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Report to Congressional Requesters

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AGRICULTURAL RESEARCH

Information on Research System and USDA's Priority Setting

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Resources, Community, and
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The Honorable Pat Roberts
Chairman
The Honorable E (Kika) de la Garza
Ranking Minority Member
Committee on Agriculture
House of Representatives

The Honorable Wayne Allard
Chairman
The Honorable Tim Johnson
Ranking Minority Member
Subcommittee on Resource Conservation,
Research and Forestry
Committee on Agriculture
House of Representatives

This report responds to your request for information on the agricultural research, education, and extension system. The report provides (1) an overview of the system, (2) the views of users of agricultural research on the extent to which the U.S. Department of Agriculture (USDA) and the land grant universities are meeting users' research needs and on how effectively research results are being disseminated, and (3) USDA's approaches to setting research priorities.

As arranged with your offices, unless you publicly announce its contents earlier, we will make no further distribution of this report until 14 days after the date of this letter. At that time, we will send copies to the Secretary of Agriculture and other interested parties. Copies will also be made available to others upon request.

If you have any questions, I can be reached at (202) 512-5138. Major contributors to this report are listed in appendix VIII.

Robert A. Robinson
Director, Food and
Agriculture Issues

Executive Summary

Purpose

For over a century, U.S. agricultural research, education, and extension activities have been major catalysts in creating a vigorous agricultural economy and a plentiful, low-cost supply of food and fiber. While each has its own purpose—research, to discover solutions to food- and agriculture-related problems; education, to formally teach future farmers and others who will work in the food and agricultural sector; and extension, to disseminate the results of agricultural research and other information to the public—the functions are closely linked. Hence, they are often referred to jointly as the agricultural research, education, and extension system. The U.S. Department of Agriculture (USDA) has a major role in the system, providing over $2 billion to support these activities in fiscal year 1994.

To help the Congress determine the future course of federal support for the system, the House Committee on Agriculture and its Subcommittee on Resource Conservation, Research and Forestry asked GAO to (1) provide an overview of the system; (2) obtain the views of various users of agricultural research on the extent to which USDA and the land grant universities are meeting their research needs and on how effectively research results are being disseminated; and (3) assess USDA's processes for planning and establishing research priorities.

Results in Brief

The U.S. agricultural research, education, and extension system is a diverse, decentralized network of federal, state, and private research and educational institutions intended to support the agricultural sector and others. USDA plays a key role in the system—it conducts in-house research at over 100 USDA laboratory locations and acts as a partner with the states by funding research, higher education, and extension activities at 74 land grant universities and other institutions. In addition, the private sector conducts and funds research, primarily for proprietary purposes.

Over 65 percent of the food- and agriculture-related associations responding to GAO's survey found value in the research and information dissemination activities performed by USDA and the land grant universities. These associations represent a broad range of users of agricultural research, such as commodity groups, public interest groups, and professional societies. However, as might be expected, many associations and others within the research community believe that the level of public funding for research and research dissemination activities is inadequate.

Several problems have hampered USDA's ability to plan and implement research priorities. First, USDA lacks a Department-wide research agenda, and its priority-setting and accountability processes are flawed in several key areas. Furthermore, its research information system does not provide the information needed to facilitate research planning. Finally, USDA's ability to shift resources among priorities is limited by factors such as an aging infrastructure (e.g., facilities and equipment) and directives from congressional committees that specific research efforts be initiated or maintained. USDA is developing plans and has proposed actions aimed at addressing some of these problems. However, it is too early to determine their effectiveness.

Principal Findings

Overview of the Agricultural Research, Education, and Extension System

The agricultural research, education, and extension system is composed of numerous federal, state, and private sector entities that conduct both independent and joint activities. USDA's Agricultural Research Service (ARS) conducts most federal in-house agricultural research. The states' land grant universities also perform research, which is funded by the states, the federal government—primarily USDA's Cooperative State Research, Education, and Extension Service (CSREES)—and the private sector. Finally, private firms conduct research, largely proprietary, in support of their food or agricultural businesses. In fiscal year 1992 (the most recent year for which private sector data were available), agricultural research expenditures totaled about $6.3 billion. The private sector provided 60 percent of these resources, while the federal and state governments provided 25 percent and 15 percent, respectively.

The extension activities that disseminate research results to the public are carried out by the land grant universities and county extension offices located throughout the nation. In fiscal year 1994, USDA's funding for extension activities totaled about $419 million. The states and counties provide most of the funding for extension activities—almost $1 billion in fiscal year 1994.

Most Survey Respondents Find Value in System's Activities, but Many Are Concerned About Funding

About two-thirds of the 218 food- and agriculture-related associations responding to GAO's survey rated ARS' research as somewhat or very effective in meeting their needs, and over 80 percent gave this rating to research conducted at land grant universities. Seventy percent of the

associations that responded indicated that extension services were somewhat or very effective in disseminating research results. While most of the respondents found the system at least somewhat effective in meeting their needs, their views were mixed on its ability to respond to emerging research needs.

Not surprisingly, many survey respondents as well as others who use or conduct agricultural research, such as administrators of land grant universities, believe that funding for research is inadequate. As a result, some associations and private companies are funding research to meet their specific needs or are entering into partnerships with ARS laboratories and land grant universities. Similarly, ARS and land grant universities are undertaking collaborative efforts to make better use of limited resources. For example, the Midwest Water Quality Initiative brings together scientists from the land grant universities, ARS, and other federal agencies to design alternative farming systems in five states and evaluate their effects on water quality.

USDA's Priority Setting Is Hampered by Lack of a Research Agenda and Other Factors

USDA's processes for identifying research priorities and facilitating accountability for research expenditures are flawed in several important ways. First, USDA lacks a Department-wide research agenda to guide priority setting for two of its principal research agencies—ARS and CSREES. Second, the two agencies' priority-setting processes do not incorporate performance goals or indicators. Third, USDA does not comprehensively evaluate the outcomes of these agencies' research programs. Fourth, USDA's research information system does not provide the data necessary to facilitate strategic planning, priority setting, and accountability. Finally, the three general advisory boards established to assist in setting priorities at USDA's research agencies have had a limited impact.

In addition, USDA's ability to shift resources to new research priorities and to implement existing priorities is limited by an aging infrastructure (e.g., laboratories and equipment), directives from congressional committees, pressures by commodity and interest groups to maintain funding levels in their areas of interest, and low funding levels for the competitive grants program. Because the infrastructure evolved to support the research needs of past decades, USDA is constrained in its ability to move into new research areas that require different equipment, facilities, and scientific expertise. Directives from congressional committees that specific research areas be funded and certain ARS laboratories remain open have also limited USDA's ability to allocate resources.

USDA is developing plans and has proposed actions to improve the management of its research resources. Its plans include a move toward an outcome-oriented strategic planning process that will establish five desired outcomes for its research agencies, along with performance goals and indicators and improved research evaluation. USDA also plans to establish a council of high-ranking officials from its research agencies to improve research coordination within the Department and help develop agencywide research priorities. In addition, USDA has proposed that (1) an independent commission be reauthorized to recommend closures and consolidations of federally funded research facilities and (2) the three general advisory boards be consolidated into one. Finally, USDA has requested funding in its fiscal year 1997 budget to develop a new research information system.

Recommendations

GAO is making no recommendations in this report.

Agency Comments

GAO transmitted a draft of this report to USDA for its review and comment. In commenting on this report for USDA, the Under Secretary for Research, Education, and Economics stated that the report accurately described ARS' and CSREES' research expenditures. He noted overall, however, that the value of the report was limited by the lack of specific recommendations. In addition, he maintained that the questionnaire's value is limited by statistical weaknesses and the failure to survey farmers, ranchers, and extension personnel. He further maintained that the report does not reflect discussions with U.S. scientific leaders in the agricultural or general sciences.

Concerning the first issue, GAO believes that recommendations are not necessary at this time because USDA is developing plans and has initiated actions to address the major problems identified in the report: the lack of an agencywide research agenda, shortcomings in ARS' and CSREES' planning and accountability processes, and inadequacies in USDA's research information system. GAO believes that USDA's initiatives have the potential to address these problems but that more time will be needed to assess their impact. Second, regarding his concerns about GAO's survey methodology, GAO surveyed a universe of 492 food- and agriculture-related associations, and the report clearly states that the survey results cannot be generalized to all research customers. Nevertheless, GAO believes that the information obtained from the 218 organizations responding to the questionnaire (including organizations representing farmers and ranchers)

provides valuable insights into how customers value agricultural research and extension. Furthermore, GAO supplemented the survey by obtaining anecdotal information on customers' views through interviews with individual farmers, ranchers, and extension personnel, among others, in seven states. Concerning the third issue, GAO held numerous discussions throughout the review with a broad range of scientific leaders in the public and private sectors, including top-level research officials from USDA, the National Research Council, the National Science Foundation, and several food-processing companies as well as deans and extension specialists at land grant universities in eight states. The views of these experts were integral to GAO's assessment of USDA's approaches to planning and priority setting. Appendix VII contains the complete text of USDA's comments, along with GAO's responses.

Contents

Tables

Figures

Abbreviations

ARS	Agricultural Research Service
CSREES	Cooperative State Research, Education, and Extension Service
CRIS	Current Research Information System
ERS	Economic Research Service
ESCOP	Experiment Station Committee on Organization and Policy
GAO	General Accounting Office
GPRA	Government Performance and Results Act
HHS	Department of Health and Human Services
NRI	National Research Initiative
USDA	U.S. Department of Agriculture

Introduction

For over a century, productivity-enhancing agricultural research has been an important catalyst in creating a vigorous agricultural economy and a plentiful, low-cost supply of food and fiber. Together with extension and education, agricultural research has helped transform U.S. agriculture into a productive, technology-based operation. While each of the three functions has its own purpose, they are interwoven and, hence, are often referred to jointly as the agricultural research, education, and extension system.

The research component of the system, devoted to discovering new solutions for food- and agriculture-related problems, is carried out through several agencies in the U.S. Department of Agriculture (USDA)—including over 100 USDA laboratory locations;[1] 74 land grant colleges and universities;[2] other institutions of higher education; and numerous private research facilities. The system's extension component, which disseminates agricultural research results and related educational information to the public, is implemented by thousands of state and county extension specialists and agents. Land grant colleges and other universities bear the primary responsibility for implementing the education component of the system, which involves providing formal education to future farmers and others who will be employed in the food and agricultural sector.

Because of the vast number of participants in the system and the proprietary nature of some of the information, composite funding information for the entire system is difficult to obtain. In fiscal year 1992 (the most recent year for which private sector data were available), agricultural research expenditures totaled about $6.3 billion. The private sector spent about $3.8 billion on agricultural research—about 60 percent of the combined federal, state, and private expenditures for that year. Information on total funding for higher education to support the agricultural sector is not readily available; however, USDA allocated about $12.8 million for higher education in fiscal year 1994. For extension activities, federal, state, and county governments allocated about $1.4 billion in fiscal year 1994.

[1]A laboratory location may include one or more laboratory facilities.

[2]The Morrill Acts of 1862 and 1890 established the land grant college system, and the Hatch Act of 1887 (7 U.S.C. 361 et seq.) established a system of state agricultural experiment stations under the direction of the land grant colleges.

The Changing Nature of the Agricultural Research, Education, and Extension System

Agricultural research and extension historically have focused on increasing agricultural productivity and improving the economic well-being of a largely rural U.S. population. Initially, research concentrated on (1) mechanical innovations for planting and harvesting that would remove much of the physical labor from farming and (2) improving the output and productivity of crop and animal production on farms. Today, much agricultural research continues to focus on increasing production through ways to better protect crops and livestock from insects, disease, and other hazards. However, along with farmers and producers, users of agricultural research now include consumers, as well as groups interested in the environment, sustainable agriculture, and rural development. Decreasing the use of chemicals in agricultural production, creating sustainable agricultural systems, improving food safety and nutrition, and enhancing the viability of small farms and rural communities are some of the newer research areas being addressed in response to this broadened customer base.

The 1914 Smith Lever Act established extension services nationwide to disseminate the knowledge generated by agricultural colleges to farmers and consumers. "University extension" is based on the concept that education and research developments achieved through public funding should be more readily available to those not attending universities. Today, agricultural extension specialists are often located at land grant universities. University-based extension specialists interact with scientists and relay scientific learning and other knowledge to farmers and other research customers. They also serve as the university's link to county extension agents. As in agricultural research, the customer base for extension services currently includes urban populations as well as farmers. In addition to providing agricultural information, extension programs are aimed at the development of communities, families, youth, and leadership and include diverse programs such as nutrition, 4-H organizations, and youth and families at risk.

Education is almost entirely a nonfederal function, but USDA has the responsibility for strengthening higher education in food and agricultural sciences through programs to enhance university teaching programs in agriculture. The origins of higher education in the agricultural sciences date back to the Morrill Act of 1862, which gave the states public lands for use in establishing colleges to teach agriculture and the mechanical arts. Initially, the purpose of these land grant colleges was to meet the educational needs of the nation's largely rural population and farm-based economy. However, most land grant colleges of agriculture are now

full-fledged universities, having expanded well beyond the teaching of agriculture. In addition, legislative actions expanded the system of agricultural colleges to include schools of veterinary medicine and forestry programs.

The agricultural research, education, and extension system is supported by numerous federal, state, county, and private sector activities. Many of the participants in the system (particularly those associated with land grant universities), have multiple responsibilities for teaching, conducting research, and providing extension services. While the system's components (e.g., USDA, the land grant universities and other institutions, and private companies) are autonomous and have no central governing authority, there is some collaboration. For example, USDA scientists and land grant university scientists sometimes work together on research projects. Similarly, land grant universities in states with common interests form consortiums that bring together specialized expertise to address problems relating to commodities or problems common to those states. Furthermore, USDA's Agricultural Research Service (ARS) has established formal arrangements with private companies aimed at developing and commercializing new technologies through the use of Cooperative Research and Development Agreements. Finally, private companies and commodity groups provide funding to land grant universities and, to a lesser extent, to USDA to conduct research.

