Agricultural Research, Education, and Extension: Issues and Background

Dennis A. Shields
Specialist in Agricultural Policy

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Summary

The U.S. Department of Agriculture (USDA) 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). The USDA administers extramural federal appropriations to states and local partners primarily through three funding mechanisms: formula funds, competitive grants, and non-competitive grant programs.

The FY2012 Agriculture Appropriations Act (P.L. 112-55, H.R. 2112) contained $2.53 billion in discretionary funds for USDA agricultural research, education, and extension programs. While inflation-adjusted public spending for agricultural research grew steadily from the 1950s to the 1970s, it has remained relatively flat since the 1970s (with a few exceptions), and growth in funding has lagged behind that of other national science agencies.

The enacted 2008 farm bill (P.L. 110-246) directed USDA to reorganize the REE mission area. The farm bill created a new entity called the National Institute for Food and Agriculture (NIFA), which assumed all programs and authorities from the Cooperative State Research, Education, and Extension Service (CSREES). A new competitive grants program for basic and applied research, called the Agriculture and Food Research Initiative (AFRI), was also established by the 2008 farm bill and is administered by NIFA. The farm bill also extends and expands mandatory and discretionary funding for specialty and organic crops research, bioenergy programs, and pollinator protection programs, among others. Several mandatory programs (research and otherwise) that were authorized in the 2008 farm bill do not have a budget baseline that extends beyond the end of the 2008 farm bill (September 30, 2012). If policymakers want to continue these programs in the next farm bill, they will need to pay for them with other offsets.

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. In addition, factors including the growing importance of specialty crops, international trade negotiations, and a renewed interest in international agricultural development have many groups believing that Congress needs to increase support of U.S. agriculture through expanded research, education, and extension programs, whereas others believe that the private sector, not taxpayer dollars, should be used to support these activities.

While the 2008 farm bill provided a significant funding boost for agricultural research, relatively speaking, it is unclear whether budgetary resources and political will can sustain funding for agricultural research and related activities.

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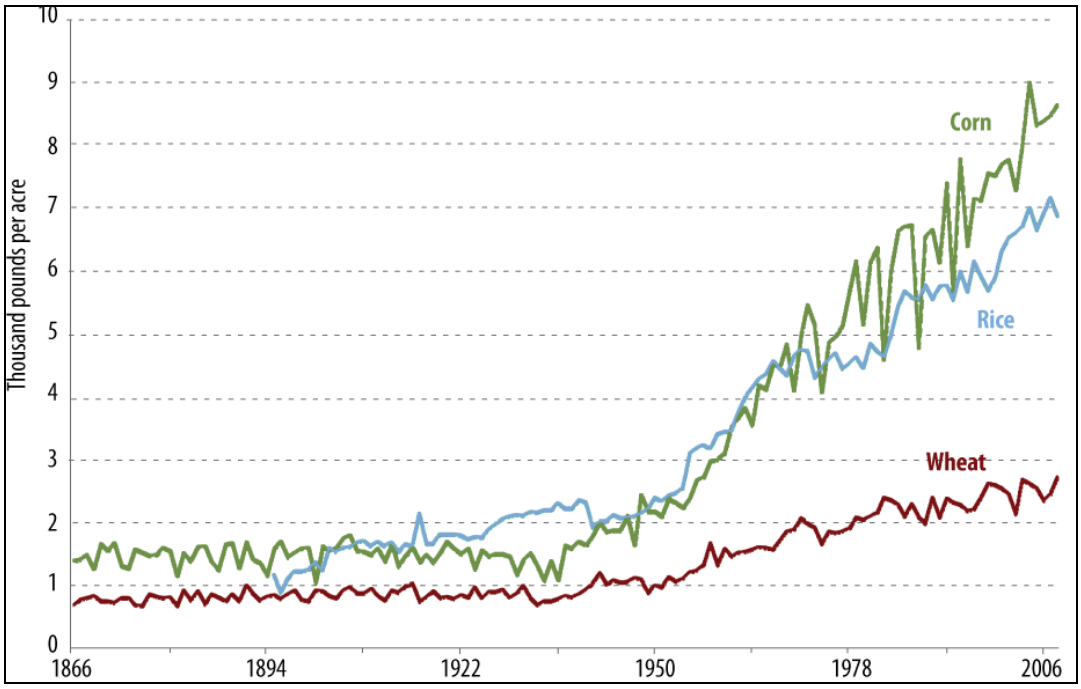
Introduction

Public investment in agricultural research has been linked to productivity gains, and subsequently to increased agricultural and economic growth.[1] Studies consistently find high social rates of return on average from public agricultural research, widely reported to be in the range of 20%-60% annually.[2]

Advances in agricultural research, education, and extension were critical to the huge agricultural productivity gains seen in the United States after World War II (**Figure 1**).[3] Agricultural productivity grew on average by about 2%-3% percent annually during the 1950s through the 1980s, but growth has slowed in recent decades (**Figure 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.

Figure 1. U.S. Commodity Yields, 1866-2008



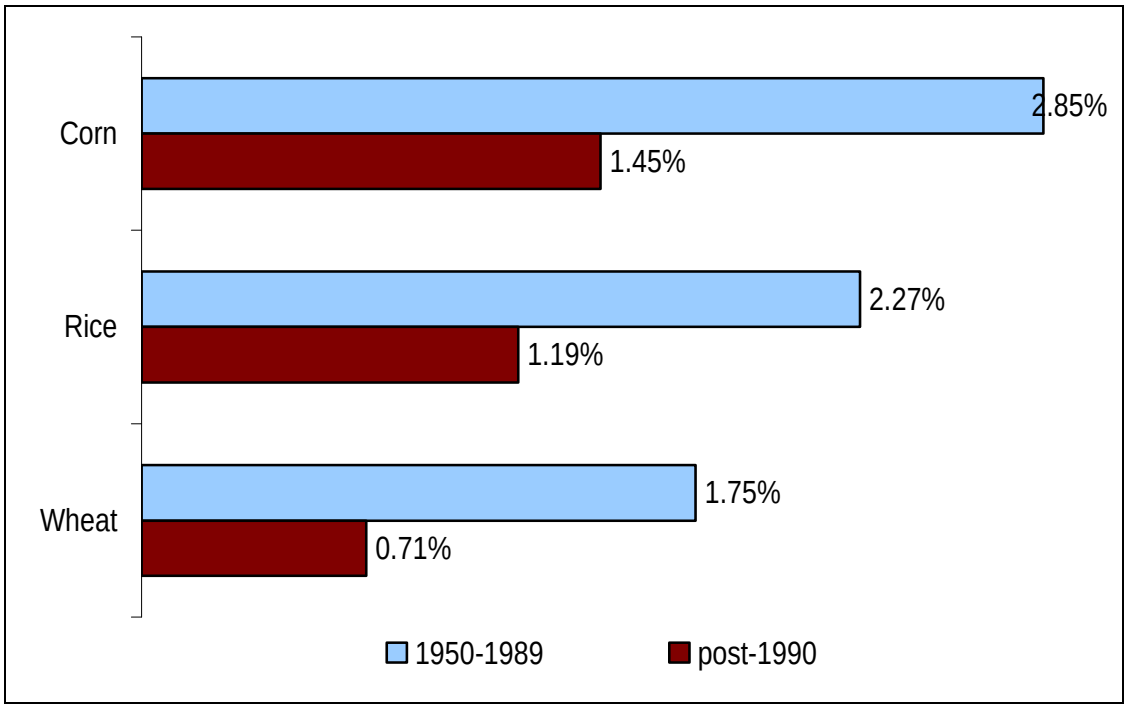
Source: Philip Pardey, "Putting U.S. Agricultural R&D and Productivity Developments in Perspective," presentation to Farm Foundation Conference, Agricultural Research and Productivity for the Future, Washington, DC, April 28, 2009, http://www.farmfoundation.org/news/articlefiles/1705-Pardey%20.pdf.

