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Agricultural Research: Background and Issues

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Summary

The U.S. Department of Agriculture's (USDA's) Research, Education, and Economics (REE) mission area has the primary federal responsibility of advancing scientific knowledge for agriculture through research, education, and extension. USDA REE responsibilities are carried out by four agencies: the Agricultural Research Service (ARS), the National Institute of Food and Agriculture (NIFA), the Economic Research Service (ERS), and the National Agricultural Statistics Service (NASS). USDA conducts its own research and administers extramural federal funding to states and local partners primarily through formula funds and competitive grants.

Discretionary funding for the REE mission area totaled $2.937 billion in FY2016, and mandatory funding from the 2014 farm bill adds another $120 million per year on average.

Debates over the direction of public agricultural research and the nature of its funding mechanism continue. Ongoing issues include the need, if any, for new federal funding to support agricultural research, education, and extension activities, and the implications of allocating federal funds via formula funds versus competitive grants. Many groups believe that Congress needs to increase support of U.S. agriculture through expanded federal support of research, education, and extension programs, whereas others believe that the private sector, not taxpayer dollars, should be used to support these activities.

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USDA's Research, Education, and Economics (REE) Mission Area

The U.S. Department of Agriculture (USDA) combines its research activities into the Research, Education, and Economics (REE) mission area. The mission area is composed of four agencies with the federal responsibility to advance scientific knowledge for agriculture. Activities include the biological, physical, and social sciences related broadly to agriculture, food, and natural resources, delivered through research, statistics, extension, and higher education (**Table 1**).

Table 1. USDA's Research, Education, and Economics (REE) Mission Area

(FY2016 discretionary budget authority)

Function	Entity	Description
Intramural Federal research	**Agricultural Research Service (ARS)** $1.144 billion salaries and expenses + $212 million buildings & facilities	ARS conducts research and disseminates information related to crop and livestock production and protection, human nutrition, food safety, rural development, natural resource management, and conservation. Emphasis is on national and regional problems, including higher-risk and long-term research such as plant and animal genome programs. Workforce of about 5,400 full-time employees located across about 100 research stations.
	National Agricultural Statistics Service (NASS) $168 million	NASS collects and compiles statistics related to U.S. agriculture (e.g., Census of Agriculture, crop forecasts, estimates of farm prices). Workforce of about 1,000 full-time employees; offices in DC, 45 states, and Puerto Rico.
	Economic Research Service (ERS) $85 million	ERS provides economic and policy analysis to inform public and private decision making related to food, farming, natural resource management, agricultural markets, and rural development. Workforce of about 365 full-time employees entirely located in Washington, DC.
Extramural Federal funding of state and other institutions	**National Institute of Food and Agriculture (NIFA)** $1.326 billion	NIFA leads and funds external research, extension, and educational programs for agriculture, the environment, human health and well-being, and communities. Provides grants and partnerships with the land-grant university system and other organizations that work at the state and local level. Workforce of about 400 employees. Federal funding through competitive grants and "formula funds" (the latter based on each state's farm and rural population, with matching fund requirements from the states).
Administrative	**Under Secretary for Research, Education and Economics** **Chief Scientist** **Research, Education, and Extension Office (REEO)** $893,000	The Under Secretary is designated as the Chief Scientist and leads the REEO, which coordinates USDA programs, sets priorities, and aligns scientific capacity across the four agencies. Six divisions: (1) renewable energy, natural resources, and environment; (2) food safety, nutrition, and health; (3) plant health and production; (4) animal health and production; (5) agricultural systems and technology; and (6) agricultural economics and rural communities.
REE total	**$2.937 billion**	

Source: CRS, using USDA and appropriations committee information. Amounts are FY2016 budget authority. For program details, see USDA's Congressional Budget Justification at http://www.obpa.usda.gov.

Federally funded *intramural* research is intended in part to address issues of national importance and promote basic research, regional coordination, and spillover.[1] Federally funded *extramural* research activities are decentralized and are often regionally specific and/or applied in nature. The federal-state research system also supports USDA's regulatory programs in the areas of meat, poultry, and egg inspection; foreign pest and disease exclusion; and control and eradication of crop and livestock threats, among other things.

