Strengthening Partnerships in Agricultural Biotechnologies for the Benefit of Smallholders in Developing Countries: Discussing North-South, South-South, Public-Private Cooperation and More

1. Background

In 2010, FAO organized an international technical conference on "Agricultural biotechnologies in developing countries: Options and opportunities in crops, forestry, livestock, fisheries and agro-industry to face the challenges of food insecurity and climate change" (ABDC-10) which took place in Guadalajara, Mexico. The conference brought together about 300 policy-makers, scientists and representatives of intergovernmental and international non-governmental organizations, including delegations from 42 FAO Member Nations.

At the end of ABDC-10, the Member Nations reached a number of key conclusions (FAO, 2011a). Among these, they acknowledged that:

- “Agricultural biotechnologies encompass a wide-range of tools and methodologies that are being applied to an increasing extent in crops, livestock, forestry, fisheries and aquaculture, and agro-industries, to help alleviate hunger and poverty, assist in adaptation to climate change and maintain the natural resource base, in both developing and developed countries”.

- “The various applications of agricultural biotechnologies have not been widely used in many developing countries, and have not sufficiently benefited smallholder farmers and producers and consumers”.

- “More research and development of agricultural biotechnologies should be focused on the needs of smallholder farmers and producers”.

and that

- “Stronger partnerships among and within countries will facilitate the development and use of biotechnologies, including south-south and regional alliances; incorporation of traditional knowledge; and public-private and research partnerships for sharing experiences, information and technologies”.

As a follow up to this last conclusion, FAO is holding this e-mail conference which focuses on the topic of strengthening partnerships in agricultural biotechnologies for the benefit of smallholder farmers and producers in developing countries.

Roughly two-thirds of the developing world’s three billion rural people live in smallholder households. It is estimated that there are nearly 500 million farmers today who farm less than 2 hectares of land, that the number of small farms is increasing and the farms are getting smaller (Hazell, 2011). Many of the smallholder farmers are poor, food insecure and malnourished with limited access to inputs and markets (FAO, 2010; IFAD, 2010).

The smallholder farming systems in developing countries face a number of serious challenges (e.g. IFAD, 2010). One of them is under-investment in agricultural research and development (R&D). In 2000, developing countries spent 56 cents on public agricultural R&D for every US$100 of agricultural gross domestic product (GDP) while developed countries spent on average US$2.35 (FAO, 2011b). In some developing country regions (e.g. in Central America), the spending was 25 cents and some individual countries spent less than 10 cents for every US$100 of agricultural GDP.

There is also increasing evidence of a growing gap between developed and developing countries and between the developing countries themselves in their financial commitment to agricultural R&D. For example, Pardey *et al.* (2006) estimated that in 2000, just five countries (Brazil, China, India, South Africa and Thailand) were responsible for over half of the public agricultural R&D expenditure in developing countries. While the biggest three (China, India and Brazil,) spent US$3.2, 1.9 and

1.0 billion respectively in 2000, the combined total expenditure of 44 sub-Saharan African countries was US$1.5 billion. These differences between developing countries in financial support for agricultural research are paralleled by similar differences between them in the area of human resources.

Although accurate data are not available, FAO (2011b) estimates that developing countries spent roughly US$1.3 billion on biotechnology in 2000 and suggests that, in recent years, there are some indications of additional public sector investments in agricultural biotechnologies in developing countries (such as Argentina, Brazil, China, India and Viet Nam) and that investments in agricultural biotechnologies now constitute a significant, and possibly increasing, component of agricultural R&D in some developing countries. FAO (2011b) also suggests that the focus of the additional investments seems overwhelmingly to be on plants and advanced biotechnologies (genomics and genetic modification), while work on livestock, farmed fish, trees and micro-organisms and on less advanced (i.e. non-molecular) biotechnologies and more conventional approaches are attracting substantially less funding.

The result is that most developing countries do not have sufficient funding and capacity on their own to develop and maintain strong agricultural R&D programmes, including those involving agricultural biotechnologies. Strengthening of partnerships between countries as well as within countries is therefore increasingly encouraged as an approach to maximize synergies and to share and optimize use of limited resources.

