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SHIFTING GROUND

Agricultural R&D Worldwide

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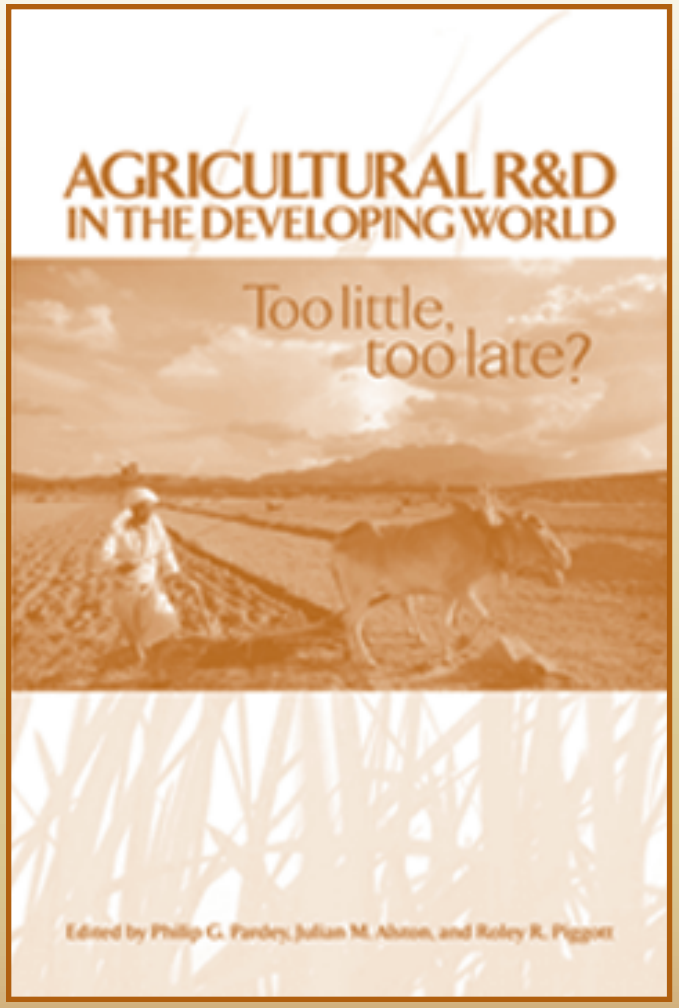
Throughout the 20th century, improvements in agricultural productivity have lifted millions from poverty and starvation and primed the pump of economic progress.

These productivity improvements have been closely linked to investments in agricultural research and development (R&D). In the past quarter century, many countries have made major changes in the way they fund and organize public agricultural R&D and in the incentives affecting private R&D. These changes raise questions about the prospects for sustaining



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productivity over the next 25 years and beyond. Early indicators suggest a global slowdown in agricultural productivity may have already begun.

The authors of the 1999 book *Paying for Agricultural Productivity* (Alston, Pardey, and Smith, eds., Johns Hopkins University Press) documented the changing institutions and investments in agricultural R&D in a selection of rich countries, and the policy shifts that affected such changes. Toward the end of the 20th century, public and private roles shifted in many countries and support for public agricultural research slowed—especially for near-market, applied, productivity-enhancing research.

Today, a slower growing, stagnant, or shrinking public agricultural research pot is increasingly being diverted away from the traditional agenda toward environmental objectives, food quality and safety, and so on. Who, then, will do the research required to generate sustenance for a growing world population when—at least for another quarter century—virtually all the population growth will occur in the poorer parts of the world? These questions and others are raised in a new book, *Agricultural R&D in the Developing World: Too Little, Too Late?*, edited by Philip G. Pardey, Julian M. Alston, and Roley R. Piggott.

