Independent Science and Partnership Council

CGIAR

ISPC - Concept note for a strategic study of biotechnology research in the CRPs, 2013

Background

In the past two decades most CGIAR Centers have built capacity and increased investment in biotechnology as part of their activities related to plant breeding, genetic resources or animal and fish research, including policy research. Biotechnology has been seen as holding tremendous potential for speeding up breeding and targeting specific traits, addressing problems in crop and animal research that have been previously intractable, and in facilitating research and discovery on the more fundamental areas of genomics, cell biology and metabolism.

In research prioritization and reporting, however, biotechnology has been generally considered a set of tools rather than a defined research component of the portfolio with its own strategies, outputs and outcomes. Subsequently the CGIAR has not had discussions on the focus and modalities of the research (including bioinformatics, capacity building and policy), level of investment or expected outputs and outcomes from this body of research. Rather, individual Centers have embraced biotechnology according to their missions and targets, and as influenced by funding opportunities and partnerships. In the System Priorities (SC, 2005), genomics research was mentioned only briefly although research based on molecular biology was seen as playing a major role in many priority areas. In the Strategy and Results Framework (SRF; CGIAR, 2011) biotechnology is mentioned in the context of the broader scientific environment and institutional landscape. It is considered institutionally as part of basic sciences with results becoming available through multi-disciplinary and multi-institutional stakeholder contacts and there is brief mention of the implications it has on intellectual property (IP) and national capacity requirements.

The need to integrate biotechnology activities across Centers for better synergy has long been recognized. The few initiatives towards this integration include the CGIAR Genomics Task Force (now practically dissolved), founded in 2002 and which comprised the genomics "focal points" of all Centers, and the Generation Challenge Program (GCP) that emerged from the collaborative genomics activities. The GCP has formed a partnership and research-for-development network on genomic research and molecular breeding, but it will close in 2014. In the System Priorities (SC, 2005) it was foreseen that the CGIAR would develop a genomics platform to facilitate genetic enhancement and serve individual commodity and regional needs. In some way the GCP functioned as such a platform regarding services albeit with a specific research focus. The BecA (Biosciences eastern and central Africa) Hub functions as a regional platform for providing research-related services and capacity building opportunities in biotechnology to the ECA region and beyond. In the first version of the SRF (2009) it was envisioned that a single Mega Program (#3) would focus on genomics research and breeding of the major commodities in order to combine genomics research, bioinformatics, phenotyping, IP management and pre-breeding across crops, animals and fish. In the current portfolio, the commodities are in 7 different CGIAR Research Programs.

Biotechnology as defined here is a fast developing area of research that requires considerable capital investments, depends on regular upgrading of laboratory instruments, technology and

skills, including bioinformatics. It is most advanced at leading universities and private sector life science companies. Therefore, collaboration within the CGIAR and with outside partners is essential for maintaining comparative advantage. Centers have formed bilateral partnerships outside the CGIAR and these partnerships were generally reconfirmed in the CRPs. Bilateral relations with the private sector have been the norm because of intellectual property issues although discussion of common or joint approaches has been advanced particularly by the Central Advisory Service on Intellectual Property (CAS-IP now incorporated in the Consortium Office). The SRF (2011) emphasizes that along with the decreasing cost of genomics analyses, the role of the private sector is likely to grow (bringing along increasingly more complex management requirements for the R&D processes) but also the scope of applications of that research is likely to widen thus opening up new partnering opportunities.

Regarding use and adoption of biotechnology research and technologies for agricultural development, developing countries are also increasingly interested and conducting research in this area. In many developing countries there is also increasing interest in transgenic technology and regulatory frameworks are under development to facilitate research and uptake of such technology. There is, however, a critical issue of capacity in developing country institutions, which at worst could prevent the CGIAR's research results in biotechnology from being used and generating benefits. The SRF (2011) also highlights the effects that underinvestment in agricultural research in developing countries has on the capacities of partner institutions at national level and the future use of new technologies.