2. Partnership Activities

Partnerships for developing countries and agricultural biotechnologies can revolve around one or more main kinds of activities.

2.1 Human resource capacity development

Partnerships can be used in a variety of ways to develop the knowledge and skills of developing country scientists and other personnel in different areas of agricultural biotechnologies. These include the exchange of experts and technicians between countries; development of tailored fellowship, internship and short-term training programmes; and development of learning resource materials, including e-learning which can be used to complement and supplement traditional face-to-face mechanisms. As FAO (2011b) points out, training in biotechnology has become highly globalized, with people from developing countries travelling to institutions in other countries to study, train and participate in scientific exchanges through workshops, courses, etc. that take place under a wide variety of programmes associated with inter-governmental and institutional agreements. Several examples of such partnerships were described during the ABDC-10 parallel session on ‘Enhancing human capacities: Training and education’ (session C.4 at http://www.fao.org/biotech/abdc/parallel/en/).

2.2 Institutional capacity development

In addition to developing capacities at the individual level, as above, partnerships can also be used to strengthen capacities at the organizational level, i.e. where measures are taken to improve the overall functioning and performance of an organization. As described by FAO (2011b), these measures might include “re-engineering” existing university departments and curricula so that they focus on the most relevant areas and approaches that are presently inadequately covered, e.g. bioinformatics; creating new institutions and “re-branding” existing institutions for biotechnology R&D (such as the Argentina-Spain Binational Center on Vegetable Genomics Research [CEBIGEVE] that is being established in Rosario city, Argentina); and establishing biotechnology incubators”, “technology parks” or “clusters” to enable research outputs to be scaled up and commercialized.

2.3 Joint research projects

Research entities in different countries can direct their often limited resources to common topics of key mutual interest for synergistic and complementary collaboration and cooperation. The net results are efficiency gains in technology development and adaptation, as well as in know-how and knowledge transfer. For example, the recent global eradication of rinderpest (cattle plague), where development of immunological- and molecular-based diagnostics played an important role, provides a powerful example of what can be achieved when the international community and individual national veterinary services and farming communities cooperate.

2.4 Sharing of biotechnologies, protocols and materials

Rather than having to "re-invent the wheel", developing countries can use partnerships to access biotechnologies, and related protocols and materials, that have been developed elsewhere and adapt them for their own purposes and production systems. The sharing of biotechnologies, protocols for their use or development, as well as the products of agricultural biotechnologies may in some circumstances be affected by intellectual property rights (IPR) issues. As discussed by FAO (2011c), research institutes in developing countries can access proprietary tools and products without seeking the owner's permission using gaps in patent and protected variety jurisdictions or using research and experimental use exemptions in national legislation, although both options have potential drawbacks. They can also access them with the owner's permission and several options are available, including material transfer agreements, licensing agreements, purchasing, patent pools, open source licensing, public sector partnerships and public-private partnerships (FAO, 2011c).

2.5 Knowledge sharing

Partnerships can also be established for networking and to enable sharing of knowledge and good practices regarding the development, adoption and adaptation of biotechnologies in developing countries. Knowledge sharing can also encompass related policy issues, including the establishment of a national biotechnology policy, something which only a few developing countries have done so far. Sharing of information can take place using electronic media (dedicated websites, newsletters or social networks).

3. Defining Agricultural Biotechnologies

The FAO Biotechnology Forum (http://www.fao.org/biotech/biotech-forum/) was launched in 2000 with the goal of providing access to quality balanced information, and to make a neutral platform available for all interested stakeholders to openly exchange views and experiences, on agricultural biotechnologies in developing countries. It covers applications in the crop, forestry, livestock, fisheries/aquaculture and agro-industry sectors. It has hosted 16 moderated e-mail conferences so far, and in these the e-mail messages have come roughly 50:50 from participants living in developing and developed countries respectively (FAO, 2001, 2006).

