

# BANGLADESH

## PRIVATE AGRICULTURAL RESEARCH AND INNOVATION

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**A**gricultural growth is crucial to reducing poverty in low- and middle-income countries. Policies and programs that facilitate the introduction of both private and public agricultural technology support growth and reduce poverty. In this respect, Bangladesh is an interesting case because of its endorsement of private agricultural innovation from the late-1980s, at a time when the country was among the poorest in the world. Subsequently, donors including the United States Agency for International Development (USAID) and the World Bank have supported projects promoting private agricultural research and technology introduction. The findings presented in this note are based on interviews, documents, and other studies, along with a survey of 51 private organizations involved in all aspects of agricultural production or processing, including input supply; large-scale crop, fish, and livestock production; and processing. The organizations included 47 locally owned companies, 2 pesticide companies that were subsidiaries of foreign companies, and 2 nongovernment

organizations (NGOs). Organizations reported medians of 40 employees (ranging from 3 to 50,000) and US\$390,000 in yearly sales (ranging from US\$6,000 to US\$435 million).

### PRIVATE SOURCING AND INTRODUCTION OF AGRICULTURAL TECHNOLOGY

Companies of all sizes innovate to provide what customers want and to improve their own production efficiency. All but one of the organizations in the study sample introduced new products or processes in the five years to 2009. Privately introduced technology included, for example, cultivars of vegetables, maize, potatoes, rice and other crops; bio-fertilizers from coconut dust; pheromones and other non-poisonous pesticides; corn shellers; poultry feed; rice processing machinery; solvent extraction for oilseeds and rice bran; and ultra-high-temperature processed milk. Overall, the private sector accounts for most technology for

**Table 1—Numbers of private organizations by source of introduced technology**

Type of technology	Number of organizations reporting innovations	Source of innovations <sup>a</sup>			
		Developed in Bangladesh		Imported from	
		Own R&D	Others' R&D	Parent company	Other source
<b>Inputs</b>					
Seed	13	5	2	—	9
Fertilizer	6	1	—	—	5
Pesticide	6	—	—	2	4
Machinery	5	3	—	—	2
Livestock, fishery inputs	4	3	—	—	1
<b>Large-scale production</b>					
Crop	9	3	1	—	6
Livestock	3	—	—	—	3
Fishery	2	1	—	—	1
<b>Processing</b>					
Crop	6	5	—	—	2
Livestock	3	1	—	—	2
Fishery	1	—	—	—	1

Source: Compiled by authors from survey data.

Note: <sup>a</sup>Indicates the number of organizations reporting innovations from each source; organizations may report more than one source.

pesticides, machinery, most crop species, livestock, and agricultural product processing.

According to the 1993 Bangladesh Seed Policy, the government must register all cultivars before seed sale is allowed. For five regulated (that is, notified) crops—rice, wheat, potatoes, jute, and sugarcane—the government asks companies to pay fees, takes time for performance tests, and then decides whether or not to allow each cultivar. For all other (nonnotified) crops, registration is required but is automatic, such that private companies are free to introduce new cultivars as they wish. Private companies have introduced hundreds of cultivars for nonnotified crops, such as maize and vegetables, but there is no centralized record of what has been introduced. A nonsystematic survey of seed stores in 2008–09 found 70 maize hybrids (which was likely an undercount), 20 of which account for most sales. Although rice is a notified crop so that registration is time-consuming and onerous, private companies obtained government approval for 76 rice hybrids during 2000–10, whereas government organizations registered only 5 rice hybrids during that time.

Among organizations that reported innovations, a large majority imported at least some technologies, often with little or no modification (Table 1). For pesticides, for example, experts can often make good guesses about what will work in Bangladesh, thereby limiting adaptive research to official trials. Private companies produce rice and wheat threshers based on models from the Bangladesh Agricultural Research Institute (BARI) and the Bangladesh Rice Research Institute (BRRI), which in turn are based on imported models. In a recent survey of Bangladesh's seed companies, most reported collaboration with seed companies in one to nine countries, primarily in Asia and Europe. Most of the world's multinational seed companies introduce cultivars into Bangladesh through locally owned collaborating companies; Syngenta is the only company in our sample that sells seeds through a subsidiary (included in Table 1 as a pesticide company).