Although all four USDA research agencies are headquartered in Washington, DC, much of the work is executed through a set of agency field stations and a network of university partners throughout the United States that operate at the state and local levels. The Agricultural Research Service (ARS) has about 100 research centers and work locations across the United States, Puerto Rico, and the Virgin Islands (**Figure 1**). The National Institute of Food and Agriculture (NIFA) partners with colleges of agriculture at land-grant universities in 50 states and eight U.S. territories, affiliated state agricultural experiment stations (SAESs), schools of forestry and veterinary medicine, and the Cooperative Extension system.[2] These colleges include the traditional land-grant colleges of agriculture established by the Morrill Act of 1862 ("1862 institutions"), 19 historically black colleges of agriculture ("1890 institutions," HBCUs) that were created by the Second Morrill Act of 1890, and 31 Native American colleges (referred to as tribal colleges) that gained land-grant status in 1994 (**Figure 2**). The Economic Research Service (ERS) is the only REE agency based entirely in Washington, DC.

The House and Senate Agriculture committees are the committees of jurisdiction for the authorizing statutes and oversight of agricultural research, education, and extension programs. In recent years, Congress has modified agricultural research policy in the "farm bill," most recently in 2014 (P.L. 113-79, Title VII). Annual appropriations bills and hearings provide more frequent opportunities for oversight and determination of funding.

Federal Funding

The majority of federal funding for agricultural research, education, and extension activities is from annual discretionary appropriations in the Agriculture and Related Agencies appropriations bill.[3] In FY2016, discretionary funding for the entire REE mission area totaled $2.937 billion (**Table 1**). A subset of research programs, especially within NIFA, is provided with mandatory funding—such as for specialty crops or organic agriculture that were created in the 2008 and 2014 farm bills. The 2014 farm bill provides an average of $120 million per year of mandatory funding to agricultural research (**Figure 3**).[4]

Intramural research at federal agencies (ARS, NASS, and ERS) is funded directly with discretionary appropriations to pay salaries and expenses of federal employees, to conduct research, and to build and maintain facilities.

[1] Economists use the term *spillover* to capture the idea that some of the economic benefits of research and development activities affect agents, locales, or activities beyond the original research purpose or location.

[2] The Cooperative Extension system is a nationwide, non-credit educational network where each U.S. state and territory has a state office at its land-grant university and a network of local or regional offices. The purpose of Extension is to gather knowledge gained through research and education and deliver it for practical use directly to farmers and other residents (rural and urban).

[3] For current appropriations issues and coverage, see CRS Report R44588, *Agriculture and Related Agencies: FY2017 Appropriations*.

[4] CRS Report R42484, *Budget Issues That Shaped the 2014 Farm Bill*.

Figure 1. USDA Agricultural Research Service Locations

Source: USDA, Agricultural Research Service, http://www.ars.usda.gov/pandp/locations.htm.

Figure 2. Land-Grant Colleges of Agriculture

Source: U.S. Department of Agriculture, National Institute of Food and Agriculture, http://nifa.usda.gov/sites/default/files/resource/lgu_map_6_25_2014_0.pdf.

Extramural research that is sponsored by NIFA is administered by a relatively small cadre of employees who are funded by a small portion of NIFA's appropriation for salaries and expenses. The vast majority of the NIFA appropriation is available for extramural research grants that are made primarily through two types of funding: formula funds and competitive grants (**Figure 3**).

1. **Formula funds** for research and extension are distributed to land-grant colleges (1862, 1890, and 1994 institutions), schools of forestry, and schools of veterinary medicine using calculations that are set in statute. The amount provided to each institution is determined by census-based statistics that change infrequently. Research priorities at each college may be influenced at the university level (7 U.S.C. 301 et seq.). Two accounts provide most of the formula funding.[5]
    - The **Hatch Act** of 1887 authorizes research funding at the **state agricultural experiment stations** (SAESs). Congress amended the Hatch Act in 1955 to distribute the appropriation based on each state's farm and rural population in the U.S. Census (7 U.S.C. 301). The Hatch Act also requires dollar-for-dollar matching funds from state budgets, but most states appropriate three to four times the federal allotment.[6] The act also requires each state to use 25% of its Hatch Act funds to support multi-state or regional research. HBCUs get similar funding through **Evans-Allen** research grants and **1890s capacity building grants**.
    - The **Smith-Lever Act** authorizes **cooperative extension** funding using statutory formulas and nonfederal matching requirements similar to the Hatch Act (7 U.S.C. 341). Federal funding supporting forestry and veterinary programs at the land grant institutions also is distributed among the institutions according to formulas, but these have different criteria than the Hatch Act and Smith-Lever Act formulas.
2. **Competitive grants** are awarded using a peer-reviewed merit selection process. Activities include fundamental and applied research, extension, and higher education activities, as well as for projects that integrate research, education, and extension functions. Competitive programs are designed to enable USDA to attract a wide pool of applicants to work on agricultural issues of national interest and to select the best quality proposals submitted by highly qualified individuals, institutions, or organizations (7 U.S.C. 450i(b)). Competitive grants are primarily funded with discretionary appropriations, but some also receive mandatory funding from the farm bill (**Figure 3**).