Agricultural R&D in the Developing World: Too Little, Too Late? documents the changing institutions and investments in agricultural R&D in less-developed countries and focuses on the implications for future productivity patterns, food security, and policy. It serves as a companion volume to *Paying for Agricultural Productivity,* providing a more complete global picture of the issues. More importantly, it takes stock of what is happening in less-developed countries, especially given the likelihood that many will have to become more self-reliant in generating crucial new agricultural technologies in light of what has already happened and will continue to happen in agricultural R&D in the United States and other key rich countries. The book documents developments in nine countries—Bangladesh, Brazil, China, Colombia, India, Indonesia, South Africa, South Korea, and Zambia—as well as in the system of International Agricultural Research Centers (IARCs), including the Consultative Group on International Agricultural Research (CGIAR). It highlights the important dependence of developing countries on technology spillovers from developed countries, both directly and through the IARCs. As the subtitle "Too Little, Too Late?" suggests, the book raises questions about the future capacity of the world's poor countries

to generate the agricultural technologies they will require to feed themselves if recent trends in the global structure of agricultural research institutions and investments continue unabated.

DIVERGING RESEARCH AGENDAS

The world's agricultural economy underwent a remarkable transformation during the 20th century as the result of agricultural productivity growth, which was primarily generated by agricultural R&D financed and conducted by a small group of rich countries—especially the United States, but also Japan, the United Kingdom, France, and Germany. In an increasingly interdependent world, both rich and poor countries have depended on agricultural research conducted in the private and public laboratories of these few countries, even though they have not contributed to financing the activity.

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But now the rich countries' research agendas are shifting. In particular, they are no longer as interested in simple productivity enhancement. Dietary patterns and other priorities change as incomes increase, but food security concerns are still pervasive among poor people, predominantly in poor countries. In rich countries, emphasis on enhancing the production of staple foods is declining in favor of interest in enhancing certain attributes of food (such as increasing demand for processed and so-called functional foods) and food production systems (such as organic farming, humane livestock production systems, localized food sources, and "fair trade" coffee).

In addition to growing differences in consumer demand for innovation between rich and poor countries, research agendas may diverge because of differences in producer and processor demands. Farmers in rich countries are demanding high-technology inputs that often are not as relevant for subsistence agriculture (such as precision farming technology or other capital-intensive methods). As well as differences in value-adding processes to serve consumer demands, there are differences in farm production technologies to serve evolving agribusiness demands for farm products with specific attributes to serve particular food, feed, energy, medical, or industrial applications. As rich-country research responds to these changing patterns of demand for innovations, the emphasis of the science is being skewed in ways that could undermine the international spillovers that have traditionally contributed significant shares of the gains in food production throughout poorer countries of the world. These spillovers are not generally well understood, and their importance is underappreciated.

Other aspects of agricultural science policy, and the context in which such policy is generated, are changing as well. In particular, the rise of modern biotechnology and enhanced intellectual property rights (IPR) regimes mean that the types of technologies that were once freely accessible will be more difficult to access in the future. Moreover, the new technologies may not be as portable as in the past. Biotech companies are mostly located in the rich countries—particularly in the United States—and they emphasize technologies that are applicable at home. These and other factors limit incentives for companies to develop technologies for less-developed countries. Hence some fear less-developed countries will become technological orphans, abandoned by their former private- and public-sector benefactors in rich countries.

INTERNATIONAL R&D SPILLOVERS— NEW PRESSURES FOR SELF-RELIANCE

International spillovers of public agricultural R&D results are extremely important. They can have profound implications for the distribution of research benefits between consumers and producers, and thus among countries, and have contributed to a global underinvestment in agricultural R&D that the existing public policies have only partly succeeded in correcting. The stakes are high because the benefits from agricultural technology spillovers are worth many times more than the investments that give rise to them.

