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Integrating public and private sector research goals for sustainable food security

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Abstract



Our ability to deliver food security to the world's poor in a sustainable way depends on three converging global challenges: climate change, population growth, and limited available natural resources. Understanding the severity of these challenges, and the actions that must be taken to successfully tackle them, is high on the international research agenda. Although the future is uncertain, it is possible to construct a range of likely scenarios, which are determined by a number of factors. This paper discusses changing trends, and provides recommendations for one of the principal factors driving the future of development: investments in international agricultural research.

CIMMYT contributes to sustainable agriculture, rural development, and value chains for maize and wheat agri-food systems, with projects in more than 50 countries. Although most research has long been funded by public sector donors and philanthropic foundations, cooperation with the private agricultural industry is increasingly necessary to achieve desired development impacts. More specifically, cooperation between public and private sector institutions is essential to develop and utilize new technologies that address current and future food security challenges. Delivering joint, high-quality research will not only improve food products for clients and build farmers' capacity, but also ensure that all partners benefit from cost-sharing and complementary technical expertise in precompetitive domains. Research will remain an academic undertaking, unless it is informed by real problems on farms and efforts are made to deliver solutions to real users. As compared to the traditional, separated approach, public-private collaborations will have the greatest impact on both agricultural productivity and long-term food security.

Introduction

The world's food production must double by 2050 in order to feed the expected two billion additional people on the planet. Moreover, they must be able to achieve this while also coping with increasingly severe resource scarcity. Water supply and access is a specific problem: in some areas of the planet, the amount of water being used every year exceeds the amount available by 54 times. Tackling these challenges requires a joint effort between the public and private sectors in research and development. The value chain development model is one such approach that can engage a large number of organizations to improve

smallholders' business environments. This value chain development model continues to be an important component of the CGIAR's strategy to reduce poverty, improve food and nutrition security for health, and strengthen natural resource systems.

Agri-food systems: a framework for public-private collaboration

Let us begin with an example of a successful public-private collaboration to raise the productivity and status of the agri-food sector, an effort in which I was personally involved. Five years ago, the Dutch government earmarked its national agri-food industry as a priority sector in terms of its potential for growth. Of the 40 largest food and drink businesses in the world, 12 are established in the Netherlands or have major research and development (R&D) activities there. Public-private partnerships were at the centre of this strategy. Leaders from industry, the scientific community, and small- and medium- enterprises (SMEs) were asked to create and execute an innovation agenda with science organisations and especially with the research organisation of Wageningen UR (an organisation similar to the Commonwealth Scientific and Industrial Research Organisation [CSIRO]). As the scientific representative member of the team, I was involved in designing and executing the jointly developed agenda. We set an agenda that added value to agricultural production by internationalising and incorporating a systems approach to the agri-food industry. We were successful because we worked as one team, with a single agenda and a shared vision. When starting this process, most Dutch people didn't realise that their country is the second largest exporter of agri-food products in the world. Today, this new direction has reinvigorated agriculture, and revived people's pride in the sector.

The question now is: how we can take this vision and knowledge about public-private collaboration in the agri-food sector and apply it to agricultural research for development? One essential ingredient is the Golden Triangle of industry, government and the scientific community—or the Golden square, if including NGOs, as we at CIMMYT believe it often should. Taking inspiration from the Dutch model, this direct interaction between these actors, will help different sectors to collaborate more fully. This will result in an open and fruitful dialogue between different sectors, as opposed to the status quo, where

scientists talk only to scientists, and industry talks only to industry. Below, I address why such an approach is necessary and beneficial to the CGIAR's and to CIMMYT's work, and provide some ideas for how public-private collaborations in agricultural investment for development can move ahead.