Each conference takes one particular theme that is relevant to agricultural biotechnologies in developing countries and opens it up for debate for a limited amount of time. The Forum covers the broad range of tools included under the general term 'biotechnology' (for more details, see FAO, 2011d). Some of the technologies may be applied to all the food and agriculture sectors, such as the use of genomics, molecular DNA markers or genetic modification, while others are more sector-specific, such as tissue culture (in crops and forest trees), embryo transfer (livestock) or sex-reversal (fish). Note, the term agriculture includes the production of crops, livestock, fish and forestry products, so the term 'agricultural biotechnologies' in the conference title encompasses their use in any of these sectors.

While biotechnology is sometimes considered to be synonymous with genetically modified organisms (GMOs), it should be underlined that this is not the case in the Forum and that the conference covers a wide range of biotechnologies, of which genetic modification is just one. Discussions in this

conference will therefore not consider the issues of whether GMOs should, or should not, be used *per se* or the attributes, positive or negative, of GMOs themselves. Instead, the goal is to discuss and exchange experiences on partnerships in agricultural biotechnologies to benefit smallholders in developing countries, covering issues such as the potential pitfalls and benefits of different kinds of partnerships; lessons learned and best practices from past experiences; and relevant advice that can be provided to developing countries or their national research organizations on the subject.

4. Kinds of Partnerships

For developing countries wishing to strengthen and develop their capacity to use agricultural biotechnologies through partnerships, a range of different options are available. Here, we provide a brief summary of four important options, while noting that other models of cooperation are also available and that a given development initiative may involve a combination of different kinds of partnerships.

Technical cooperation for developing countries has historically been characterized by collaboration between the "North", i.e. the rich countries of Australia, Europe, Japan, New Zealand and North America, and the "South", i.e. the poorer countries of Africa, Asia and Latin America. Still today, the vast majority of funding for development assistance to developing countries continues to come from North-South cooperation (NSC). However, the landscape of development assistance is evolving. Driven by rapid economic progress of some developing countries in an increasingly globalized world, South-South cooperation (SSC), involving collaboration between developing countries, is becoming increasingly important (ECOSOC, 2010). SSC is perceived to have features that set it apart from NSC, such as cost effectiveness; absence of conditionality; horizontal relationships and complementarity between parties (ECOSOC, 2010). NSC and SSC are not, however, antagonistic, as underlined by Governments on many occasions, such as the High-Level United Nations Conference on South-South Cooperation, held in Nairobi, Kenya on 1-3 December 2009, where the outcome document (later adopted by the UN General Assembly) states: "We stress that South-South cooperation is not a substitute for, but rather a complement to, North-South cooperation" (http://southsouthconference.org/?page_id=6).

Accompanying the rising importance of SSC, there has been increasing interest in triangular cooperation, also called North-South-South Cooperation or trilateral cooperation, where donors provide development assistance to Southern governments to execute projects/programmes to assist other developing countries (ECOSOC, 2008). Triangular cooperation might arise, for example, through one or more Southern countries that wish to cooperate with one another and which ask a Northern donor to support their initiative. It might also take place when a donor forms a partnership with a developing country willing to provide technical support to other Southern partners and whose initiative matches the Northern donor's priorities and interests (UNDP, 2005).

Another kind of partnership which has generated large interest worldwide in recent years is that between the public and private sectors. The main impetus behind the use of public-private partnerships (PPPs) for the delivery of public goods is that they make it possible to combine the resources, management skills and technology of the private sector with the regulatory actions and protection of the public interest inherent in the public sector (UNECE, 2008).

4.1 North-South cooperation

According to UNDESA (2010), international development cooperation exceeded US$170 billion in 2009, of which the largest proportion, about US$120 billion, came from the 24 members of the Development Assistance Committee (DAC) of the Organisation for Economic Co-operation and Development (OECD), i.e. Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Republic of Korea, Spain, Sweden, Switzerland, the United Kingdom, the United States and the Commission of the European Communities.

About two thirds of OECD DAC assistance is provided bilaterally and one third through multilateral institutions. About 90% of multilateral assistance from OECD DAC countries goes to developing country programmes as well as about 50% of the bilateral assistance (the remainder is spent in the donor countries or on debt relief and humanitarian aid). Of the assistance available for the developing country programmes, over 60% is used for capital goods and commodities and over 35% for technical cooperation (UNDESA, 2010).