Many organizations that reported innovations did not report any R&D expenditures or employing any researchers or any technical staff even with BSc degrees. This suggests that many companies rely heavily on staff with practical, hands-on knowledge to evaluate and adapt new and imported technologies. Even so, private agricultural R&D in Bangladesh has expanded rapidly in recent years. Among the sample organizations, those reporting that they employed one or more researchers (excluding research technicians) increased from 12 in 2001 to 23 in 2008 (including one organization with research in both seeds and livestock product processing). That year, the combined number of professional research staff (researchers, research technicians, and administrators) totaled 1,101 individuals, including 19 with PhDs, 74 with MScs, and 242 with BScs. These numbers include 9 women with MScs and 25 with BScs (Table 2). In 2008, the seed industry accounted for 86 percent of all professional research staff and 89 percent of all research staff with PhDs, MScs, or BScs. Much of this expansion resulted from existing private companies diversifying into seed. Some of the larger private seed research programs not only assessed imported cultivars, but also bred new rice, maize, and vegetable hybrids from both imported and local genetic material. Bangladesh and Assam are the centers of origin for bottle gourd, with local genetic material that supports local breeding. Aside from the seed industry, five pesticide companies and one organization that processes livestock products accounted for most of the remaining research staff.

The reported R&D budgets across all 23 organizations totaled US\$10.8 million in 2008, of which the seed industry accounted for US\$9.7 million or 90 percent (although the survey sample omitted one major seed company, as well as large companies with tea estates, jute processing, shrimp exporting, and food processing). The survey team estimated that, as of 2008, total private R&D spending in Bangladesh was about US\$20 million, equivalent to 50 million 2005 purchasing power parity dollars (PPP\$).<sup>1</sup> With

**Table 2—Researchers, research technicians, support staff, and R&D budgets, 2008**

Product type	Organizations reporting researchers	Research and research support staff (headcount)						Administrative support staff	Total R&D budget in US\$1,000s (range)
		Researchers by qualification (number of women in brackets)			Research technicians by qualification (number of women in brackets)				
		PhD	MSc	BSc	MSc	BSc	Diploma or other		
<b>Inputs</b>									
Seed <sup>a</sup>	13	16	48 (6)	27 (2)	2	204 (17)	558	92	9,700 (16–3,000)
Pesticide	5	3	11	2	—	—	16	20	920 (7–590)
Machinery	1	—	—	1	—	—	7	1	NR
Livestock, fishery inputs	1	—	1	—	—	—	2	2	NR
<b>Large-scale production</b>									
Crop	2	—	—	2	1	1	6	2	40 (4–36)
Fishery	1	—	4 (1)	2 (1)	—	—	5	2	43
<b>Processing</b>									
Livestock <sup>a</sup>	1	—	2 (1)	—	5 (1)	3 (2)	11	42	63
<b>Total</b>	<b>23</b>	<b>19</b>	<b>66 (8)</b>	<b>34 (3)</b>	<b>8 (1)</b>	<b>208 (19)</b>	<b>605</b>	<b>161</b>	<b>10,800</b>

Source: Compiled by authors from survey data.

Notes: Organizations reporting one or more researchers are considered to have R&D programs; this excludes organizations reporting research technicians but no researchers. NR indicates that data were not reported to protect firms' confidential information. <sup>a</sup>One organization reported researchers in both seed and livestock processing.

some caveats, this estimate can be compared with an estimated 2005 PPP\$120 million spent on agricultural research by 31 public organizations in 2009 (Rahija et al. 2012). Notably, private agricultural research expanded faster than public research in the 10 years to 2009.