CIMMYT's approach

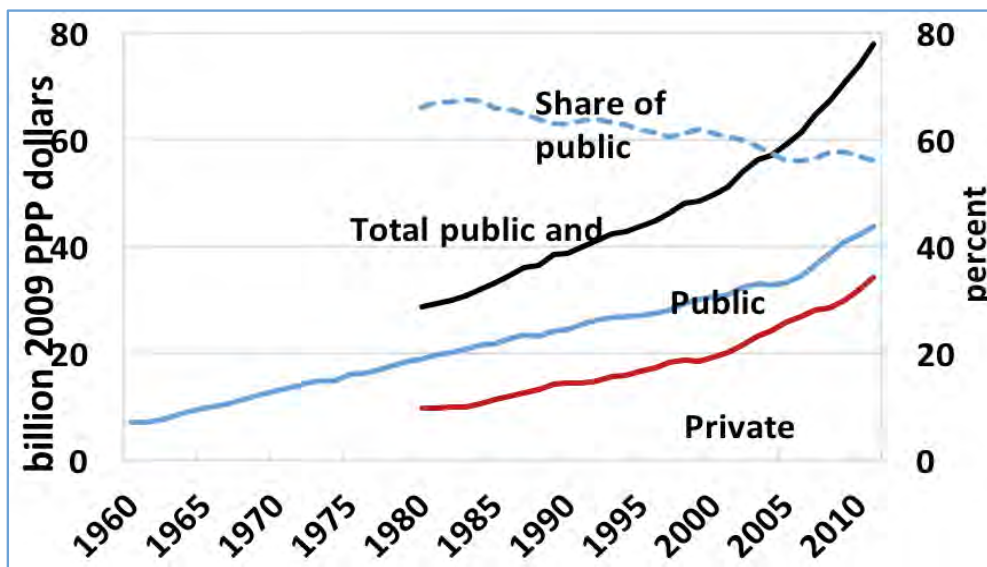
The International Maize and Wheat Improvement Center (CIMMYT) is one of the 15 Research Centers located strategically in major crop-producing regions across the globe that comprise the CGIAR. The CGIAR Centres conduct agricultural research for development, guided by a mission to achieve, by 2030, 150 million fewer hungry people, 100 million fewer poor, and 190 million less hectares of degraded land. CIMMYT has the oldest roots back to the 1950s and is the second longest-existing International CGIAR Research Center, celebrating its 50th anniversary in 2016; it is considered the birthplace of the Green Revolution due to the work of Dr Norman Borlaug to reduce the incidence of famine. Its work is focused on improving maize and wheat farming systems, including the livelihoods and wellbeing of farmers who produce these crops. In total, CIMMYT contributes to sustainable agricultural and value chain development for Agri-Food systems with projects in more than 50 countries.

While breeding is at the heart of what we do, CIMMYT is not just about breeding. That is, CIMMYT conducts its research through an incremental and balanced approach to technology and socioeconomics that achieves impacts along the value chain, from a single gene to the food that lands on our plates. We have 150,000 accessions of wheat and 28,000 of maize in our Genebank, have developed novel tools and traits for highly effective breeding, and use predictive economics to target our research on the most likely future development challenges. We must maintain and continue to strengthen these approaches to consistently achieve our demonstrated impacts. Attracting more and new sources of investment is key to this strategy, but the funding climate is in flux, creating challenges for the sustainability of our projects.

The changing global landscape for agricultural R&D

The CGIAR is a relatively small organisation on the global playing field, with only \$1 billion invested across 15 agricultural research centres worldwide. In 2011, this was only 0.86 per cent of global food and agricultural research and development (R&D), and just 0.047 per cent of all R&D. However, its research has had a major impact, such as in wheat where 60% of the varieties in the world are derived from CIMMYT material. What's more, the CGIAR is encountering a changing global landscape regarding the composition of players in agricultural R&D, in terms of both major country donors and the balance of public and private funds. There are several notable recent trends in the composition of agricultural R&D funds (Fig. 1), which create challenges for the CGIAR, as explained below.

Figure 1. Public and private agricultural R&D, 1960–2010.



Source: Pardey et al. 2015.

The first trend is that public spending on agricultural R&D is on the decline. That is, the total investments of traditional donor countries (i.e. wealthier nations) in agricultural research are decreasing. There are multiple explanations for this pattern. One is economic crisis and fiscal austerity in recent years, which places mounting pressure on donors to invest in national organisations rather than international ones – for example Horizon 2020 and Newton Fund. Moreover, in this context, conservative governments in several key donor countries (e.g. Australia,

Canada, the Netherlands) have merged development into trade or foreign affairs departments and restricted international aid. Another major explanation is that wealthy country donors' investment priorities are shifting from agricultural development to health. These changing priorities of donors are particularly detrimental to agricultural research, which requires long-term planning with stable funding to bring new projects from the lab, to field tests, and farmers over a period of time.