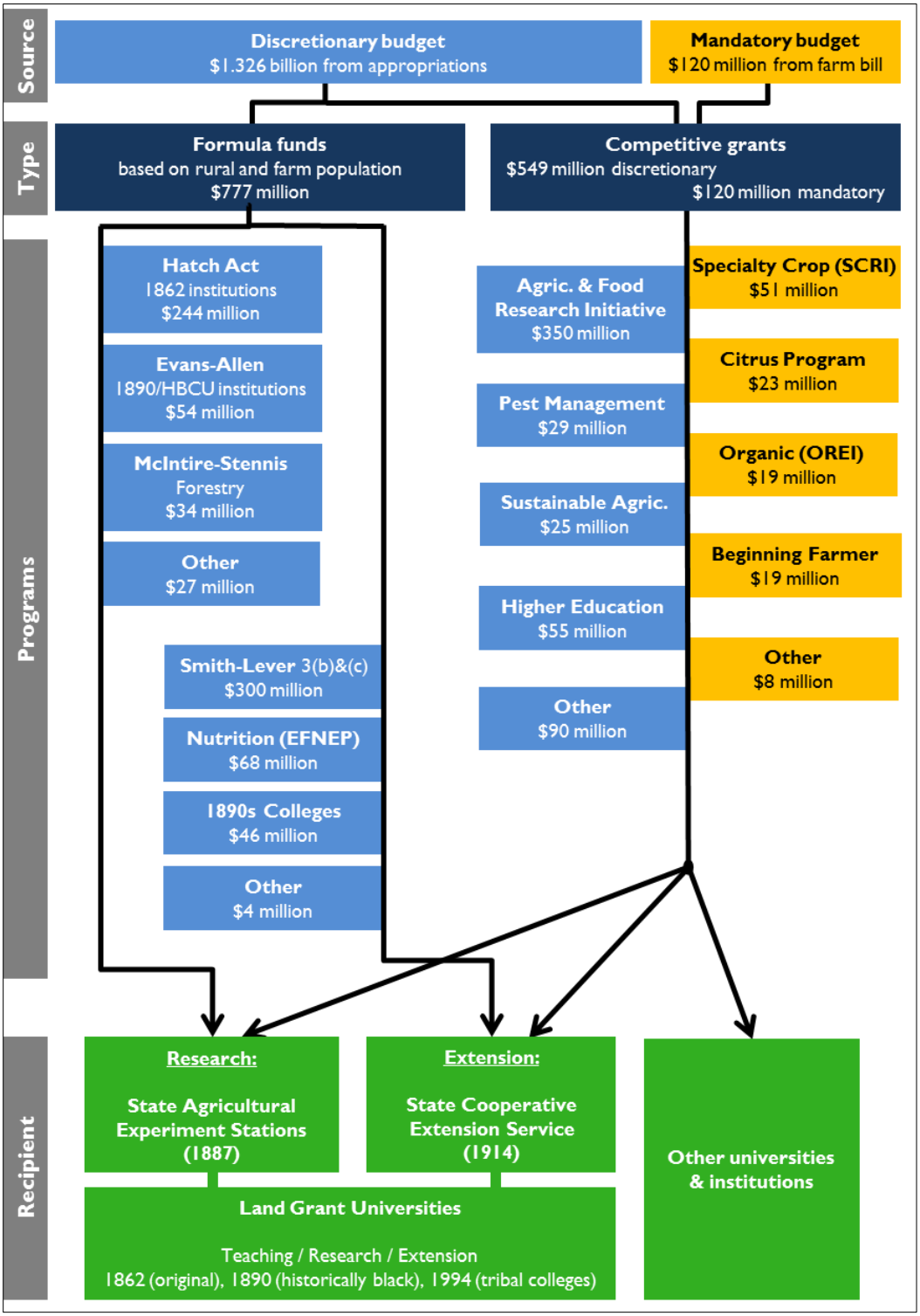
The **Agriculture and Food Research Initiative (AFRI)** is NIFA's flagship competitive grants program. It funds basic and applied research, education, and extension to colleges and universities, agricultural experiment stations, and other organizations conducting research in priority areas that are established partially in the farm bill. The 2008 farm bill mandated that AFRI allocate 60% of grant funds for basic research and 40% for applied research. At least 30% of total funds must be used to integrate research with education and/or extension activities.

[5] Additional details are available in the USDA *Budget Summary* and *Explanatory Notes* for NIFA, available at http://www.obpa.usda.gov.