[1] 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/.

[2] 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, Research Report 113, Washington, DC, 2000, http://www.ifpri.org/sites/default/files/publications/rr113.pdf. This analysis showed that the actual rate of return is highly dependent upon many factors including the specific commodity, the type of research conducted (basic vs. applied), and the duration of the research investment among other things.

[3] Philip Pardey, "Putting U.S. Agricultural R&D and Productivity Developments in Perspective," presentation to Farm Foundation Conference, Agricultural Research and Productivity for the Future, Washington, DC, April 28, 2009, http://www.farmfoundation.org/news/articlefiles/1705-Pardey%20.pdf.

Figure 2. Annual Yield Growth Rate, 1950-2008



Source: Philip Pardey, "Putting U.S. Agricultural R&D and Productivity Developments in Perspective," presentation to Farm Foundation Conference, Agricultural Research and Productivity for the Future, Washington, DC, April 28, 2009, http://www.farmfoundation.org/news/articlefiles/1705-Pardey%20.pdf.

Some see a need for increased public investment in agricultural research in order to maintain high productivity growth. Congress determines the level of federal funding for agricultural research, education, and extension and must prioritize these activities in relation to other federal agriculture programs, such as commodity-based price and income support and rural development programs.

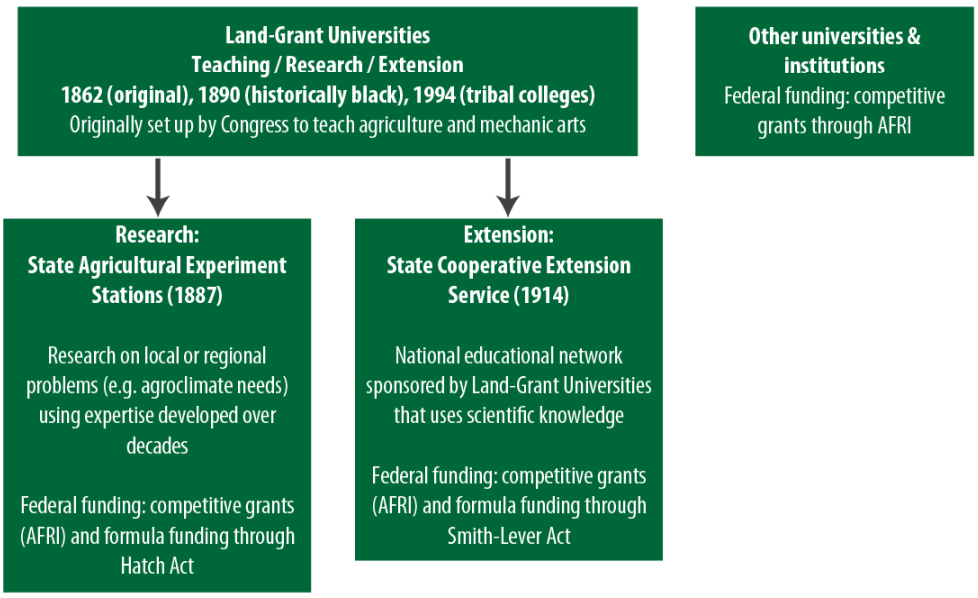
USDA Research, Education, and Economics Mission Area

The U.S. Department of Agriculture (USDA) Research, Education, and Economics (REE) mission area has the primary federal responsibility of advancing scientific knowledge for agriculture through research, extension, and education. The USDA REE agencies (see **Figure 3**) provide federal leadership in creating and disseminating knowledge spanning the biological, physical, and social sciences related to agricultural research, economic analysis, statistics, extension, and higher education. For FY2012, Congress provided $2.53 billion for the REE mission area, down $53 million from FY2011.

Figure 3. USDA's Research, Education, and Economics (REE) Mission Area

	Appropriations **$2.53 billion in FY2012**	USDA states that the REE Mission Area is dedicated to the creation of a safe, sustainable, competitive U.S. food and fiber system and strong, healthy communities, families, and youth through integrated research, analysis, and education.
Intramural (federal)	**National Agricultural Statistics Service (NASS)** **$159 mil.**	Provides timely and accurate statistics related to U.S. agriculture (e.g., Census, crop forecasts, estimates of farm prices). DC & state offices.
	Economic Research Service (ERS) **$78 mil.**	Provides economic and policy analysis to inform public and private decision making related to food, farming, natural resource management, agricultural markets, and rural development. DC only.
	Agricultural Research Service (ARS) **$1,095 mil. total**	Conducts research and disseminates information related to crop and livestock production and protection, human nutrition, food safety, rural development, and 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 program. The agency's research programs include New Products/Product Quality/Value Added; Livestock/Crop Production; Food Safety; Livestock/Crop Protection; Human Nutrition; and Environmental Stewardship. ARS has a workforce of about 6,500 full-time employees. About 100 research locations across the country, e.g., Center for Grain and Animal Health Research in Manhattan, KS.
Extramural (state with federal funding)	**National Institute of Food & Agriculture (NIFA)** **$1,202 mil. total** **Funding:** *Hatch Act, Evans-Allen (1890s historically black colleges), McIntire-Stennis (forestry research), Agriculture and Food Research Initiative (AFRI), Smith-Lever*	Provides federal leadership in advancing research and knowledge for agriculture, the environment, human health and well-being, and communities through grants and partnerships with the *land-grant university system* and other organizations that work at the *state and local level*. Workforce is about 350-400 employees. Formerly known as the Cooperative State Research, Education, and Extension Service (CSREES). Federal funding is provided through competitive grants and "formula funds" based on each state's farm and rural populations and matching funds from states.

NIFA Funding Destinations:



Source: CRS, using information published by USDA, http://www.usda.gov. For program details and agency descriptions, see USDA's FY2013 Budget Explanatory Notes, http://www.obpa.usda.gov/FY13explan_notes.html.

Four USDA agencies are responsible for carrying out the REE mission:

- **National Institute of Food and Agriculture (NIFA)**, formerly the Cooperative State Research, Education, and Extension Service (CSREES).[4] As the Department's primary agency that supports extramural agricultural research, education, and extension activities, NIFA provides federal leadership in advancing research and knowledge for agriculture, the environment, human health and well-being, and communities through grants and partnerships with the land-grant university system[5] and other organizations that work at the state and local level. For FY2012, NIFA received appropriations of $1.20 billion.
- **Agricultural Research Service (ARS)**. As the Department's primary intramural science agency, ARS conducts research and disseminates information related to the nation's top agricultural issues, including crop and livestock production and protection, human nutrition, food safety, rural development and natural resource management and conservation. For FY2012, ARS received appropriations of $1.09 billion.
- **Economic Research Service (ERS)**. As the Department's primary agency responsible for economic research and analysis, ERS conducts intramural research and provides economic and policy analysis related to food, farming, natural resource management, agricultural markets, and rural development in order to better inform public and private decision-making. For FY2012, ERS received appropriations of $77.7 million.
- **National Agricultural Statistics Service (NASS)**. The mission of NASS, the Department's primary data-gathering agency, is to provide timely, accurate, and relevant statistics related to U.S. agriculture. For FY2012, NASS received appropriations of $158.6 million.

