

Summary and Conclusions

What conclusions emerge from this updated look at the impacts of international maize breeding research in Latin America?

- *The primary locus of maize breeding research has shifted to the private sector.*

During the past decade, the primary locus of maize breeding research in Latin America has shifted from government research organizations to private seed companies. Private-sector research and development (R&D) expenditures have increased steadily, while support to public maize breeding organizations has declined. Although research investment data remain incomplete, there can be little doubt that the level of private-sector investment now significantly exceeds the level of public-sector investment. Not only does the number of researchers employed by private seed companies exceed the number working for public research organizations, but on average private-sector researchers are better paid than their public-sector counterparts and enjoy larger operating budgets.

- *Commercial maize seed production is now dominated by private companies.*

The decline in public-sector support for maize research has been accompanied by a gradual disengagement of the state from commercial seed production activities. The crushing

economic crises that struck most Latin American countries during the 1980s triggered a series of structural reforms designed to reduce the fiscal burden imposed by inefficient state industries. Many money-losing government seed agencies were privatized or shut down because they were imposing an unacceptable burden on public treasuries; those that remain today account for an insignificant proportion of the total market. State disengagement from commercial maize seed production has been accompanied by rapid growth of the private seed industry. Private seed companies now dominate the market in virtually every country in Latin America, except for the countries of the Caribbean region.

- *The maize seed industry has become increasingly concentrated.*

Mirroring a trend that is seen throughout the industrialized world, the emergence of a flourishing private maize seed industry in Latin America has been characterized by steady consolidation among firms. As the large multinational seed companies have penetrated the Latin American market, they have swallowed up many smaller local seed companies through acquisitions and mergers. The maize seed industry in Latin America is today highly concentrated; in most countries, the three largest seed companies control 75%

or more of the total market share. This level of concentration has raised concerns among some analysts about the possible exercise of oligopoly power.

- *The total area planted to improved germplasm continues to expand.*

The area planted to improved maize germplasm in Latin America continues to expand. In 1996, nearly 14 million ha were planted to MVs, equivalent to approximately 48% of the total area planted to maize. This represents a significant increase from 1990, when just under 10 million ha were planted to MVs, equivalent to approximately 43% of the total maize area.

- *The pattern of adoption of improved germplasm has been uneven.*

Use of improved germplasm has increased throughout Latin America as a whole, but the pattern of MV adoption has been uneven. Use of improved germplasm is concentrated in areas where maize is produced as a commercial crop. The most extreme example is the Southern Cone region, where approximately 63% of the total area planted to maize in 1996 was planted to MVs. In contrast, use of improved maize germplasm remains modest in regions characterized by subsistence-oriented agriculture. The area planted to MVs remains particularly limited in some of the poorest countries and/or regions of Latin America, including Mexico (20.3%), Central America (21.8%), and the Caribbean region (31.3%).

- *Use of hybrids has increased dramatically relative to use of improved OPVs.*

The increasing importance of the private seed industry has been reflected in a marked shift in the types of improved materials being

planted in farmers' fields. The area planted to hybrids has increased dramatically, while the area planted to improved OPVs has declined. By 1996, the area planted to hybrids already far exceeded the area planted to improved OPVs; in that year, over 12.5 million ha were planted to hybrids, compared to less than 1.5 million ha planted to improved OPVs. Despite warnings that hybrid technologies would be adopted only by large-scale commercial producers, in many countries hybrids have been adopted successfully by small-scale producers.

- *CIMMYT materials have been used extensively by public breeding programs.*

Public maize breeding organizations have made extensive use of CIMMYT materials. From 1966 to 1997, approximately 55% of all varieties and hybrids released by public breeding programs in Latin America contained CIMMYT germplasm. Contrary to expectations, this percentage has increased over time. However, the way in which CIMMYT germplasm is used has changed. Public-sector breeders have increasingly tended to subject CIMMYT materials to additional cycles of selection before using them to form finished cultivars.

- *CIMMYT materials have been used extensively by private-sector breeders.*

Private-sector breeders have used CIMMYT materials as extensively, if not more extensively, than public-sector breeders. Although many private companies are reluctant to provide detailed information about the genetic background of their commercial hybrids, we estimate that approximately 75% of all seed of proprietary hybrids sold in Latin America in 1996 contained CIMMYT-derived germplasm. The way CIMMYT materials are used tends to

differ by type of seed company, however. Small seed companies that lack strong breeding capacity frequently make direct use of CIMMYT lines in forming hybrids. Large seed companies with strong in-house breeding programs (including most multinationals) rarely make direct use of CIMMYT lines; rather, these companies look to CIMMYT's broad-based populations and pools as sources from which inbred lines can be extracted.

- *The total area planted to CIMMYT-derived OPVs and hybrids continues to increase.*

The total area planted to improved OPVs and hybrids that contain CIMMYT germplasm in their ancestry continues to increase. In 1996, CIMMYT-derived cultivars were planted on approximately 10.7 million ha, representing over 36% of the total maize area in Latin America and over 75% of the area planted to MVs. Use of CIMMYT-derived cultivars is concentrated in lowland tropical production environments. Use of CIMMYT-derived cultivars is relatively modest in temperate production environments, which is hardly surprising because CIMMYT does not target these environments.

- *Adoption of MVs depends on many factors beyond the control of breeders.*

Adoption of improved germplasm is influenced by many factors, only some of which pertain to the characteristics of the germplasm itself. Generally speaking, the level of adoption of MVs is higher in countries where it is profitable for farmers to adopt MVs and for seed companies to supply MVs. For this reason, policy makers must be realistic about the ability of research organizations and seed companies to bring about desired changes in farm-level productivity. Improved germplasm—the principal output of research organizations and seed companies—is certainly necessary if farm-level productivity is to be raised, but improved germplasm in and of itself is not sufficient. Other things are needed as well, including attractive economic incentives, appropriate institutional structures, and favorable government policies.