

AGRICULTURAL BIOTECHNOLOGIES IN DEVELOPING COUNTRIES: OPTIONS AND OPPORTUNITIES TO FACE THE CHALLENGES OF FOOD INSECURITY AND CLIMATE CHANGE (ABDC-10)

“Investing in agricultural research and agricultural biotechnologies”

Tuesday, 2 March 2010

**Dr. R.D. Cooke, Director, Operational Policy and Technical Division
International Fund for Agricultural Development (IFAD), Italy¹**

I. The scale of these challenges and why we need to invest

The climate change negotiations of 2009 looked to political will to secure a future worth living for our children. A future in which there is food security for all. A future in which the challenge of climate change is acknowledged, addressed and overcome. Critical to achieving both of these goals is rural development.

The first MDG which was adopted by the world leaders of the UN in 2000 was an undertaking to reduce the number of hungry people by half by 2015 from 850 million, at that time, to around 400 million. A few years ago little progress had been made and the food price crisis of 2007-08 actually led this figure to rise to over 1 billion people. Serageldin (2009)² referred to this “silent holocaust which causes some 40,000 hunger-related deaths every day”.

In IFAD we believe the world community has learnt important lessons from the recent food price crisis:

First: The world can ill afford to under-invest in agriculture. While the food crisis of 2007/2008 was exacerbated by short-term developments -- such as crop failures in major cereal producing countries - it was fundamentally a reflection of the failure of world supply to keep pace with growing demand, largely due to declining or stagnant agricultural productivity in developing countries after two decades of under investment.

Second: In today’s interconnected world, food crises will undoubtedly have an immediate and massive impact on the poor in developing countries. Recent estimates indicate that more than 100 million people joined the ranks of the hungry as a result of the food and global economic crises.

The world’s population is projected to grow from 6.8 billion to 9.1 billion by 2050. Most of the growth is expected to take place in developing countries. Feeding 9.1 billion will require that overall global food production increase by 70 percent. Production in the developing countries would need to almost double. Over the past three decades, agricultural productivity in developing countries has been stagnant or in decline, as a consequence of under-investment in the sector. Developing countries’ public spending on agriculture declined from 11 per cent of national budgets in the 1980s to 7 per cent in recent years. And the share of ODA allocated to agriculture dropped from about 20 per cent to 4 per cent.

While increased food production is necessary, it is not sufficient on its own to avert food crises. Food security requires distribution mechanisms that enable equal access to food for all people. It is not enough

¹ This paper was produced for the FAO international technical conference on Agricultural Biotechnologies in Developing Countries (ABDC-10), held in Guadalajara, Mexico 1-4 March 2010. The views expressed in this information product are those of the author(s) and do not necessarily reflect the views of the Food and Agriculture Organization of the United Nations.

² I. Serageldin, 2009 National Academy of Sciences, 25 (4) 35-38

to increase production and productivity; farmers should be linked to markets; not necessarily international markets but the last mile to vibrant and competitive local markets. Smallholder farmers need to increase their production to enhance national food security, but governments have to create the environment to enable them to do so. The crisis has shown that smallholder farmers often find it difficult to respond to sharp increases in demand and higher food prices in the absence of supporting institutions and appropriate infrastructure.

Climate change is expected to put some 49 million more people at risk of hunger by 2020³. And in Africa alone, where about 95 per cent of agriculture depends on rainfall, climate change is expected to cause severe water shortages that will affect between 75 million and 250 million people by 2020. In some countries yields from rain-fed agriculture could fall by 50 per cent by the same date. In other words, the people that will pay the price of climate change are the poor and vulnerable, and especially the three quarters of the world's poor living in rural areas and depending on agriculture. These people stand to be hit first and hardest.

But agriculture is not just a victim, it is also in part a culprit creating climate change. Agriculture and deforestation together account for an estimated 26 to 35 per cent of greenhouse gas emissions. Afforestation and reforestation, better land-management practices such as agro-forestry, rehabilitation of degraded crop and pasture land and better farming practices can all contribute significantly to reducing greenhouse gas emissions.