USDA's Involvement in the Research, Education, and Extension System

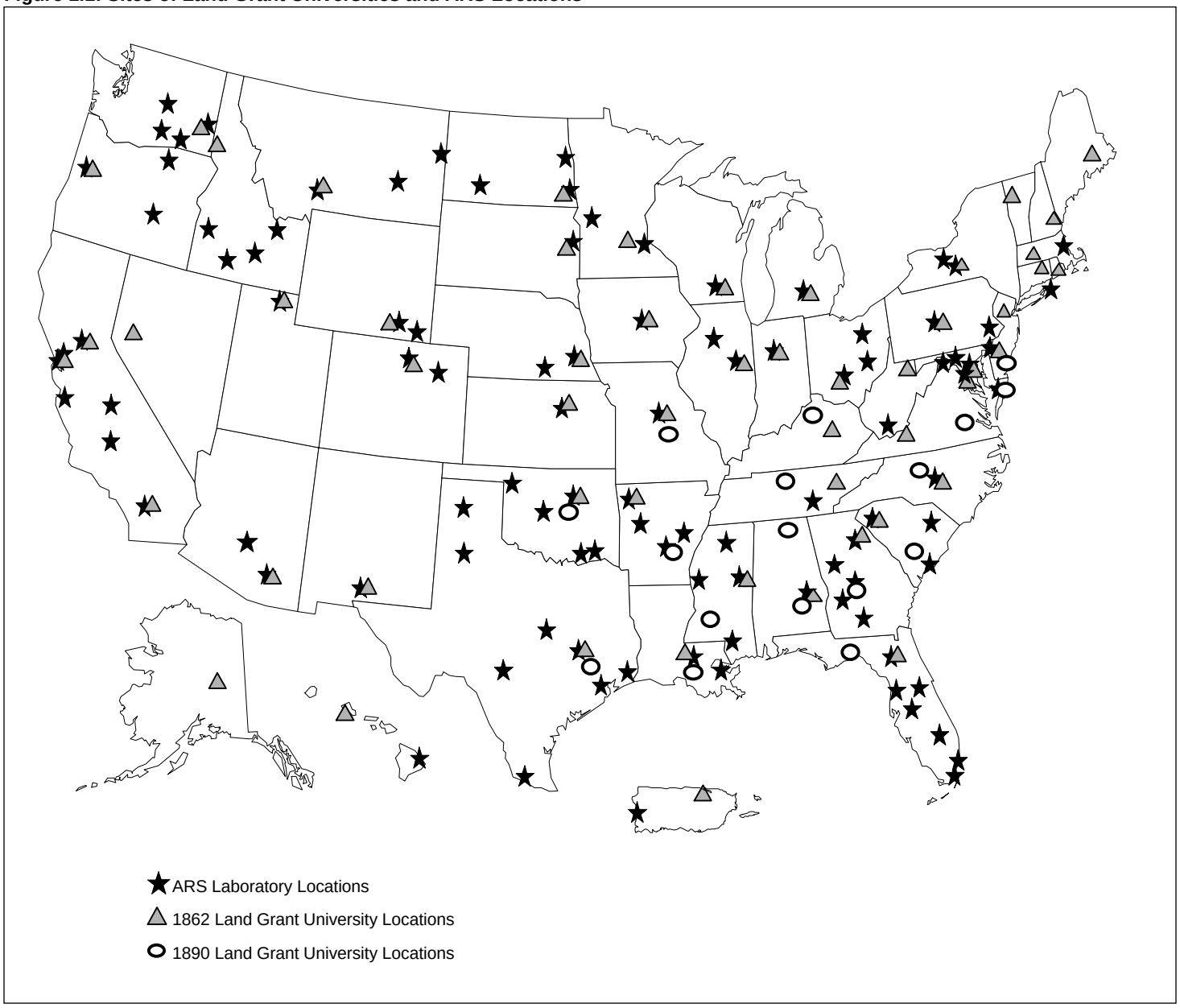
USDA is involved in the research, education, and extension system primarily through ARS and the Cooperative State Research, Education, and Extension Service (CSREES).[3] ARS conducts research at its 107 laboratory locations and 35 worksites[4] throughout the United States, Puerto Rico, and in four foreign countries, while CSREES administers funding for research at the land grant universities and other research institutions. CSREES is also the primary federal agency supporting agricultural education and extension activities.

Figure 1.1 shows the location of the ARS facilities, land grant universities established under the Morrill Act of 1862, and universities established under the Second Morrill Act of 1890 (historically black land grant colleges).

[3]In addition, the Economic Research Service and the Forest Service conduct in-house agricultural research.

[4]ARS defines a worksite as a location with four or fewer scientists with leadership at another location.

Figure 1.1: Sites of Land Grant Universities and ARS Locations



Note: At the beginning of fiscal year 1996, ARS laboratories were also located in Argentina, France, and Panama; 1862 land grant universities were also located in American Samoa, Guam, Micronesia, Northern Marianas Islands, and the U.S. Virgin Islands.

ARS Performs Most Federal In-House Agricultural Research

ARS, USDA's largest research agency, performs most federal in-house agricultural research. ARS has a broad role to develop the knowledge essential to solving technical agricultural problems that are broad in scope and have high national priority. At the end of fiscal year 1994, ARS had a staff of about 6,500 permanent employees, including over 1,900 research scientists[5] and conducted about 1,500 research projects at 128 laboratory locations nationwide and in several foreign countries.[6] Ten years earlier, in fiscal year 1984, 2,600 ARS scientists worked on about 2,700 projects in 140 laboratory locations.

In addition, ARS collaborates with land grant universities and other research institutions—through cooperative agreements, memorandums of understanding, and other means—to address research problems of mutual concern. Finally, ARS has established Cooperative Research and Development Agreements[7] with the private sector aimed at translating research into practical products, processes, and services. Under these agreements, ARS scientists and private companies work together to develop and commercialize new technologies. Since 1987, ARS has entered into over 500 cooperative agreements, 239 of which were active in November 1995. In addition, over 200 licenses for ARS-developed technologies have been granted to industries to make, use, and sell ARS-patented inventions.

In addition to ARS, the Economic Research Service (ERS) and the Forest Service conduct research. ERS provides economic and social science analyses relating to agriculture, food, natural resources, and rural America. The Forest Service conducts research on forest biology, ecology, and forest products.

CSREES Distributes Funds for Research, Education, and Extension

CSREES distributes funds for research to state agricultural experiment stations (the research arm of land grant universities), schools of forestry, the 1890 historically black land grant colleges and Tuskegee University, colleges of veterinary medicine, and other institutions. It distributes the funds for research through the formula grants program, competitive grants program, special grants program, and various other programs. Specifically:

[5]Other personnel include research technicians and administrative personnel, such as procurement specialists and clerical staff.

[6]As of February 29, 1996, ARS had reduced the number of laboratory locations to 107.

[7]The Federal Technology Transfer Act of 1986 (P.L. 99-52) [15 U.S.C. 3710a] authorizes each federal agency to permit its government or contractor-operated laboratories to enter into cooperative research and development agreements.

- Formula funds are allocated to the states according to statutory formulas that were established in three separate acts.[8] In fiscal year 1994, about 76 percent of the formula funds was distributed under the authority established by the Hatch Act to state agricultural experiment stations to conduct agricultural research. The experiment stations have wide latitude in deciding how to allocate and use these formula funds. Other acts provide formula funds for forestry research, animal health research, and agricultural research at the 1890 historically black land grant colleges and Tuskegee University.
- The competitive grants program, known as the National Research Initiative (NRI),[9] awards funds on the basis of peer-reviewed research proposals. Each year, NRI publishes a program description and request for proposals. The program is open to scientists both inside and outside of the land grant university system. In fiscal year 1994, 833 grants were awarded to scientists at colleges and universities, other research organizations, and federal agencies. The grants are awarded for a fixed term—usually 1 to 5 years.
- The special research grants program was established in 1965 as a general authority for agricultural research grants.[10] Conference committee reports accompanying USDA's appropriations often direct USDA to fund specific research projects at designated institutions (often referred to as "earmarked" projects). These earmarked projects frequently address constituents' specific concerns and represent the majority of special grant funding (74 percent in fiscal year 1994). The remaining funds are for projects that CSREES designates as national or regional priorities beyond the normal emphasis of the formula grants program. These projects are in areas such as water quality, aquaculture, and integrated pest management. Some of these non-earmarked projects are awarded competitively.
- Several other grant programs fund specific research, including research on rangelands, sustainable agriculture, and crops such as canola. The Congress also adds line item appropriations for specific research projects.

There is considerable debate in the agricultural research community about the efficacy of the various funding mechanisms. The debate often centers on two issues: whether funding mechanisms are creating inefficiencies in allocation and whether federal funds should support local priorities as well as national priorities. For example, supporters of formula funding

[8]These acts are the Hatch Act of 1887, the McIntire-Stennis Forestry Research Act of 1962, and sections 1433 and 1455 of the Farm Bill of 1977.

[9]The Food, Agriculture, Conservation, and Trade Act of 1990 (also known as the 1990 Farm Bill) authorized the National Research Initiative, which replaced a smaller competitive grants program.

[10]The Act of August 4, 1965 (7 U.S.C. 450i).

maintain that these funds provide a steady base of support for long-term research, whereas opponents contend that formula allocations may no longer reflect the areas of greatest research need. Similarly, proponents of competitive grants believe that these grants provide a flexible means of supporting new and emerging high-priority research areas. However, some groups contend that the larger, richer colleges obtain most of the competitive grants at the expense of the land grant colleges in smaller states. Special grant funding is particularly controversial. Supporters maintain that these grants provide the funding needed to address local problems, while critics argue that the states should support issues of local importance and that federal dollars should be directed toward national priorities.

In addition to supporting research, CSREES supports extension and technology transfer programs that are conducted in partnership with the states. Extension activities are conducted at the state and local level by extension staff at the land grant universities and about 3,150 extension offices, primarily located in counties and cities. CSREES provides funds for these activities in three areas: basic support for state and local programs; programs designated by the Congress, such as Water Quality and Youth and Families at Risk; and facility construction. The funds for extension activities are distributed to land grant universities through formula grants and competitive programs.[11]

CSREES also provides funding for education. Although higher education is almost entirely a state and local function, CSREES supports higher education in food and agricultural sciences through four programs to enhance college and university teaching in agriculture.[12] These programs provide grants for graduate fellowships to attract students into agricultural research and grants that provide incentives for innovations in curriculum development.

Finally, to support agricultural research, extension, and higher education, CSREES administers grants to construct and renovate buildings and facilities. Each year the conference committee for USDA's appropriations specifies funds for specific projects at specific institutions to carry out these activities. About $54 million was appropriated for building and

[11]Authority for most extension funding is provided in the Smith-Lever Act of 1914, sections 3(b), (c), and (d) (7 U.S.C. 343 et seq.). The act limits the distribution of funds to land grant universities established under the Morrill Act of 1862.

[12]These programs are the Higher Education Challenge Grants Program, Higher Education Multicultural Scholars Program, 1890 Institution Capacity-Building Grants Program, and the Food and Agricultural Sciences National Needs Graduate Fellowship Grants Program.

facilities grants in fiscal year 1994. An additional $7.9 million was appropriated for extension facilities at the 1890 historically black land grant universities. The latter funding was requested by USDA.

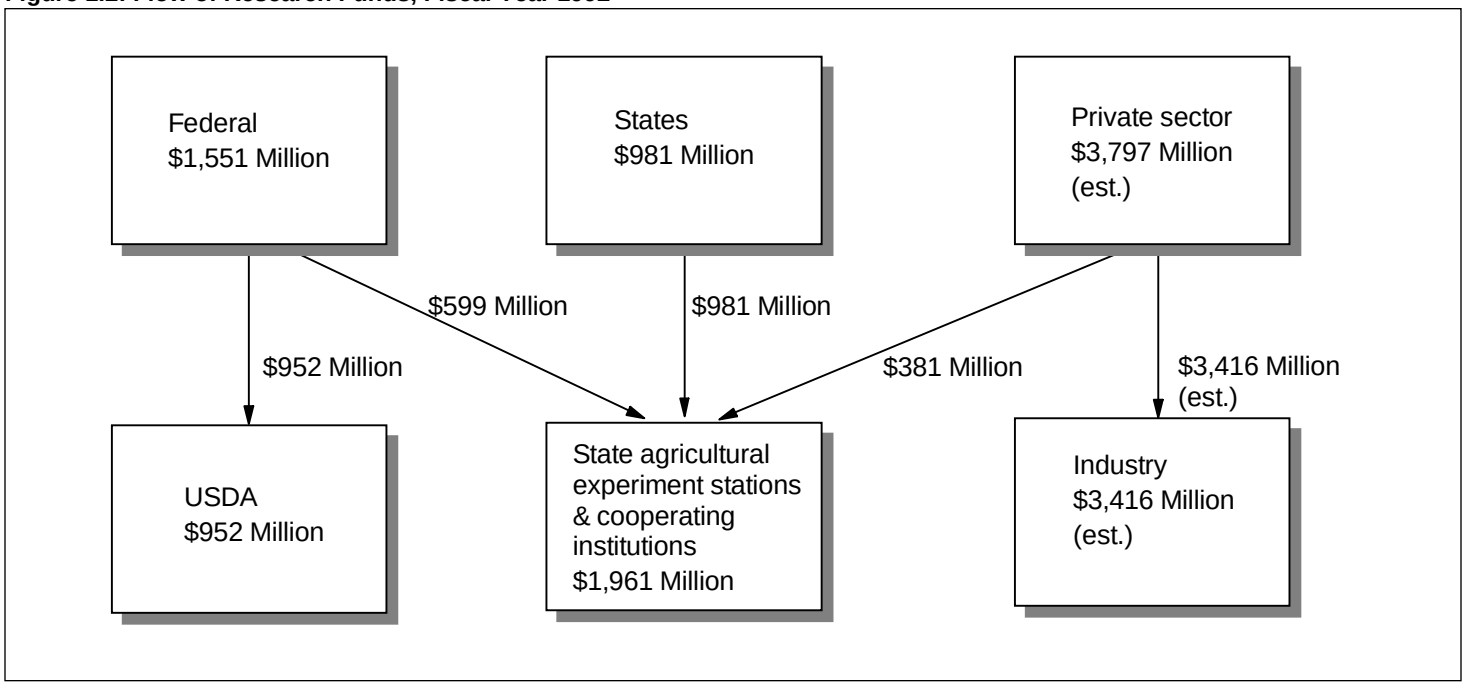
System Is Funded by a Mix of Federal, State, and Private Expenditures

USDA provides considerable support for the agricultural research, education, and extension system; over $2 billion was appropriated for these activities in fiscal year 1994. However, it does not provide the greatest share of funding. In fiscal year 1992 (the most recent year for which private sector data were available), the private sector provided more than half of the research dollars, and the states provided most of the funding for higher education and extension activities.