[6] An exception exists in statute for states that cannot meet the matching requirement. The lack of matching funding for some institutions, however, reduces the resources available to often minority-serving institutions (see Association of Public and Land-Grant Universities, *Land-Grant But Unequal: State One-to-One Match Funding for 1890 Land-Grant Universities*, September 2013, at http://www.aplu.org/library/land-grant-but-unequal-state-one-to-one-match-funding-for-1890-land-grant-universities/file.

Figure 3. National Institute of Food and Agriculture (NIFA) Budget

(FY2016 budget authority)



Source: CRS, based on USDA FY2017 Budget Summary.

Notes: AFRI=Agriculture and Food Research Initiative; EFNEP=Expanded Food and Nutrition Education Program; OREI=Organic Agriculture Research and Education Initiative; SCRI=Specialty Crop Research Initiative.

Formula Funds vs. Competitive Grants

Policymakers continue to debate the appropriate role and implications of various funding mechanisms for agricultural research. At the federal level, this debate entails formula funding versus external peer-reviewed competitive grant funding. Those wanting to focus on agricultural research efficiency often call for more competitive grants to allocate limited federal resources.

Two historically influential reports published by the National Academy of Sciences (NAS)[7] and the Rockefeller Foundation[8] argued that the agricultural research of 30-40 years ago had become overly focused on applied research rather than cutting-edge basic research, and both reports recommended shifting to more competitive funding rather than formula funding of the state agricultural experiment stations (SAESs).

The creation of a new, separate grant-making agency within USDA that was solely responsible for administering competitive grants programs in agricultural research and extension was one of the recommendations that came out of a National Academy of Sciences 2000 report looking at the efficacy of the National Research Initiative Competitive Grants Program.[9] In July 2004, a USDA task force advocated for a revised extramural research agency (what is now NIFA) modeled on the National Institutes of Health (NIH) and National Science Foundation (NSF).[10] It believed that NIFA should accomplish its mission primarily through administering competitive peer-reviewed grants that support and promote high-caliber, fundamental agricultural research.

In its 2012 report, the President's Council of Advisors on Science and Technology recommended a continued focus on increasing the proportion of research funds awarded competitively.[11]

The choice of funding mechanisms is viewed by some as important because it is thought to determine where and by whom the research is conducted, and the type of research performed. On the one hand, the competitive, peer-reviewed process is thought to have an advantage because a wider pool of candidates is eligible to apply for funding (e.g., grant recipients are not limited to land-grant institutions or SAESs), and it is thought to engage the best and brightest minds in addressing challenges facing the agriculture sector.

At the same time, the agricultural community widely acknowledges that USDA-funded research has an important role to play, whether carried out intramurally (e.g., ARS) or through formula funds. Census-based formulas and nearly constant appropriations has meant that states receive a predictable allocation every year. Although all federal sources account for 30% or less of total funding for the experiment stations (including grants from non-research agencies within USDA and from other federal departments), the reliability of the formula funds has resulted in them traditionally being used to support the core ongoing research programs of the state agricultural experiment stations, which underpin academic programs at many universities (**Figure 5**).

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[7] National Academy of Sciences (NAS), *Report of the Committee on Research Advisory to the U.S. Department of Agriculture*, National Academy Press, Washington, DC, 1972.

[8] Rockefeller Foundation, *Science for Agriculture*, The Rockefeller Foundation, New York, NY, 1982.

[9] National Academy of Sciences, *National Research Initiative: A Vital Competitive Grants Program in Food, Fiber, and Natural-Resources Research*, Washington, DC, 2000, http://www.nap.edu/catalog/9844.html.

[10] USDA, Research, Education, and Economics Task Force, *National Institute for Food and Agriculture: A Proposal*, July 2004, http://www.ars.usda.gov/sp2userfiles/place/00000000/national.doc.

[11] President's Council of Advisors on Science and Technology, *Report to the President on Agricultural Preparedness and the Agriculture Research Enterprise*, December 2012, p. 31, http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast_agriculture_20121207.pdf.

Studies have shown that funding through competitive grants tends to favor basic research, reach a greater proportion of non-land grant universities, and are concentrated among fewer states than funding that is allocated by statutory formula funds.[12] States with large agricultural production and top-ranked academic programs in biology and agricultural sciences were generally more competitive and more successful in receiving larger shares of federal funds allocated as competitive grants.

