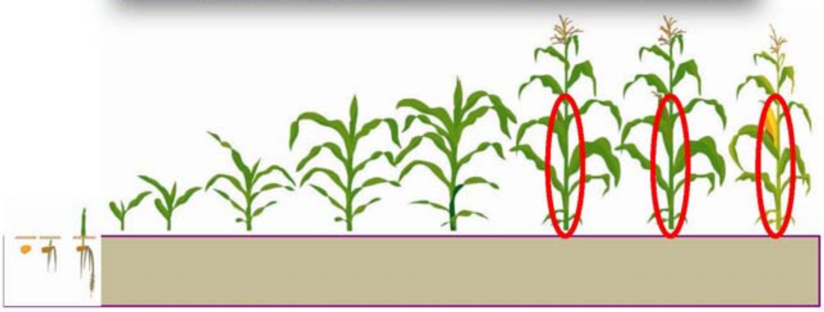
## Safeguarding the investment: crop protection

**Maize pests and diseases -- global complexity**

| Lepidoptera stemborers | | | N. Europe | S. Europe | E. Europe | N. Africa | W. Africa | E. Africa | S. Africa | USA | Latin America | Pakistan, India | China, Asia |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Ostrinia* | *nubilalis* | European Corn Borer | x | x | x | x | | | | x | | | x |
| *Ostrinia* | *furnicalis* | Asian stem borer | | | | x | x | x | | | | | x |
| *Diatraea* | *grandiosella* | Southwestern cornborer | | | | | | | | x | | | |
| *Diatraea* | *saccharalis* | Sugarcane borer | | | | | | | | x | x | | |
| *Papaipema* | *nebris* | Common Stalkborer | | | | | | | | x | | | |
| *Eldana* | *saccharina* | African Sugarcane Stalkborer | | | | | x | x | x | | | | |
| *Elasmopalpus* | *lignosellus* | Lesser cornstalk borer | | | | | | | | x | x | | |
| *Sesamia* | *nonagrioides* | Mediterranean Corn Borer | | x | | x | x | x | | | | | |
| *Sesamia* | *calamistis* | African Pink Stem Borer | | | | | x | x | x | | | | |
| *Sesamia* | *critica* | Greater Sugarcane Borer | | x | x | x | x | x | | | | x | x |
| *Busseola* | *fusca* | African Maize Stalk Borer | | | | | x | x | x | | | | |
| *Chilo* | *partellus* | Spotted Stem Borer | | | | | | x | x | | | x | x |
| *Chilo* | *agamemnon* | Oriental Corn Borer | | | | x | | x | | | | | |
| *Chilo* | *suppressalis* | Asiatic rice borer | | x | | | | | | | | x | x |
| *Chilo* | *orichalcociliellus* | Coastal Stalk Borer | | | | | | x | | | | | |

- x Severe pest
- x Important pest
- x Minor pest
- x Sporadic pest
- Pest absent



Source: Syngenta, 2009

**EXHIBIT 14**

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## Crop protection registration, selected countries

***Comparing crop protection active ingredient registration, EU vs. selected countries***

| Type of use | Number of active ingredients registered for use on crops (2009) | | | | |
|---|---|---|---|---|---|
| | EU | South Africa | Ethiopia | Nigeria | Bangladesh |
| Fungicides | 73 | 111 | 22 | 9 | 34 |
| Insecticides | 108 | 169 | 44 | 12 | 66 |
| Herbicides | 59 | 92 | 24 | 17 | 24 |
| Total | 240 | 372 | 90* | 38* | 124** |
| % of number EU registered | | 53% | 20% | 8% | 23% |

- Current registration of crop protection chemicals in EU is 240
- 47 pending review and 497 registrations phased out since 1999
- * include chemicals phased out in EU
- ** includes chemicals for rice not registered in EU

**EXHIBIT 15**

Source: Published lists from government registration agencies

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## Distribution of benefits from adopting biotech crops

| Region/Crop | Crop year | Input suppliers | Domestic farmers | Domectic consumers | Net ROW* | Source |
|---|---|---|---|---|---|---|
| EU, various GM crops | Various years | 38% | 62% | | | Demont (2007) |
| US, Bt cotton | 1997 | 35% | 29% | 14% | 22% | Price et al (2003) |
| US, HT cotton | 1997 | 6% | 4% | 57% | 33% | Price et al (2003) |
| US, HT soybean | 1997 | 68% | 20% | 5% | 6% | Price et al (2003) |
| China, Bt cotton | 1999 | 13-18% | 82-87% | | | Pray et al. (2001) |
| India, Bt cotton | 2002 | 33% | 67% | | | Qaim (2003) |
| South Africa, Bt cotton | 2000/01 | 33% | 67% | | | Gouse et al (2004) |