Funding for the Research Component

In fiscal year 1992, the federal government funded about 25 percent of all agricultural research, state governments about 15 percent, and the private sector about 60 percent. Federal agricultural research funds supported USDA's in-house research and research conducted at land grant and other institutions. The states funded research conducted at land grant and other institutions. Private funds supported private sector research and research at land grant institutions and, to a lesser degree, federal laboratories. Figure 1.2 shows the flow of agricultural research funds in fiscal year 1992.

Figure 1.2: Flow of Research Funds, Fiscal Year 1992



Notes:
1. Public sector data are expenditures reported in USDA's Current Research Information System. Private sector data are estimates of research expenditures made by ERS. Fiscal year 1992 was the most recent year for which private sector data were available.

2. Other institutions include the 1890 historically black land grant colleges and Tuskegee University and veterinary and forestry schools.

3. Private sector funding to the state system includes $143.4 million in direct grants from industry, $116.1 million from product purchases (such as sales of college-owned livestock) and patent license fees, and $121 million from other sources (such as grants from nonprofit foundations). The private sector also provides limited funding to federal research agencies.

Source: ERS.

As shown in the figure, private sector funding for all agricultural research—estimated at $3.8 billion in fiscal year 1992—exceeded the total of $2.5 billion in funds provided by the federal and state governments in that year. Most private sector funds—$3.4 billion—supported specific industry needs, and the results of this research are generally proprietary.

As figure 1.2 shows, about 10 percent of this total—$381 million—went to research at land grant universities.[13]

In fiscal year 1994, ARS spent 72 percent—$673 million—of the $939 million expended for federal in-house research.[14] ARS' funding has remained relatively level over the past 10 years, increasing only 5 percent in constant dollars between 1984 and 1994. However, according to ERS, the cost of conducting research increased faster than the overall rate of inflation during this period. If this factor is taken into account, the real level of ARS' funding decreased by about 10 percent.

The remaining $266 million for in-house research was spent by USDA's Forest Service ($207 million), ERS ($56 million), and the Agricultural Cooperative Service ($3 million). In addition to these direct expenditures for research, USDA also funds the National Agricultural Library and the National Agricultural Statistics Service to provide informational and statistical support.

Additional federal funds for agricultural research—$703 million in fiscal year 1994—were spent by the land grant university research system. Of these expenditures, CSREES provided just over 50 percent—about $353 million. This amount included $214 million in formula funds, $63 million in competitive grants for the NRI program, $54 million in special grants, and $22 million in other research grants administered by CSREES. A number of other federal agencies—within and outside of USDA—also contributed to the system. Other USDA agencies provided about 11 percent (about $80 million) of the research funds spent at the land grant universities. Another 38 percent (over $270 million) was provided by other federal agencies, including the National Institutes of Health ($68 million), National Science Foundation ($39 million), Department of Health and Human Services ($31 million), and Agency for International Development ($27 million).

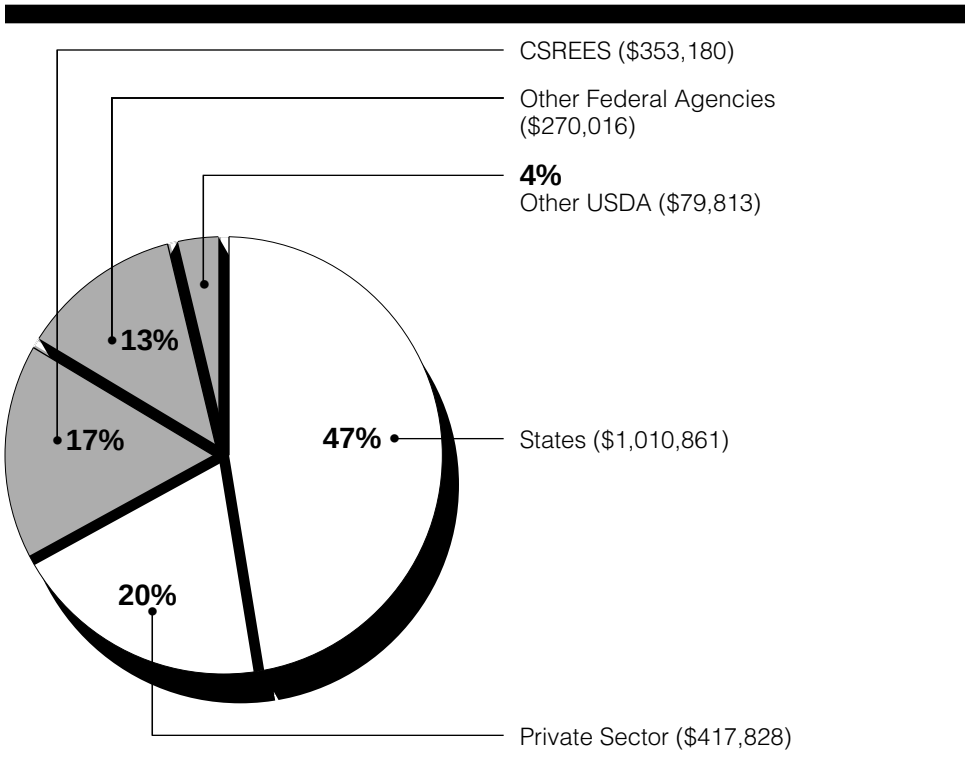
While the federal contribution to research at the land grant universities is significant, most research support for these institutions comes from the states—over $1 billion in fiscal year 1994. The private sector also provides funds for research, which include grants from industry and nonprofit organizations and revenue generated by commercial sales of products

[13]Private sector funding to the state system includes direct grants from industry, product purchases (such as sales of college-owned livestock) and patent license fees, and support from other sources, such as grants from nonprofit foundations.

[14]Most research funds were provided by USDA. Another 3 percent came from other federal agencies and private sector funds provided to federal organizations.

(such as college-owned livestock) and licenses. According to USDA officials, product sales are different in source and purpose from industry grants. Land grant universities can actively develop, manage, and invest in sales operations to provide steady, predictable income. Funding from industry grants, however, is less unpredictable. Figure 1.3 shows the distribution of fiscal year 1994 funds for land grant system research. (App. I provides information on research funding for each state and other jurisdiction in fiscal year 1994.)

Figure 1.3: Fiscal Year 1994 Funding for Land Grant System Research

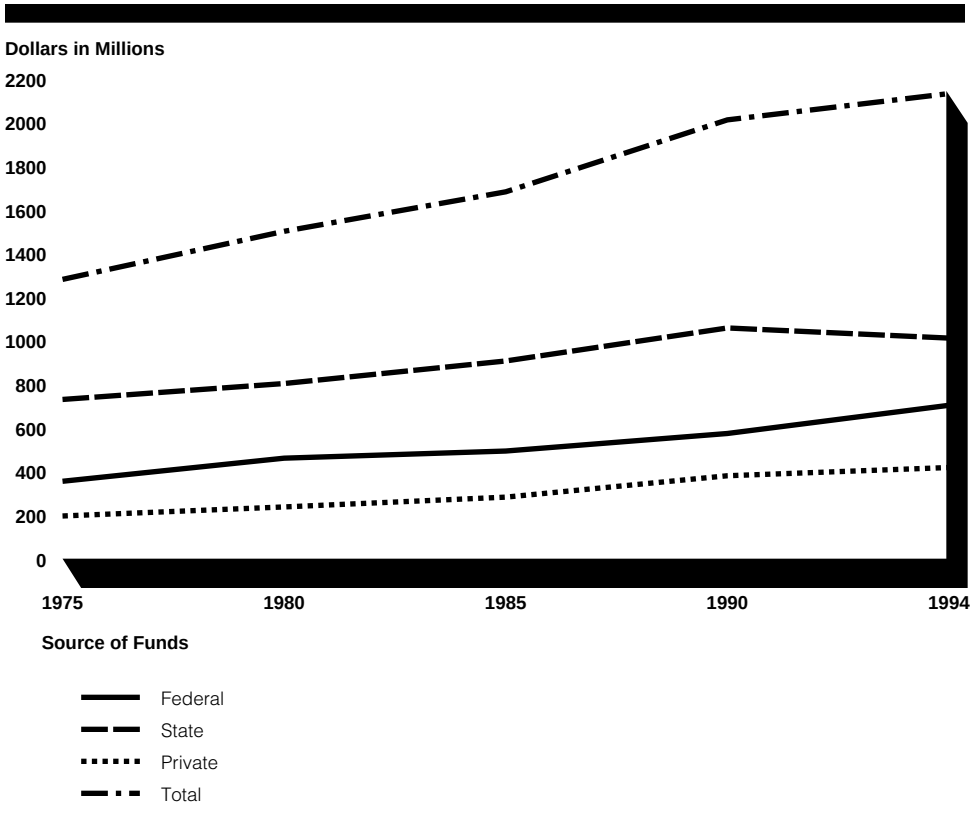


Dollars in parentheses are in thousands. Total funding = $2,131,698,000. Shaded areas note the total federal funding, which is $703,009,000. Percentages total more than 100 percent because of rounding.

Source: USDA, Current Research Information System.

As shown in figure 1.4, overall funding for land grant research has steadily increased from $1.3 billion to $2.1 billion from 1975 to 1994. However, in constant dollars, funding from the states has declined since 1990, while both federal and private support has increased. Taking all sources of support for land grant research into account, the states' share decreased by 10 percent between 1975 and 1994. Private sector funding more than doubled over the period, from about $196 million to about $418 million in constant 1994 dollars. In 1975, the greatest proportion—49 percent—of private sector funding came from product sales by the universities, with an additional 31 percent from grants and 20 percent from other sources (e.g., grants from nonprofit foundations). However, by 1995, product sales accounted for 29 percent of private sector funding, ranking third behind grants (37 percent) and other sources (35 percent).

Figure 1.4: Funding for Land Grant Research by Source, Fiscal Years 1975-94



Source: USDA, Current Research Information System.

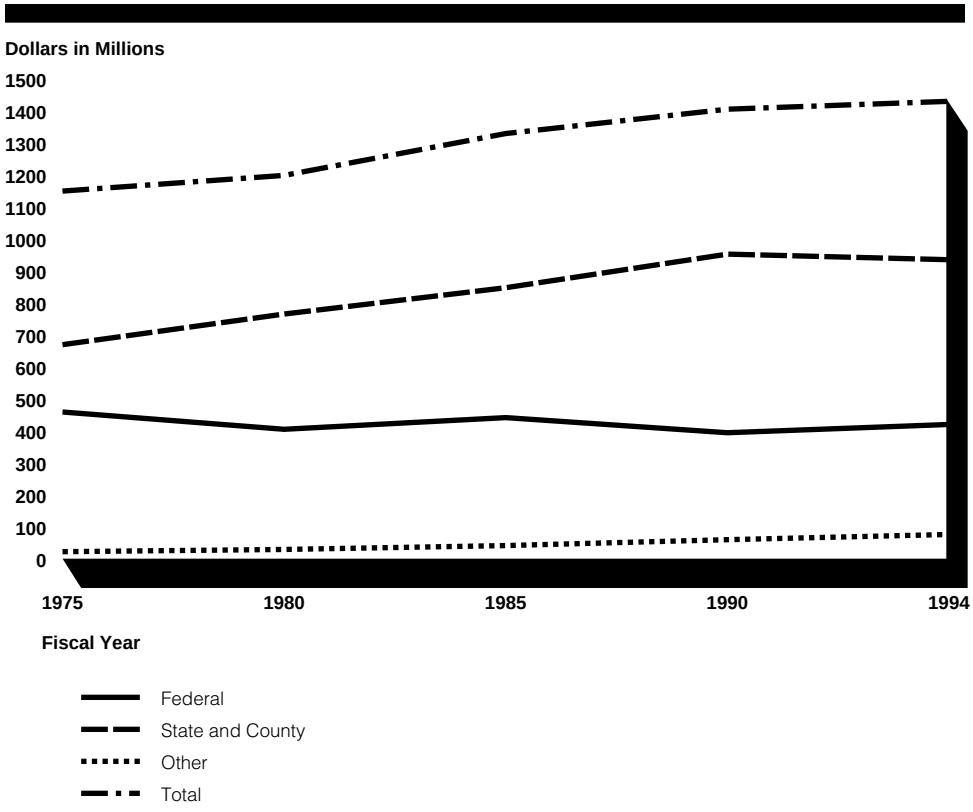
Funding for Extension and Education Activities

Overall, federal, state, and county governments provided almost $1.4 billion in fiscal year 1994 for extension activities. Extension activities also received approximately $76 million from such sources as private grants, endowments, and fees charged for services. Total funding for higher education in the agricultural sciences is not available. (App. I provides information on federal extension funding for each state and other jurisdiction in fiscal year 1994.)

To support extension and education activities in fiscal year 1994, the federal government provided about $419 million for extension activities—over 70 percent of these funds was distributed by formula, and the remainder was designated by USDA or congressional committees for specific programs. The federal government's support for extension activities constituted about 29 percent of all funding for extension activities. The states' and counties' funding for extension activities are clearly much more significant. In fiscal year 1994, state and county governments provided almost $1 billion, or about 65 percent of the total funding for these activities. While the total funding for higher education in agriculture-related areas is not available, the federal support in this area has been and continues to be subordinate to the states' support. In fiscal year 1994, USDA provided about $12.8 million for higher education.