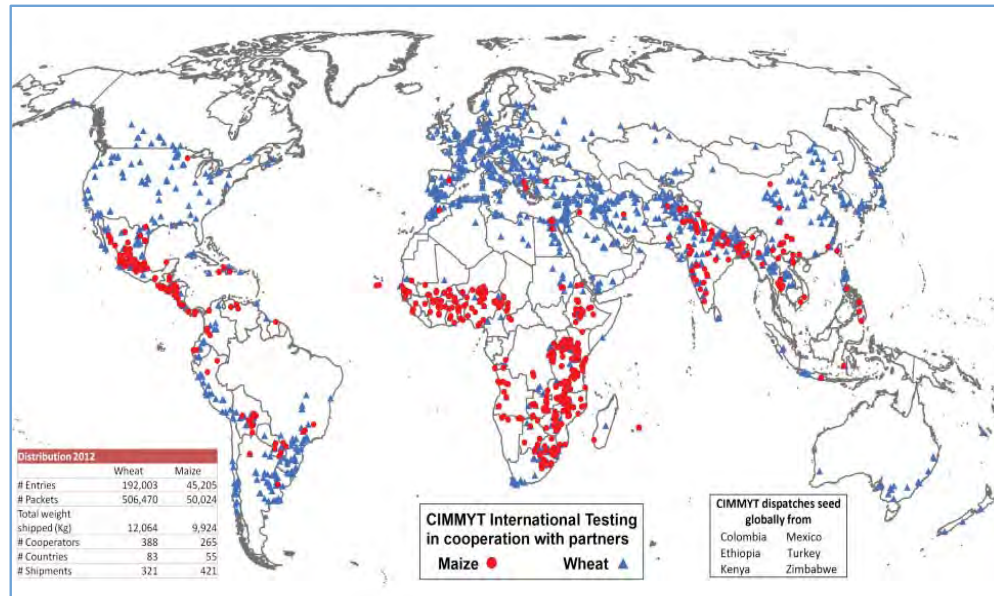
However, emerging economies are playing a greater role. Currently, China, India and Brazil account for 35.8% of global food and agricultural R&D (Pardey et al. 2015). This creates the opportunity for new partnerships, where donor countries are also immediate beneficiaries of agricultural R&D. There is also an opportunity to collaborate where lower-income and emerging economies are funding their own development projects – such as in India, Iran, Mexico and Nigeria. Some of these countries likewise demonstrate interest in funding projects with their very low-income neighbour countries.

The second trend in the global agricultural R&D landscape is that the private share of total agricultural R&D is on the rise. With this comes a new orientation towards food processing and purchased inputs, rather than farm productivity alone, as has often been funders' main focus in the past. This creates a significant opportunity for CGIAR Centres to bring badly needed market integration and value chain development projects to fruition.

Agricultural R&D: high-impact investing

Investment in research and development may be low in the public sector, but the return on investment is high. It has been calculated that for every US\$1 invested in the CGIAR the return on investments is US\$17. Investments are particularly high-impact in those countries that need development support for smallholder farmers. CIMMYT maize and wheat varieties are routinely requested by and distributed to institutions in countries that are inhabited by over 98% of all poor (see Fig. 2), proving tremendous coverage and impact pathways for two of the world's main food crops that lead back to CIMMYT breeding programs.

Figure 2. Global distribution of CIMMYT maize and wheat varieties.



Source: CIMMYT Seed Distribution Unit. (Please note this graph may underestimate the number of locations due to missing data from partners).

The impacts of investing in agricultural science are extensive when the work is scaled up and out. There are few examples of investments in science that can deliver a return on investment comparable to that of CIMMYT wheat breeding. For example, 59% of all wheat varietal releases between 1994 and 2014 are CGIAR-related (Baum et al. 2015). Additional annual production due to international wheat improvement research has been estimated to range from 24 million to 65 million tonnes per year. Moreover, in a recent study, US\$30 million per year given to wheat and breeding research at CIMMYT generated a worldwide return on investment of US\$2–5 billion annually (US 2010 dollars).

These impressive figures further indicate that, while at CIMMYT our goal is to help people living in poverty, there are also spillover effects that are benefiting developed countries. Australia has received significant benefits from CIMMYT work (Brennan and Quade 2004). Its researchers receive many of the 500,000 packets of seed sent to researchers worldwide from CIMMYT’s Genebank. Up to 98% of Australia’s wheat is derived from CIMMYT varieties – increasing the value of outputs from the Australian wheat industry by at least \$A750 million.