Development assistance is committed to a range of different areas, such as improving sanitation, human health, education, governance and infrastructure. In the period 2000-2008, the OECD DAC countries dedicated about 4-6% of the development assistance each year to agriculture, including forestry and fisheries (UNDESA, 2010).

In the area of North-South research collaboration, it is often perceived that the Northern partner is just the "giver", providing funds and expertise, and that the Southern partner is a mere "receiver" (Binka, 2005). The donor countries may, however, also benefit economically, although this is rarely quantified. The study by Pardey *et al.* (1996) is a notable exception. They examined the United States' investments in international agricultural research in wheat and rice and estimated that the research yielded economic benefits to farmers in the United States that far outweighed the economic investments. While North-South research collaborations were sometimes described as "scientific colonialism" in the past, there are many cases of mutually beneficial research collaborations where, for example, the Southern partner defines the research agenda and where guidelines to ensure true partnerships in North-South research collaborations are followed (Binka, 2005).

Regarding agricultural biotechnologies, the United Nations University Institute for New Technologies (UNU-INTECH) presented an interesting overview of NSC in three sub-Saharan countries – Kenya, Tanzania and Uganda (UNU-INTECH, 2004). In Kenya, 60 North-South research partnerships were identified, most of which involved tissue culture techniques while some included newer biotechnologies such as molecular markers. The typical format of the partnerships was that the local partners, in collaboration with researchers from the North, prepared proposals that were funded by Northern donors, and that collaboration between Northern and Kenyan researchers in research projects was less common. In Tanzania, 16 partnership projects were documented. Again, the typical partnership involved a local research organization and a Northern funding organization, and focused on training and capacity building; the direct involvement of Northern partners in implementation of research projects was rare; and projects focused on tissue culture with some also incorporating more advanced technologies such as molecular markers. In Uganda, 23 North-South collaborative projects were documented. The partnerships focused on training of local scientists and joint research ventures, which included purchase of equipment and building/strengthening research facilities. The primary role of donors was to provide funding, offer technical advice and participate in project monitoring and evaluation.

Ayele *et al.* (2007) analysed data from 19 crop biotechnology projects in Kenya and, together with data from 12 projects in Uganda and Tanzania produced in collaboration with UNU-INTECH, they concluded that two key lessons could be learned. First, "the evidence indicates that partnership efforts tend to be supply driven and not always linked to user demand. Partnership projects tend to originate outside national agricultural systems and are not clearly linked to national development goals. Although project initiation methodology invariably refers to a "participatory" approach and commitments to "capacity building" and "pro-poor" agendas, some of the projects we studied tend to start with given solutions (influenced by personal, professional, and commercial interests) and considerations of need assessment and delivery systems to end-users often become an ex-post exercise". Second, "many partnership projects are small, aid-dependent and loosely coordinated. Moreover, projects concentrate around a few locations and commodities".

4.2 South-South cooperation

SSC has been the object of increasing interest and emphasis since the 1970s (UN, 1995, 2009). One of the main drivers behind this trend has been the rising economic power of specific countries in the developing world and the closer economic ties that have evolved between developing countries. For example, whereas world trade expanded 4-fold between 1990 and 2008, South-South trade increased over 20-fold in the same time period (UN, 2011a). In 2010, China became the largest trading partner of Africa, as well as Latin America, the Caribbean and South Asia. India is among the top five sources of goods for over one third of Africa, and Brazilian-African trade has multiplied 8-fold in 8 years (Mounir Zahran *et al.*, 2011).

In 2008, an estimated US$15.3 billion was spent on SSC, representing almost 10% of the US$161 billion dedicated to international development cooperation that year. This figure is considered to be a considerable under-estimate and, although information on future plans of Southern providers is limited, SSC is expected to continue growing rapidly in the future. The share of SSC in global development cooperation has doubled in ten years, with the largest support coming from China, Saudi Arabia and Venezuela (UNDESA, 2010).

