

Structure, Competition and Policy in India's Seed and Agricultural Biotechnology Industries

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Introduction

Many of the technological changes in developing-country agriculture during the past five decades have been driven by public investment in science and technology. This has been the case in India, where the Green Revolution of the 1960s and early 1970s was a result of public research and extension programs and public support to rural infrastructure, irrigation and input provision to farmers.

But during the last two decades, new opportunities to combine conventional plant breeding with advanced biotechnology applications have increased the scope for private investment. These technological advances, combined with liberalization of the economy that began in the late 1980s, have opened the door for the private sector to take a leading role in boosting India's agricultural productivity. However, much of that contribution has been limited to the cotton sector, principally through the introduction of cotton hybrids and transgenic insect resistance traits. There has been relatively little private investment in research, development and marketing of improved cultivars and seed-based technologies for rice and wheat.

This study¹ examined current constraints to increased private sector investment in the seed and agricultural biotechnology (agbiotech) sectors in India, particularly in relation to rice, wheat and maize improvement. It examines the structures of these industries, their potential effects on competition and innovation, and the policies that may improve both industry performance and the delivery of new productivity-enhancing technologies to India's cereal production systems.

India's Booming Seed Sector

The study focuses exclusively on India's formal seed market – the world's fifth-largest seed market, valued between US\$ 1.3-1.5 billion in 2008-09 and growing at a rate of 12 to 13 percent each year². The private sector holds a 76 percent share of market volume, and it is a market with further room for growth. Only one-quarter of all seed



The Cereal Systems Initiative for South Asia (CSISA) is a research-for-development partnership implemented jointly by five CGIAR institutions – the International Maize and Wheat Improvement Center (CIMMYT), International Food Policy Research Institute (IFPRI), International Livestock Research Institute (ILRI), International Rice Research Institute (IRRI) and World Fish – in close partnership with public and private sector organizations across South Asia.

transactions in India are conducted in the formal market, indicating that there are growth opportunities in the informal market where seed provisioning relies on farmer-to-farmer exchanges and farmer-saved seed in the informal market.

The study focuses on three core questions. First, how do market signals and public policies incentivize innovation in the seed and agbiotech industries? Second, how do these signals and policies influence the structure and conduct of these industries? Third, what are the growth and development implications of the emerging scenarios for these industries?

To answer these questions, the study integrates data and information from a wide range of primary and secondary sources to explore relationships between science, innovation, industry structure and growth in the context of Indian agriculture.

Key Findings

In general, the private sector in India has focused its investments on cotton, maize, pearl millet, sorghum and horticulture crops where genetic improvements can be developed in hybrid backgrounds. Their rationale is that hybrids provide an effective biological means of protecting a company's investments in breeding – its intellectual property – that is embodied in the seed. Genetic improvements embodied in hybrids typically last for only one generation, so farmers must buy fresh seed every year to continuously capture the yield gains associated with hybrids. This allows breeders to recoup their investments in breeding.

However, there are challenges in developing good rice hybrids, and wheat hybrids are still largely under development. Without legal means of protecting intellectual property rights (IPRs) for companies that invest in rice and wheat improvement, it is unlikely that the private sector will invest in these crops.

India's Plant Varieties and Farmers' Rights (PPV&FR) Act of 2001, the establishment of the PPV&FR Authority in 2005, and the commencement of varietal protection application processing in 2007 have helped to some extent in providing the IPR environment needed to incentivize private investment in the seed sectors. However, a snapshot of varietal protection applications submitted through 2008-09 suggests that companies have focused their applications on parent lines for cotton hybrids (Figure 1).

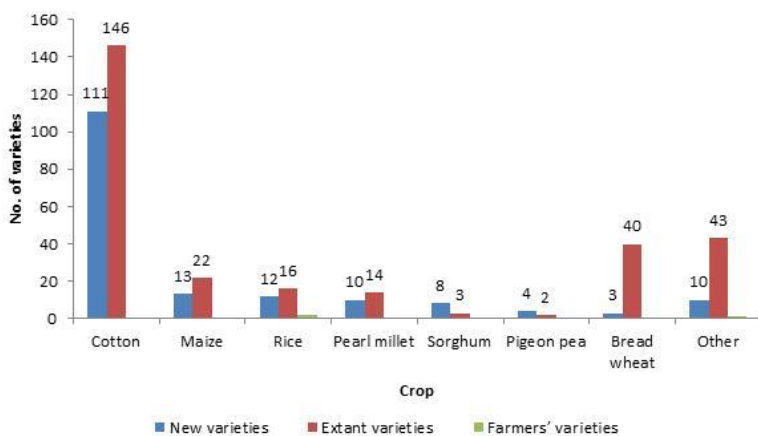


Figure 1: Most applications for crop varietal protection are concentrated in cotton and other crops marketed as hybrids