A challenge now for CIMMYT is to look beyond maize and wheat to entire farming systems and along value chains. Maize and wheat each function within complex natural and socio-economic systems, and to be effective our scientists must work in inter-disciplinary partnerships that consider such factors as the other crops, landscape, resource availability, farm size, production technologies, and gendered production roles that these systems encompass. The second round of proposals for the CGIAR Portfolio has been organised around four Global Integrating Programs to help achieve this. These cross-cutting programs are: Agriculture for Nutrition and Health; Climate Change, Agriculture and Food Security; Policies, Institutions and Markets; and Water, Land and Ecosystems. In addition to closer systems-level cooperation, closer integration with the private sector will also be required to continue achieving high-impact research at the systems and value chain levels. However, this necessity comes up against significant historical disagreements between the sectors.

Challenges to establishing public-private partnerships in agricultural R&D

It is often pointed out that the public and private sectors differ in fundamental ways, and these have sometimes hindered their cooperation in agricultural investments. These can be summarised in terms of a desire for exclusivity within the private sector, versus the goal of inclusivity in the public sector. This difference can result in competing views in areas such as the distribution of gains from research outcomes, and on ownership of scientific knowledge and technology. Moreover, there are misconceptions and mistrust between the two sectors that present a cultural and ideological barrier to cooperation. That is, it is often wrongly assumed that the public sector only gives everything away, while the private sector only wants to make a profit.

Finding a mutual way forward will continue to be difficult, but not impossible. There is a key overlapping interest between the two sectors: both public and private sector investors are interested in making technologies available for developing countries. The private sector does this through competition, and engages in research that will result in products that appeal to customers with high purchasing powers. Public

sector investors tend to cater to end-users with more limited purchasing power. The common ground between them is their interest in serving emerging markets, and in finding new applications for research for multiple end-users. The CGIAR is in a prime position to link their interests and ensure shared goals are met.

Finding common ground in technology development

Cooperation between public and private sector institutions to develop new technologies is essential to address current and future food security challenges. Delivering joint high-quality research will improve products for consumers, and build capacity for farmers (many of whom are also consumers). What's more, cost-sharing in precompetitive domains also ensures that all partners benefit from a greater total investment and technical expertise.

Returning to the Netherlands example, common ground was found in pre-competitive research, where Unilever and other large companies worked together with science organisations such as Wageningen UR on new technologies that were in a too-early stage for an individual company with an R&D division. At the same time co-innovation projects with SMEs (Small-Medium Enterprises) were supported in large public private partnerships with a focus on innovative processes that cannot be initiated by the SMEs without an R&D division. At CIMMYT we do this in the frame of a wide range of cutting-edge projects, including for unlocking the genetic diversity contained in our genebanks and for substantially raising the yield barrier in wheat. We can continue to capitalise on the recent surge in interest from the private sector in wheat improvement technologies, including from Syngenta, CSIRO-Bayer, Pioneer ACPFG and many more.

There are significant benefits to both sectors in taking such an approach. The private sector gains access to farmers in emerging markets, although they must work hard to line up their new business. They also gain the opportunities to wield influence in the development of legal and regulatory regimes, and to participate in pro-poor research fora. Companies can also improve their corporate profiles, reputations and build up trust with the public – in the multiple collaborations I have undertaken with executives in the agri-food sector, they have

demonstrated that they take sustainability seriously. Thus industry not only has a lot more opportunity but also more public responsibility today than it did 30 years ago.

Through collaboration, the public sector also gains access to new mechanisms for developing, marketing and distributing products and financial resources. New access to cutting-edge scientific expertise is especially important because, in many instances, their investment in research is small compared with that of companies. By working with industry they can gain access to those technologies and knowledge.

The need for collaboration

The challenges for both the CGIAR and national agricultural research systems are to work further and farther along the value chain, for which they need private sector collaboration. As national extension systems decline in size and importance and as industry plays an increasingly important role in the farmer outreach scene, it will be imperative for their activities to become better aligned.

As one example, the impact of CIMMYT germplasm is enhanced through the private sector's participation. National and international agricultural research system breeders can conduct testing and registration, but small- and medium- sized companies can greatly improve efficiency in bringing seed to farmers. Seed companies can work with extension agents (private and public) on seed production, and on promotion and marketing, to deliver CIMMYT-improved seed to smallholders and help them improve their competitiveness. CIMMYT is currently working on developing partnerships of this nature, with a special focus on developing the commercial attractiveness of the project to help ensure its long-term sustainability.