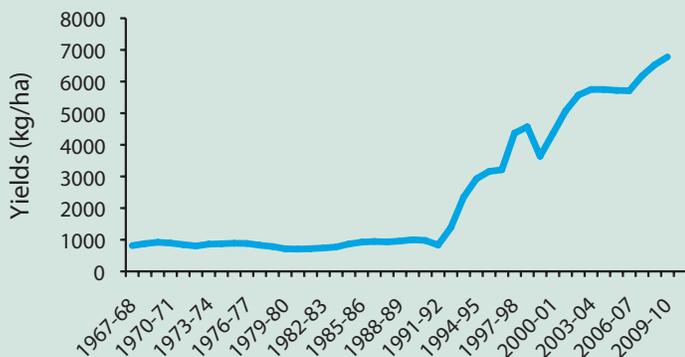
Technology transfer appears to have motivated in-country R&D. For example, in 1990, when Kushtia Seed Store imported and introduced the first maize hybrids from Thailand, the company had no trouble finding hybrids that would yield much more than available open-pollinated varieties. Twenty years later, with scores of hybrids already in the market, companies systematically review available hybrids from foreign breeding; some also breed for desired characteristics. In this case, technology spill-in led to technology-based competition, motivating companies to invest in R&D.

## THE IMPACT OF PRIVATE INNOVATION

The overall impact of private technology on agricultural growth and poverty reduction is difficult to measure because of the ubiquity of the technology and numerous factors impacting agricultural and economic growth. However, for the following categories of agricultural technology, the impact of private technology introduction can be estimated from available data.

**Irrigated Area.** In December 1988, the Government of Bangladesh dropped import duties on small diesel engines and removed a ban on nonaid-funded import of engines for irrigation. Removing duties and allowing farmers to choose engines led to an immediate shift to low-cost engines from China and to more options in the market, including smaller engines. From 1976 to 1988, irrigated area expanded by an average of 108,000 hectares per year. After reforms allowed private traders to introduce engines according to farmers' demand, the average annual expansion of irrigated area increased to 167,000 hectares during 1988–2007, or by an additional 58,000 hectares per year. Additional net income resulting from the private choice of irrigation equipment can be estimated as additional irrigated area multiplied by land rent for irrigated crops (roughly equivalent to the

Figure 1—Maize yield, 1967/68 to 2009/10



Sources: Data for 2003–10 are from the Department of Agricultural Extension (DAE) *Krishi Diary* (Dhaka, 2003 through 2010); data for 2001/02 and 2002/03 are estimated; all other data are from DAE, Bangladesh Agricultural Research Institute (BARI), and International Maize and Wheat Improvement Center, *Integrated Maize Promotion Project: Maize Production and Use* (Dhaka, 2003).

## ASTI Website Interaction



More details on trends in investments, capacity, and policies in private-sector agricultural research and innovation in Bangladesh are available at <http://www.asti.cgiar.org/pdf/Bangladesh-Private-Sector-Report.pdf>.



More information on recent trends in public-sector agricultural research investments and capacity in Bangladesh is available at <http://www.asti.cgiar.org/pdf/Bangladesh-Note.pdf>.

[www.asti.cgiar.org/bangladesh](http://www.asti.cgiar.org/bangladesh)

value of one ton of rice per hectare). Between 1988 and 2010, additional irrigated area had reached 1.3 million hectares, yielding additional net income of US\$534 million.

**Power Tillers.** In 1988 power tillers were so rare that one could spend weeks traveling the country without seeing one. Cutting import duties in late-1988 led, over the next 15 years, to power tillers almost completely replacing oxen for land preparation.

**Maize.** Shortly after the government removed controls on the introduction of new cultivars for all but five crops, private companies and NGOs began to introduce maize hybrids from Thailand and other countries, later supplemented with some in-country breeding. With private hybrids, maize yields increased from an average of less than one ton per hectare for several decades through 1992 to more than six tons per hectare in 2010 (Figure 1). Additional net income from private hybrids is estimated at US\$125 million in 2010.

**Hybrid Rice.** Although rice is a notified crop, private companies and NGOs have successfully brought hybrid rice seed to the market. In 2009–10, farmers planted private hybrids on 6 percent of the country's rice area. Estimating a yield increase of one ton per hectare of paddy on 670,000 hectares, private hybrids accounted for an additional production of 450,000 tons of clean rice in 2010, cutting the country's rice import bill by US\$200 million. Because the farm-gate price for paddy from hybrids is less than from varieties, farmers realize only a portion of this benefit in additional income.