Although all four USDA research agencies are headquartered in Washington, DC, much of the work is executed through a set of field offices and a network of partners throughout the United States that operate at the state and local levels. Only ERS is an entirely Washington DC-based social science agency. ARS has research centers and work locations across the United States, Puerto Rico, and the Virgin Islands (**Figure 4**). NASS has offices in 45 states and Puerto Rico and a National Operations Center in St. Louis, Missouri. USDA's extramural agency, NIFA, primarily partners with state colleges of agriculture at land-grant universities in 50 states and eight U.S. territories, with their affiliated state agricultural experiment stations (SAES), schools of forestry and veterinary medicine, and the cooperative extension system.[6] The system also includes 18

[4] The Food, Conservation, and Energy Act of 2008 (P.L. 110-246, the 2008 farm bill) established the National Institute of Food and Agriculture (NIFA), which is under the jurisdiction of the REE mission area. All authorities previously administered by CSREES were transferred to NIFA (Section 7511 of P.L. 110-246). NIFA is covered in more detail in the "Recent Legislative Action" section of this report.

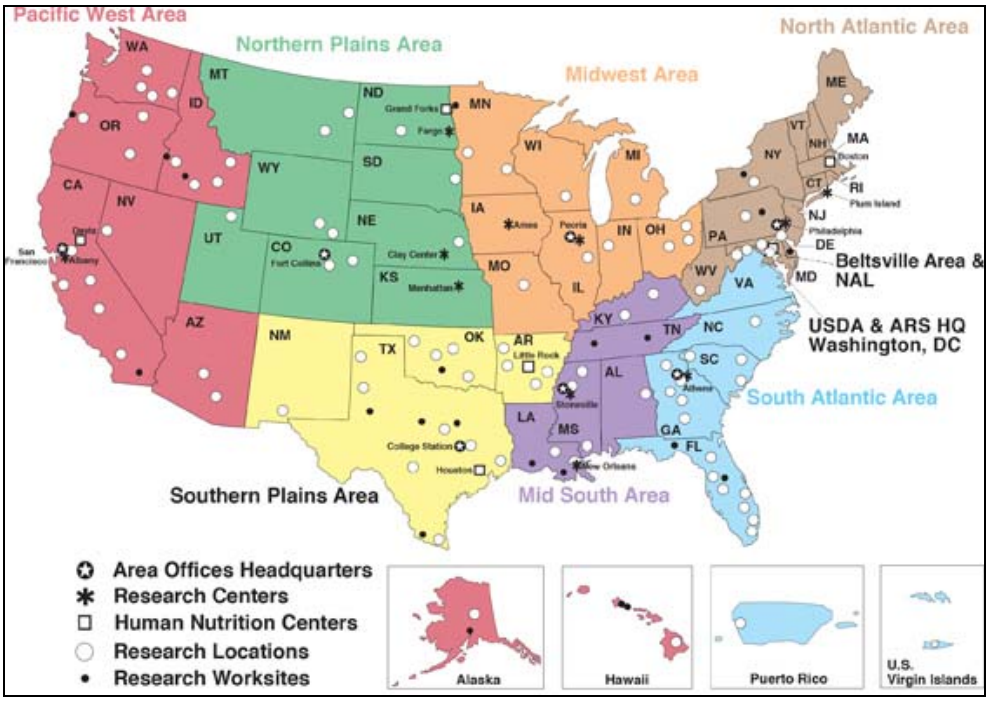
[5] The term "land-grant" refers to the law first establishing an institution of public higher education in each state to teach the "agricultural and mechanical arts." The Morrill Act of 1862 gave a grant of federal land to each state and directed the state to sell the land and use the proceeds to establish a college of agriculture. In many states, the original 1862 school became the foundation for the state university, growing to include a wide range of academic disciplines, including agriculture. These large institutions sometimes are referred to as "land-grant universities," but USDA funding and programs pertain only to the colleges of agriculture within them.

[6] 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.

historically black land-grant colleges of agriculture (the 1890 institutions) and 31 Native American colleges (referred to as tribal colleges) that gained land-grant status in 1994 (**Figure 5**).

The decentralized state-led structure for federally funded extramural activities has resulted historically in geographically specific applied research. Federally funded intramural research, on the other hand, is intended in part to address issues of national importance, and to promote basic research, regional coordination, and spillover.[7] 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.

Figure 4. USDA/ARS Locations



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

[7] Economists use the term "spillover" to capture the idea that some of the economic benefits of research and development activities affect agents and locales beyond where the research was performed.

Figure 5. Land-Grant Colleges of Agriculture

Source: U.S. Department of Agriculture, National Institute of Food and Agriculture, http://www.csrees.usda.gov/qlinks/partners/map_lgu_all_front_12_9_09.pdf.

USDA administers extramural federal appropriations primarily through three funding mechanisms:

- **Formula Funds.**[8] Funds for research and extension are awarded to land-grant institutions (1862, 1890, and 1994 institutions), schools of forestry and schools of veterinary medicine through several formula program authorities. The amount of funds provided to each institution is determined by census-based statutory formulas. Research priorities are more geographically focused as local or regional university leaders decide which specific projects will be supported by an institution's formula grant allotment (7 U.S.C. 301 et seq.).
- **Competitive Grants.** Funds are awarded using a competitive, peer-reviewed process for 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)).
- **Noncompetitive Grant Programs.** Until recently, funds have been directed (i.e., earmarked) by Congress to support a designated institution or set of institutions for particular research, education, or extension topics of local, regional, or national priority. These projects have been supported through Special Research Grants or Direct Federal Administration Research or Education Grants (7 U.S.C. 450i(c)). Unlike during FY2008-FY2010, the enacted appropriations in FY2011 and FY2012 did not include any earmarks or congressionally designated spending items for REE-related activities.