The discourse on biotechnology in the CGIAR has commonly focused on its tremendous potential. The Third System Review (Strong, 1998) highlighted the rapid advances in biotechnology and how the world's food and agriculture systems were rapidly reshaping. The Vision and Strategy for the CGIAR (TAC, 2000) also foresaw a radical change for the future of breeding of crops, forest species, animal and fish species. One of the seven planks for the integrated CGIAR research strategy was to "bring modern science to bear on the often difficult-to-address causes of poverty and food insecurity". The System Priorities (SC, 2005) assumed quantum advances to be generated by genomics research and reference was made to on-going work on drought genomics (by Generation CP) which was foreseen to lead to spillovers also in salinity research due to biological similarity in the adaptation mechanisms. The SRF (2011) foresees research efficiency gains from effective application of genomics and molecular tools to genetic improvement, and from effective management of data at the molecular, phenotypic and phenotype-by-environment levels. The SRF states that the advances in biotechnology, although not replacing conventional agricultural research technologies, are starting to show up in the efficiency and effectiveness of crop genetic enhancement processes in many ways.

Globally, the debate on biotechnology has been dominated by the debate on genetic modification and acceptance of transgenic crops. The CGIAR's position and strategic choices in biotechnology in general and in genetic modification in particular have not been made clear or been openly discussed within the CGIAR community. This has likely resulted from the fact that a considerable segment of the CGIAR donor community does not support use of funds for development or deployment of transgenic crop varieties. Nevertheless, research continues on biotechnology within the CGIAR and many developing countries of importance to the CGIAR are approving or preparing to approve transgenic crops. It is therefore time for a well informed analysis and discussion about the role of biotechnology in general and of transgenic crops in particular within the CGIAR portfolio. The ISPC could serve as an unbiased, independent

convener of this dialogue and summarize the outputs and recommendations from such a discussion.

Rationale for a strategic study on biotechnology

CGIAR Centers started their biotechnology research more than 20 years ago. They have largely focused on technologies aimed at more efficient genetic enhancement of their mandate crops and animal research products. At the same time, looking at the global scene, there have been multiple and rapid discoveries on gene functions and genomics in organisms including the sequencing of agriculturally important species and model organisms. In genomics research and its application, bioinformatics and phenotyping are becoming the challenges for advancement. CGIAR Centers have kept abreast of these developments and occasionally been among leaders in the applied side of this work. Several technologies have become routine, for instance use of double haploids and genetic markers for many crops. All Centers dealing with commodities engage in genetic engineering either as a research tool or for product development.

At the turn of the century when the advances in genomics were rapid but research and applications in agriculture were still quite modest and exploratory, particularly in the CGIAR, there were several efforts at the CGIAR System level to steer this field of research and canvas its possibilities. Since then, more than a decade later, the topic has not been addressed strategically at the System level despite the fact that it represents a dynamic field with huge implications for CGIAR research investments and potential impact on the SLOs.

The ISPC considers that the CGIAR System would benefit from a strategic study with three main objectives:

i. to assess the biotechnology research pipeline in the CGIAR exploring to what extent and in what time frame the research is likely to produce improved technologies and/or improved efficiencies in research with significant impact on the CGIAR target beneficiaries;

In the last decade results from agricultural biotechnology have started to reach the intended users. For instance, the cultivation of varieties resulting from genetic modification has increased from <200,000 hectares in 1997 to about 170 million hectares in 2012 when 20 developing countries were cultivating such varieties (James, 2012). Marker assisted selection has also resulted in facilitation of conventional breeding and release on non-transgenic varieties. However, the summative information on the results of the CGIAR's biotechnology research and what the pipeline looks like regarding products from biotechnology is sparse; for instance, regarding transgenic varieties (none yet released) and MAS. However, the commodity programs contain sizable components of biotechnology research that are expected to contribute to the program deliverables although indirectly through, for instance, plant breeding and more efficient use the genebanks.

ii. to analyze how CGIAR programs (CRPs) are positioning themselves strategically in internal partnerships and with partners outside to achieve maximum synergy and efficiency in biotechnology research;

Resulting from the CGIAR reform, the restructuring appears to locate biotechnology research in each individual commodity program. The results and activities of the Generation CP will be embedded in the separate programs when the CP ceases to operate. Yet, over the years there have been calls for greater synergy within the CGIAR and recognition of the CGIAR's dependency

on upstream partners (in public and private sector) in order to access and maintain the state-of-the art and efficiently serve the development mission. Of particular concern to CGIAR research in this area is how to best access or develop adequate expertise and infrastructure to take advantage of rapid advances in bioinformatics and high-throughput phenotyping.

iii. to provide strategic guidance to the CGIAR System and CRPs based on an analysis of the near- and mid- term developments in biotechnology research, research application and constraints to adoption that will influence the investment choices in the CGIAR. Issues of particular importance include: proprietary control of technologies, capacity and resources in the CGIAR's partner and beneficiary countries including development of regulatory frameworks, and the political landscape that influences the choice of research pathways.