The world's poorest countries have depended on the spillover of technologies from industrialized countries (especially from the United States, but also the United Kingdom, France, and others), both individually and through their collective action via the CGIAR. Until recently, much of the successful innovative effort in most of the world's poorer countries occurred at the very last stage of the process—selecting and adapting varieties for local conditions using breeding lines and other materials developed elsewhere. Only a few larger countries, such as Brazil, China, and India, were able to achieve much by themselves at the more upstream stages of the research and innovation process, even for improved crop technologies for which conventional breeding methods are widely applied. Until recently, that strategy was reasonable, given an abundant and freely accessible supply of suitable materials, at least for the main temperate-zone food crops.

Changes in the emphasis of rich-country research, combined with new intellectual property rules and practices in conjunction with an increased use of modern biotechnology methods, have already begun to spell a drying up of the public pool of new varieties. In addition, the other main source of varietal materials—the CGIAR—has changed its emphasis and is scaling back its role in providing finished material or advanced breeding lines. The reduction in spillovers from these traditional sources will mean that less-developed countries will have to find new ways of meeting their demands for new varieties.

PERVASIVE UNDERINVESTMENT

Investment in agricultural research yields high returns, and agricultural research has played a major role in helping to provide food for large and expanding populations. But underfunding of agricultural research is pervasive, especially in the poorer countries. Underfunding of agricultural research is alarming for a number of reasons related to the continuing demand for new technologies and concern about the opportunities that will be available to the world's poorest people. Specific factors include:

- the continuing and substantive growth of populations, especially in the world's poorest countries;
- an increasingly scarce and deteriorating natural resource base;
- the pervasive pockets of hunger and poverty that persist in developing countries, in many cases despite impressive national average productivity increases; and
- the growing divergence between rich-country research agendas and the priorities of poor people.

RESEARCH SPENDING PATTERNS

During the past two decades, worldwide public investments in agricultural research grew by 51 percent in inflation-adjusted terms, from an estimated $15.2 billion (2000 international dollars) in 1981 to about $23 billion in 2000. This public spending was concentrated in only a handful of countries. Just four countries—the United States, Japan, France, and Germany—accounted for two-thirds of the $12.8 billion of public research done by rich countries in 2000. Similarly, four of the developing countries among those included in this book—China, India, Brazil, and South Africa—spent almost 50 percent of the developing world's public agricultural research money in 2000. Since the 1990s, developing countries as a group have undertaken more of the world's public agricultural research than the developed countries.

In many parts of the world, the rapid growth in spending during the 1970s and early 1980s gave way to a dramatic slowdown in the first half of the 1990s. In the rich countries, public investment shrank by 0.58 percent annually in inflation-adjusted terms between 1991 and 2000, compared with an increase of 2.3 percent per year during the 1980s. Investment in Africa grew by only 0.82 percent per year, much slower than the 1.25 percent per year growth of the 1980s. This was the continuation of a longer-run trend for agriculture generally and agricultural R&D in particular that began with rapid growth in spending in the 1960s, debt crises in the 1980s, then curbs on government spending and waning donor support in the 1990s. Spending growth slowed in the Middle East and North Africa as well and in Asia as a whole.

China and India are exceptions. Growth in spending during the 1990s was strong, averaging 5.04 percent per year in China and 6.37 percent per year in India. Things look a little better in Latin America, too, with growth in spending of 2.06 percent per year from 1991 to 2000, compared with about half that rate during the previous decade. But the recovery in Latin America seems fragile and is not shared widely throughout the region. Many of the poorer (and smaller) countries have failed to experience any sustained growth in funding for the past several decades.

By 2000, roughly one-third of the $36.9 billion total investment in agricultural research worldwide was by private firms, including those involved in providing farm inputs and processing farm products. But little of this research took place in developing countries. The overwhelming majority was conducted in developed countries ($12.6 billion, or more than 90 percent of the global total). In the less-developed countries, where public funds are still the major source of support, the private share of research was just 8.3 percent. (Public funds remain a significant source of support in rich countries, too, accounting for 45 percent of their total funding in 2000.) While more than one-half of the world's public R&D dollars are spent in developing counties, only one-third of the public plus private research spending occurs in that part of the world. In addition, the research intensity gap between rich and poor countries is wide and growing.