There are also challenges in developing new transgenic traits for crops such as rice and wheat. The Indian government has not approved any genetically modified (GM) crops since the country's first

forays into Bt cotton in 2002. And the 2010 moratorium on the commercial release of Bt eggplant effectively dampened private sector interest in furthering transgenic research.

Uncertainty in the current regulatory system is probably the greatest obstacle to private investment in the seed and agbiotech industries. Although the National Biotech Development Strategy of 2007 and the National Biotechnology Regulatory Authority of India (NBRAI) Bill of 2009 aim to streamline regulatory agencies and processes, the uncertainty is persistent and largely unaddressed to date. This uncertainty is likely exacerbated by the slow progress on moving the 2004 Seed Bill through Parliament.

But uncertainty in the policy and regulatory environment has not necessarily closed down growth in India's seed and agbiotech industries. Between 1997 and 2008, a total of 79 sets of transgenic research materials were imported into India, 85 percent of them by private-sector firms. More than two-thirds of the imports were by just two groups of firms – Monsanto-Mahyco Group and Bayer Group. Imports of transgenic planting materials have increased markedly since 2005, and the number of firms involved has also increased, indicating increases both in innovative activity in the industry and in the number of firms active in the industry. Monsanto-Mahyco Group and Bayer Group also conducted 61 percent of all GM field trials between 2006 and 2010, and the number of private firms conducting such trials increased in 2009 and 2010.

And yet, the concentration of activities in the industries' top four firms is much greater in India than in other parts of the world, especially the United States. This may explain the low level of mergers and acquisitions seen in these industries to date, and further suggests that there is still potential for growth, expansion and maturation in these industries in India.

So what are the prospects for private investment in rice and wheat improvement in India? Rice is potentially of considerable interest to the private sector in the seed and agbiotech industries. More than half of the rice seed planted in India in 2008-09 was purchased (rather than saved) by farmers, suggesting that farmers are willing to pay for quality seed. This opens the door for growth in the market for hybrid rice seed, even though only 6 percent of the rice area was planted to hybrids in 2008-09. Many companies have recognized this potential, and several are investing heavily in research and marketing to increase and stabilize yield, improve grain quality and enhance marketing and distribution networks.

In contrast, farmers in India buy less than 20 percent of the wheat seed planted each year, preferring to save their own seed or exchange seed with neighbors. Weak enforcement of plant variety protection, coupled with poor performance of hybrids to date, discourages investment in development of wheat hybrids. GM wheat has not met with much success anywhere in the world, and concerns about acceptance of GM cultivars by the public have restricted investment in research and development (R&D) on GM wheat.

Policy Recommendations

Growth in India's seed and agbiotech industries will require close collaboration between the public and private sectors. In the past, these collaborations have often worked well – India's public research system is typically credited with producing the upstream research on hybrid parent line development that has led to a vibrant private sector-led market in hybrid seed for pearl millet, sorghum and cotton.

Yet, despite increasing public expenditure on agricultural research in recent years in India³, the public sector's contribution to crop improvement remains constrained by factors including top-heavy organization and management structures, and a lack of incentives to encourage public researchers to rapidly release viable technology products or collaborate with the private sector. Greater policy attention must be given to improving management systems and innovation incentives in India's vast public research system, and to strengthening the public-private interface in the areas of crop improvement.

At the same time, greater attention must be given to the policy and regulatory uncertainty clouding GM crop development in India. The extent to which the private sector invests in innovation and product markets for cereal crops will depend partly on reducing this uncertainty and encouraging private investment in transgenic solutions that accelerate yield growth for rice and wheat. The 2001 PPV&FR Act could play a role in addressing corporate concerns over IPR protection, although the PPV&FR Authority's capacity to live up to its mission depends on the courts' ability to adjudicate fairly on infringement cases. Promulgation of the proposed Seed Bill and NBRAI Bill will also be critical to addressing regulatory uncertainty and widening the technology pipeline.