Biotechnology is an area where supply to a large extent determines the strategically most promising investments. It is also an area where costs are relatively high (although falling for many analytical procedures) and research risks can be very high regarding achieving successful outputs and in predicting time frames for results. At the same time biotechnology research results enter the main impact pathways of research towards outcomes indirectly, for instance through the generic impact pathway for crop improvement and productivity enhancement, and therefore it may be missed in the main priority setting. Technologies, analytical processes and products are increasingly protected, which has implications both to the CGIAR and the national research programs and end users. A critical issue for the CGIAR, given its mandate to produce international public goods for the benefit of the poor, is whether there is sufficient capacity in developing countries to use the results in their own research, breeding and product development. The CGIAR thus also plays a role in capacity building. Finally, due to contrasting positions among donors and some advocacy groups opposed to genetic modification, the CGIAR community has refrained from discussing biotechnology and decisions on investment have been made at bilateral levels. The CGIAR reform calls for a more transparent strategic debate and clearer statement about the CGIAR's role in contributing or leading development of GMO crop cultivars for use by resource-poor, smallholder farmers in developing countries.

Brief review of CGIAR Strategic studies on biotechnology in the past

The predecessors of the ISPC (TAC, the Technical Advisory Committee and SC, the Science Council) have conducted strategic studies and reviews on biotechnology. Triggered by the concern in the Third System review (Strong, 1998) that the CGIAR system was slow in recognizing the full potential of biotechnology, In 1999 TAC commissioned a study on Plant Breeding Methodologies that included an assessment of biotechnology in breeding with the following conclusion:

> *"This review has established that use of, equipment or personnel biotechnology in breeding at the CGIAR Centres will not enable replacement of any significant amount of the ongoing conventional plant breeding operations, and it will not produce any savings in expenses". Instead, it significantly will increase the Centres' budgetary, equipment, and personnel requirements. Nevertheless, the new tools of biotechnology very likely will enable breeders to speed up the delivery of materials with improved traits. They also will be able to develop varieties and breeding stocks with hitherto unattainable kinds of tolerance to disease and insect pests, new (and needed) levels of tolerance to abiotic stresses such as mineral deficiencies or drought, and new kinds of desirable quality traits. The fruits of molecular biology are expected to be indispensable aids to plant breeding in future years. But most of*

their projected benefits are not likely to be realized soon, for various reasons: scientific, technical, and political.

The study recommended that to reap benefits from biotechnology research without burdening Center budgets too much, the CGIAR would need to a) increase the *efficiency* of on-going methodologies; b) *outsource* some operations to avoid in-house investment in infrastructure and personnel, or (c) *consolidate or centralize* unnecessarily duplicative functions to produce economies of scale and (importantly) increases in power, proficiency, and scope of action. To some extent consolidation was achieved through the Generation Challenge Program that focused on genomics research on genetic resources and drought tolerance.

This study followed a report on 1998 from a TAC-convened CGIAR Panel on General Issues on Biotechnology that had recommended a CGIAR Systems strategy on biotechnology to deal with understanding of germplasm, fostering of international networks for the service of the CGIAR's mission and ensuring Center capacity

In 2003, the interim Science Council published a discussion document on genomics and breeding for crop abiotic stress tolerance. A pan-System policy on the acquisition and deployment of genomics technologies recommended centralization and outsourcing between Centers as critical for improved effectiveness and efficiency of this type of work within the CGIAR.

The Plant Breeding Methodologies study also included an inventory of investments in all areas of biotechnology. In 1999 the nine Centers involved in the study invested a total about USD 14 million on biotechnology (excluding overhead and capital costs), which was about 25% of total plant breeding expenditures. A correspondingly large proportion of staff time was devoted to biotechnology. In 1999 the biggest budget item was Marker identification and MAS (USD 4 million) and the second biggest was Genetic modification (USD 3 million). In absolute numbers and considering world-wide investments in biotechnology, the CGIAR effort was modest at that time. A study by Morris and Hoisington estimated that in 1999 biotechnology accounted for about 8% of total CGIAR investment (excluding CIFOR and WorldFish Center) with ILRI investment being the largest (USD 6.5 million; 23% of Center budget).

A biosafety study, commissioned by TAC/SC contained an inventory of CGIAR research on Living Modified Organisms and biosafety practices at Centers as of 2004. The SC in its commentary endorsed the notion that Centers should continue to strengthen biosafety policies for the products of breeding research, including LMOs, and that they should develop "business plans" from the outset for LMO products.