As synthesized by Kumar (2008), the key relevance of SSC lies in the fact that, over time, developing countries accumulate valuable lessons, skills and expertise that can be valuable for other developing countries and which are often more appropriate than those from developed countries. They are often more appropriate for other developing countries because the skills and technologies have evolved under conditions that are similar with respect to land, labour and capital availability, infrastructural levels and climate. Also, technologies and expertise available from developing countries are likely to be cost effective, having been adapted for low-income consumers in developing countries, and scaled to be more appropriate to the size of markets in developing countries compared to mass production skills in developed countries.

Technical cooperation is a key modality of SSC, and is the main focus for many SSC contributors, such as Argentina, Brazil, Chile, Cuba, Egypt, Indonesia, Malaysia, Mexico, Nigeria, Singapore and Tunisia. Many of these have dedicated technical cooperation departments or agencies in charge of most of their SSC, some of which have existed for more than 35 years (UNDESA, 2010). Knowledge and experience sharing continue to be a major priority in South-South technical cooperation exchanges. For example, the South-South Cooperation Network was established by China to facilitate the sharing of information, joint research, technical exchanges and PPPs with other developing countries in the area of applied technologies in the development of microhydropower, biogas and solar energy (UN, 2011a).

Institution-building is an important focus of SSC and Brazil, India and Turkey have all made notable contributions to institution-building among countries of the South. For example, technical expertise from the Brazilian Agricultural Research Corporation (EMBRAPA) supported the Senegalese Agricultural Research Institute's efforts to increase the quality and the competitiveness of rice production (UN, 2011a). In terms of country allocation, much SSC is focused on regional neighbours, and it also specializes in funding regional programmes and institutions. Some SSC providers have made major efforts at global cooperation outside their own regions (UNDESA, 2010).

Although the importance and value of SSC for international development is accepted, UNDP (2009) argued that the practical aspects of SSC have been given little consideration, so they analysed an extensive series of case studies from 16 developing countries to collect and compile a wide range of information on the current situation, as well as existing good practices, with respect to SSC. Among the many important conclusions, they point out that the programmes/projects which achieved successful results were "based upon a demand-driven approach in both programme/project formulation and implementation, as well as attention to measures for ensuring sustainability, such as adaptation of technology and know-how to local circumstances as well as the creation of sustainability mechanisms. As such, it is important to consider integrated solutions and measures, featuring a demand-driven approach, sustainability mechanisms, and achievement of results" (UNDP, 2009).

Regarding agricultural biotechnology, many cases studies of SSC exist. For example, Brazil, through EMBRAPA, has been actively involved in SSC for agricultural development. One of its most important SSC projects is the 'Cotton-4 Project' where Brazil provides agricultural technical assistance for development of the cotton industry in the C-4 Countries (Benin, Burkina Faso, Chad and Mali), given the similarity between their soil and climatic conditions and those of Brazil. The project began in 2008 and involves, *inter alia*, the introduction of nine Brazilian varieties developed by EMBRAPA to a research station in Mali for testing and adaptation as well as the building of two laboratories, for biotechnology and for biological control (OECD-WTO, 2011a).

Regional biotechnology centres are also facilitating SSC. For example, the Biosciences eastern and central Africa (BecA) Hub, situated on the campus of the International Livestock Research Institute in Nairobi, aims to provide affordable access to first class research laboratories for African scientists and postgraduates to conduct their research in Africa and address African problems (http://hub.africabiosciences.org). The Hub achieves this purpose by hosting research projects implemented by African partners; providing research and technology related services; and conducting a capacity building and training program for African scientists. For example, since 2005, over 100 students from more than five eastern and central African countries have been trained there in the field of bioinformatics.

4.2.1 The UN's role in South-South cooperation

Responding to the requests from its Member States, the UN development system has progressively scaled up its efforts to enhance and strengthen SSC. Reviewing SSC over the past 30 years, UN (2009) concluded that UN agencies and programmes have played a key role in promoting cooperation among developing countries and it documented some of their key achievements as a promoter and catalyst of SSC, their policy efforts as well as contributions in research and training, technical advice, documentation of best practices, networking and technology transfer.