As shown in figure 1.5, the total funds for extension services increased slightly between 1975 and 1994. However, the federal share of the total decreased from 40 percent to 29 percent over the period.

Figure 1.5: Funding for Extension Services, Fiscal Years 1975-94



Funding in constant 1994 dollars. "Other" includes non-tax sources, such as private grants and endowments, and fees charged for services.

Objectives, Scope, and Methodology

The Chairmen and Ranking Minority Members of the House Committee on Agriculture and its Subcommittee on Resource Conservation, Research and Forestry asked us to examine the U.S. research, education, and extension system. Specifically, we agreed to (1) provide an overview of the system; (2) obtain the views of various users of agricultural research on the extent to which USDA and the land grant universities are meeting their research needs and on how effectively research results are being disseminated; and (3) assess USDA's processes for planning and establishing research priorities.

To address the first objective, we reviewed the legislative history of the agricultural research, education, and extension system; examined the literature assessing various aspects of the system; and obtained and

reviewed documents describing the mission, organizational structures, staffing, funding mechanisms, and budgets of USDA's research organizations. We obtained information on federal, state, and private expenditures for agricultural research from USDA's Current Research Information System. We performed a limited review of the accuracy of the funding data, but we did not independently verify it. We engaged a consultant, Dr. Ron Cooper, to provide technical advice on agricultural research and assist in analyzing funding data obtained from USDA.

For the second objective, we conducted a nationwide mail survey of 492 associations that deal with food and agriculture issues. We obtained the list of associations from the 1995 Encyclopedia of Associations.[15] The food- and agriculture-related associations in the encyclopedia represent areas such as agribusiness, agricultural science, animal breeding, conservation, forestry, fruits and vegetables, livestock, nurseries, and poultry. These organizations provide a cross-section of the potential customers of agricultural research. However, they do not include such customers as individual farmers, producers, and extension agents. A total of 218 associations, representing a 44-percent response rate, completed and returned the survey.[16] The responses from these associations, which we report in chapter 2, cannot be generalized to other users of agricultural research. An additional 41 associations returned the survey and indicated they were not familiar with agricultural research; they did not complete the survey. A copy of the survey, including total responses, is included in appendix II. Appendix III lists the 218 associations that completed the survey.

To address the second objective, we also interviewed land grant university scientists and administrators in eight states (California, Colorado, Georgia, Kansas, Michigan, Oregon, Pennsylvania, and Texas) and other research customers, including farmers, commodity groups, public interest groups, private companies, and extension specialists and/or administrators in those states and Washington, D.C.

To address the third objective, we reviewed relevant literature and USDA planning documents and strategic plans; previous GAO reports; and reports from USDA's Office of Inspector General, the Congressional Research

[15]Our list included all food- and agriculture-related associations located in the United States that we judged to be potential users of agricultural research. We excluded associations, such as boards of trade and stock exchanges, that we expected would not use agricultural research. We sent questionnaires to the resulting universe of 492 associations and did not sample from it.

[16]To increase our response rate, we sent postcard reminders followed by telephone calls to all associations that had not responded.

Service, the National Research Council, the Office of Technology Assessment, and ERS. Within USDA, we interviewed officials from ARS, CSREES, and the Research, Education, and Economics mission area. In addition, we interviewed the Chair, National Association of State Universities and Land Grant Colleges' Board on Agriculture; the Executive Director, National Research Council's Board on Agriculture; ARS laboratory and regional directors; and deans, department heads, and extension specialists at the land grant universities in the eight states mentioned above. We also interviewed officials and obtained documents concerning research evaluation from the Office of Science and Technology Policy, the National Science Foundation, and the National Institute of Standards and Technology at the Department of Commerce.

Unless otherwise noted, the dollar figures we report are in constant 1994 dollars.

We conducted our review from July 1995 through February 1996 in accordance with generally accepted government auditing standards. We provided USDA with a draft of our report for comment. USDA's comments and our response are in appendix VII.

Associations Find Value in Research and Extension but Perceive Funding Constraints

Most of the 218 associations responding to our survey, representing a broad spectrum of the food and agriculture sector, believe that the research performed by ARS and the land grant universities is either somewhat or very effective in meeting their needs. Similarly, most associations that responded said that state extension services are either somewhat or very effective in disseminating research results. Not surprisingly, however, many of the associations believe that the sector needs more funding for agricultural research and extension.

In response to perceived funding constraints, some associations and private companies are funding desired research themselves or entering into partnerships with ARS laboratories and land grant universities. Similarly, USDA and the land grant universities are initiating collaborative efforts to make better use of limited resources.

Associations View Research as Somewhat or Very Effective in Meeting Their Needs

Over 65 percent of the associations responding to our survey believed that the research conducted by ARS and the land grant universities was somewhat or very effective in meeting their needs.[17] The respondents also indicated that the areas of plant sciences, integrated pest management,[18] animal sciences, and food safety were most useful to them. The associations' views were mixed regarding ARS' and the land grant universities' ability to respond to changing research needs.

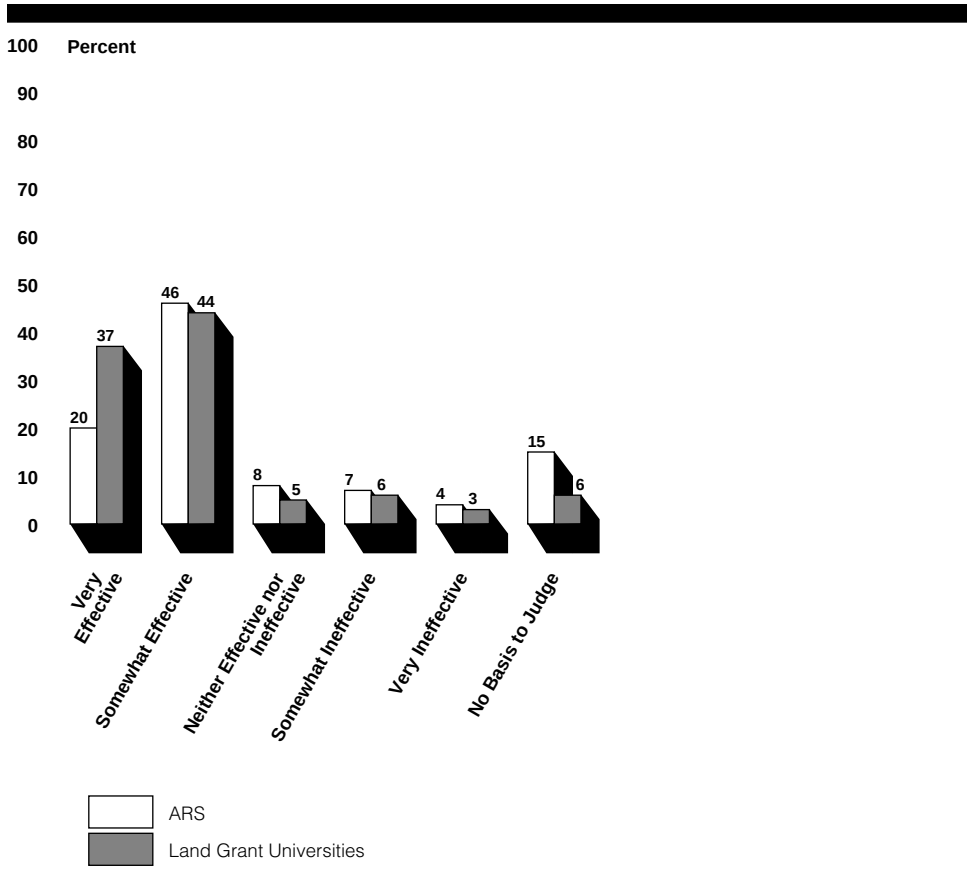
Views on Effectiveness in Meeting Research Needs

Of the 218 associations responding to our survey, 81 percent rated research conducted at land grant universities as somewhat or very effective in meeting their research needs. Sixty-six percent gave these ratings for ARS' research. Figure 2.1 summarizes the respondents' views on the effectiveness of the research.

[17]Appendix II shows the number of responses for each survey question.

[18]Integrated pest management uses all suitable techniques, including biological controls—such as predators, parasites, and pathogens—as well as chemicals to control pests.

Figure 2.1: Effectiveness of ARS and Land Grant Universities in Meeting Research Needs



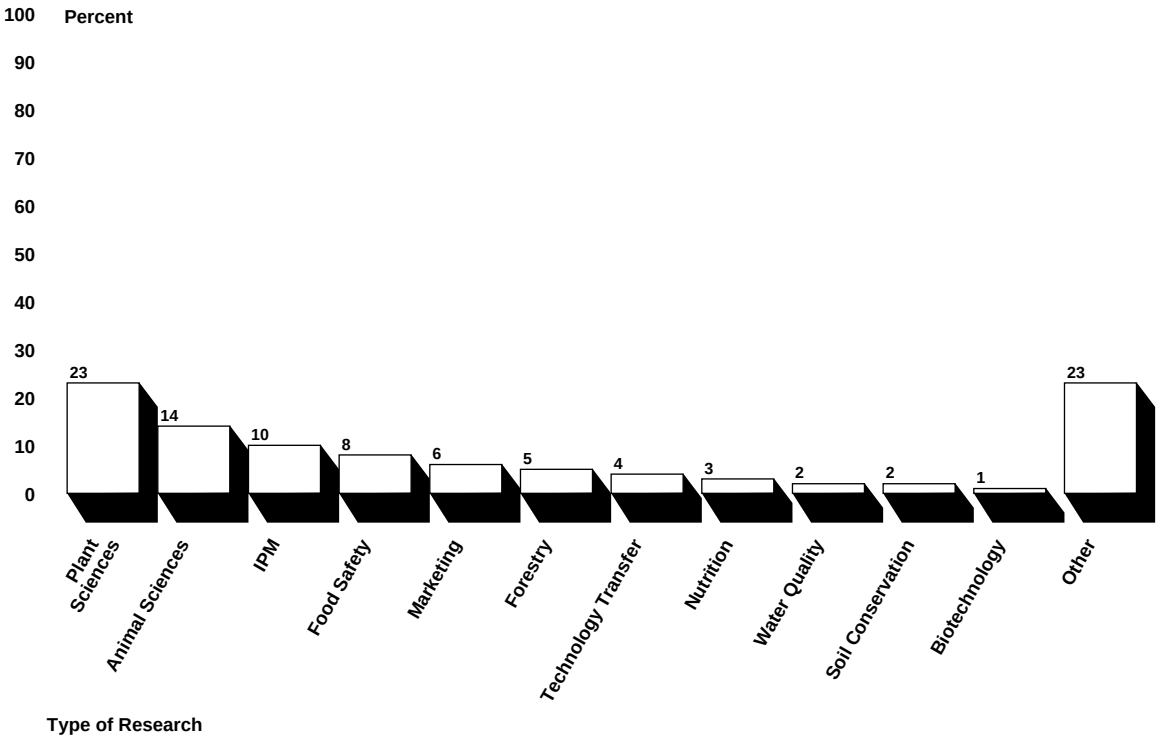
Some of the associations that rated ARS and/or land grant universities as very effective in meeting their members' needs supplemented their ratings with written comments. For example, an association of plant physiologists indicated that the National Research Initiative's competitive grant research, which is primarily conducted at land grant universities, was contributing significantly to advancements in agricultural research. A state association of apricot producers commented that both ARS and land grant universities play a major role in the continuing survival of the agricultural economy. Another association, representing ranchers, commented on the high caliber of the scientists performing research at land grant universities, but it also expressed the need for scientists to spend more time with agricultural groups to identify producers' needs.

The need for obtaining greater input from customers was also raised by some associations that rated ARS' and the land grant universities' research as somewhat effective in meeting members' needs. For example, an association representing the poultry and egg industry commented that agricultural research should be more problem-oriented and that industry should have a greater voice in the program. On the other hand, an environmental and research association rated ARS' and land grant universities' research as very ineffective because it believed that their research programs were largely determined by commercial needs and did not sufficiently address environmental needs.

Areas Viewed as Most Useful to Respondents

As shown in figure 2.2, research on plant and animal sciences was most useful to 37 percent (23 percent and 14 percent, respectively) of the respondents. In addition, 18 percent of the responding associations rated the research areas of integrated pest management and food safety as most useful.

Figure 2.2: Types of Research Most Useful to Respondents

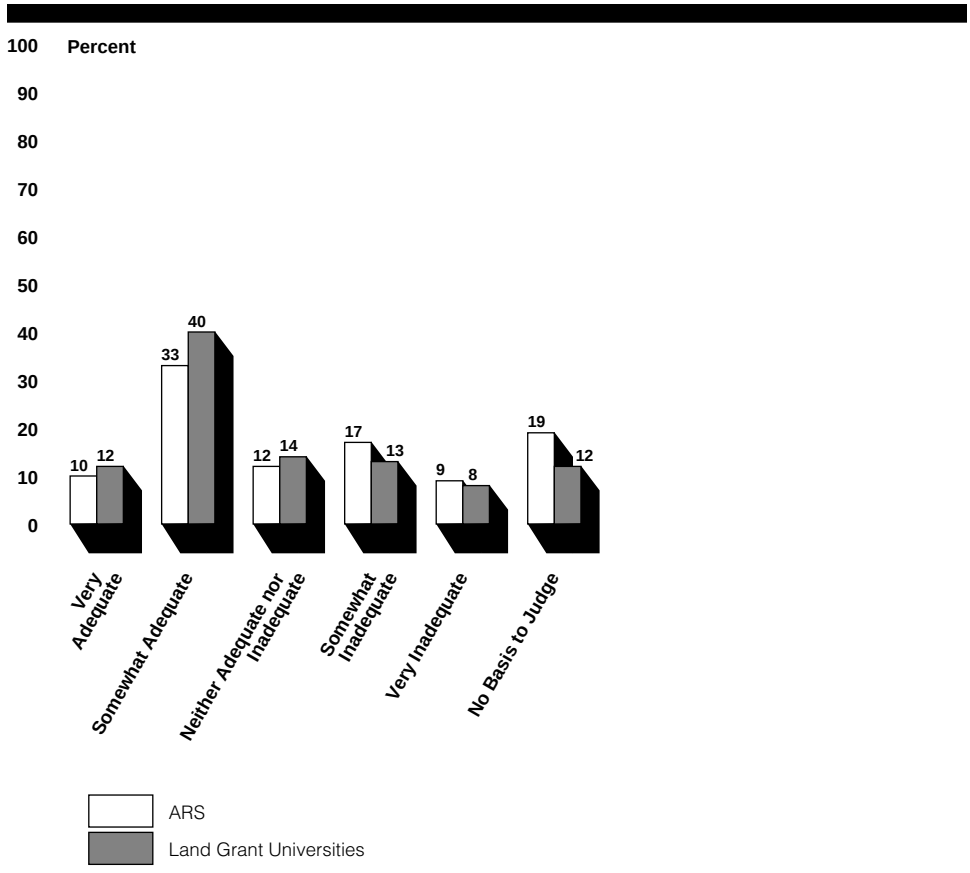


Note: "Other" includes specialized areas of agricultural research, such as aquaculture and apiculture.