* ROW: rest of the world

**EXHIBIT 16**

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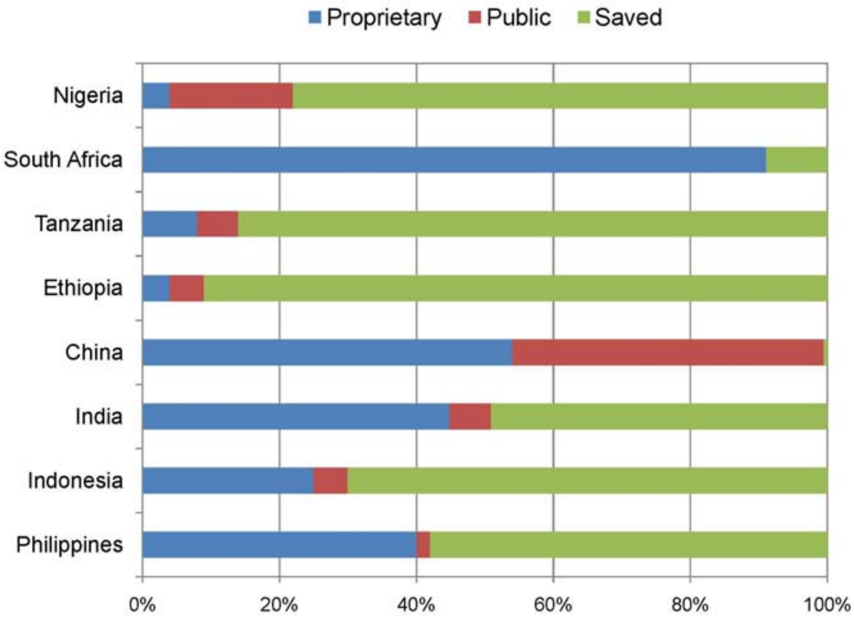
## Area share of maize seed types, selected countries




Source: Global Seed Market Database, 2009

**EXHIBIT 17**

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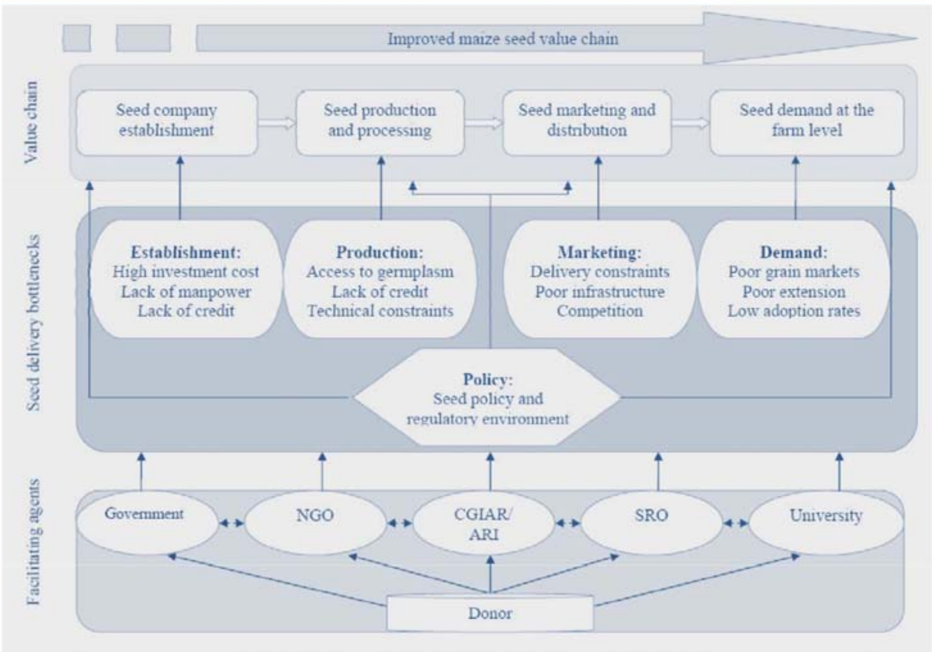
## Factors limiting maize seed deployment, Africa