Hosted by the United Nations Development Programme (UNDP), particular mention should be given to the Special Unit for South-South Cooperation (SU/SSC), established by the UN General Assembly in 1978, which plays a coordinating role in mainstreaming SSC throughout the UN system (UN, 2009). Among its many roles, it assists in organizing the United Nations Day for South-South Cooperation, held on 19 December each year since 2004 to mobilize global awareness and support for SSC (http://www.un.org/en/events/southcooperationday/index.shtml). The SU/SSC also launched the first Global South-South Development Expo (GSSD Expo) in 2008, where over 100 partner countries and organizations came together to showcase and exchange successful South-South development solutions. Since then, the GSSD Expo has become an annual event, hosted by the World Bank in 2009 and the International Labour Organization in 2010. In 2011, it will be hosted by FAO and take place at FAO Headquarters, Rome from 5-9 December 2011 (http://www.southsouthexpo.org).

In the UN system, most organizations have programmes and/or projects that support SSC either at headquarters, regional and/or country level while three organizations have specialized units that deal primarily with SSC i.e. the Integrated Food Security Support Service at FAO, the Economic Cooperation and Integration among Developing Countries Unit at the United Nations Conference on Trade and Development (UNCTAD), and the SU/SSC at UNDP. For example, in the past 15 years, FAO has supported SSC programmes in more than 40 countries and over 1 500 experts and technicians have assisted for periods of one to three years, including 800 people fielded by China. Under FAO's Strategic Alliance with China, training courses for African experts are planned to take place in Chinese research and training centres (UN, 2011b).

4.3 Triangular cooperation

The first developed country to offer substantial and sustained support for SSC was Japan, which launched its programme in 1993 (UN, 2009). Japan's initial commitment to triangular cooperation grew out of its bilateral aid projects as, on completion, it encouraged the recipient country to

disseminate the results to other countries with similar problems (UNDESA, 2010). Quantifying the funding involved in triangular cooperation is very difficult as they are not formally recorded and data are lacking (ECOSOC, 2008). UNDESA (2010) reports, however, that Japan has taken a leading role in funding triangular projects in Asia, Africa and Latin America; Canada and Germany mainly in Africa and Latin America; and Spain primarily in Latin America. Mounir Zahran *et al.* (2011) report that Japan is the main actor in triangular cooperation, followed, in the last decade, by the European Union, Nordic countries, the United States and, more recently, Republic of Korea.

A rough idea of the extent of triangular cooperation can be got from the UNDP (2009) survey. Responses from 12 developing countries that provide SSC indicate that the proportion of triangular cooperation in their overall SSC, by number of programmes/projects, varies from less than 5 to 50%, with about half of the countries reporting that the proportion was around 10%. Survey responses from the developing countries that tend to receive SSC indicate that triangular cooperation is responsible for 20-30% percent of all the SSC they receive.

One of the difficulties in quantifying and monitoring the extent of triangular cooperation is that there are still no universally accepted definitions of SSC or triangular cooperation (Mounir Zahran *et al.*, 2011; UNDP, 2009). For example, in some cases, the contribution of a third developing country or a multilateral organization (such as a UN body) to a South-South project has been considered as triangular cooperation (Mounir Zahran *et al.*, 2011).

The main advantages of triangular cooperation are similar to those presented earlier for SSC. As summarized by UNDESA (2010), they are: a) Southern implementing countries have expertise which is more relevant or appropriate to the beneficiary country's needs, because they have more recently resolved similar problems, b) Beneficiary and implementing countries may share economic and regional characteristics and cultural and linguistic ties, c) Southern expertise is more cost effective in terms of lower consultancy or training costs, and more relevant and cheaper technologies, d) OECD DAC donors often can help recipients identify relevant experiences in other continents as they have broader global networks of expertise.

Numerous case studies of triangular cooperation involving agricultural biotechnologies exist. For example, the first triangular project implemented by the Korea International Cooperation Agency (KOICA) involved the Republic of Korea and Peru providing technical assistance in potato production skills, including tissue culture, to Algeria that led to strengthening of seed potato production techniques and establishment of a potato research institute in Algeria as well as strengthening of cooperation between Peru and Algeria in the agricultural sector (TT-SSC, 2010).