Views on Responsiveness to Changing Needs

Our survey results were mixed concerning USDA's and the land grant universities' ability to respond to emerging research needs. Specifically, 43 percent of the associations responding to the survey believed that ARS' response to changing research needs was somewhat or very adequate, while about 26 percent believed that it was somewhat or very inadequate. With respect to the land grant universities, about 52 percent rated their response to emerging needs as somewhat or very adequate, while about 21 percent rated it somewhat or very inadequate. (See fig. 2.3.)

Figure 2.3: Adequacy of Response by ARS and Land Grant Universities

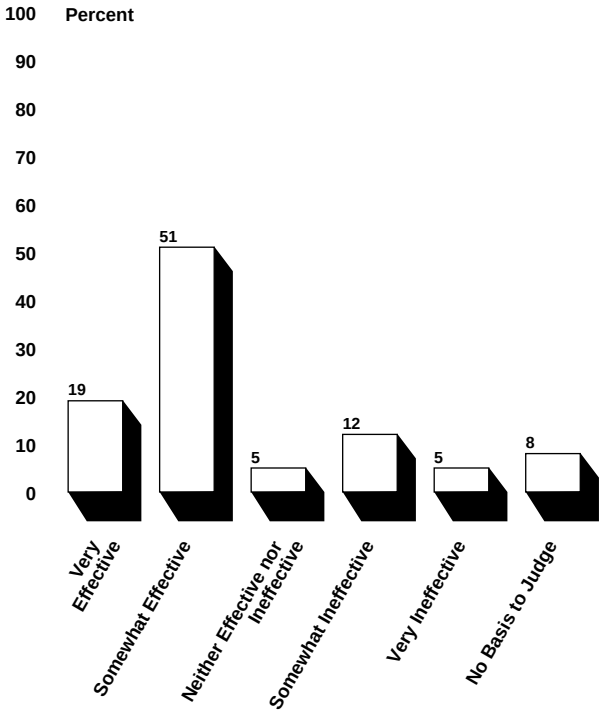


For example, a public policy organization commented that both ARS and, to a lesser extent, the land grant universities are slow in responding to changing priorities unless they are of high public interest. This institute indicated that higher priority should be given to research on the nutritional quality of food and growing food with fewer chemicals. Another association that conducts and funds agricultural research commented that the departmental structure of land grant universities made it difficult for them to develop new programs. Finally, an association that represents farmers indicated that both ARS and the land grant universities needed to give higher priority to research on rural development.

Respondents Value Extension Services

Seventy percent of the respondents indicated that state extension services were somewhat or very effective in disseminating research results. (See fig. 2.4.) While 45 percent indicated that extension services were one of their primary sources for obtaining research results, the respondents also obtained research information from other sources. Seventy-seven percent obtained research results from publications and 55 percent through professional networking.

Figure 2.4: Effectiveness of State Extension Services in Disseminating Research Results



While most associations we surveyed found value in the extension services' role in disseminating research results, 44 percent believed that increased funding was necessary to improve research dissemination. One respondent commented that in addition to a reduction in funding, there has been a shift of funds from agriculture to social issues. In 1995, USDA sponsored focus groups with users of agricultural research and extension. The participants agreed that many issues needed to be addressed in

connection with the extension services, including the appropriate role for the services. Other research customers that we spoke with, as well as state and federal research and extension officials, raised similar concerns.

For example, several land grant officials told us that the effectiveness of the extension services in disseminating agricultural research results has been diminished as a result of the increased emphasis on social issues, such as community and economic development, family and youth services, and nutrition and health information. One administrator of a land grant university commented that the need to respond to social issues has diverted the extension services from their basic mission of transferring research information and technology. Other customers of agricultural research commented that it was difficult for extension agents to provide all the information that producers need because there are too few agents. On the other hand, two extension service administrators said that the services' increased emphasis on social issues was needed and appropriate. USDA officials recognize that there are divergent concerns and are examining the federal role in supporting extension services.

Concerns About Funding Are Leading to Alternative Funding Arrangements and Increased Collaboration

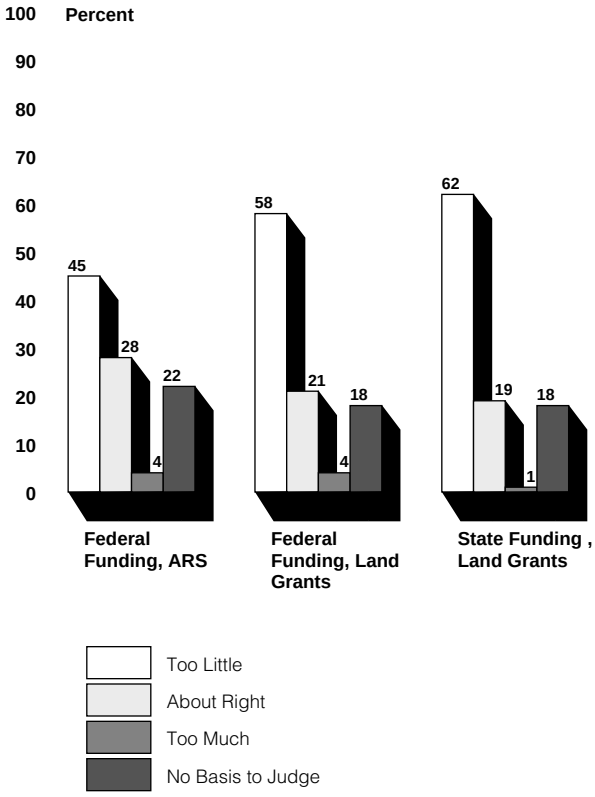
Not surprisingly, many users of agricultural research believe that current funding for research is inadequate and needs to be increased. As discussed in chapter 1, funding for ARS has been relatively level over the past decade, while the cost of performing research increased faster than the rate of inflation. Similarly, although total funding for land grant university research and the extension services increased moderately during the 1990s, state funding for these activities decreased.

Concerns about funding constraints by users of research as well as those conducting it have resulted in alternative funding arrangements, the formation of research partnerships among members of the research community, and calls for more efficient use of existing resources.

Respondents' Concerns About Funding Levels

The respondents to our survey expressed varying degrees of concern about the appropriate levels of federal and state funding for agricultural research. Forty-five percent of the respondents said that too little federal funding was provided for ARS, and 58 and 62 percent, respectively, indicated that too little federal and state funding was provided for research by the land grant universities. (See fig. 2.5.)

Figure 2.5: Perceived Adequacy of Public Funding for Land Grant Universities and ARS



For example, a state association of fruit producers responded that federal and state governments provided too little funding for land grant universities and that funding cuts would jeopardize the agricultural sector. Another association of farmers commented that ARS fulfills a necessary and vital function but that its ability to fulfill its role is often limited by inadequate physical and financial resources. An association of agricultural scientists voiced similar concerns about inadequate funding and added that greater coordination of research between the government, industry, and academia was particularly important when budgets are constrained.

Some of the administrators of land grant universities that we spoke with also discussed the impact of funding constraints on their operations. For example, Kansas State University eliminated its corn, grass, and alfalfa breeding programs because administrators felt that research in these areas already being conducted by the Universities of Nebraska and Missouri

would be applicable to Kansas farmers. They noted, however, that over time the university may lack adequate programs to train future scientists to conduct research in these breeding programs. At Michigan State University, officials said that federal funding for agricultural research had not increased for many years and that formula grant funds had not kept pace with inflation.

Alternative Arrangements for Supporting Research

In response to funding limitations, some private sector organizations we visited as well as some of the associations we surveyed are providing resources to USDA and the land grant universities to perform the research they need. For example, a Pennsylvania meat processing company has supported ARS' research over the last 10 years by allowing agency scientists to have access to the company's facilities. Through this arrangement, ARS scientists conduct research on meat in the processing plant itself. The research undertaken in this partnership includes efforts to reduce pathogens on equipment, eliminate salmonella in meat, and develop a system for using recycled water in food processing plants.

Another association representing producers and processors in the poultry and egg industry told us it spends about $1.2 million annually on research in poultry processing, poultry breeding, feed mill management, and poultry health. In 1995, it helped fund about 80 research projects at ARS and land grant universities. Additionally, since 1987, over 500 companies have entered into Cooperative Research and Development Agreements with ARS to develop and commercialize new technology.

In addition, some land grant universities are initiating efforts to use resources more efficiently through increased collaboration, as shown in the following examples:

- The Midwest Water Quality Initiative has brought together scientists from land grant universities, ARS, the U.S. Geological Survey, and the Environmental Protection Agency as well as extension service specialists. The project involves designing and field-testing alternative farming systems in five states and evaluating their effects on water quality.
- The ARS Food Animal Protection Research Laboratory at College Station, Texas, works with a land grant institution to reduce salmonella in poultry. The ARS laboratory is a focal point for (1) developing new technology, (2) obtaining the Food and Drug Administration's approval to test the technology in commerce, (3) developing research partnerships with

universities and private industry, and (4) transferring the technology to the private sector.

- A tri-state food safety consortium—comprising Kansas State University, Iowa State University, and the University of Arkansas—was initially funded by a special grant but is currently funded by a combination of formula funds, special grants, state funds, and private industry grants. Memorandums of understanding were prepared to spell out the funding, structure, and cooperative agreements among the universities to perform interdisciplinary research on meat-borne pathogens. Kansas State specializes in beef animal research, Iowa State in swine research, and the University of Arkansas in poultry research. According to Kansas State officials, this coalition of researchers has improved communication and collaboration, education and training, technology transfer, and the overall efficiency and effectiveness of conducting research.

To promote more efficient use of resources, USDA officials are proposing regional centers specializing in high-priority research areas. Scientists participating in these centers would not necessarily be physically co-located. Fundamental to this concept is the notion that not all institutions need to have research programs in all specialties or problem areas. USDA officials believe that such centers would be less costly to taxpayers since they make better use of resources by reducing the need for a broad range of specialized expertise at every laboratory or university.

Priority Setting Is Impaired by Lack of a Department-Wide Research Agenda and Constraints on Resource Allocation

In view of the concerns about funding levels for agricultural research and the current environment of fiscal constraint, it is critical that USDA's funds be allocated as effectively and efficiently as possible. USDA's primary influence on research priorities lies in the over $800 million budgeted for ARS and the National Research Initiative (NRI) competitive grants program, which is administered by CSREES.[19] In connection with these programs, we found that the following problems hamper the effectiveness and efficiency of USDA's processes for identifying research priorities, allocating resources among those priorities, and achieving accountability for research expenditures:

- USDA lacks a Department-wide research agenda to guide priority setting. Furthermore, the priority-setting processes used by two of its principal research agencies—ARS and CSREES—do not include important elements of planning and accountability. For example, neither agency incorporates performance goals or indicators into its processes or comprehensively evaluates the outcomes of its research programs.
- USDA's research information system does not provide sufficient information on the costs of research or the outcomes of research projects.
- The three general advisory boards established to assist USDA's research agencies in setting priorities have had limited impact.

In addition, USDA's ability to shift resources among research priorities is limited by an aging infrastructure (e.g., laboratories and equipment), directives from congressional committees that specific research activities be undertaken, pressures from commodity and interest groups to maintain funding in their areas of interest, and low funding levels for the NRI program.

As a result of the Government Performance and Results Act of 1993 and the administration's 1995 Farm Bill Guidance, USDA has developed plans and proposals to improve its priority setting for research. Key to these actions is a move toward an outcome-oriented strategic planning process with performance goals and indicators to determine if the goals were achieved. While these initiatives have the potential to address some of the problems we identified, more time will be needed to assess their impact.

[19]While USDA's Economic Research Service and Forest Service also conduct in-house research, we did not examine the processes these agencies used to establish research priorities.

USDA Lacks an Agencywide Research Agenda and Effective Priority-Setting Processes

USDA has not developed a Department-wide agenda to guide the activities of its research agencies. Instead, ARS and CSREES independently plan and set priorities for the research over which they have primary influence—ARS' in-house research and CSREES' NRI program. Although CSREES also funds agricultural research through formula funds and special grants to the land grant universities and other institutions, it has a minimal impact in directing the use of these funds. In addition, neither ARS nor the NRI program (1) incorporates performance goals or indicators into its priority-setting processes, (2) assesses the relative importance of its research priorities in the context of USDA's total research portfolio (i.e., research activities conducted and/or funded by USDA), or (3) comprehensively evaluates the outcomes of its research programs.

ARS' and NRI's Research Priorities Are Set Without a Department-Wide Agenda

ARS and CSREES plan and implement in-house research programs independently, with limited coordination between them and without the benefit of Department-level mission objectives and strategies. According to USDA officials, problems in cooperation among USDA's research agencies are long-standing and result, in large part, from (1) a lack of incentives for interagency cooperation and (2) competition for funding. The officials added that although cooperation between the agencies has been lacking, scientists from ARS and the land grant universities frequently collaborate and share information on scientific issues. In addition, the NRI program has a board of directors comprising the administrators of USDA's research agencies. USDA officials noted that the board is designed to provide coordination in such areas as program planning and reviewing proposals.