**Schematic diagram of bottlenecks affecting the seed value chain**

**EXHIBIT 18**

Source: CIMMYT 2008

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## Stylistic representation of seed market development, India

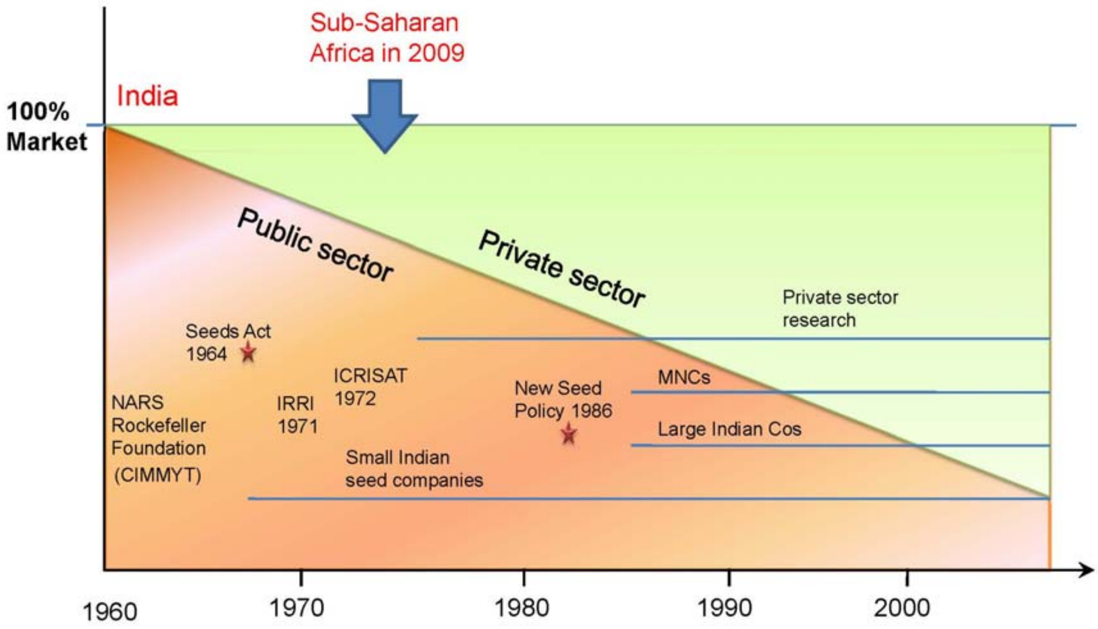


**EXHIBIT 19**

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## Fertilizer delivery through public-private partnerships

- Government and the private sector must work together to supply fertilizers to small farmers
- Example: Rwanda's fertilizer distribution model, PPP in practice:
  - Government imports fertilizers
  - It auctions them to private enterprises
  - Private enterprises distribute them to farmers
  - Impact:
    - Raised import of hybrid seed and fertilizer from stagnant figure of 13,000 MT in 2007 (mainly for coffee and tea) to 22,500 MT in 2008 and 43,500 MT in 2009
    - Maize yield on areas planted with improved inputs increased: 0.7T/Ha (2007) → 1.1 T/Ha (2008) → 1.7 T/Ha (2009)

Source: Government of Rwanda

**EXHIBIT 20**

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## Agricultural extension

**India: 90 mn smallholder farms < 2 ha**

- About 40% of all farmers are accessing information. Of these, most get it from **input dealers** – directly or via progressive farmers!
- How to consolidate this advance and reach the remaining 60%?