Given the complexity of the process, entrepreneurship is needed – not only from the large, but also from small and medium enterprises (SMEs). This is because of their different time horizons: large companies with shareholders believe that the time lags for a return in some markets (such as seeds) take too long. In the Dutch collaboration cited above, it was a Dutch-owned family seed company, Rijk Zwaan, that made the decision to invest in Tanzania, because larger companies with

shareholders would not accept the 15-year time-horizon before the venture would become profitable. Furthermore, this small family-owned company had a social responsibility and development support mission, which would be impossible to develop in a shareholder model.

In Africa, CIMMYT is building up seed sectors with small companies. Furthermore, smaller companies might be better integrated and trusted in markets that are otherwise difficult to access. On the other hand, local seed companies might suffer from high operating costs, limited access to quality foundation seed, and a lack of trained personnel. Thus researchers and their public and private sector collaborators must work with a number of business models, market strategies and forms of chain coordination to offer the flexibility needed in seed markets comprised mainly of smallholders. Given the importance of affordability, access, and availability, science organisations have good reason to continue trying to support small and medium enterprises.

The 'Triple Win'

Australia is one of CIMMYT's largest financial supporters in funding breeding and sustainable intensification research. This partnership, and others like it, pose a 'triple win' by creating benefits for donor countries, for people living in poverty, and for development cooperation. For donors, as cited above, a key outcome of Australia's investment in CIMMYT is the contribution of our research and development outputs to Australian farming and the Australian economy. That benefit has been passed along to the world's poor, who include to smallholder farmers, who now have varieties that give better yields, and the urban poor, who benefit from prices that are kept low. Finally, such benefits extend throughout society, considering how in 2008 the steep rise in food prices led to widespread rioting in many places, and that food insecurity is one contributing factor to the contemporary global migration crisis. In other words, the third win of a successful development cooperation is social stability at a broad level.

Concluding thoughts

The agricultural sector kick-starts economic development. This is the case not only in developing countries, but also in developed countries facing economic pressures. In the Netherlands in 2008, the only stable

sector was the agri-food sector, making it a focal point for the government. However, the lesson from the Dutch experience is that agriculture can only work as an economic engine insofar as people are proud of its contributions to their society, which encourages investment, consumption, and involvement in the export sector. This is the so-called ‘agri-food sector link-up’, and it can create the Triple Win discussed above. This requires both innovative ideas, and putting these ideas into practice at scale. For this to work, government must link not only with industry but also with NGOs and other organisations—the golden square.

Approaches are needed from multiple actors that are both multidisciplinary and interdisciplinary. Important elements are feedback, networking, reflecting, and, of course, dreaming. It’s important that companies and people have dreams, looking forward to not only a brighter tomorrow, but a brighter future 20 years from now.

Agriculture is strong on the agenda in Australia. The country must evaluate its priorities and determine where agricultural research for development will lie in the future. It could provide leadership for CIMMYT research on wheat breeding, for example, because it had a tremendous impact on Australia’s own wheat sector. Australia has an opportunity to take the lead particularly because the interest of in funding CGIAR breeding research is diminishing, despite their significant development impact and return on investment.

In summary, we cannot work in silos, but rather must come together in an interdisciplinary and trans-sectoral way. A great company and well-intentioned government are essential ingredients, but they have to work together to achieve a truly beneficial outcome—a Triple Win for donors, the world’s poor, and global society.

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Dr Martin Kropff became Director General of International Maize and Wheat Improvement Centre (CIMMYT) in June 2015. He was formerly Rector Magnificus and Vice Chairman of the Executive Board of Wageningen University and Research Center (Wageningen UR) in the Netherlands. He obtained his Bachelor's and Master's degrees in biology at Utrecht University and a PhD in agricultural and environmental sciences at Wageningen University, both cum laude. In 1984, he was appointed assistant professor at Wageningen University. From 1990 to 1995 he was the systems agronomist at the International Rice Research Institute (IRRI) in the Philippines, where he led an interdisciplinary program on the introduction of systems analysis and simulation in rice production research. Upon his return to the Netherlands in 1995 he served successively as Full Professor of Crop and Weed Ecology, Scientific Director of the University's C.T. de Wit Graduate School for Production Ecology and Resource Conservation and Director General of the Plant Sciences Group.

In 2005 he joined the Executive Board of Wageningen UR. He played a key role in raising the university's profile worldwide. In 2013, he joined the CGIAR Consortium Board, where he worked to improve cohesion and develop a new CGIAR strategy.