Agricultural Research Budget Overview and Trends

Congress traditionally considers research, education, and extension policy in periodic omnibus farm bills that cover virtually all USDA programs and policies. Congress focused specifically on federal agricultural research, education, and extension policies in the 1996 farm bill (P.L. 104-127) and the 2002 farm bill (P.L. 107-171), as well as in free-standing legislation enacted in 1998, (P.L. 105-185, the Agricultural Research, Extension, and Education Reform Act of 1998). The 2008 farm bill (Title VII of P.L. 110-246) reauthorized the research, education, and extension provisions of the 1996 and 1998 laws through FY2012 and contained some further revisions. The

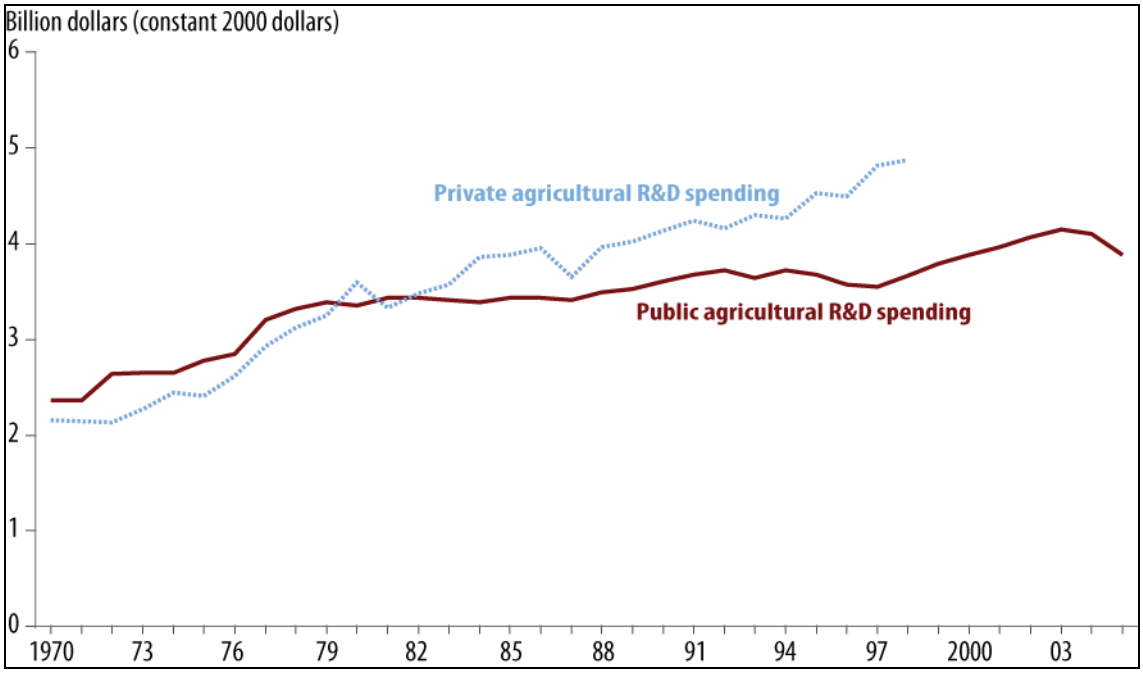
[8] Federal "formula funds" provide a major source of funding for public research and extension activities at land-grant institutions, including the 1862, 1890, and 1994 land-grant institutions, and are appropriated to the states on the basis of statutory formulas that change infrequently. Formula funds for research at the state agricultural experiment stations (SAESs) are authorized under the Hatch Act of 1887, which Congress amended in 1955 to include a formula that distributes the federal appropriation among states based on each state's farm and rural population as determined by the U.S. Census (7 U.S.C. 301). The Hatch Act, as amended, also requires dollar-for-dollar matching funds from state appropriations; most states, however, appropriate three to four times the federal allotment. The Hatch Act also requires each state to use 25% of its Hatch Act funds to support multi-state or regional research. The Smith-Lever Act provides federal formula funds through NIFA for cooperative extension activities using statutory formulas and non-federal 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. In addition, McIntire-Stennis formula funds support state designated institutions' cooperative forestry research programs (16 U.S.C. 582a et seq.). Animal Health formula funds support research into the prevention and control of animal diseases that affect agricultural productivity (7 U.S.C. 3195).

House and Senate Agriculture Committees are primarily responsible for oversight of agricultural research, education, and extension programs.

The majority of funding for agricultural research, education, and extension activities is discretionary, and is generally provided for through annual appropriations acts. Some specific programs, such as for specialty crops, were made mandatory in the 2008 farm bill.[9]

When adjusted for inflation, public funding[10] for agricultural research grew steadily from the 1950s to the mid-1970s, remained basically level from the end of the 1970s through the 1980s, and increased only slightly during the 1990s (**Figure 6**).[11] In contrast, all public non-defense research and development spending grew considerably during that period.[12] For agriculture, there was a marked rise in public funding from 1998 through 2001, at a time of a budget surplus. One-time, supplemental funding specifically appropriated for anti-terrorism activities, not ongoing programs, was a significant factor for the increases in the FY2001-FY2003 period. Funding levels peaked in FY2010, but declined in FY2011 and FY2012 as Congress cut federal spending.

Figure 6. Real U.S. Public and Private Agricultural R&D Expenditures, 1970-2006



Source: David Schimmelpfennig and Paul Heisey, *U.S. Public Agricultural Research: Changes in Funding Sources and Shifts in Emphasis, 1980-2005*, Economic Research Service, USDA, Economic Information Bulletin Number 45, Washington, DC, March 2009, http://www.ers.usda.gov/Publications/EIB45/EIB45.pdf.
Note: Reliable estimates for total private sector investments in agricultural R&D are not available after 1998.

[9] For more discussion of mandatory funding for agricultural research and the 2008 farm bill, see the "Other Farm Bill Research Initiatives" section of this report.

[10] Public funding in this figure includes research funded by USDA intramurally (ARS) and extramurally (NIFA, formerly CSREES), other non-USDA federal agencies (i.e., NIH, DOE, NSF etc), and state appropriations.

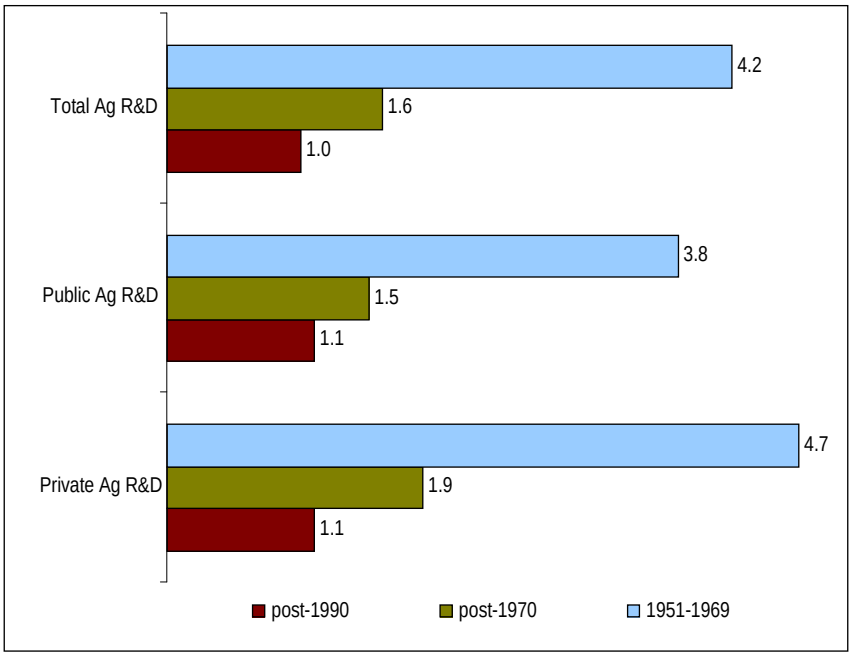
[11] David Schimmelpfennig and Paul Heisey, *U.S. Public Agricultural Research: Changes in Funding Sources and Shifts in Emphasis, 1980-2005*, Economic Research Service, USDA, Economic Information Bulletin Number 45, Washington, DC, March 2009, http://www.ers.usda.gov/Publications/EIB45/EIB45.pdf.