While ARS and the NRI program have their own priority-setting processes that serve their particular needs, the processes are similar in several ways. Both categorize their research into broad program areas (currently six for ARS and seven for NRI) that generally correspond to the priorities established in the 1990 Farm Bill.[20] Within these broad program areas, ARS has identified 52 research priorities and the NRI program, 27. In addition, both obtain information on research needs from a wide range of stakeholders, including the Congress, commodity and interest groups, USDA advisory groups, and others.

ARS has shifted its emphasis among its six research areas only marginally over the past 12 years. As shown in table 3.1, funding in each area, as a

[20]The purposes in the 1990 Farm Bill include (1) satisfying human food and fiber needs; (2) increasing global competitiveness; (3) expanding rural economic opportunities and enhancing the quality of life for farmers, rural citizens, and society as a whole; (4) developing new crops and uses for agricultural commodities; (5) enhancing the environment and natural resources; and (6) enhancing human health.

percentage of total funding, changed less than 4 percentage points from fiscal years 1982 to 1994.

Table 3.1: Comparison of Funding in ARS Research Areas, Fiscal Years 1982 and 1994

Research area	Percentage research funding in FY 1982	Percentage research funding in FY 1994
Soil, water, and air	13	13
Plant productivity	40	37
Animal productivity	20	17
Commodity conversion and delivery	18	20
Human nutrition and well-being	7	9
Systems integration	2	4

Source: ARS.

The percentage of funding allocated among six of NRI's seven research areas changed little from fiscal year 1992 to 1994. As discussed later, directives from congressional committees and legislation have affected the allocation of funds among NRI's research areas. With total funding of about $100 million during those years, the program has allotted about 40 percent of its funds to plant systems, 25 percent to animal systems, 20 percent to natural resources, 7 percent to nutrition, and 4 percent each to (1) processing for value-added and (2) markets, trade, and rural development. The seventh research area—agricultural systems—was added by program staff in fiscal year 1994 and funded with 2 percent of the funds from each of the other six areas.

Concerns about the inadequacies in USDA's research planning and priority-setting processes are not new. Reports dating back 15 years have identified the need to improve USDA's strategic planning to provide a basis for more efficient research management. For example, in a 1981 review of long-term planning for agricultural research, GAO called upon USDA to prepare a long-term assessment of the food and agriculture sector's needs and to determine the research necessary to meet those needs. Similarly, in 1993 the Office of Technology Assessment testified on the need to set better and more consistent goals for USDA's research. It noted that

resources cannot be allocated appropriately unless priorities are determined and goals established.[21]

USDA's Priority Setting for Formula Funds and Special Grants Is Limited

Although formula funds and special grants made up about 70 percent of CSREES' research funding in fiscal year 1994, USDA generally has had a limited impact on establishing priorities for these programs. The systemwide priorities for formula funds distributed to agricultural experiment stations[22] under the Hatch Act are laid out by a committee of experiment station administrators under the auspices of the National Association of State Universities and Land Grant Colleges. CSREES is one of many participants involved in the strategic planning process used to develop these priorities every 4 years. (See app. IV for a summary of this process.)

According to a CSREES official, the agency's role in the planning process is to help ensure that systemwide priorities fall within the six broad program areas set out in the 1990 Farm Bill. While CSREES administers the Hatch Act's formula funds and has certain oversight responsibilities for them,[23] it does not play an agenda-setting role in directing their use. This situation is not surprising since CSREES provided less than 30 percent of the total funding for land grant research in fiscal year 1994. (See ch. 1 for information on agricultural research funding.)

CSREES awards two categories of special grants: those involving funds for specific research projects at specified institutions designated in reports from appropriations committees (often referred to as "earmarked" grants) and those that CSREES awards to address areas it has identified as national or regional needs. In fiscal year 1994, special grant funding was about $71 million, of which about $53 million was designated in congressional committees' reports.[24]

[21]Long-Range Planning Can Improve the Efficiency of Agricultural Research and Development (CED-81-141, July, 24, 1981) and The Federal Role in Agricultural Research Priority-Setting, Office of Technology Assessment testimony before the Subcommittee on Department Operations and Nutrition, House Committee on Agriculture, June 17, 1993.

[22]State agricultural experiment stations are the research arms of land grant universities.

[23]CSREES' oversight responsibilities for Hatch Act funds include reviewing the experiment stations' annual work plans that specify projects supported wholly or in part by formula funds. In reviewing these projects, CSREES focuses on relevancy to the six broad program areas and technical quality. It recommends modifications to projects as it deems necessary.

[24]In fiscal year 1994, about $54 million of the total special grant funding was expended, as discussed in chapter 1.

USDA has little to no impact on setting priorities for earmarked special grants. These grants, which often reflect local interests, support projects in all 50 states and several other locations. (See app. I for the locations and amounts of special grant funding in fiscal year 1994.) As with formula funds, CSREES has administrative and oversight responsibilities for the grants. For example, CSREES staff review all special grant proposals from eligible institutions, focusing on potential duplication of research and the quality of the science. The agency discusses its comments with grant applicants; however, according to an agency official, it rarely disapproves earmarked special grant proposals.[25]

According to USDA officials, CSREES has considerable influence over the special grants that are not earmarked. In fiscal year 1994, CSREES was allocated approximately $18 million to fund projects that primarily involve problems of national and local interest in such areas as water quality and integrated pest management. CSREES awarded about $7 million of these grants competitively. These grants were also used to support interagency agreements, cooperative agreements, and research consortia.

Research Programs' Priority-Setting Processes Lack Important Planning and Accountability Elements

Neither ARS nor the NRI program has incorporated performance goals or indicators into its research programs. Such tools would allow target levels of performance to be set and the results of program performance to be measured. These measures would enhance the management of research programs and strengthen accountability for research expenditures. Furthermore, the data obtained from such measures are important in evaluating research outcomes.

In addition, neither program systematically assesses the relative importance of its research priorities in the context of USDA's overall research portfolio. Although individual research projects are assessed for scientific merit within a specific area of research, the projects are not assessed in terms of their relative contributions to USDA's total portfolio. Without such assessments, there can be little assurance that research resources are being appropriately allocated to the areas of greatest need.

Similarly, USDA does not employ comprehensive evaluations of the impacts of research programs—the total consequences of research programs, including both intended and unintended positive and negative results. Such evaluations can provide important information, such as social and

[25]USDA's Under Secretary for Research, Education, and Economics said that on one or two occasions, USDA has rejected earmarked grant proposals because the proposed projects did not fall within the areas covered by the authorizing legislation.

economic costs and benefits. This information is useful in making informed decisions on research investments and enhancing accountability.

Currently, NRI's and ARS' evaluations primarily involve peer reviews[26] of proposed projects. For example, in ARS, scientists peer-review project plans to improve the scientific quality of proposed projects. ARS also uses various types of peer review in assessing individual scientists' accomplishments for purposes of promotion; conducting research planning workshops; and reviewing manuscripts, laboratories, and research areas. The NRI program uses peer review panels to assess the quality, relevance, and importance of each proposal submitted to NRI. Panels rank proposals and submit recommendations to NRI's chief scientist for use in determining which proposals to fund.

In 1994, the National Research Council's Board on Agriculture found that USDA had done little to track the output of the NRI program and recommended that USDA systematically evaluate the program's performance. In addition, the board suggested that USDA evaluate its investment in agricultural research across all four of its research funding areas—NRI competitive grants, in-house research, formula funds, and special grants. According to USDA research officials, the Department's upcoming strategic planning process for research will address these issues.

Research Information System Is Inadequate

According to USDA officials, the Department's Current Research Information System (CRIS) does not provide the information needed to facilitate strategic planning, priority setting, and accountability. CRIS is a computerized database, used by thousands of researchers and others, to document and inventory publicly funded agricultural research. Developed in the late 1960s, the system was intended to help researchers and others to identify research projects. However, it was not designed to be a management information system that would give managers the information they need for strategic planning and priority setting. As a result, CRIS lacks information important to managers and policymakers, such as planned expenditures and outcomes for research conducted by other agencies.

Although CRIS is the only national database with information on publicly funded agricultural research, it has significant limitations, according to

[26]Peer review is an evaluation by scholars or other individuals with the expertise necessary to judge the scientific merit of a project, manuscript, or other matters requiring expert assessment.

USDA and university officials. First, its system for classifying research activities into categories does not include many current research areas. For example, neither sustainable agriculture nor biotechnology, which are current areas of major concern, are standard CRIS categories. To identify projects in these areas, CRIS users must judgmentally select a combination of standard categories, with no assurance that projects identified by one user will be the same as those identified by another user. As a result, USDA cannot accurately identify the extent of publicly funded research in those categories. In 1993, USDA contracted with the Colorado Agricultural Experiment Station to assess CRIS. The assessment recommended, among other things, that USDA change the classification system by adding new categories, such as biotechnology, and eliminating others that are obsolete. USDA has initiated a project to develop a new classification system with a target completion date of summer 1997.

In addition, CRIS lacks such information as planned research expenditures and comprehensive data on agricultural and food science projects supported by other federal agencies, such as the Environmental Protection Agency.

Furthermore, CRIS does not track progress toward achieving desired research outcomes. In addition, according to USDA officials, information on outcomes is often incomplete because land grant universities and others do not systematically collect data on the outcomes of their research projects. USDA and other members of the research community believe that such information is necessary in order to provide accountability for public research expenditures. Oregon Invests, a database developed by Oregon State University, is one of the few agricultural research databases that describe the potential economic, social, and environmental outcomes of its research projects. (App. V describes this system.)

Finally, CRIS' data are not current. For example, financial information on fiscal year 1995 research activities will not be compiled until June 1996 because some states and agencies delay in providing data to USDA.

To address these problems, USDA officials stated that the Department has requested funding in its fiscal year 1997 budget request to develop a system to include data on research, extension, and education issues. Agency officials said that if the Congress does not provide the requested funds, USDA will be unable to develop a system with the substantial improvements and expanded capabilities needed to respond to congressional mandates, including the Government Performance and

Results Act of 1993 (GPRA) and other accountability requirements. Without additional funds, they will consider scaling back the data maintained in CRIS and focus on improving the timeliness and quality of the remaining data.

USDA's Advisory Boards Have Had Limited Impact

The three general advisory boards established by the Congress to advise USDA on research activities have played a negligible role in establishing research priorities. Two of the boards—the Joint Council on Food and Agricultural Sciences and the National Agricultural Research and Extension Users Advisory Board—were established in 1977 to improve coordination and priority setting within USDA and the land grant research and extension system. A third board, the Agricultural Science and Technology Review Board, was established in 1990 to provide advice on emerging technologies.[27] (See app. VI for an overview of these boards as well as 10 other research advisory committees.) According to USDA's Under Secretary for Research, Education, and Economics, the practical impact of these boards has been minimal. The boards' recommendations have been used primarily to validate what USDA has already determined should be priorities and to support budget requests.

In recent years, funding for the general advisory boards has been so reduced that they have been unable to adequately fulfill their roles, according to USDA officials. In fiscal years 1992 through 1994, the funding levels decreased by more than 50 percent. The limited budget has affected some boards' ability to fulfill their mandated responsibilities, such as updating the Joint Council's 5-year plan and preparing the Users Advisory Board's annual report commenting on the President's budget for agricultural sciences.

USDA Has Limited Flexibility to Shift Research Priorities

As a result of the environment in which its research programs are conducted, USDA faces a number of limitations on its ability to shift resources among research areas. These include ARS' aging infrastructure that cannot easily be adapted to meet new research needs, direction from congressional committees on specific research activities and laboratories, pressures from commodity and interest groups to maintain funding levels for projects in their areas of interest, and low funding levels for the NRI program.

[27]The Federal Agriculture Improvement and Reform Act of 1996 eliminates the three general advisory boards and replaces them with a National Agricultural Research, Extension, Education, and Economics Advisory Board.

ARS' Infrastructure Limits Flexibility

ARS' infrastructure—facilities, equipment, research scientists, and land—has evolved over the decades to support specific research needs, some of which have declined in importance. The need to maintain this infrastructure has limited ARS' ability to move into new research areas that require different equipment, facilities, and scientific expertise.

ARS has over 1,900 permanent research scientists, almost 3,000 buildings, and about 400,000 acres at 107 laboratory locations and 35 worksites in the United States and Puerto Rico and at 4 foreign locations. Some of this infrastructure, such as quarantine facilities and special equipment for work on recombinant DNA[28] and foreign animal diseases, was acquired to conduct specific types of research and cannot be easily modified for use in other research areas.

Moreover, scientists at these facilities have acquired specialized expertise. ARS has about 40 scientific career tracks for research scientists, the primary ones being chemistry, entomology, plant physiology, genetics, and microbiology. Within these fields, many ARS scientists have acquired expertise in specific commodities, insects, and diseases. According to an ARS official, while the agency moves these scientists to related areas, major shifts can cause reductions in productivity. Successful research depends on the training and experience of individual scientists and on the teamwork that develops within and among laboratories. For both individuals and groups, many years are required to reach peak productivity.

Congressional Committees' Directives and Commodity Groups' Pressures Affect USDA's Ability to Reallocate Research Resources

Congressional committees' directives and legislation affect CSREES' and ARS' abilities to implement priorities by limiting their ability to shift funding to different research areas, commodities, and/or facilities. Congressional committees' directives have had the greatest impact on CSREES' special grants program—in particular, the earmarked grants. As discussed earlier, each year the conference committee for USDA's appropriations legislation directs that a large portion of special grant funding be awarded to specific institutions for specific purposes. The National Research Council reported in 1995 that congressionally earmarked special grants are much more significant today, in terms of total USDA research funding to the land grant universities, than they were 20 years ago. According to USDA, while the earmarking of special grants meets the priorities of constituents in specific congressional districts, the

[28]Deoxyribonucleic acid is the class of nucleic acids that function in the transference of genetic characteristics.

process dilutes the Department's ability to coordinate research activities and address national priorities. USDA has recommended that earmarks be eliminated and that all special grants be awarded competitively.