In other words, agriculture – as well as being part of the problem – can also be part of the solution to climate change and food security. But most of the key players are the poor and vulnerable: rural people in developing countries. There are five hundred million smallholder farms worldwide supporting around two billion people, or one third of the world's population. They farm 80 per cent of the farmland in Asia and Africa. They produce 80 per cent of the food consumed in the developing world and they feed one third of the global population. Our focus should be on increasing smallholder productivity, and reducing their vulnerability.

Rural women in particular need to be able to fulfill their potential. Women are increasingly the farmers of the developing world, performing the vast majority of agricultural work and producing between 60 and 80 per cent of food crops. To boost smallholder productivity and production will require consistent and sustained investment in agriculture. Such investment can pay huge dividends: GDP growth generated by agriculture is at least twice as effective in reducing poverty than growth in other sectors (WDR, 2008).

Two key challenges face humanity, namely our ability to meet the goal of food security for all while managing climate change. Both of these simultaneously constitute a tremendous challenge. Old failures in rural development and now these new challenges call for new solutions in approaching rural poverty reduction. This indicates the important role for research, but in effective innovation systems.

II. Innovation Systems: Effective investments in agricultural research

Agricultural investment plans must be coherent with overall national plans for economic development and poverty reduction. They must distinguish between situations which are amenable to economic development through technical advances, and in cases where the lot of the poor can be better or must first be improved by other means, such as support for health, domestic water, education or infrastructure programmes. The planning process will be country specific. An essential need in an agricultural research plan is that it provides for knowledge and information flow in two directions. A farmer-centric

³ IPCC 2007

participatory approach requires that the products of a strategic and applied research is moved from trained scientists to farmers in rural communities and that the demands and indigenous knowledge of the rural community should flow to the scientists. This is multi-disciplinary in its approach to constraint identification and alleviation and must widen stakeholder participation to engage the contributions of those concerned with the non-technical constraints to poverty reduction. These innovation systems intend to lead to sustainable production systems which include the following attributes⁴:

- Utilises crop varieties and livestock breeds with high productivity per externally derived input.
- Avoids the unnecessary use of external inputs.
- Harnesses agro-ecological processes such as nutrient cycling, biological nitrogen fixation, etc.
- Minimise the use of practices that have adverse impacts on the environment and health.
- Makes productive use of human and social capital in the form of knowledge and capacity to adapt and innovate, and to resolve common landscape-scale problems.
- Minimises the impacts on externalities such as GHG emissions, clean water availability, carbon sequestration and conservation of biodiversity.

It is essential that rural people are provided with the means to adapt to climate change. They need seeds that are more resistant to drought or to floods and they need cutting-edge agricultural technologies. This must be linked to rural financial services to allow them to invest in the future and to help tide them over in lean times.

III. What does this mean for agricultural biotechnologies?

Paper ABDC-10/8.1 reminds us that “Science, technology and innovation underpin every one of the MDGs – it is inconceivable that gains can be made without a focused science, technology and innovation policy” (UN Millennium Project, 2005). Yet the almost total neglect of S&T in the Poverty Reduction Strategy Papers emphasizes again the need for more joined-up S&T management. Securing appropriate and consistent levels of funding for agricultural S&T has consistently been hugely problematic for most developing countries.

Options to increase the levels of funding and increase the impact of S&T (derived from ABDC-10/8.1 B) include:

- Increased funding:
 - redirecting part of the total public support package for agriculture to innovative technological packages;
 - developing much closer partnerships with R&D supported by other ministries and their donors;
 - encouraging commercialization of agricultural R&D;
 - introducing commodity levies and tax check-offs to support “pro-poor” agricultural R&D.
- Efficiency and targeting of funding:
 - moving progressively away from traditional arrangements for centrally-based national agricultural research organization;
 - changing the criteria for priority setting and procedures for allocating funds;
 - linking research priorities more explicitly to wider social and economic needs;
 - creating formal structures and mechanisms for stakeholder participation in R&D policy;

⁴ Adapted from “Reaping the Benefits”, The Royal Society 11/09 (2009)

- giving increasing priority to research that is jointly formulated and implemented through public-private partnerships;
- giving increased priority to research projects on local and regional product value chains and production systems;
- In general establishing S&T and innovation funding windows based on thematic “problem-based” priorities and “value chains”;
- encouraging and enforcing intellectual property protection.