Other studies have shown that federal formula funding has a larger impact on agricultural productivity over the longer term than federal competitive grants and contracts.[13] The rationale is that federal-level research is steady funding that can support core or foundation research and is best able to take on higher-risk and long-term projects of national importance, such as deciphering plant and animal genomes, conducting longitudinal studies on human nutrition, and measuring and analyzing current and historical socioeconomic factors in the U.S. food and fiber sector. Proposals that address problems of concern to an entire state or region, and/or are multi-disciplinary, are typically underfunded in a national competitive-grant process, despite the fact that such research problems are considered by many to be of critical concern and may have a large net social payoff to the agricultural sector.

Intramural vs. Extramural Funding

ARS is the principal in-house or intramurally funded research arm of the USDA. Many believe that maintaining some level of federally funded internal research allows ARS to fill an important niche that is not met by industry or other institutions. Specifically, some believe that intramural research is best to address research problems of national and long-term priority, such as conservation and improvement of plant genetic resources, surveillance and monitoring of national and regional disease outbreaks, soil and water resource management, and adaptation to increasing climate variability and extreme events. On the other hand, some believe that ARS scientists have an unfair advantage in competing with other agricultural scientists, who do not have an endowed source of support like the federal budget for core research expenditures.

Public and Private Funding

A recurring policy issue is whether more federal spending should be provided for agricultural research, education, and extension. A related issue is the role of publicly funded research in context with privately funded research.

Over the long run, and adjusted for inflation, public funding for agricultural research grew steadily from the 1950s to the late 1970s, and remained basically constant from the end of the 1970s through the 1980s (**Figure 4**). There was a marked rise in public funding from 1998 through 2001, at a time of a budget surplus. One-time, supplemental funding for anti-terrorism activities increased funding in the several years after 2001. Funding levels peaked in FY2010, but began declining in FY2011 as Congress cut federal spending.[14] As a result of a relatively flat or

[12] Kelly Day Rubenstein et al., "Competitive Grants and the Funding of Agricultural Research in the United States," *Review of Agricultural Economics*, vol. 25, no. 2 (September 24, 2003), pp. 352-368.

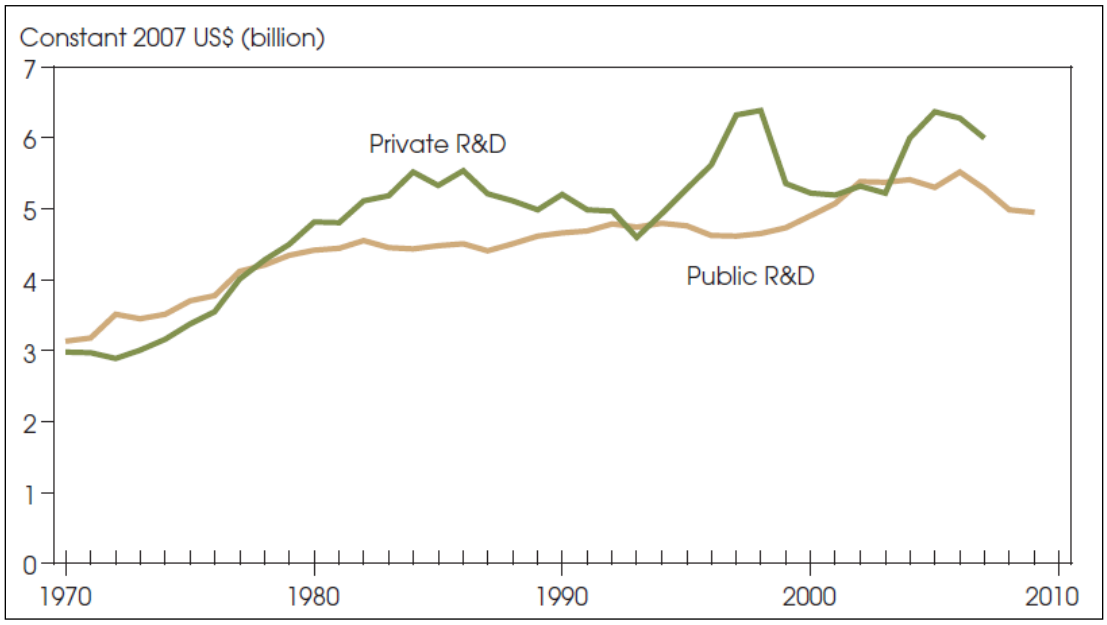
[13] Wallace E. Huffman and Robert E. Evenson, "Do Formula or Competitive Grant Funds Have Greater Impact on State Agricultural Productivity," *American Journal of Economics*, vol. 88, no. 4 (November 2006), pp. 783-798.