USDA's ability to establish priorities for the NRI program has also been affected by directives from congressional committees and by legislation. According to USDA officials, congressional direction and legislation drive the broad priorities of the NRI program; however, CSREES sets specific priorities for research within these broad categories. When the program was established in the 1990 Farm Bill, the Congress specified that it fund research in six broad categories, as discussed above, and, where appropriate, that grants be consistent with the goals of sustainable agriculture. The legislation also identified the percentages of funds to be allocated for specific types of research. For example, at least 30 percent of NRI funds was to support multidisciplinary research by fiscal year 1993.[29]

In addition, in fiscal year 1995, the House Committee on Appropriations directed that $10.8 million of the program's $103 million be awarded for specific programs. The Committee designated $2.5 million for the U.S.-Israel Binational Agricultural Research and Development program[30] and $8.3 million for three research programs—water quality, integrated pest management, and pesticide impact assessment. The fiscal year 1996 appropriations had no committee directives for the NRI program. While CSREES plans to continue funding research in the three designated areas, it does not plan to fund the U.S.-Israel research program with NRI's funds.

In connection with the formula funds authorized by the Hatch Act, legislation has shaped the structure, purpose, and funding of research programs supported by these funds. However, congressional committees' directions have had little impact on the agricultural research conducted by land grant universities that are the recipients of formula funds. As discussed in chapter 1, Hatch Act formula funds are distributed to the states on the basis of a mandated formula. Systemwide priorities are established for these funds. However, in reality, each experiment station has considerable latitude in allocating and using formula funds to meet the needs of its respective state and local communities.

[29]The legislation also specified that at least 20 percent of NRI's funds support mission-linked research and at least 10 percent be used to strengthen the research and educational capacity of educational and research institutions.

[30]USDA transferred $2.5 million from the NRI program to the special grants program to support the U.S.-Israel Binational Agricultural Research and Development program, which is administered by ARS.

Congressional committees' directives have also affected ARS' ability to reallocate resources. For example, two appropriations committees' reports[31] on agriculture appropriations have stated that in complying with the committees' intentions, ARS is expected not to "redirect support for programs from one state to another without prior notification to and approval by the House and Senate Committees on Appropriations."

According to a former ARS Administrator and other ARS officials, most research funds can be traced through the years as having been earmarked or targeted by congressional committees for specific commodities or states. Local economies are sometimes closely tied to a particular commodity. Thus, it is not surprising that the congressional representatives of such communities will seek to ensure that research efforts relating to that commodity are undertaken and maintained.

Appropriations committees' directives have also made it difficult for ARS to close laboratories that are old, possibly underutilized, and perform research similar to that of other ARS locations. For example, according to an ARS official, over 60 percent of ARS' facilities are over 30 years old, and in 1995, 50 ARS laboratories had less than 10 scientists each. As of fiscal year 1993, ARS estimated that $700 million was required to repair its facilities, many of which do not meet modern building codes or the technical demands of high-technology research programs. When funds are spent on building renovation and modernization, fewer funds are available for research. Recognizing this problem, ARS proposed closing 12 laboratories in its fiscal year 1996 budget request. However, the House and Senate committees' reports for USDA's appropriations directed that a total of nine of these laboratories remain open and that the research conducted at the remaining three continue to be funded.[32]

In addition, ARS and other USDA research officials noted that pressures from commodity and other interest groups affect ARS' ability to shift resources among research areas. According to USDA, the responsiveness of the federal research agencies has been driven by the ability of groups to organize and gain access to the policy-making process. USDA officials noted that these groups act as "watchdogs," tracking funding by commodity or

[31]S. Rep. No. 142, 104th Cong. 1st Sess. at 28 (1995); H.R. Conf. Rep. No. 212, 103d Cong. 1st Sess. at 12 (1993).

[32]The Senate and House committees' reports for USDA's appropriations differed in their directions regarding the status of most of these laboratories. However, the combined reports directed that nine laboratories remain open or be designated as worksites. However, based on additional verbal directions from the committees, ARS ultimately designated eight laboratories as worksites and kept the remaining four laboratories open.

problem area and working through their congressional representatives or through ARS to ensure that funding in their areas of interest is not reduced. For example, according to ARS officials, as a result of the Cotton Council's long-term influence, ARS funds cotton research at levels higher than it would otherwise. ARS currently conducts about 100 cotton-related research projects—which include breeding, production, pest control, and cotton processing and finishing—at 20 separate locations.

Funding Levels Limit NRI's Ability to Adequately Fund Research Priorities

The NRI program has never been fully funded, thus limiting the program's effectiveness in meeting its goals. The 1990 Farm Bill authorized the program at $150 million in fiscal year 1991, with increases each year, reaching $500 million in fiscal year 1995.[33] However, appropriations have hovered at about $100 million for each of fiscal years 1992 through 1995.[34]

Both the Office of Technology Assessment and the National Research Council's Board on Agriculture, in separate evaluations of the NRI program, concluded that the program was underfunded. In 1994, the Council's Board on Agriculture recommended that the program be funded at its authorized level of $500 million. According to the Board, competitive grants are the best way to stimulate fundamental research activities in specific areas of science. At current funding levels, the Board felt that the program would be unable to achieve the goals envisioned for it. In a report issued the following year, the Office of Technology Assessment concluded that insufficient funding was detrimental to NRI's goals, increased the frustration and lowered the productivity of participating scientists, and made obtaining foundational knowledge (i.e., knowledge that serves as a basis for applied research) more difficult.[35]

According to the Acting Deputy Administrator, CSREES, the NRI program was set up to support a $150 million to $200 million annual program, in terms of the number of priority areas receiving funding. Because of the funding shortfalls, program staff have begun reducing the number of research priorities funded each year. Starting in fiscal year 1996, not all of the 27 priorities will be funded annually. For example, in fiscal year 1996,

[33]The NRI program was authorized at $275 million in fiscal year 1992, $350 million in fiscal year 1993, and $400 million in fiscal year 1994.

[34]The Congress funded the program at $97.5 million in fiscal year 1992, $97.5 million in fiscal year 1993, $105.4 million in fiscal year 1994, and $103.1 million in fiscal year 1995.

[35]Challenges for U.S. Agricultural Research Policy, OTA-ENV-639 (Washington, D.C.: U.S. Government Printing Office, Sept. 1995).

they are not requesting project proposals for "biological control research," a current priority under the plant research area.

USDA Is Taking Actions to Improve Research Planning and Management

As a result of the Government Performance and Results Act of 1993 (GPRA) and the administration's 1995 Farm Bill Guidance, USDA has taken, or is planning to take, several actions to improve the planning and management of research. It is too soon, however, to evaluate the effectiveness of these steps.

GPRA Requires Strategic Planning and Outcome Measures

GPRA requires, among other things, that agencies develop strategic plans that contain goals and objectives for the agencies' major functions. In response to this mandate, USDA's Research, Education, and Economics mission area[36] is spearheading the development of a 5-year strategic plan that it expects to begin implementing in fall 1996. The draft plan includes desired outcomes for the mission area as well as general goals intended to facilitate attainment of the outcomes and articulate the mission area's direction for the 5-year period. The mission area plans to prepare its annual plan and budget using the priorities of the strategic plan. Beginning with the fiscal year 1998 budget request, its goals, objectives, and outcomes are expected to be published, thus enabling the Congress to base appropriation decisions on the mission area's performance in executing its strategic plan.

The mission area's current draft strategic plan outlines five desired outcomes:

- An agricultural production system that is highly competitive in the global economy.
- A safe and secure food and fiber system.
- A healthy, well-nourished population.
- Greater harmony between agriculture and the environment.
- Enhanced opportunity for farmers, ranchers, and rural people and communities.

The plan also lists several important challenges, such as the need to strengthen federal-state partnerships, manage the downsizing of programs without compromising their priorities, and improve the public's understanding and appreciation of the value of agricultural research.

[36]The Research, Education, and Economics mission area, headed by an Under Secretary, includes ARS, CSREES, ERS, and the National Agricultural Statistics Service. This mission area is one of seven within USDA.

Ultimately, USDA intends to measure the performance of research activities[37] according to their contributions to one or more of these outcomes. However, as discussed earlier, CRIS currently does not track research outcomes.

To be consistent with GPRA, each agency in the mission area is developing its own strategic plan describing how it will contribute to achieving the mission area's outcomes. The mission area anticipates that its draft strategic plan will be completed by March 31, 1996. After that, the mission area is planning an extensive review process with the Congress, customers, partners, and stakeholders before the plan is finalized by early fall 1996.

The draft strategic plan addresses, or plans to address, many of the shortcomings we identified in USDA's processes for setting research priorities. Specifically:

- Through its desired outcomes, the mission area's draft plan provides an agenda and a direction for the research programs of its component agencies.
- To be consistent with GPRA, the mission area's strategic plan, as well as the plans of its component agencies, will identify priorities and use those priorities as the basis for developing annual budgets.
- GPRA requires agencies to establish performance goals and indicators. ARS' draft plan contains such goals and indicators, and CSREES officials said they plan to define performance goals and measures for the NRI program.

USDA Faces Challenges in Evaluating Research Outcomes

The need for improved evaluations of the outcomes of USDA's research programs has been recognized both within and outside of USDA. At the same time, however, there is acknowledgement that such evaluations are difficult to implement and costly to perform. For example:

- Research efforts—particularly those in basic research—often take many years before they yield results that are apparent as measurable impacts.
- Research outcomes are usually the result of many factors, not just one project or set of projects. Furthermore, they are often not easily quantifiable, particularly in areas such as the environment or human health.

[37]A research activity may include a number of projects related to a specific area, such as methyl bromide alternatives or soil erosion prediction and control.

- The costs of evaluation studies can range from under $50,000 to over $1 million, according to a 1994 study prepared by a practitioners' working group on research evaluation for the Office of Science and Technology Policy. The study adds that evaluations cannot be done competently unless they receive adequate funding.

Comprehensive evaluations of research programs have been relatively rare, according to a RAND draft report[38] being developed for the Office of Science and Technology Policy. Most assessments of federal research programs are descriptive—far removed from the quantification of performance generally required under GPRA. However, several agencies are undertaking efforts to quantify the impacts of research. For example:

- The Advanced Technology Program at the National Institute of Standards and Technology[39] funds projects expected to lead to new technologies that award recipients will commercialize through the use of funds from other sources. The program is attempting to track short-term results and long-term national economic impacts. Research evaluation begins with market and industry assessments to better understand the potential of proposed projects.[40] During project implementation, the program attempts to assess the research's impact through occasional surveys of, among other things, awardees' perceptions of the program's short-term impacts. It also conducts case studies of projects to determine the rate at which new technologies are adopted and changes experienced by the participating company as a result of the project. The program is currently exploring ways to project the impact of the research across the entire economy (e.g., national employment and industrial output measures) through the use of large-scale macroeconomic models in conjunction with microeconomic project analysis.
- The Office of Energy Research at the U.S. Department of Energy conducts highly structured peer assessments of selected programs, evaluating hundreds of projects each year. Projects are rated using standard categories, which results in quantitative ratings that can be compared across projects to identify those projects needing improvement.

[38]Assessment of Fundamental Science Programs in the Context of the Government Performance and Results Act, draft, Susan E. Cozzens, PM—417—OSTP. According to the author, the final report should be issued by late spring 1996.

[39]The Institute is part of the U.S. Department of Commerce.

[40]In a previous GAO report, Performance Measurement: Efforts to Evaluate the Advanced Technology Program (RCED-95-68, June 15, 1995), we noted a number of problems with these evaluation efforts; for example, the evaluations have overstated the program's impact or lack adequate support.

While recognizing the difficulties inherent in evaluating research outcomes, USDA officials say they are committed to strengthening the evaluation of their research programs. To meet GPRA's requirements, the Research, Education, and Economics mission area plans to develop a set of quantitative and qualitative evaluations for its research programs. According to USDA officials, the quantitative assessments will measure research outcomes in a variety of ways, depending on the research being evaluated. For example, some programs may use a scored survey of customers' satisfaction, whereas others may employ a retrospective (after-the-fact) review based on benchmark data.[41] These reviews will be used in conjunction with more subjective qualitative assessments, such as experts' reviews of research programs and anecdotal success stories.

These evaluations will require varying amounts of resources. USDA officials noted that some evaluation methods that are labor intensive may be prohibitively expensive and that data systems will need to be modified to collect the necessary information.

Farm Bill Guidance Is Intended to Improve Coordination and Increase Flexibility

The administration's 1995 Farm Bill Guidance called for, among other things, changes in USDA's agricultural research and extension program to improve coordination among USDA's agencies and to streamline the advisory committees' structure. The proposal would create a council of high-ranking officials from USDA's research agencies and all the Under Secretaries and Assistant Secretaries in the Department. This council is intended to help establish agencywide research priorities.

In addition, the proposal would have USDA consolidate its three general research advisory boards into one National Research, Education, and Economics Advisory Committee, advised by four regional subcommittees. This proposal reflects the concern of USDA officials that there are more advisory groups than are needed and can be adequately supported. The membership of the proposed committee would include representatives of commodity groups, general agriculture organizations, resource conservation groups, consumers, and the land grant university community. The committee would advise USDA and the land grant universities on the priorities relating to the five outcomes outlined in the mission area's strategic plan and play a role in obtaining broader input to the plan from customers. This reorganization will require congressional approval.

[41]Benchmark data are target levels of performance (expressed as tangible, measurable objectives) against which actual achievements can be compared.

Finally, the administration called for the reauthorization of an Agriculture Research Facilities Study Commission to make recommendations for closing, consolidating, constructing, or modernizing federally funded facilities. The 1990 Farm Bill authorized a similar commission; however, the commission was never funded. The newly proposed commission would include representatives from the land grant university community and from farm, commodity, resource conservation, scientific, and consumer organizations. In addition, the commission would outline a 10-year strategic plan for federally funded facilities from a national and regional perspective.

Agricultural Research and Extension Funding for Fiscal Year 1994

This appendix presents information on federal, state, and private sector funding, by state and other jurisdiction, for research and extension activities in fiscal year 1994.