In another example, the Singosari National Artificial Insemination Center (SNAIC) of the Indonesian Ministry of Agriculture, in cooperation with the Government of Japan, conducted the "Third Country Training Programme on Artificial Insemination on Dairy Cattle" so that the knowledge they gained from Japanese experts could be shared with other developing countries to help them improve their own national livestock breeding and development programs (OECD-WTO, 2011b). Participants were trained from Afghanistan, Bangladesh, Cambodia, Fiji, India, Kenya, Lao PDR, Malaysia, Mongolia, Myanmar, Papua New Guinea, the Philippines, Sri Lanka, the Sudan, Thailand, Timor-Leste, Viet Nam, Yemen and Zimbabwe. For the implementing institute it also had a positive impact through expansion of the market for frozen superior bull sperm produced by the centre (OECD-WTO, 2011b).

4.4 Public-Private partnerships

As noted earlier, in recent years there has been growing interest and commitment by governments and other stakeholders to PPPs to provide infrastructure and social services to promote development. PPPs can be established within an individual country or through SSC or triangular cooperation and a number of informative case studies of PPPs, illustrating both successes and failures, are provided by the SU/SSC (http://www.ncppp.org/undp/index.html).

While noting that there is plenty of evidence that they work well, UNECE (2008), in its guidebook on promoting good governance in PPPs, also cautions that they present a severe organizational and institutional challenge for the public sector, are complex in nature, and that they require well-functioning institutions, transparent, efficient procedures and accountable and competent public and private sectors, i.e. “good governance”.

In the field of agricultural innovation, there has also been a marked increase in PPPs in recent years, involving partnerships between public research organizations and universities on the one hand, and private sector entities such as agribusiness companies, associations and farmer organizations on the other. Hartwich *et al.* (2005) analysed 124 of these PPPs in nine Latin American countries, noting that PPPs may soon become a dominant mode of funding for agricultural research in the region. Average funding for the projects was about US$270 000 and the public sector contributed over 60% of the funds. They concluded that, in many cases, public sector agents do not clearly establish public priorities and, consequently, public sector goals are not addressed sufficiently and that “one key recommendation to emerge from the study is that when entering into public-private partnerships, public agents should ensure that these partnerships comply with public needs” (Hartwich *et al.*, 2005). Regarding agricultural biotechnologies, FAO (2011c) notes that PPPs have also gained importance and that government policy in both developed and developing countries has moved (decisively in some instances) to bring biotechnology R&D closer to filling perceived market failures, resulting in a diverse set of institutional arrangements for fostering partnerships between the public and private sectors and within the public sector itself at both national and international levels. For example, many of the national biotechnology strategy frameworks that have been approved by specific developing countries identify a role for the government in providing strategic investments and other incentives to foster partnerships between universities, public research institutions and commercial companies (FAO, 2011e).

The last e-mail conference hosted by the FAO Biotechnology Forum, which took place as part of the build-up to ABDC-10, documented numerous examples where the private sector (either national or multinational companies) has played a significant role in commercializing products resulting from agricultural biotechnologies in various developing countries, including biofertilizers in Mexico, genetic modification in the Philippines and India, marker-assisted selection in India and tissue culture in El Salvador, the Philippines and Sri Lanka (FAO, 2011d). For example, researchers at the Universidad Nacional Autónoma de México (UNAM) developed a rhizobium-based biofertilizer for the common bean. Efforts to involve the government in promoting and applying it were not successful so an agreement was signed with a Mexican company to commercialize the product allowing it to be made available to the farmers (Peralta and Mora, 2010).