POLICY IMPLICATIONS

Agricultural R&D for less-developed countries is at a crossroads. The close of the 20th century marked changes in policy contexts, fundamental shifts in the scientific basis for agricultural R&D, and shifting funding patterns for agricultural research in rich countries. These changes imply a requirement for both rethinking national policies in less-developed countries and reconsidering multinational approaches to determine the types of activities to conduct through the CGIAR and like institutions and how these activities should be organized and financed.

Even though there is no evidence to suggest that the world can afford to reduce its rate of investment in agricultural research and every indication that we should invest more, we cannot presume that the rich countries of the world will play the same roles as in the past. In particular, countries that in the past relied on technological spillovers from the North may no longer have that luxury available to them in the same ways or to the same extent. This change can be seen as involving three elements:

1. The types of technologies being developed in the rich countries may no longer be as readily applicable to less-developed countries as they were in the past.

2. Those technologies that are applicable may not be as readily accessible because of intellectual property protection of privately owned technologies.

3. Those technologies that are applicable and available are likely to require more substantial local development and adaptation, calling for more sophisticated and more extensive forms of scientific research and development than in the past.

In short, different approaches may have to be devised to make it possible for less-developed countries to achieve equivalent access and tap into technological potentials generated by rich countries, and in many instances less-developed countries may have to extend their own R&D efforts farther upstream to more fundamental areas of the science.

CONCLUSIONS

The balance of global agricultural research investments is shifting in ways that will have important long-term consequences, especially for the world's poorest people. The primary reason is changes in the supply and demand for agricultural technologies in the world's richest countries, which have been the main producers of agricultural technologies. These countries seem unlikely to provide the quantities of productivity-enhancing technologies, suitable for adaptation and adoption in poor countries, that they did in the past. This trend has been compounded by a reduction of rich-country support for the international agricultural research system, which had already diverted its own attention away from productivity-enhancing technologies, especially for staple food crops.

These changes mean that developing countries will have to become more self-reliant in the development of applicable agricultural technologies. To achieve complete self-reliance will be beyond many countries, especially given recent and ongoing structural changes in science and scientific institutions—in particular the rise of modern biotechnologies and other high-tech agriculture, and the associated roles of intellectual property. The largest

developing countries—Brazil, China, and India—are making the transition; nevertheless, they have yet to overcome the problem of chronic underinvestment in agricultural research, and they have many problems to overcome with respect to the effective management and efficient use of the resources that they have available.

The poorest of the poor will continue to rely on the supply of spillovers from other countries and from multinational efforts, but current international investments in productivity-enhancing research seem too small to fill the vacuum being created by the changes in rich-country research agendas. Recent trends raise the specter of a return to an era of a large and growing scientific and productivity gap, with attendant human problems. A rethinking of some national and multinational policies is required.

The issues are large scale and long term and demand serious attention, including further, more specific analysis. The national governments of developing countries can take some initiative, as indicated by the analysis of case studies in the book, in areas of national agricultural research policy such as: (1) enhancing IPR and tailoring the institutional and policy details of intellectual property to best fit local circumstances, (2) increasing the total amount of government funding for their national agricultural research systems, (3) introducing institutional arrangements and incentives for private and joint public–private funding, such as matching grants and check-off funds, and (4) improving the processes by which agricultural research resources are administered and allocated. But such initiatives alone may not be sufficient. Another role for poor-country governments and others who care will be to remind rich people in developed countries that they can and should do more to help poor people in developing countries to feed themselves.

This brief is based on the book *Agricultural R&D in the Developing World: Too Little, Too Late?,* edited by Philip G. Pardey, Julian M. Alston, and Roley R. Piggott and published by the International Food Policy Research Institute. For more information, go to www.ifpri.org.

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