

Evolving Role of the Public and Private Sector in Agricultural Biotechnology for Developing Countries

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Most agricultural biotechnology products to date have been developed by the private sector. The process involves a number of steps, including the initial invention of transformation technologies and the identification of genes for plant improvement. Large-scale production of transformed plants for field testing and intensive agronomic evaluation are required, followed by the detailed guiding of the plants and plant products through national and international registration and regulatory processes. After (or during) these first developmental stages, a relationship was established in the United States between the private sector entities and all of those elements of the agriculture and seed industry (private and public) that were needed to commercialize these new crop products. These partnerships have taken many forms, driven largely by the nature of the seed systems and of the products to be commercialized, and by national and commercial considerations. The public sector participants have included national seed companies, universities and other research entities, and provincial, state and national governments. These partnerships and the shared experiences of the private and public sectors, while largely in more industrialized countries so far, have been repeated to a lesser extent in some developing countries, and support the probability that equally productive interactions will continue in these newer areas.

Adoption of Genetically Improved Crops

By 1998, improved crops derived from agricultural biotechnology had been widely adopted by farmers in the United States and Canada, and new genetically improved GI varieties made up to 25 percent of the U.S. corn, 40 percent of the U.S. soybean, 45 percent of the U.S. cotton, 35 percent of the North American canola, and a smaller percentage of the North American potato crops. The new traits included herbicide tolerance, insect protection, virus protection, and hybridization technology. In 1999, the adoption of these improved crops expanded. In some cases expansion was limited only by seed availability.

Adoption and expansion has also occurred elsewhere, with significant acreage of GI crops being grown in China, Australia, and Argentina. About 28 million hectares were planted worldwide in 1998 and 40 million hectares in 1999 (James 1998, 1999). In most cases, the crops developed outside of North America were extensions (by breeding) into locally adapted germplasm of products already produced in North America. This has not always been the case, and as can be seen from the growing development of products specific or exclusive to developing countries, this could be expected to become the exception over time.

The development of these improved crops has taken many years and has required many tech-

nological breakthroughs. The early phase, up to first commercialization in 1995-96, probably took close to 20 years. The ability to transform plants, beginning with petunia and tobacco, and later moving to cotton, potato, tomato, soybean, and corn, and still later to wheat and rice, was often discovered and developed by private and public sector researchers, working together or separately. Not inconsequentially, the early recognition of the promise of biotechnology for the improvement of agriculture was evident by the high level of funding for such research in both sectors in many industrial countries, and in the rapid development and dissemination of technology in this area.

The product development phase, characterized by the often large-scale production of transformed crop plants and the initial evaluation in field tests, was carried out almost entirely by the private sector.

The next product development phase, including the larger-scale field evaluations and the beginning of the introgression or backcrossing of the trait into a broad germplasm base, was usually a collaboration between private and public sectors and with other private sector entities. For efficiency, most crops use a limited number of genotypes for genetic transformation, but to serve the farmers, and to remain competitive with other aspects of seed research, the successful trait is quickly bred into all appropriate germplasm. No market was served fully at the outset, but within a very few years, the improved traits have been bred into almost all widely used germplasm, and the diversity of availability of these traits is often equal to that of other agriculturally important traits. RR (herbicide tolerant) soybean, for example, was initially launched in the first year, with a small number of seed companies in varieties in a few maturity groups, but very shortly thereafter was available in the germplasm of over 350 seed companies and germplasm providers.

The later stages, including varietal registration trials or other official evaluations, involved the public sector to a large extent. At this point, the private sector, and with seed partners, entered the new crop lines into the appropriate approval processes that are used to evaluate any new seed or plant. In addition, the added regulatory process and registrations involved the public sector

entities not only as approval agents, but also in some cases in the production of the appropriate data to support these approvals.

The final stages, including commercialization, advanced demonstration plots, and continued refinement of product use, involved the private and public sectors and often reflected the existing participants in the seed and or processing industries.

The interactions that have been tried so far include collaborating with extension services and agricultural universities, testing the improved crops in national seed certification and varietal registration systems, licensing the crop trait (and often codevelopment of these) to national breeding programs or to local seed companies, and involving national, provincial, or state governments to ensure that the needs of their constituents are met.

Expansion into Developing Countries

The continued expansion of agricultural biotechnology products into new areas, and the development of such products that are specific or exclusive to developing countries, are planned and under way. In some cases, direct adoption of already developed traits, such as insect resistance or herbicide tolerance, is planned following breeding into local germplasm and the completion of relevant registration and approvals processes. These phases also require extensive testing under local conditions and refinement of the use of the technologies to maximize their effectiveness in a new environment. This kind of development was also undertaken for the initial launch areas. There is a growing interest and activity in the study and testing of new biotechnology traits that are required to mimic or complement the traits already developed in other areas of the world. Examples of these include the screening and testing of new *Bacillus thuringiensis* (Bt) proteins that may be used to control the different insect pests found in other areas, or that may be used to extend the range and value of other existing approaches. Additional areas of research include improvement of efficiencies of genetic transformation in crop subspecies or in new species. This new wave of research is being carried out by public and private sector enti-

ties from industrial or developing countries, and may involve partnerships between such entities and regions.

It is possible that very few new forms of interactions may be needed between the private and public sectors for the successful deployment of existing or new products over those already experienced in industrial countries, although there would be differences in degree. These interactions will, as before, reflect the realities of the participation of different private and public sector entities in the development and in the businesses of seeds and agriculture and the most effective combinations that ensure the best delivery of the products to the farmers. In many cases, involvement with national agricultural research systems (NARS) is expected to be productive. Direct involvement with the CGIAR system is a possibility, but is more likely to occur with specific CGIAR centers.

Other models have been used to foster the availability of important products and technologies to those that need them. In some cases, this has involved the transfer of proven technology for crops in developing countries, including technology for virus protection for potato (Mexico), virus protection for sweet potato (East Africa), virus protection for papaya (Southeast Asia), and Pro-VitA for oilseeds (India). The transfers have been accomplished through partnerships of technology holders and parties interested in jointly providing these to new areas.

Conclusion

The possibility of growing interactions between the private and public sectors has been based on a number of experiences and changes that have occurred over the course of the early phases of the plant biotechnology work. A confidence in, and a fuller understanding of, the different technologies has been gained over time in the development of the earlier commercial products and over a growing geographic base.

Regulatory processes have become clearer in many countries, and the private and public sectors have shown commitments to training and other support, and support for local regulatory system development. Most importantly, the movement of agricultural technologies beyond the purview of the private sector originators has often been driven and encouraged by responsible partners, who recognized the need for these technologies for the people and areas that they were committed to serving.

References

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