**Non-hybrid Rice.** Bangladeshi farmers have adopted high-yield varieties of rice from India, planting seed smuggled from India or grown and informally traded in Bangladesh. In 2010, Indian rice varieties covered 12 percent of planted rice area. Farmers plant Indian varieties especially in the late rainy season, when the short field duration of many Indian varieties gives farmers more options for the subsequent dry season crop. Estimating that the advantage farmers realize with Indian varieties is equivalent to one-tenth of the rental value of irrigated land in the dry season, the additional net income from Indian rice varieties introduced through the informal private sector was US\$59 million in 2010.

In addition to the above estimates, private technology has supported a rapid expansion of the country's poultry production; enabled off-season vegetable production; and had many other impacts on farm-level production, processing, and exports. However, not all impacts have been favorable. Agricultural growth brings a variety of concerns about environmental and public health. Choice and expanded use of pesticides can have major impacts. Pesticide consumption increased at an average yearly rate of 11 percent from 4,800 tons in 1989 to 25,500 tons in 2005 (about 3 kilograms per hectare of net cultivated area). Even with proper use, pesticide poisons threaten the environment and public health, although some pest-control technologies actually reduce those threats. This study encountered public and private programs promoting integrated pest management, as well as the use of pheromones, parasitic wasps, and other nonpoisonous pest control inputs.

## PROGRAMS AND POLICIES AFFECTING PRIVATE INNOVATION

Government agencies and donors have multiple points of contact with private organizations through which they can influence private innovation and R&D. Of the surveyed organizations, 12 reported current grant support for R&D from the government or donors or both. Private organizations ask for more research grants as well as tax relief, including a tax holiday for R&D. They look to public agencies not only for money, but also for technical assistance. For example, BRRRI reports dozens of pending requests from private organizations wanting to access BRRRI technologies or facilities. BARI works with several private organizations to research biological control agents, pheromones, and microbial pesticides. Science-based companies look to the government to provide scientists. Companies not only recruit entry-level technical staff from public universities, but also engage public-sector scientists as consultants, and often hire them away mid-career, or recruit them after retirement.

All governments regulate agricultural technology that threatens the environment or public health. Many governments also

regulate the introduction of some technologies based on performance, which can impede private technology introduction. In Bangladesh, such regulations apply, inter alia, to cattle breeds, fertilizers, and cultivars for five crops. Among all agribusinesses, seed companies were most interested in regulations, asking, for example, for government to relax barriers to the introduction of new rice and potato cultivars and to establish plant breeders' rights. Government controls on the private introduction of rice and potato cultivars based on performance have suppressed private innovation, hurting farmers, consumers, and agriprocessors.

## CONCLUDING COMMENT

For more than two decades, the Government of Bangladesh has encouraged private agricultural innovation. This support has evolved over time, adapting to technological opportunities as well as business interests. Private companies have responded, sourcing and introducing technologies that have had a major impact on crops, livestock, and processing.

## NOTE

<sup>1</sup> PPPs reflect the purchasing power of currencies more effectively than do standard exchange rates because they compare the prices of a broader range of local—as opposed to internationally traded—goods and services.

## FURTHER READING

Harun-Ar-Rashid, M. Ali, and D. Gisselquist. 2012. *Private Agricultural Innovation and R&D in Bangladesh Agriculture: Description, Impact, and Policy Options*. Washington, DC: International Food Policy Research Institute.

Rahija, M. A., S. M. M. Hossain, M. M. Rahman, and G. J. Stads. 2012. *Bangladesh: Recent Developments in Public Agricultural Research*. ASTI Country Note. Washington, DC and Dhaka: International Food Policy Research Institute and Bangladesh Agricultural Research Council.



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Rutgers, the State University of New Jersey, is a leading national public research university and the state's preeminent, comprehensive public institution of higher education. Rutgers has strong research programs with internationally recognized scholars focused on policy and management issues in three key areas: technology and innovation, food and agricultural systems, and land use.

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