In the crops background paper (ABDC 10/3.1) priority options for developing countries are brought together under eight headings. But the sequence or flow of these headings should be perhaps recast as follows:

Policy development and priority setting

- Countries should develop expertise to ensure that they can make sovereign decisions about adopting biotechnologies and be able to carry out their own independent, broad based risk/benefit analyses of implementing such technologies

Linkages Biotechnology/Other agricultural R&D

- Biotechnological research should be more effectively linked to strong and well resourced agricultural R&D programmes.

Capacity development

- Countries should develop biotechnology capacities of the National Agricultural Research Systems.

Regulation of biotechnology utilization

- All countries should be encouraged to establish consistent and transparent, evidence-based decision-making processes to regulate crop biotechnology R&D, and its application.

Shared access to technologies

- Effective and equitable mechanisms for PPP and South-South collaboration should be established, where appropriate.

Uptake of biotechnologies

- Biotechnology development should be strongly linked with strategies for its widespread dissemination. Stronger extension services involving participatory crop improvement programmes, should be an integral part of national/regional agricultural support structures, including enhanced seed production and distribution systems.

Documentation of development and impact

- Developing countries should document and analyse the adoption and socio-economic impacts of crop biotechnological innovation to advise policy makers on the cost/benefit implications of biotechnology application.

Investments in Biotechnology R&D

- Developing countries, possibly working in regional groups, should build up indigenous research, development, and advisory capacities for generation, assessment and adoption of appropriate biotechnologies.

In the livestock paper for this conference (ABDC 10/5.1), the way forward notes that the application of such biotechnologies should be supported within the framework of a national livestock development programme. Secondly, that the targeted users of these biotechnologies are normally resource poor farmers with limited purchasing power, therefore appropriate models are needed to ensure that the eventual products are acceptable to them. Thirdly, if biotechnologies are to be adopted they should build upon existing conventional technologies.

IV. Agricultural biotechnologies, sustainable agriculture and agricultural biodiversity

Professor Swaminathan, in his opening message to ABDC-10, observed that Biodiversity has so far served as the feedstock for sustainable food and health security and can play a similar role in the development of climate resilient farming and livelihood systems.

The UN General Assembly has declared 2010 as the International Year of Biodiversity. Sustainable agriculture comes with the notion of financial and institutional viability but also ecological soundness and technological appropriateness. Farmers in climatically unreliable, low-external-input environments usually need to maintain more diversity by default: they plant more than one variety per crop, using traditional varieties that have been adapted to environmental variation and uncertainty as well as to local preferences and socio-economic settings through repeated reproduction and selection.

However, we must recognise that these traditional farm-based systems usually have fewer opportunities for genetic recombination and cross-breeding, and often perform poorly in the production of disease-free seed and in seed storage, which are some of the domains in which formal institutional seed systems appear to be far more effective.

This calls for the development of synergies between formal science and informal knowledge systems and requires the design of new, specific and locally adapted approaches to analyze genetic diversity and farmers' practices – the intellectual property embedded in these which drives the incentive structure of farming communities to sustain such diversity – and ultimately the sustainability of the agricultural production system. There is a need to identify the relevance and the dynamics of genetic variability conservation in the context of small-holders' coping strategies, enhance the use of diversified plant genetic resources for sustainable agriculture and sustained improvements in food production – towards better household food security. Recent studies indicate that too narrow a range of crops is leading to reduced honey bee populations in many countries - bees seem to require pollen from a diverse range of flowering plants if they are to develop strong immune systems that are essential to survival. This is an example of one of many “knock-on effects” of diminishing plant diversity in rural areas.

IPR and Traditional Knowledge and Germplasm: The Role of CBD

The Convention on Biological Diversity (CBD) mandates that the contracting party shall: “respect, preserve and maintain knowledge, innovations, and practices of indigenous and local communities embodying traditional lifestyle relevant for the conservation and sustainable use of biological diversity”.