[12] American Association for the Advancement of Science (AAAS) R&D Budget and Policy Program, http://www.aaas.org/spp/rd/histda13.pdf.

Private-sector spending on agricultural research has continued to increase over the past several decades (**Figure 6**). The average annual growth rate (in real dollars) of agricultural spending from both the public and private sectors was highest, at over 4%, during the 1950s-1970s, and has declined considerably over time to about 1% in the most recent two decades (**Figure 7**).

Figure 7. Average Annual Real Growth, 1950-2007

(percentage)



Source: Philip Pardey, "Putting U.S. Agricultural R&D and Productivity Developments in Perspective," presentation to Farm Foundation Conference, Agricultural Research and Productivity for the Future, Washington, DC, April 28, 2009, http://www.farmfoundation.org/news/articlefiles/1705-Pardey%20.pdf.

Note: Reliable estimates for total private sector investments in agricultural R&D are not available after 1998.

The FY2012 Agriculture Appropriations Act (P.L. 112-55) contained $2.53 billion in discretionary funds for USDA agricultural research, education, and extension programs. ARS and NIFA accounted for most of the research mission area's budget, consuming about $1.09 billion (43%) and $1.20 billion (47%) of the total USDA REE budget for FY2012, respectively. This represents a 3% decrease over the FY2011 appropriation for ARS and a 1% decrease for NIFA.[13]

Over the past few decades, the growth in the research budget of USDA has lagged behind that of other national science agencies such as the National Institutes of Health (NIH), the National Science Foundation (NSF) and the National Aeronautics and Space Administration (NASA). In fact, between 1983 and 2003 the annual growth rate of USDA research spending was about one-eighth that of the NIH and about one-fourth that of all other government non-defense R&D spending overall (**Table 1**).

[13] For more detailed analysis of Agriculture appropriations, see CRS Report R41964, *Agriculture and Related Agencies: FY2012 Appropriations*.

Table 1. Annual Real R&D Budget Growth by Federal Agency, 1983-2003

Federal Agency	Average Annual Growth Rate (percentage)
NIH	5.73
NASA	3.17
NSF	2.43
USDA	0.70
Non-Defense R&D overall	2.75

Source: USDA Research, Education, and Extension Task Force Report, 2004.

Notes: Actual spending adjusted for inflation using 2000 as base year.

As a result of a relatively flat or declining USDA research budget, funding from federal agencies other than USDA has accounted for an increasing portion of total federal support for research at the state agricultural experiment stations (SAESs). Historically the USDA has been the primary federal government agency channeling funds to the SAESs. In 1970, the USDA disbursed almost 70% of the federal funds flowing to the SAESs, but by 2004 that share had declined to less than 50%, with more than half of the federal funds being disbursed by a wide range of federal agencies, including the NSF, NIH, DOE, DOD, U.S. Agency for International Development (USAID), and others. Funds from private industry for agricultural research have also been steadily increasing (**Figure 6**). Public-private partnerships can facilitate technology transfer and at the same time help to supplement federal and state support. However, some observers are concerned that both the increase in non-USDA funding 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.

Omnibus 2008 Farm Bill

The Food, Conservation, and Energy Act of 2008 (the 2008 farm bill, P.L. 110-246), authorized and directed the implementation of USDA's major programs through FY2012. The research title of the 2008 farm bill, Title VII, reorganized the Department's Research, Education, and Economics mission area and created a new competitive grants program for agriculture. Title VII created an umbrella coordinating entity known as the Research, Education, and Extension Office (REEO) in the Office of the Under Secretary for Research, Education, and Economics, and designated the Under Secretary as the Chief Scientist of USDA.

The 2008 farm bill also 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. In addition, all programs and authorities formerly administered by the Cooperative State Research, Education, and Extension Service (CSREES) were transferred to a newly created entity called the National Institute for Food and Agriculture (NIFA) in October 2009. 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).[14]

The 2008 farm bill authorized the Agriculture and Food Research Initiative, a new competitive grants program for basic and applied research administered by NIFA. AFRI expands and replaces the National Research Initiative (NRI) Competitive Grants Program and incorporates and replaces the former Initiative for Future Agriculture and Food Systems (IFAFS), both of which the 2008 farm bill repealed. The Under Secretary is required to submit a unified annual budget covering all activities of the REEO and NIFA.

The farm bill authorized annual appropriations of $700 million for AFRI, representing the combined level of authorized and mandatory funding that the NRI and IFAFS were authorized to receive in previous years.[15] The 2008 farm bill also provided a total of $333 million in mandatory funds over five years for (1) a new specialty crop research initiative ($230 million), (2) research on fresh produce food safety ($25 million), and (3) organic agriculture research ($78 million). Annual appropriations of such sums as necessary for research, education, and extension programs were much the same as in the previous farm bill.

In addition, the research title of the enacted farm bill included major initiatives to provide capacity-building support to Hispanic-serving agricultural colleges and to make them eligible to receive funding through a wider range of grant programs.

The following subsections provide additional detail on the significant changes made to the USDA REE mission area in the enacted 2008 farm bill.[16]

The REEO and the Roadmap

Section 7511of the 2008 farm bill required the Under Secretary, designated as the Chief Scientist of the Department, to establish the Research, Education, and Extension Office (REEO) "to coordinate research programs and activities of the Department of Agriculture." Located in the Office of the Under Secretary for Research, Education, and Economics, the REEO is designed to be the central office within USDA where science priorities are set, research activities are coordinated and prioritized, and scientific capacity is strategically aligned. The REEO is organized into 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)

[14] APLU was previously known as National Association of State Universities and Land Grant Colleges (NASULGC); NASULGC changed its name to APLU in March 2009.

[15] AFRI annual authorization of $700 million discretionary spending essentially combines NRI discretionary funding (authorized at $500 million annually) with IFAFS mandatory funding ($200 million annually). NRI was appropriated $182 million in FY2008. IFAFS was established by the Agricultural Research, Extension, and Education Reform Act of 1998 (P.L. 105-185) as a five-year, $600 million, competitive grants program supported by mandatory funds made available from the USDA's Commodity Credit Corporation, instead of appropriated funds. Congress reauthorized the initiative in the 2002 farm bill, raising its authorized funding level from the original $120 million annually to $140 million in FY2004, $160 million in FY2005, and $200 million annually thereafter. USDA awarded grants under the initiative in FY2000 and FY2001. In FY1999 and every year since FY2002, Congress has blocked CCC funds from being spent on the initiative except to service existing grants until they end. Both NRI and IFAFS were eliminated in the 2008 farm bill.

[16] For a more complete examination of the issues and legislative proposals, see CRS Report RL34352, *Agricultural Research, Education, and Extension: Farm Bill Issues*.

agricultural systems and technology; and (6) agricultural economics and rural communities. Each division has its own division chief. The REEO is to identify key science issues and needs, coordinate and prioritize research activities and programs, and strategically align the department's scientific capacity. The division chiefs are expected to work with the National Agricultural Research, Extension, Education, and Economics Advisory Board to coordinate all of the mission area's activities across the department, including intramural research (ARS, ERS, NASS) and extramural research (NIFA).