[14] Critics have been concerned about the effect on research programs. For example, universities reported widespread delays and reductions in research activities as a result of sequestration (Association of Public and Land-Grant Universities, *Survey on Sequestration Effects—Selected Results from Private and Public Research Universities*, Washington, DC, November 11, 2013, http://www.aau.edu/WorkArea/DownloadAsset.aspx?id=14798).

declining USDA research budget, funding from other federal agencies, such as NIH and NSF, has accounted for an increasing portion of federal support for agricultural research.

Funds from private industry for agricultural research also generally have increased since the 1970s (**Figure 4**). This includes public-private partnerships that can facilitate technology transfer and at the same time help to supplement federal and state support. Private-sector spending on agricultural research has grown faster than publicly funded research and development over the long term.

Figure 4. Real U.S. Public and Private Agricultural R&D Expenditures



Source: John King, Andrew Toole, and Keith Fuglie, *The Complementary Roles of the Public and Private Sectors in U.S. Agricultural Research and Development*, USDA Economic Research Service, Economic Brief No. (EB-19), September 2012, at http://www.ers.usda.gov/media/913804/eb19.pdf.

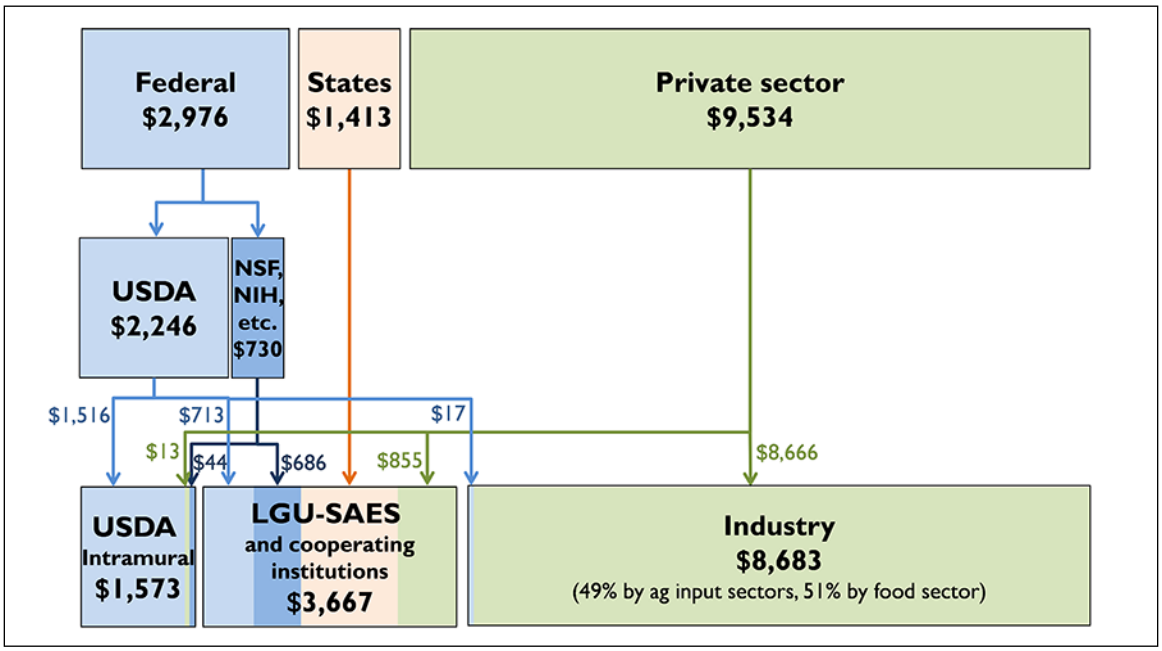
Figure 5 shows the many funders of agricultural research, the scale of their contributions, and the destinations for that funding. In 2009, out of $13.9 billion of agricultural research funding, about 68% came from the private sector ($9.5 billion) and about 62% remained in the private sector ($8.7 billion). State governments passed through $1.4 billion to land-grant universities (LGUs) or state agricultural experiment stations (SAESs), which incidentally received a majority of their funding from combined federal sources in nearly equal shares from USDA, other federal agencies such as NSF and NIH, and the private sector.[15] USDA intramural research by ARS, ERS, and NASS accounted for about 11% of total agricultural research spending in 2009.

Some observers are concerned that both the increase in non-USDA public funding (e.g., NSF and NIH) and the increase in private funding might cause the focus of agricultural research to shift away from the U.S. agricultural sector's highest priorities and needs. They believe that such a shift could hamper the nation's ability to remain cutting-edge with regard to new innovations, to be competitive in a global market, and to cope with long-term challenges such as pest and disease outbreaks, climate change, and natural resource management.

[15] This accounting is for the research function only and excludes funding for the Cooperative Extension system.

