

## **Biotechnology and Sustainability**

*Pace Lubinsky*<sup>1</sup>

“Biotechnology” and “genetic engineering” are terms that are often used interchangeably, but they are not synonymous. This is because biotechnology is constantly changing. In fact, biotechnology is best thought of as a constantly evolving continuum of technologies.

In 1972, the concept of sustainability was articulated at the United Nations (UN) Stockholm Convention in the sense of meeting present-day needs while also taking into account future generations.

In 1992, Brazil hosted the UN Earth Summit in Rio de Janeiro, which was attended by many Heads of State, and laid the groundwork for work on sustainability on many fronts; the initiation of environmental Conventions (e.g., on climate change, desertification, biological diversity) occurred during this period, and Agenda 21, the action plan for implementation of the 1992 Rio Declaration, was also started.

In Agenda 21, it is specified that the environmentally safe use of agricultural biotechnology is required to meet sustainable development objectives, especially in developing countries. In 2012, developing countries surpassed developed countries in the amount of land cultivated with genetically engineered (GE) crops.

The first GE crops were commercialized in the mid-1990s. In the United States, the adoption of GE, herbicide-tolerant crops was akin to a revolution in weed management in terms of labor-saving and time-saving benefits, and the crops were rapidly adopted by U.S. farmers. The crops also provided significant environmental benefits, and facilitated the use of no-till agriculture, which helped improve soil and water quality, including increased carbon sequestration and reduced greenhouse gas emissions from farm machinery.

Also during this time, U.S. farmers rapidly adopted GE, insect-resistant crops (i.e., “Bt crops”), which helped reduce the use of harmful pesticides and water, and helped regionally suppress some agricultural pests. The International Food Research Policy Institute (IFPRI) is currently undertaking studies on the impact of Bt crop adoption by women in developing countries. They are finding that women in countries like Burkina Faso are benefiting from the use of these crops in terms of having increased income from farm activities, reduced exposure to harmful pesticides, and time-savings that come from less effort needed to fetch water to mix pesticides.

As GE crops were rapidly adopted by U.S. farmers, organic farming also began to experience rapid growth. In 2012, U.S. organic production and production using GE crops were each valued in the billions of dollars, and continue to grow and find export opportunities. The U.S. experience demonstrates proof-of-concept that countries can benefit from having both organic agriculture and agricultural systems using GE crops, and that there is no need for a country to choose between one or the other. USDA organic certification lists the use of GE crops, specifically recombinant DNA, as an “excluded method”. Therefore, certified organic farmers cannot use GE crops.

In 2007-2008, the world experienced a food price crisis. Agriculture was put back on the international development agenda, and food security initiatives were launched. The

---

<sup>1</sup> Foreign Agricultural Service , U.S. Department of Agriculture  
Email: [pace.lubinsky@fas.usda.gov](mailto:pace.lubinsky@fas.usda.gov)

global community became aware of projected doubling of food demand by 2050, fueled by regional population growth, but especially by consumption demand associated with a global middle class, rising incomes, and more demand for meat.

This increasing demand for food and especially meat is projected to exert an enormous pressure on natural resources, and it was recognized that the challenge of sustainable agriculture was actually two challenges: producing more food using fewer resources, or “sustainable intensification”, which focuses on productivity gains per unit of land or water. In contrast, increasing agricultural production through agricultural expansion may raise food production, but also requires additional resources, including potential loss of biodiversity and increased greenhouse gas emissions from land conversion.

In 2010, the U.S. National Academy of sciences published a report on the sustainability of GE crops in the United States. They concluded that the adoption of GE crops has provided significant environmental benefits (in addition to economic benefits to farmers) to U.S. agriculture.

The report also mentioned that some of the benefits could be lost if proper stewardship of GE crops was not adhered to. Specifically, the issue of weed and pest resistance to GE, herbicide-tolerant and insect-resistant crops, was mentioned. Best management practices that can prevent or slow the evolution of pests to crops that have herbicide-tolerance and insect resistance traits (GE and non-GE) include integrated management practices like crop rotation and cover crops. GE crops currently in the pipeline also offer multiple modes of action that can help delay resistance. The key to slow evolution of weed and pest resistance is to avoid overreliance on any one single management practice.

In 2012, during preparation and discussions taking place around the Rio+20 Conference, the integral role of agriculture in sustainable development and the green economy was recognized. Global agriculture already accounts for 70% of freshwater use and the majority of the workforce in developing countries work in the agricultural sector. Talk of sustainable agriculture focused on the concept of “agro-ecology”, yet despite demonstrated environmental benefits, GE crops seem to be excluded from “agro-ecology” formulations, as they have been excluded from organic certification.

In conclusion:

- Sustainability in agriculture is not just production only. In 2012, food waste, both in developed and developing countries, was recognized as a serious challenge, with an estimated 30–40% of food currently being lost/wasted.
- “Sustainable intensification” is a term that describes how agricultural production can simultaneously address the twin food security and sustainability challenges. A science and evidence-based approach to what constitutes sustainable intensification should be a guiding principle, and some of the most productive and sustainable production systems identified by science may require a hybrid of what today is considered organic with conventional/GE crop production.
- Sustainability is a complex issue that needs complex institutional arrangements and partnerships to address challenges. Governments, the private sector, public sector researchers, civil society, farmers, and local actors as well all have an important role to play.

What role will the public sector researcher institutions, like EMBRAPA, have going forward? Will they be empowered to help develop new crops (especially non-commodities), or will regulatory costs/uncertainty and other barriers ultimately stifle public sector research innovation? Will public sector institutions be empowered to provide extension services that will help farmers implement best management practices?