Section 7504 of the 2008 farm bill required that the REEO, under the leadership of the Under Secretary, prepare a Roadmap for Agricultural Research, Education, and Extension to identify current trends, constraints, gaps, and major opportunities that no single entity within the USDA would be able to address individually. The reorganization of REE and the Roadmap were based largely on a proposal developed by APLU, *Create Research, Extension, and Teaching Excellence for the 21st Century* (CREATE-21), a comprehensive recommendation for reorganizing the REE system after a nationwide deliberative process within the land-grant system.

National Institute of Food and Agriculture (NIFA)

Section 7511 of the 2008 farm bill established the National Institute of Food and Agriculture (NIFA), in an attempt to streamline and reinvigorate national investment in agricultural research. In October 2009, NIFA assumed all authorities and programs from CSREES, which was responsible for funding USDA extramural research. Through the creation of NIFA, Congress intended to "increase the visibility of competitive programs at USDA's research agencies,"[17] and to create an agency equal in stature to other federal science grant-making agencies such as the National Institutes of Health (NIH) and the National Science Foundation (NSF).

Changes in the funding, structure, and priorities of USDA REE, and the vision for a NIFA, drew heavily from recommendations made by several stakeholder groups, including APLU and USDA itself. The 2002 farm bill authorized USDA to create a task force to prepare a report examining the merits of establishing national institutes in one or more of the agricultural sciences.[18] 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.[19] In July 2004 the USDA task force published its report, which advocated for the concept of a new NIFA.[20] The task force modeled NIFA on NIH and NSF, recommending that NIFA should accomplish its mission primarily through administering competitive peer-reviewed grants that support and promote high-caliber, fundamental agricultural research. It recommended that the head of NIFA should be a distinguished scientist, appointed by the president for a six-year term, with the potential for one reappointment. In addition, the task force recommended that NIFA distribute research grants

[17] S.Rept. 110-220.

[18] The FY2003 Emergency Supplemental Appropriation Act (P.L. 108-11) authorized $499,000 from the ARS budget to support the study.

[19] 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.

[20] *National Institute for Food and Agriculture: A Proposal*, report of the Research, Education, and Economics Task Force of USDA, July 2004. The report is available at http://www.ars.usda.gov/sp2userfiles/place/00000000/national.doc.

through a competitive, peer-reviewed process with a budget that would increase over a five-year period until it reaches $1 billion per year.

Enhanced Competitive Grant Funding: Agriculture and Food Research Initiative (AFRI)

Section 7406 of the 2008 farm bill amended the Competitive, Special, and Facilities Research Grant Act to establish the Agriculture and Food Research Initiative (AFRI), which is designed to be the flagship competitive grants program at USDA and is housed at NIFA. AFRI replaces two other USDA grant programs, the Initiative for Future Agriculture and Food Systems (IFAFS), which emphasized more applied research, and the National Research Initiative (NRI) competitive grants program, which emphasized fundamental, or basic research. Both of these programs were eliminated in the 2008 farm bill. AFRI provides competitive grants for basic and applied research, education and extension to colleges and universities, agricultural experiment stations, and other organizations conducting research in priority areas of food and agriculture including plant health and production; animal health and production; food safety, nutrition, and health; renewable energy, natural resources, and environment; agriculture systems and technology; and agriculture economics and rural communities.

AFRI was authorized to receive appropriations of $700 million annually in the 2008 farm bill. However, actual appropriations were $201.5 million in FY2009, $262.5 million in FY2010, and $264.5 million in both FY2011 and FY2012. 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.

Other Farm Bill Research Initiatives

Specialty and Organic Crops Research

Funding for specialty (fruits and vegetables) and organic crops research was extended and expanded in the 2008 farm bill.[21] Supporters of specialty crops, including producers, processors, and trade associations, argued in favor of increasing federal expenditures for specialty crops research. They argued that growth in the value of production of specialty crops has not been matched by commensurate growth in public agricultural research spending. In addition to expanding discretionary funded programs, Congress also increased the use of mandatory funds specifically for specialty crop and organic research.

- **Specialty Crops Research Initiative**. The farm bill included $230 million in mandatory funds ($30 million for FY2008, and $50 million annually thereafter for FY2009-FY2012) for a specialty crops research initiative over five years and authorized annual appropriations of $100 million. Five research areas are prioritized, including crop improvement; identification of pest and disease threats, production efficiency; improved technologies; and prevention and detection of food safety hazards. Each area is to receive at least 10% of the grant

[21] For a more complete examination of specialty crops issues and legislative proposals, see CRS Report RL33520, *Specialty Crops: 2008 Farm Bill Issues*.

funds. Grant recipients must provide a 100% match either in funds or in-kind support. The program gives priority to projects that are multistate, multi-institutional, or trans-disciplinary, and includes explicit mechanisms to communicate results to producers and the public.

- **Organic Agriculture Research and Extension Initiative**. Originally authorized under the 2002 farm bill at $3 million per year in mandatory funding, the Organic Agriculture Research and Extension Initiative funds research and extension programs that are intended to enhance the ability of producers and processors who have already adopted organic standards to grow and market high quality organic agricultural products. This program emphasizes research and outreach to assist farmers and ranchers with farm planning and ecosystem integration, and aims to deliver applied production information to producers. The 2008 farm bill increased the mandatory funding level from $3 million annually to $18 million for FY2009, and $20 million annually thereafter in FY2010-FY2012. The 2008 farm bill also included an authorization for an additional $25 million in discretionary funds each year.

Bioenergy Research

Three agricultural energy provisions that extend and expand existing programs, as well as create a new competitive grants program for on-farm biomass crop research, were included in the research title of the 2008 farm bill.[22] These programs provide grants to develop innovative methods and technologies for the economic and efficient conversion of agricultural waste to bioenergy, support the dissemination and implementation of biobased energy technologies, and encourage collaboration between the USDA, DOE, and land-grant universities.

- **Nutrient Management Research and Extension Initiative**. This program, originally authorized in the 1990 farm bill (P.L. 101-624), provides matching grants for finding innovative methods and technologies for economic use and/or disposal of agricultural waste. The 2008 farm bill amended this program to include the production of renewable energy from animal waste as an eligible activity, and extended the program through 2012, authorizing such sums as necessary annually.
- **Agricultural Bioenergy Feedstock and Energy Efficiency Research and Extension Initiative**. This new program awards competitive matching grants (up to 50%) for projects with a focus on supporting on-farm biomass crop research and the dissemination of results to enhance the production of biomass energy crops. Discretionary appropriations of $50 million annually were authorized for FY2008-FY2012.
- **Sun Grant Program.** This program was added to the Energy Title (Title IX) subsequent to the 2002 farm bill under the Sun Grant Research Initiative Act of 2003, and established five national Sun Grant research centers at land-grant universities, each covering a different national region, to enhance coordination and collaboration between USDA, DOE, and land-grant universities in the development, distribution, and implementation of biobased energy technologies.

[22] For a more complete examination of bioenergy issues and legislative proposals, see CRS Report RL34239, *Biofuels Provisions in the 2007 Energy Bill and the 2008 Farm Bill: A Side-by-Side Comparison*.