Figure 5. Funders and Performers of U.S. Food and Agricultural Research in 2009

(dollars in millions)



Source: USDA, Economic Research Service (update by CRS of Figure 2 in USDA-ERS EB-19, September 2012, based on ERS data obtained by personal communication in June 2015).

Notes: Includes research and development funding only; that is, does not include Cooperative Extension.

Agricultural Research Supports Productivity

Public investment in agricultural research has been linked to productivity gains and economic growth.[16] Studies consistently report high social rates of return (20%-60% annually) from public agricultural research.[17] The rate of return may depend on the type of research (basic vs. applied), the duration of the research investment, and the specific commodity being studied.

Advances in agricultural research and extension were critical to the huge productivity gains in the United States after World War II (**Figure 6**).[18] Yields for some major crops grew about 2% annually from the 1950s through the 1980s, but that growth has moderated since 1990 (**Table 2**).

Advances in the basic and applied agricultural sciences—such as disease-resistant crop varieties, efficient irrigation practices, and improved marketing systems—are considered fundamental to achievements in agricultural yields, increases in farm sector profitability, higher competitiveness in international agricultural trade, and improvements in nutrition and human health.

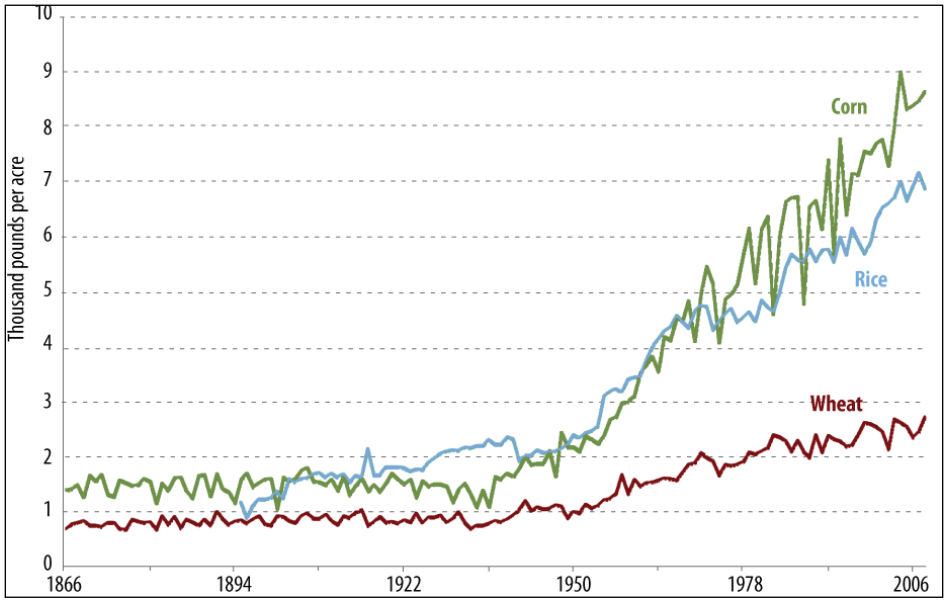
[16] Keith O. Fuglie and Paul W. Heisey, *Economic Returns to Public Agricultural Research*, USDA Economic Research Service, Economic Brief Number 10, Washington, DC, September 2007, http://www.ers.usda.gov/Publications/EB10/.

[17] J. M. Alston, C. Chan-Kang, and M. C. Marra et al., *A Meta-Analysis of Rates of Return to Agricultural R&D*, International Food Policy Research Institute, 2000, http://www.ifpri.org/sites/default/files/publications/rr113.pdf.

[18] Philip Pardey, "Putting U.S. Agricultural R&D and Productivity Developments in Perspective," Farm Foundation Conference, 2009, http://www.farmfoundation.org/news/articlefiles/1705-Pardey%20.pdf.

Some want more public spending on agricultural research to maintain U.S. competitiveness and increase agricultural productivity in the face of world population growth and food demand.[19] But agricultural research competes for federal funding in relation to other federal agricultural programs, such as conservation, farm income and risk management programs, food safety inspection, rural development, and domestic and foreign food aid programs.[20]

Figure 6. U.S. Farm Commodity Yields, 1866-2008



Source: Philip Pardey, "Putting U.S. Agricultural R&D and Productivity Developments in Perspective," Farm Foundation Conference, 2009, http://www.farmfoundation.org/news/articlefiles/1705-Pardey%20.pdf.

Table 2. Percentage Growth Rates per Year of Average U.S. Crop Yields

	Corn	Wheat	Rice	Soybeans
1950-1989	2.85	1.75	2.27	1.02
Post-1990	1.5	0.15	1.37	1.16

Source: J. M. Alston, J. M. Beddow, and P. G. Pardey, "Agricultural Research, Productivity, and Food Commodity Prices," University of California, 2009, http://giannini.ucop.edu/media/are-update/files/articles/v12n2_5.pdf.

