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Propellers of Agricultural Productivity in India

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What Is the Issue?

In recent years, economists have questioned India's continued ability to supply food to its 1.24 billion citizens. Central to these questions has been the waning impact of cereal grain technologies typified by the Green Revolution, concurrent with rising consumer demand for high-value foods. Key determinants of India's food supply and income growth are the rate of agricultural productivity growth and how its major sources affect that growth. Because India's regions differ substantially in the quality and quantity of their natural resources and levels of average income, a regional evaluation of productivity growth is critical to understanding the policies propelling growth.

What Did the Study Find?

Between 1980 and 2008, India's agricultural growth has expanded beyond the Northern grain belt, led primarily by rapid production growth in horticulture and livestock products. India's agricultural output grew, on average, by 3.1 percent per year. That growth was due more to an increase in productivity than to an increase in resources; efficiency and technical changes accounted for 66 percent of that growth, while more conventional inputs (land, labor, capital, and materials) accounted for 34 percent. Over the same period, Indian agriculture's productivity growth rate averaged 2.1 percent per year. However, productivity growth rates varied considerably by region: the Center (1.7 percent) and Northeast (1.0 percent) regions showed the slowest growth; the North (1.9 percent) and East (1.9 percent) regions showed faster growth; and the West (2.3 percent) and South (2.7 percent) regions showed the fastest growth.

ERS researchers identified several policies propelling productivity growth in Indian agriculture. Of these, public investments in both India's agricultural research and higher education system and its irrigation infrastructure had the greatest effects on productivity. From 1980 to 2008, public investment in agricultural research had the greatest effect on productivity in the northern, western, and central States. India's average return on public investment in its agricultural research and higher education system was 85 percent: for each \$1 invested in India's research-and-education program, \$18.34 in research benefits were generated.

The second-greatest effect on productivity was from an expansion of irrigated area. During the 1980-2008 period, extending irrigation infrastructure had a greater effect on productivity

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in the northern and western States than in the rest of the country. Focusing on the sources of irrigation, India's expansion of groundwater-well-irrigated area had a larger effect on productivity growth than did the expansion of canal-irrigated area. Groundwater wells have released the geographic constraint presented by accessing canal water, which in turn has boosted production by allowing more land to be double cropped. Investments in public rural education had mixed productivity effects. Investments in education accelerated productivity when the per capita average level of rural schooling was already greater than 4.3 years. However, when the average level of education was less than 4.3 years, the investments dampened productivity growth. Reaching 4.3 years of education is thus important for farm labor to successfully adapt and adopt new farm technologies and practices, thereby improving productive efficiency. International public agricultural research investments also contributed to India's rising productivity growth, although the effects were difficult to disentangle from those of private research investments.

How Was the Study Conducted?

To evaluate agricultural sector productivity change from 1980 to 2008, ERS researchers constructed output, input, and total factor productivity (TFP) quantity indexes for each Indian State as well as at the regional and national levels. TFP growth is defined as the difference between agricultural output growth and the weighted sum of land, labor, capital, and materials applied in the sector. Each input's aggregation weight is obtained from its relative share of total expenditures; each output's aggregation weight is obtained from its relative share of total revenues. A comprehensive State-level dataset was assembled, accounting for a broader mix of outputs than previous studies to more fully capture the agricultural sector's growth from 1980 to 2008, the last year for which State-level data were available. ERS researchers investigated the effects of India's research and development on TFP, including examination of how national research benefits were modeled.