**Percentage of farm households accessing information on modern agricultural technologies, by source**

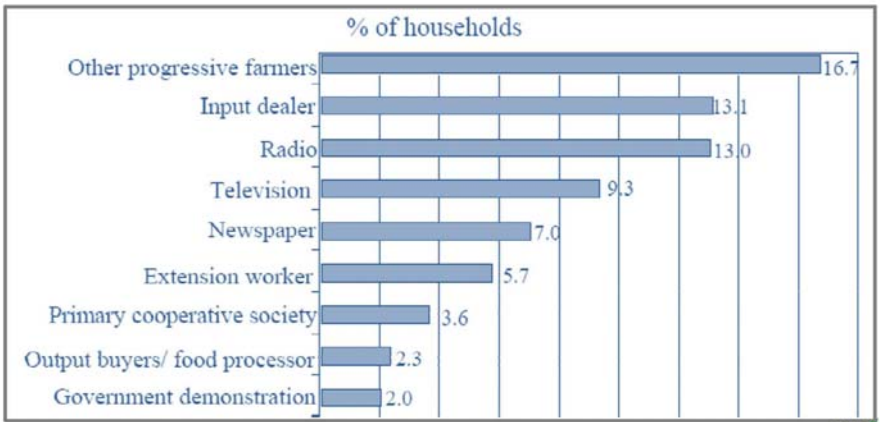


**EXHIBIT 21**

Source: NSSO, 2005/7

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## Input suppliers as sources of extension


- **Input suppliers:**
  - The crop science industry, agro-dealers
  - Rural businesses like Hariyali Kisaan Bazaar; Godrej Agrovet Ltd; E-Choupal; etc.
- **Extension advanced through networks involving:**
  - Distributors
  - Retailers
  - NGOs, technical personnel
  - Lead farmers
  - Farmer organizations
  - Women's groups
  - Advertisement (mass media, internet)
- **Input suppliers understand that they sell not products, but effects. This necessarily requires knowledge transfer to go along with the sale of products. Market share a function of the quality and extent of knowledge transfer**
- **Potential concerns:**
  - Advice may be limited to the product(s) sold
  - Stewardship and training regarding application may not be guaranteed
  - Limited incentive to reach out to remote and marginal farms

**EXHIBIT 22**

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## Agricultural insurance pilot, Kenya 2009

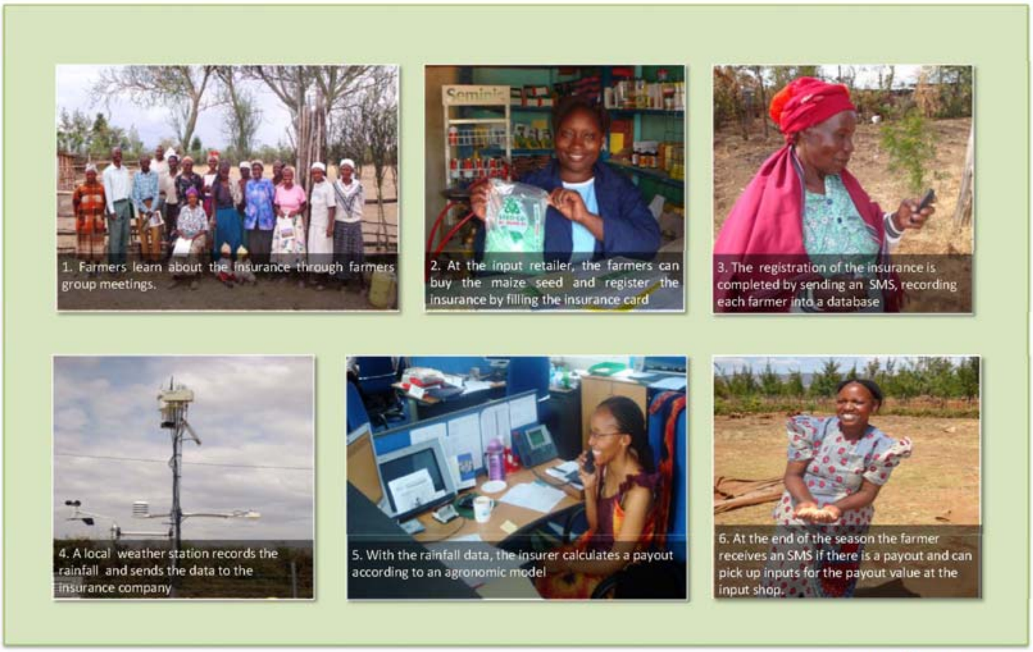


**EXHIBIT 23**

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## Conclusion

*World Food Security: Can Private Sector R&D Reach Small Farmers?*
*Yes, if we get organized*

- Research + Technology
  - IP is not the issue, tech partnerships are
- Development + Services
  - Horses for courses
  - Partnerships to kick-start input markets

**EXHIBIT 24**

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