In some cases, third party brokers, such as the International Service for the Acquisition of Agri-Biotech Applications (ISAAA) and the African Agricultural Technology Foundation (AATF), have played a key role in facilitating PPPs, by promoting the transfer of proprietary tools and technologies and related knowledge from private companies to public sector institutes. One such example is the water efficient maize for Africa (WEMA) project launched in 2008, whose goal is to produce drought-tolerant maize varieties (using conventional breeding, marker-assisted breeding and genetic modification) and make them available to smallholder farmers in sub-Saharan Africa. Led by AATF, the PPP includes the International Maize and Wheat Improvement Center (CIMMYT, an international research centre belonging to the CGIAR), Monsanto (a private company) and the national agricultural research systems of five African countries (the Kenya Agricultural Research Institute [KARI], Agricultural Research Institute of Mozambique [IIAM], Agricultural Research Council of South Africa [ARC], National Agricultural Research Organization of Uganda [NARO] and Tanzania Commission for Science and Technology [COSTECH]) while funding is provided by the Bill and Melinda Gates Foundation and the Howard G. Buffett Foundation.

5. Topics to be Discussed in this E-mail Conference

As with each conference hosted by this FAO Biotechnology Forum, the focus is on applications in developing countries. In this conference on strengthening partnerships in agricultural biotechnologies for the benefit of smallholders in developing countries, some of the specific questions that participants might wish to address in the e-mail conference are given below:

- What can we learn from specific past experiences of partnerships in biotechnologies (in crops, forestry, livestock, fisheries or agro-industry) for smallholders in developing countries? What were the key lessons learned? What were the problems and what were the features of the partnerships that worked?

- A number of specific kinds of partnerships (NSC, SSC, triangular cooperation and PPPs) were described in Section 4. Which of these (or, indeed, other kinds of partnerships) in the area of agricultural biotechnologies are most likely to be beneficial for smallholders in developing countries?

- Are there particular biotechnology-related areas of education/training or research that are more suitable for SSC or for NSC?

- When wishing to engage in biotechnology-related PPPs to benefit their smallholders, which kind of guidelines or best practices should developing country governments or organizations follow?

- A number of biotechnology-related partnership activities were described earlier in Section 2 (individual and institutional capacity development; joint research projects; sharing of biotechnologies, protocols and materials; and knowledge sharing). Which of these (or others not mentioned here) are likely to be most beneficial for smallholders in developing countries? Which kind of partnership (Section 4) is recommended for the different partnership activities?

- For each of the different sectors (crops, livestock, forestry, fisheries and agro-industry), in the context of agricultural biotechnologies, a) are there certain kinds of partnerships which are likely to be more beneficial for smallholders in developing countries? b) are there certain technical areas which can benefit most from partnerships?

- What kind of policy initiatives should developing countries undertake if they wish to strengthen partnerships for the development and use of agricultural biotechnologies to benefit their smallholders?

- Which institutional arrangements can be established to provide robust support to biotechnology-related partnerships to ensure their success and sustainability? What are the hurdles that can prevent effective international collaboration and how can they best be overcome?

- What is the most appropriate level for the establishment of biotechnology-related partnerships (for example, between countries, between institutions, between research laboratories/units or between individuals)? What incentives can be provided to foster collaboration at each of these levels?

Note, before submitting a message, participants are requested to:
a) ensure that it considers the kinds of issues mentioned above
b) limit its length to 600 words
c) read the Rules of the Forum and the Guidelines for Participation in the E-mail Conferences. These were provided by e-mail when joining the Forum, and they can also be found at http://www.fao.org/biotech/biotech-forum/. One important rule is that participants are assumed to be speaking in their personal capacity, unless they explicitly state that their contribution represents the views of their organization.

When submitting their first message, participants should introduce themselves briefly, providing also their full address at the end of the message.

6. References, Abbreviations and Acknowledgements

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ABBREVIATIONS: ABDC-10 = FAO conference on 'Agricultural Biotechnologies in Developing Countries'; DAC = Development Assistance Committee; GMOs = Genetically modified organisms; NERICA = New Rice for Africa; NSC = North-South cooperation; OECD = Organisation for Economic Co-operation and Development; PPPs = Public-private partnerships; R&D = Research and development; SSC = South-South Cooperation; SU/SSC = Special Unit for South-South Cooperation; UNU-INTECH = United Nations University Institute for New Technologies.

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