Today, IFAD commits three-quarters of a billion dollars annually to loan and grant-financed projects to fight rural poverty. This is set to average around 1 billion US dollars per year in the next three years. All Fund-financed projects and programmes impinge on agricultural production systems and, so, have an impact on agricultural biodiversity. We have long recognised that the rural poor and the farming communities, who our projects are designed to benefit, are in fact the custodians of a diverse gene pool and are the main purveyors of agricultural agro-biodiversity.

Through its focus on a pro-poor innovations agenda IFAD supports the generation, development and diffusion of sustainable agricultural technologies. This means that we clearly recognise that technological change should not happen at the expense of the natural resource-base. IFAD's projects and programmes address around 30 million smallholder farmers every year – and a large majority of these eke out a survival in remote, marginalised agro-ecosystems where the conservation of their fragile agricultural biodiversity is critical to the sustainability of their livelihood systems. This requires application of significant local knowledge, skills, ingenuity and innovation to the biophysical resources at hand – and

equally to the conservation and utilization of germplasm – local planting material that is adapted to the local conditions.

With financial support from IFAD, Bioversity International has investigated sustainable utilisation of plant genetic resources in desert-prone areas of Mali and Zimbabwe. Through programmes of action–research, scientists worked with farmers to develop innovative methods to identify, protect and utilize endangered traditional crops. These genetic resources were, are and hopefully will continue to be of significant importance to the food security of poor rural communities. Of particular importance was the testing of alternative models for community-based in-situ seed conservation in conjunction with farmers benefiting from development projects financed by IFAD loans. Using participatory methods, appropriate sites rich in crop genetic diversity were identified, selected, and then mapped before drawing up procedures for the conservation of the genetic resources. Farmers were encouraged to build upon their own knowledge to enable them to identify and characterise traditional varieties and seed-systems. This work resulted in prototype models for in-situ gene-banks, on-farm seed production, storage and exchange between small farmers. Replication of successful models have not only led to better on-farm management of crop genetic resources but have promoted sustainable improvement of rural livelihoods through the forging of strategic partnerships between public and private sector entities, such as farmers organisations, government entities and seed companies. Another successful model led to the development of “Seed Diversity Fairs” which provide space for interaction between farmers, development workers and researchers that leads in turn to decentralized approaches in research, training and curriculum development in plant breeding and seed systems. Crops involved in the programmes described included millet, sorghum, cowpea and Bambara groundnut – important crops in desert margin areas.

The impact of intellectual property rights on farmers’ seed systems

Pro-poor IPR systems build on the comparative advantage of these communities as custodians of the genetic resources, local know-how and innovation capacity. In order to foster creativity and innovation to promote sustainable agriculture – it is imperative to develop and deploy an appropriate system of intellectual property rights (IPRs) systems for fair and equitable sharing of benefits of new or original knowledge or capital embedded in germplasm – for instance, a landrace.

In general, very few investors in agriculture and rural development have adequately realized the role that agricultural biodiversity can play in addressing poverty and household food security, in an eco-sustainable way. One way forward is the link between IPRs, incentives and agricultural biodiversity-conservation-based sustainable production systems.

Farmers often receive commercial varieties as part of a package that includes, credit, seed and agro-chemicals. In many cases accepting such packages is the only way farmers can access credit in rural areas. The end result is a progressive marginalization or disappearance of local varieties. This follows the questionable idea of progress favouring the replacement by high yielding (“improved”) varieties of traditional crop varieties in the most productive areas. And farmers’ seed systems are important to resource poor farmers in poor agro-ecological environments because of the importance of locally adaptive varieties. In other words, intellectual property rights are working to reward standardization and homogeneity, when what should be rewarded is agro-biodiversity particularly in the face of climate change and the need to build resilience by encouraging farmers to rely on a diversity of crops. For this reason member states should promote innovation in both the commercial seed systems and the farmers’ seed systems, ensuring that innovation in both works for the benefit of the rural poor.