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IN ORDER to feed the growing population of the world, expected to reach 9.6 billion people—a 29 percent increase over 2013—by 2050 without causing immense environmental damage and hunger, society must increase agricultural productivity. Investing further in public agricultural research and extension will help alleviate this problem. Developed countries, like the United States, have been a leader in this area for most of the twentieth century. For example, US public agricultural research grew rapidly from 1960–1980, but slowed considerably from 1980–1995, showed negative growth from 1995–1998, then flattened by 2010.

Rapidly developing countries, such as Brazil and China, are investing heavily in agricultural research, putting the future international competitiveness of US agricultural exports at risk. Future investments in public and private agricultural research and extension may not be large enough to deliver declining real world food prices, leaving consumers worse off. Moreover, those currently engaged in public agricultural science and agricultural extension policy debates need up-to-date estimates of the expected returns on investment of public funds in both of these activities.

In the United States, agricultural research and cooperative extension are separate public programs, each jointly funded primarily by the federal and state governments. Public agricultural research is undertaken primarily by state institutions, such as state agricultural experiment stations (SAES) and veterinary medicine colleges/schools, and federal institutions such as the USDA’s Agricultural Research Service (ARS) and Economic Research Service. In addition, public agricultural research received a small amount of funding from the private sector and from non-governmental organizations and public extension receives significant funding from county governments.

Although SAES were established to conduct original research on agriculture, the breadth of the research undertaken has increased over time to include research on improving the rural home and rural life, agricultural marketing and resource conservation, forestry and wildlife habitat, and rural development. In addition, the breadth of research undertaken by the USDA has expanded through new institutions. For example, in 1924, the Bureau of Home Economics was established, and in 1957, the Home Economics Division and Utilization Division, which focused on post-harvest agricultural research, were combined into the Nutrition, Consumer, and Industrial Uses Division.

As part of the federal-state partnership on funding of public agricultural research, the USDA’s intramural research agencies, SAESs, state forestry schools, and other cooperating institutions agree to provide Current Research Information System (CRIS) data on research projects. Hence, the range of research topics covered by US public agricultural research data span traditional crop and livestock production, diseases, pests, and resources, and also forestry research, post-harvest research (food processing, agricultural marketing and agricultural policy), rural and community development research, and home economics and human nutrition research.

However, with the details available in CRIS, it is possible to relatively accurately net out public agricultural research expenditures that clearly do not have a traditional agricultural productivity focus. How much of a difference does it make? In 1970, 70 percent of the US total expenditures on public agricultural research reported to CRIS were on agricultural productivity-oriented research, but that has been slowly declining. In ARS, a significantly larger share of research undertaken is agricultural productivity oriented than in the state public agricultural research system. Public agricultural research undertaken in one state produces discoveries benefiting local farms and agri-businesses but also spilling over to the public and private agricultural research efforts in other states and to technologies available to farms and agri-businesses in these areas. Spillover benefits are linked to similarity of agroecological zones, output-mix similarities, or geographical proximity.

When areas are close to one another it reduces the physical distance that discoveries and information must travel before they can be used by farmers and agribusiness in another area. This reduces one dimension of the costs of information transfers. For example, discoveries made by public agricultural research in Iowa on corn can easily travel to agribusinesses and farmers in Illinois and southern
Minnesota but are less useful to Mississippi and New York.

Extension is primarily adult education for immediate decision making of farmers, households, and communities and youth activities. Broadly, the goal has been to provide information for better farm, agribusiness and home decision making. Youth activities are comprised of "boys" and "girls" clubs, called "4-H" clubs, where members undertake practical projects in agriculture, home economics, and related subjects, such as developing a product to "show" and be "judged" at a local county fair, (e.g., fattened lambs or pigs, baked cookies or cakes, canned fruits, etc.). The science of these 4-H projects has been roughly comparable to high school science classes.

Although a gross measure of cooperative extension is possible, it seems most likely that only agriculture and natural resource extension contribute significantly to state agricultural productivity. This requires netting out resources allocated to other types of extension activities (i.e., home economics, community development and 4-H). How much of a difference is their between the net and gross measures of cooperative extension? From 1977 to 1992, only 55 percent of the gross activities were for agricultural and natural resource extension. In addition, in 1977, 30 percent of the gross extension was allocated to 4-H, but this share declined to 23 percent in 1992 and seemingly leveled off.

Real expenditures on public productivity-oriented agricultural research undertaken by state and USDA institutions grew at an average rate of 3.2 percent, from 1960 to 1980; however, its growth slowed to 0.9 percent from 1980 to 1990, then fell to -0.8 percent from 1990 to 2009. In particular, real public agricultural research effort peaked in the United States in 1994, and then was 22 percent lower in 2009. To give a little more perspective, in California, Iowa, North Carolina, and Texas productivity-oriented public agricultural-research expenditures peaked in the late 1980s and the early to mid-1990s (see Figure 1).

Using new and updated data and allowing for lags in realizing within state and interstate spillover benefits, this study estimates that the real annual internal rate of return to investments in productivity-oriented public agricultural research is 67 percent and for agricultural and natural resource extension is over 100 percent. These are large returns that have not been matched by other public sector investments. Hence, there is no evidence of low returns to public agricultural research or extension in the United States, or that public funds should be shifted from public agricultural extension to agricultural research.

Other countries can learn from the research undertaken in the United States to estimate rates of return to public agricultural research and extension. First, it is important to think carefully about and identify plausible benefits and costs. In particular, one should guard against creating variables that contain obvious forms of measurement error, such as inaccurately measuring the costs and benefits or aggregating public agricultural research and extension together.

![Figure 1. Real public agricultural research expenditures, CA, IA, NC, and TX, 1970–2009 (millions of 2006 dollars).](http://lib.dr.iastate.edu/agpolicyreview/vol2016/iss1/3)