The 2008 farm bill moved this provision to the research title, established a sixth regional center—Western Insular Pacific Sub-Center at the University of Hawaii—and authorized $75 million per year for FY2008-FY2012.

Pollinator Protection Research

The 2008 farm bill amended the Food, Agriculture, Conservation and Trade Act of 1990 by authorizing three new pollinator protection programs for FY2008-FY2012, and repealing a previously enacted honey bee disease research program.[23] The 2008 farm bill authorized $10 million a year for research and extension grants that address pollinator biology, ecology, immunology, and genomics, including factors affecting colony collapse disorder in honeybees. An additional $7.25 million annually was included to increase the capacity and infrastructure of USDA to address pollinator health issues and to conduct in-house research on colony collapse order at USDA facilities. The 2008 farm bill also authorized $2.75 million annually for a national honey bee pest and pathogen surveillance program.

Current Issues

New Funding for Agricultural Research

A recurring policy issue is whether or not there is a need for more federal spending for agricultural research, education, and extension. The current fiscal and political situation will likely result in debate and discussion, especially if Congress considers the creation of new programs, expansion and/or scaling back of existing programs, changes in mandatory program spending,[24] and congressional earmarks. 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. 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.

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 drought 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, there are limited resources available with which to support the agricultural sector. Historically, Congress has not prioritized increasing funding for agricultural research, education, and extension

[23] For more about pollinator issues including colony collapse disorder, see CRS Report RL33938, *Honey Bee Colony Collapse Disorder*.
[24] CRS Report R41245, *Reductions in Mandatory Agriculture Program Spending*.

activities, and instead has tended to fund programs designed to provide more immediate benefits to farmers, such as income support and safety net programs. Some believe that farmers would have to wait too long to see the payoff from research activities, and that it is difficult to justify the investment when farmers typically need federal support to address their needs in the short term. Others believe that the states and the private sector should fill the research funding gap left by the federal government.

While some in Congress have attempted to provide alternative sources of funding for research programs, such as authorizing $600 million in mandatory funding in the Agriculture Research, Extension, and Education Reform Act of 1998 for a competitive research grants program, Congress has blocked mandatory funds from being spent on new competitive agricultural research grants every year since 2002.

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 among some 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.

Funding Mechanism: Formula Funds vs. Competitive Grants

Much debate has surrounded the implications of various funding mechanisms for agricultural research, in particular federal formula funding vs. external peer-reviewed competitive grant funding. Efforts to improve public agricultural research efficiency have often included calls to increase the use of competitive grants as a means of more effectively allocating limited federal resources. Two historically influential reports published by the National Academy of Sciences (NAS)[25] and the Rockefeller Foundation[26] 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 a shift in funding mechanisms toward more use of competitive funding rather than formula funding of the state agricultural experiment stations (SAESs).

The USDA differs from other federal research agencies in allocating the majority of its annual research appropriation directly to in-house research agencies (ARS, ERS, and NASS), and in allocating the majority of its extramural funding to state agricultural colleges and land-grant universities through statutory formula funds. In contrast to USDA's research and extension funding mechanisms, the federal government's two largest science agencies, the National Science Foundation (NSF) and the National Institutes of Health (NIH) allocate the majority of their appropriations through competitively awarded grants to scientists in a variety of research venues nationwide.[27] In another report published in 1989, the NAS recommended that at least 35% of total USDA research funding be distributed competitively, and called for the expansion of USDA's competitive grants programs.[28] The 1989 NAS report also recommended that expanded

[25] 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.

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

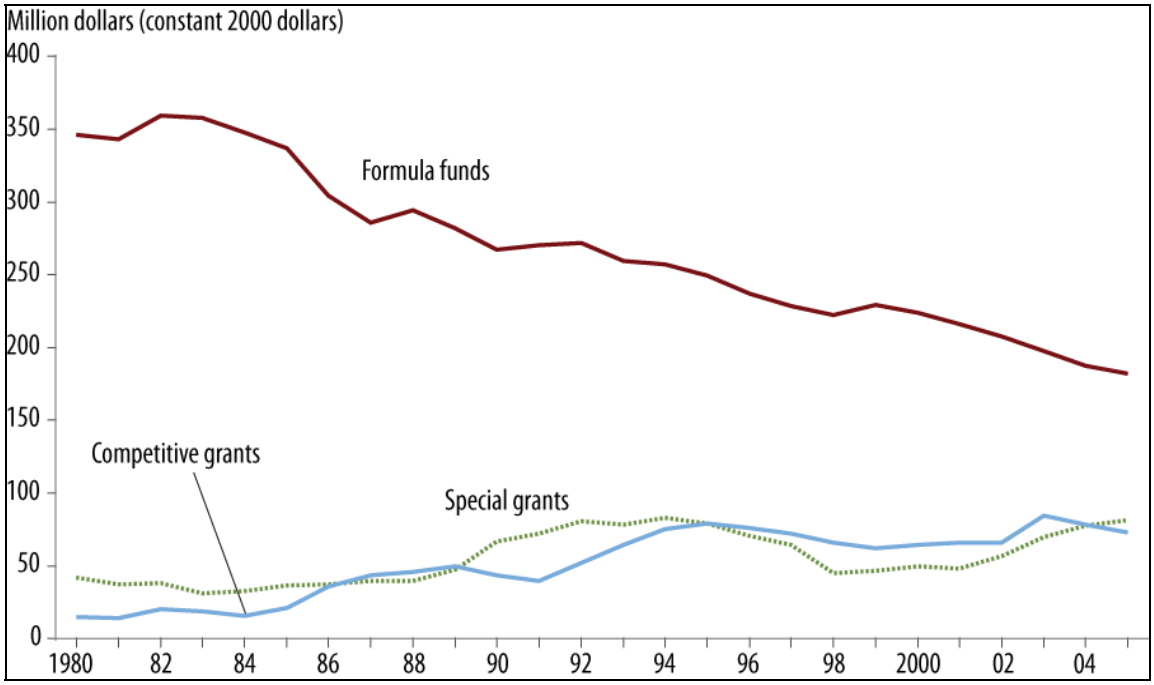
[27] It should be noted that although the majority of NIH funding is competitively awarded, the NIH also has a large in-house research component.

[28] National Academy of Sciences, *Investing in Research: A Proposal to Strengthen the Agricultural, Food, and Environmental System* (Washington, DC: National Academy Press, 1989).

support for competitive programs should come from new money and specifically advised against redirecting funds from ARS or the Hatch and Smith-Lever Acts, which are the primary and longest-standing formula fund provisions for cooperative research and extension, respectively. When the NAS made its recommendation in 1989, it determined that less than 6% of USDA's research funding was competitively awarded. In FY2008, it was approximately 14%, according to CRS calculations.[29]

Formula funds represent the largest allocation of USDA extramural funds, but the relative and absolute amount of resources distributed by formula funds has been steadily declining over the past three decades (**Figure 8**). The decrease in formula funds has been met with a commensurate increase in allocation to competitive grants and special grants.

Figure 8. USDA Extramurally Administered Funds, 1980-2005



Source: David Schimmelpfennig and Paul Heisey, *U.S. Public Agricultural Research: Changes in Funding Sources and Shifts in Emphasis, 1980-2005*, Economic Research Service, USDA, Economic Information Bulletin Number 45, Washington, DC, March 2009, http://www.ers.usda.gov/Publications/EIB45/EIB45.pdf.