The 2008 farm bill required the REEO to develop and implement a USDA Roadmap for Agricultural Research, Education, and Extension to plan and coordinate across the entire department both capacity and competitive programs, as well as USDA-administered intramural and extramural programs.[21] The objective was to identify current trends, constraints, gaps, and

[19] For example, see Charles Valentine Riley Memorial Foundation, *Pursuing a Unifying Message: Elevating Food, Agricultural and Natural Resources Research as a National Priority*, 2014, http://192.254.250.185/~swcs/wp-content/uploads/2014/11/UnifyingReport_8Frevised2.pdf; USDA Economic Research Service, *Public Agriculture Research Spending and Future U.S. Agricultural Productivity Growth: Scenarios for 2010-2050*, EB-17, 2011, http://www.ers.usda.gov/media/118663/eb17.pdf; and United Nations, Food and Agriculture Organization, "2050: Increased Investment in Agricultural Research Essential," 2009, http://www.fao.org/news/story/en/item/35686/icode.

[20] CRS Report R43938, *FY2016 Agriculture and Related Agencies Appropriations: In Brief*.

[21] USDA-REE, *A Roadmap for USDA Science*, 2010, at http://www.ree.usda.gov/ree/news/REE_Roadmap9_final.pdf.

major opportunities that no single entity within the USDA would be able to address individually. The research provisions, including changes to the management and structure of REE in the 2008 farm bill, drew heavily on proposals and recommendations put forth by key stakeholder groups, including the USDA Task Force on Research, Education, and Extension and the Association of Public and Land-Grant Universities (APLU).[22] USDA subsequently published an "Action Plan" that builds upon the Roadmap.[23]

Some argue that the stagnant growth in inflation-adjusted USDA funding for agricultural research, education, and extension over the past few decades has hurt the ability of the U.S. agricultural sector to stay productive and competitive.[24] It is widely acknowledged that new innovations and technologies related to production, processing, marketing, and natural resource management are essential for continued productivity gains and economic growth of the sector.

Some of these same critics argue that USDA has not been successful at elevating agricultural research to the same priority level with policymakers as other sectors, such as health, and that U.S. agriculture will suffer over the long term because of a lack of new innovations. These critics argue that the lack of public investment in new agricultural innovations will have dire consequences in the future, especially given new and varied challenges, such as rising production costs, especially for fuel and inputs; new pest and disease outbreaks; increasing frequency of extreme weather events, such as droughts and floods; and climate change.

On the other hand, some argue that the federal government should have a limited role in funding agricultural research and that taxpayer dollars should not be used to support what should be a private sector endeavor. In addition, due to a severely constrained federal budget in recent years, limited resources are available to support the agricultural sector. Historically, Congress has not prioritized increasing funding for agricultural research, education, and extension activities, and instead has tended to fund programs designed to provide more immediate benefits to farmers, such as income support and crop insurance. Others believe that the states and the private sector should fill the research funding gap left by the federal government.

At the same time, while private sector funding has increased over time to fill some of the gap in public spending, there is growing concern that private sector funding focuses primarily on taking existing technologies to market (i.e., more applied research) and does not focus on basic problems and/or longer-term challenges that the agricultural sector may face in the future, such as environmental sustainability or adaptation to climate variability.

Some advocates have argued that some of USDA's agricultural research portfolio duplicates private sector activities on major crops, including corn, soybeans, wheat, and cotton.[25] They argue that funding should be reallocated to basic, noncommercial research to benefit the public good that is not addressed through private efforts. Others point out that these crops are economically important to the food, feed, and energy sectors and should continue to receive significant amounts of public funding, especially for emerging threats, such as new pests and pathogens, limited water availability, and impacts of agriculture on human and environmental health.

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[22] *Create Research, Extension, and Teaching Excellence for the 21st Century* (CREATE-21). APLU was previously known as National Association of State Universities and Land Grant Colleges (NASULGC); NASULGC changed its name to APLU in March 2009.

[23] USDA-REE, *Research, Education, and Economics Action Plan*, February 2012, revised March 2014, at http://www.ree.usda.gov/ree/news/USDA_REE_Action_Plan_03-2014.pdf.

[24] See footnote 19.

[25] President's Council of Advisors on Science and Technology, *Report to the President on Agricultural Preparedness and the Agriculture Research Enterprise*, Washington, DC, December 2012, http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast_agriculture_20121207.pdf.

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