Conduct of the review

Biotechnology is potentially a huge area for single review to address. Therefore the study must have a clearly defined scope and set of specific strategic issues to be addressed. It is also very important that the study is conducted in close collaboration with CGIAR staff leading CRP biotechnology research at the Centers and that it will make full use of Center- and CRP-commissioned strategic studies and reviews. Planning of the details of the study will therefore be done in consultation with focal persons nominated by the Centers and CRPs.

From the initial feed-back from Centers/CRPs and the CGIAR Consortium received before and at ISPC7 we conclude that there are two major areas of activity where strategic advice for CGIAR

System- and CRP-level decisions are needed: (i) transgenic research relevant to crops and livestock and (ii) crop genomics and bioinformatic research.

Regarding transgenics, the major issues include: application to pro-poor crops and traits (e.g. traits of relevance, IP issues) and delivery pathway (time frames, regulatory frameworks, product stewardship and capacity).

The main issues for genomics research relate to rapid advances in the genotyping and sequencing technologies while bioinformatics, phenotyping and capacity still appear as bottlenecks.

Other areas that emerge from the discussions as important for both broad areas of the study include: role of the private sector and how it develops both in terms of IP and relevance for developing country agriculture; international and national policies and policy debates related to biotechnology and genetic resources; centralization vs. de-centralization and outsourcing of research or components as technologies advance and costs change.

The final list of strategic issues and ways to address them will be decided by the study panel in consultation with the Center/CRP focal persons.

The competences and expertise required in the study panel of four persons include:

- international experience in biotechnology application in agricultural research with poverty alleviation, food security, nutrition and resource sustainability goals;
- expertise on cutting edge science issues related to biotechnology including bioinformatics and genomics;
- vision regarding the near-to-medium term promise of biotechnology in areas relevant for the study and the most likely future breakthroughs with relevance to agriculture;
- knowledge of the most prominent players in internationally relevant biotechnology research, particularly the private sector, and how their roles are going to evolve with respect to agricultural applications and development solutions;
- knowledge of policy, capacity, regulatory and IP issues related to biotechnology

The strategic study intends to be largely forwarding looking but, nevertheless, will need to draw from information regarding current status of biotechnology research in the Centers/CRPs. For instance, an inventory of the current pipeline of deliverable technologies and knowledge products will be conducted. Other methods to collect data, information and perspectives may include surveys and interviews.

Tentative time line 2013
January-March Contacting CGIAR Centers and CRPs, identification of focal persons
April appointing study panel
May Organizing among study panel, decisions on scope, approach and methods, data needs
June Consultation with CGIAR/CRP focal persons
June-September Collection of data and information, surveys, interviews
ISPC8, September Update of progress
October-November Drafting of panel report, possibly face-to-face writing workshop
December Semi-final report
January 2014 Multi-stakeholder workshop on study findings
February 2014 Final report including workshop report

References

CGIAR 2011. A Strategy and Results Framework for the CGIAR.

interim Science Council 2003. Applications of Molecular Biology and Genomics to Genetic Enhancement of Crop Tolerance to Abiotic Stress. A Discussion Document. interim Science Council Secretariat, Rome Italy.

CGIAR Science Council, 2005. System Priorities for CGIAR Research 2005-2015. Science Council Secretariat, Rome, Italy

CGIAR Science Council 2007. Report of the Biosafety Panel to the CGIAR Science Council on Biosafety Policy and Practices of the CGIAR Centers. Rome, Italy: Science Council Secretariat.

Morris, M.L. and Hoisington, D. 2000. Bringing the benefits of biotechnology to the poor: the role of the CGIAR centers. In M. Qaim, A.F. Krattiger and J.von Braun (Eds.), Agricultural Biotechnology in Developing Countries: Towards Optimizing the Benefits for the Poor, Kluwer Academic Publishers, Boston, MA, pp. 327-356.

James, C. Global Status of Commercialized Biotechnology/GM Crops: 2012. ISAAA Brief 44

Strong M. 1998. Third System Review of the Consultative Group on International Agricultural Research. CGIAR System Review Secretariat, Washington, DC.

Technical Advisory Committee 2000. A Food Secure World for All: Toward a New Vision and Strategy for the CGIAR. TAC Secretariat, Rome Italy.

Technical Advisory Committee 2001. Systemwide Review of Plant Breeding Methodologies in the CGIAR. TAC Secretariat, Rome Italy.