Attention must also be given to improving access to data and information. There is a need for a publicly accessible clearinghouse or database that integrates information on applications for, ownership of, and issuances of patents, plant variety protection certificates, field-testing permits and commercialization approvals. There is also a need for more and higher-quality data on agbiotech research in India to improve the efficiency and effectiveness of the regulatory system. Corporate managers, public regulators, policymakers and researchers could use this information to make informed and evidence-based decisions about innovation, competition, private profits and social welfare.

Finally, while there are currently no major concerns over concentration in India's seed and agbiotech industries, there is no room for complacency, and the seed and biotech industries throughout the world are subject to constant scrutiny over anti-trust and competition issues. India's Competition Act of 2007 provides a mechanism for addressing anti-competitive practices, and close industry monitoring ensures that both innovation and competition in the industry are encouraged without the need for price controls and other market distortions.

Looking to the Future

Several scenarios may play out in India over the coming decade, with implications for innovation, competition and yield growth for the major cereals.

The Fragmentation Scenario

If the Indian seed and agbiotech industries continue to operate as they do today, they will remain fairly fragmented, forgoing synergies that emerge from joint research investment, mergers, acquisitions, licensing and other strategies that bring together expertise, capital and intellectual property.

The Competition Scenario

Alternatively, as was the case with Bt cotton, there may be rapid innovation through widespread dissemination of a single set of viable technologies and protection of IP through biological mechanisms (hybrids) and legal mechanisms (licensing). This strategy tends to provide the technology firm with a high degree of market power in the upstream segment, while stimulating vibrant competition among seed firms that license the technology and introduce it into their own cultivars.

The Competitive Growth Scenario

Growth in the seed and agbiotech industries could easily be led by the expansion of private investment in maize and rice hybrids. Ultimately, a mix of domestic and foreign investment in maize and rice hybrids through technical partnerships, joint ventures, mergers and acquisitions could result in rapid growth in India's seed and agbiotech industries. This scenario is deeply dependent on government support for agbiotech, foreign direct investment and improved R&D incentives.

The Transformation Scenario

Innovation and competition in the downstream seed market will depend on commercialization times, product performance and spillovers, as well as on the terms and conditions of licensing agreements, the scope of patent protection, the ownership of elite germplasm and the design of appropriate business models for the Indian market. Transformative technology platforms, such as hybrids, may be particularly important in this scenario, especially for reaching small-scale, resource-poor farmers in India's more marginal agro-ecologies. Hybrids may provide a stepping stone for private investment in other crop improvement technologies embedded in the hybrids, including transgenic technologies for drought tolerance, salinity tolerance and insect resistance.

Which One?

Unless there are marked changes in current public attitudes and regulatory uncertainties surrounding GM crops and technologies, the most optimistic outlook is for a transition from fragmentation to a competitive growth scenario that is led by an expansion of private investment in maize and rice hybrids.

The evidence suggests that several elements must converge before the private sector's contribution to both innovation and productivity growth can be realized in India's cereal systems. Continued public investment is needed in 'push' mechanisms that lower the costs of research and promote spillovers from public research into the private sector. However, additional investment is also needed in 'pull' mechanisms that increase the expected returns to research by improving market conditions, particularly for those crops, traits and technologies that are most relevant to small-scale, resource-poor farmers in India.

¹Spielman, D.J., D.E. Kolady, A.J. Cavalieri, and N.C. Rao (2014), "The Seed and Agricultural Biotechnology Industries in India: An Analysis of Industry Structure, Competition, and Policy Options." *Food Policy* 45: 88-100.

²Rabobank (2006), "Indian Seed Industry: Market Overview and Outlook." Industry Note 184-2006 (Utrecht, The Netherlands: Rabobank).

³Stad, G.J., and M. Rahija (2012), "Public Agricultural R&D in South Asia: Greater Government Commitment, Yet Underinvestment Persists." *Agricultural Science and Technology Indicators (ASTI) synthesis report* (Washington, DC: IFPRI).

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