Notes: Actual spending adjusted for inflation using 2000 as base year.

Previous Congressional Action on Competitive Agricultural Research Funding

Following publication of the 1989 NAS report, Congress expanded USDA's existing competitive research grant program in the 1990 farm bill (P.L. 101-624). Authority for competitive grants originally had been established in the 1977 farm bill (P.L. 95-113), but the program remained small in comparison to the direct and formula-funded research programs. Congress authorized

[29] Computed to include funding for the NRI competitive grants program, competitively awarded extension grants, integrated research and extension program, and outreach programs for socially disadvantaged farmers, divided by total funding for ARS and CSREES for FY2008.

annual appropriations for the expanded program, the National Research Initiative (NRI), of $150 million in FY1991, $275 million in FY1992, $350 million in FY1993, $400 million in FY1994, and $500 million in FY1995. Congress subsequently reauthorized the NRI in the 1996 farm bill, the 1998 agricultural research law, and the 2002 farm bill, each time renewing a $500 million authority for annual appropriations. Yet, NRI funding rarely exceeded the appropriated level of $182 million in FY2008, the last year of the program's existence.

In 2006, President George W. Bush proposed eliminating federal formula funding of agricultural research and replacing it with increased funding for NRI, and a new competitive grants program for the SAES system. Together, the NRI increase and the new grant program would have constituted a 14% increase in federal funding for state research over the previous year. At the state level, however, the proposal would have represented a 50% cut in funding for core programs. APLU opposed the President's proposal and Congress did not include it in the final FY2006 appropriations act (P.L. 109-97). In FY2007 the Bush Administration made another attempt to alter the allocation of formula funds in favor of a more competitive process, but these proposals were again rejected by Congress.

With the 2008 farm bill, Congress strengthened the competitive process for agricultural research. The establishment of the National Institute of Food and Agriculture (NIFA) as the primary agricultural research agency within the USDA and the new flagship competitive grants program that NIFA administers, called the Agriculture and Food Research Initiative (AFRI), are the outcome of ongoing efforts to elevate the role of competitive grants as an important federal funding mechanism for agricultural innovation.

Implications of Funding Mechanism

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, it is widely acknowledged in the agricultural community that USDA-funded research, whether carried out intramurally or through formula funds, also has an important role to play. Using a census-based formula to calculate the annual distribution of research funds to each state has meant that the state allocations have been quite constant from year to year, since annual appropriations have remained level or increased slightly. 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.

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. 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.[30]

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.[31] 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, not met by industry or other institutions, specifically 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. At the same time, while intramural funding is intended to cover all costs needed to conduct mission research, funding levels for intramural research have been relatively flat over the past decade and some feel that funding levels are not sufficient. ARS is allowed to accept funds from outside sources, including other USDA agencies; other federal agencies; state, county, and municipal agencies and institutions; and colleges and universities. USDA leadership has recently been encouraging ARS scientists to leverage extramural funding and partnerships where appropriate.

Some believe that in order for ARS to maintain strong, relevant research programs, ARS scientists should pursue extramural partnerships and sources of funding to carry out their work. Others express concern that pursuing extramural funding may be a distracting and time-consuming endeavor for ARS scientists, which would take away focus from ARS's primary national program priorities. There is also concern over setting specific quantitative goals or unrealistic expectations for extramural funding of ARS research. In addition, some believe that ARS scientists have an unfair advantage in competing with other agricultural scientists, who do not have an endowed source of support for core research expenditures.

Earmarks

One of the most controversial sources of funding for ARS, NIFA, and the land-grant agriculture schools are earmarked grants in annual agricultural appropriations acts. For FY2009, Congress appropriated over $159 million for 102 ARS research projects at various labs across the nation,

[30] Kelly Day Rubenstein, Paul W Heisey, and Cassandra Klotz-Ingram 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.

[31] 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.

and over $122 million for 254 designated research and extension projects at various land-grant institutions administered by NIFA. In FY2010, earmarks totaled $115 million for ARS and $135 million for NIFA. The FY2011 and FY2012 enacted appropriations did not include any earmarks or congressionally designated spending items for REE-related activities.

Congressionally designated grants typically do not receive any type of formal review before they are awarded. However, in response to repeated criticism that such funds could be supporting weak or unnecessary research, NIFA (formerly CSREES) developed many years ago an internal merit review process that research projects must undergo before the funds will be released. Merit reviews may result in improvements being made to the project (in research methodology, for example) before the funding is transferred to the designated institution.[32]

Under appropriations rules for the 112th Congress, Congress banned earmarks. Prior to that, controversy over earmarked appropriations had arisen nearly every year. Each annual budget request had proposed eliminating the designated grants under both ARS and NIFA, stating that they deflect money away from higher-priority research in the national interest. Supporters of such grants countered that Members are most qualified to know what research is most important to their districts and to make sure those local needs are not ignored in the larger research picture.

The Federal Budget and Agricultural Research in the Next Farm Bill

The federal budget continues to be severely constrained, which makes finding new money for agricultural research a difficult endeavor. While the 2008 farm bill provided a significant funding boost for agricultural research, relatively speaking, it is unclear whether budgetary resources and political will can sustain funding for agricultural research and related activities.

Several mandatory programs that were authorized in the 2008 farm bill do not have a budget baseline that extends beyond the end of the 2008 farm bill (September 30, 2012).[33] If policymakers want to continue these programs in the next farm bill, they will need to pay for them with other offsets. Of the 37 mandatory farm bill programs that have no budget baseline after the 2008 farm bill expires, three were authorized in the Research title: the Specialty Crop Research Initiative ($230 million over five years); the Organic Agriculture Research and Extension Initiative ($78 million over five years); and the Beginning Farmer and Rancher Development Program ($75 million over five years). In addition, eight mandatory programs in the Energy Title (Title IX), totaling about $1.9 billion over five years, also do not have budget baseline going into the next farm bill. Some of these programs, such as the Biomass Research and Development Program, have research objectives and are administered by NIFA.[34]

Finally, there has been interest in Congress and the Administration in increasing resources for an international agricultural development agenda to reduce global hunger and poverty, particularly in sub-Saharan Africa. Some key areas that have been identified include U.S. support for

[32] See policies and procedures for ARS Reimbursable and Trust Fund Agreements, at http://www.afm.ars.usda.gov/ppweb/pdf/324-0.pdf.

[33] For more information, see CRS Report R41433, *Expiring Farm Bill Programs Without a Budget Baseline*.

[34] For a discussion of issues across all titles of the farm bill, see CRS Report R42357, *Previewing the Next Farm Bill*.

international agricultural research and education, and U.S. support for technical capacity strengthening abroad.

Some believe that the convergence of several factors, including the constrained federal budget, ongoing international trade negotiations, the growing importance of non-program, specialty crops to the U.S. agricultural economy, and the potential role of international agricultural development as a key pillar of U.S. foreign affairs strategy, could foster congressional consideration of increasing federal support for U.S. agriculture through agricultural research, education, and extension funding beyond the farm bill.

Author Contact Information

Dennis A. Shields
Specialist in Agricultural Policy
dshields@crs.loc.gov, 7-9051

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