Table I.1: Sources of Funding for Research by Location, Fiscal Year 1994

Dollars in Thousands

Location	Federal	State	Private	Total
Alabama	$13,247	$20,171	$7,168	$40,586
Alaska	2,001	2,370	271	4,642
American Samoa	670	0	0	670
Arizona	16,275	20,137	7,590	44,002
Arkansas	10,539	17,365	8,083	35,987
California	56,380	96,765	26,056	179,201
Colorado	29,655	9,929	18,409	57,993
Connecticut	4,989	7,279	1,179	13,447
Delaware	2,632	5,539	3,435	11,606
D. C.	522	328	0	850
Florida	20,772	64,719	13,906	99,397
Georgia	15,502	40,515	7,820	63,837
Guam	1,231	1,431	0	2,662
Hawaii	11,173	12,817	2,080	26,070
Idaho	7,565	12,750	4,520	24,835
Illinois	14,538	17,589	13,720	45,847
Indiana	17,614	22,056	12,491	52,161
Iowa	23,661	34,763	18,402	76,826
Kansas	10,386	22,261	10,993	43,640
Kentucky	10,408	18,209	4,088	32,705
Louisiana	7,490	25,325	10,703	43,518
Maine	4,733	5,513	1,988	12,234
Maryland	12,087	10,533	2,392	25,012
Massachusetts	8,182	3,115	2,005	13,302
Michigan	19,810	28,160	9,768	57,738
Micronesia	N/A	N/A	N/A	N/A
Minnesota	15,495	34,367	18,303	68,165
Mississippi	16,970	20,317	11,484	48,771
Missouri	15,382	18,491	11,089	44,962
Montana	7,541	8,448	5,037	21,026
Nebraska	13,505	24,101	17,100	54,706
Nevada	3,961	4,584	1,221	9,766
New Hampshire	1,797	3,022	272	5,091

(continued)

Dollars in Thousands

Location	Federal	State	Private	Total
New Jersey	7,799	12,542	4,246	24,587
New Mexico	5,794	8,781	1,413	15,988
New York	39,246	45,758	27,846	112,850
North Carolina	23,358	39,235	13,579	76,172
North Dakota	8,977	13,017	6,882	28,876
Northern Marianas	150	0	0	150
Ohio	12,193	20,170	6,835	39,198
Oklahoma	8,571	18,165	4,626	31,362
Oregon	23,864	25,160	13,045	62,069
Pennsylvania	17,313	20,872	8,413	46,598
Puerto Rico	4,185	6,462	312	10,959
Rhode Island	1,712	1,575	0	3,287
South Carolina	9,426	17,835	2,885	30,146
South Dakota	3,795	6,348	4,456	14,599
Tennessee	9,800	16,426	4,729	30,955
Texas	38,710	55,299	23,987	117,996
Utah	5,871	7,605	4,001	17,477
Vermont	3,765	1,802	948	6,515
Virginia	15,262	22,107	8,968	46,337
Virgin Islands	959	433	0	1,392
Washington	23,300	23,864	15,701	62,865
West Virginia	3,910	3,242	1,062	8,214
Wisconsin	35,745	27,572	12,241	75,558
Wyoming	2,594	3,620	83	6,297
Total	**$703,009**	**$1,010,861**	**$417,828**	**$2,131,698**

Notes:
1. Numbers do not add due to rounding.

2. Data are expenditures for research conducted at state agricultural experiment stations, historically black institutions and Tuskegee University, forestry schools, colleges of veterinary medicine, and other institutions.

3. N/A = Not Available.

Source: USDA, Current Research Information System.

Table I.2: Distribution of CSREES Funding for Research and Facilities, Fiscal Year 1994

Dollars in Thousands

Location	Hatch formula grants	Other formula grants[a]	NRI	Special grants	Other grants[b]	Facility grants	Total
Alabama	$3,645	$3,882	$950	$955	$1,800	$0	$11,232
Alaska	914	447	313	5	0	0	1,678
American Samoa	668	0	0	0	0	0	668
Arizona	1,791	334	1,231	635	433	776	5,201
Arkansas	3,156	2,040	532	3,428	571	2,588	12,314
California	4,745	1,100	11,344	2,449	882	2,023	22,543
Colorado	2,490	591	1,828	1,478	0	310	6,697
Connecticut	1,689	237	1,221	398	0	0	3,544
Delaware	1,194	639	368	5	348	319	2,874
D.C.	519	0	157	5	4	0	686
Florida	2,714	1,873	2,214	2,692	298	268	10,059
Georgia	4,304	2,601	2,057	649	2,016	1,635	13,261
Guam	790	38	0	293	0	0	1,121
Hawaii	1,196	149	314	1,780	3,700	0	7,140
Idaho	1,939	477	598	1,022	168	0	4,203
Illinois	5,068	497	5,836	667	892	810	13,770
Indiana	4,576	436	3,073	2,747	0	0	10,832
Iowa	5,555	479	2,054	5,409	764	0	14,261
Kansas	3,136	378	1,243	1,212	92	1,164	7,225
Kentucky	4,575	2,505	1,296	135	873	0	9,384
Louisiana	2,929	1,961	1,011	1,343	822	0	8,066
Maine	1,686	590	361	1,667	0	0	4,303
Maryland	2,267	1,231	1,563	411	213	1,619	7,302
Massachusetts	2,042	286	2,907	425	764	0	6,425
Michigan	4,717	605	2,978	5,373	789	0	14,462
Micronesia	294	0	0	0	0	0	294
Minnesota	4,548	675	1,709	1,380	0	0	8,312
Mississippi	3,735	2,306	647	2,559	2,762	91	12,100
Missouri	4,336	2,524	2,596	2,007	1,003	2,355	14,821
Montana	1,929	486	1,104	47	0	1,812	5,378
Nebraska	3,087	374	1,577	1,341	1,580	0	7,959
Nevada	1,117	84	607	307	0	0	2,116
New Hampshire	1,324	332	633	5	0	0	2,293
New Jersey	2,618	210	1,403	1,779	0	2,123	8,134
New Mexico	1,490	284	544	1,079	38	774	4,209

(continued)

Dollars in Thousands

Location	Hatch formula grants	Other formula grants[a]	NRI	Special grants	Other grants[b]	Facility grants	Total
New York	5,060	895	6,115	3,604	733	2,428	18,175
North Carolina	5,986	3,287	4,035	1,288	640	2,982	18,218
North Dakota	2,205	128	979	1,530	879	1,662	7,381
Northern Marianas	554	0	0	0	0	0	554
Ohio	5,408	477	1,760	962	25	255	8,887
Oklahoma	2,865	1,796	1,016	1,171	0	341	7,190
Oregon	2,615	791	2,623	3,644	69	2,428	12,169
Pennsylvania	5,643	631	2,657	1,428	15	0	10,373
Puerto Rico	3,807	114	130	279	0	0	4,331
Rhode Island	1,137	120	744	156	0	0	2,157
South Carolina	3,137	1,895	726	615	900	0	7,272
South Dakota	2,261	226	437	370	83	0	3,377
Tennessee	4,413	2,446	1,446	129	1,202	2,211	11,848
Texas	6,068	3,494	5,054	1,253	1,034	567	17,469
Utah	1,712	212	585	264	1,759	752	5,284
Vermont	1,335	311	121	222	1,722	0	3,711
Virginia	772	2,303	1,384	297	2,056	1,425	11,282
Virgin Islands	3,817	51	0	238	0	0	1,061
Washington	3,342	819	4,766	3,026	1,312	4,655	17,918
West Virginia	2,456	400	197	5	0	0	3,058
Wisconsin	4,672	654	5,017	666	148	1,919	13,076
Wyoming	1,421	247	572	87	0	971	3,297

Notes:
1. Numbers do not add due to rounding.

2. Data are funds obligated for grants to state agricultural experiment stations, historically black institutions and Tuskegee University, forestry schools, colleges of veterinary medicine, and other institutions.

[a]Other formula grants include the McIntire-Stennis Act, the Evans-Allen Program, and the Animal Health and Disease Research Program.

[b]Other grants include the following grant programs: Biotechnology Risk Assessment, Aquaculture Centers, Critical Agriculture Materials, Rangeland Research, Supplemental and Alternative Crops, and Sustainable Agriculture. Other grants also include direct appropriations for federal administration.

Source: USDA.

Table I.3: Sources of Extension Funding, Fiscal Year 1994

Dollars in Thousands

Location	Federal	State	County	Other[a]	Total
Alabama	$12,537	$21,692	$2,244	$707	$37,181
Alaska	1,384	3,276	0	207	4,867
American Samoa	940	150	0	0	1,090
Arizona	2,740	6,600	611	644	10,595
Arkansas	8,944	17,501	1,515	483	28,442
California	10,799	37,291	9,898	4,588	62,576
Colorado	3,660	7,473	7,576	395	19,103
Connecticut	2,591	3,135	0	0	5,726
Delaware	2,336	2,208	123	177	4,843
D.C.	984	903	0	0	1,887
Florida	8,464	22,471	17,752	1,514	50,201
Georgia	12,484	26,087	9,070	7,427	55,068
Guam	991	1,393	0	0	2,385
Hawaii	1,667	6,063	0	0	7,730
Idaho	3,148	6,848	0	0	9,996
Illinois	11,665	22,357	4,215	2,029	40,265
Indiana	9,738	13,165	10,643	294	33,840
Iowa	10,217	18,199	9,127	4,750	42,293
Kansas	6,403	13,948	12,859	3,490	36,701
Kentucky	13,104	19,011	11,369	0	43,483
Louisiana	8,948	21,061	647	722	31,378
Maine	2,705	3,390	404	532	7,032
Maryland	5,556	13,270	2,241	1,814	22,881
Massachusetts	3,650	2,317	645	770	7,381
Michigan	10,478	20,740	10,927	1,080	43,225
Micronesia	1,025	100	248	0	1,373
Minnesota	9,771	18,077	10,623	5,324	43,795
Mississippi	10,787	15,283	2,016	1,120	29,206
Missouri	12,369	15,960	3,510	3,547	35,386
Montana	2,948	2,966	2,988	902	9,803
Nebraska	5,658	13,864	6,569	2,782	28,873
Nevada	1,472	3,889	3,608	0	8,970
New Hampshire	1,942	3,102	2,033	479	7,556
New Jersey	3,917	6,757	3,565	574	14,812
New Mexico	2,757	6,668	1,734	726	11,884
New York	11,762	10,450	23,352	18,693	64,257
North Carolina	17,190	29,383	16,065	322	62,960

(continued)

Dollars in Thousands

Location	Federal	State	County	Other[a]	Total
North Dakota	3,981	5,179	2,625	976	12,761
Northern Marianas	921	0	0	223	1,143
Ohio	12,167	15,199	12,480	1,993	41,838
Oklahoma	8,162	14,885	3,493	1,651	28,190
Oregon	4,529	14,009	3,480	29	22,046
Pennsylvania	12,562	13,191	6,560	0	32,313
Puerto Rico	7,985	6,703	1,431	17	16,135
Rhode Island	1,439	1,364	41	25	2,869
South Carolina	8,984	18,950	1,557	1,101	30,592
South Dakota	3,881	4,837	2,088	371	11,177
Tennessee	12,996	18,702	5,242	183	37,123
Texas	20,350	40,004	13,800	466	74,619
Utah	2,175	6,692	1,626	273	10,766
Vermont	2,036	3,234	0	0	5,270
Virginia	10,937	21,234	9,257	275	41,703
Virgin Islands	965	641	0	0	1,606
Washington	4,969	11,827	6,257	558	23,610
West Virginia	5,028	3,000	500	0	8,528
Wisconsin	9,437	20,992	14,082	1,333	45,842
Wyoming	1,820	3,135	1,579	0	6,534

Notes:
1. Data for state, county, and "other" are based on USDA estimates; federal data are allocations. USDA allocated an additional $47.3 million for extension activities that is not reflected in this table.

2. Numbers do not add due to rounding.

[a]"Other" includes nontax sources, such as private grants and endowments and fees charged for services.

Source: USDA.

Total Responses to GAO's Questionnaire

United States General Accounting Office

GAO

Survey of Food And Agricultural Associations. Filled-In Questionnaire for 218 Respondents.

INTRODUCTION

The U.S. General Accounting Office (GAO) is an agency of the Congress that reviews federal programs. As part of a GAO review, we are surveying food and agricultural associations concerning their perceptions of the U.S. Department of Agriculture's (USDA) responsiveness in meeting the needs and priorities of research users. We have been asked to determine the views of research consumers on the extent to which USDA is meeting their research needs and to collect information on how effectively research results are being disseminated to these users.

Our effort focuses on research conducted by USDA's Agricultural Research Service and research/educational activities undertaken by state land grant institutions and extension agencies.

This questionnaire is being sent to approximately 500 food and agricultural associations. Your cooperation in completing the questionnaire is vital to our study. The information collected through these questionnaires along with other information will be summarized in our report to the Congress.

Please complete the questionnaire and return it within **7 days of receipt**. We recognize that this is not much time and we greatly appreciate your assistance. We have also provided a postage-paid business reply envelope to facilitate the return of your questionnaire. In the event that the return envelope is misplaced, please send the completed questionnaire to:

U.S. General Accounting Office
Attn:LaSonya Roberts/Food & Agriculture Issues
1110 Vermont Ave/Suite 1000
Washington, D.C. 20548

If you have any questions, please call either LaSonya Roberts at 1-202-512-9861 or Ruth Ann Decker at 1-913-384-7545.

Please provide the following information about the person(s) who completed this questionnaire. This information will assist us if clarification of answers is necessary.

Name & Telephone:

SECTION I: GENERAL INFORMATION

1. In general, how would you describe your organization? *(Check all that apply.)*

76 Trade association
9 Public interest group
3 Non-profit association
2 For profit association
5 Professional society
43 Other

2. How familiar are you with the federal agricultural research program? *(Check one.)*

89 Very familiar
129 Somewhat familiar
41 Not familiar——→***STOP! Do not answer any further questions. Please return questionnaire in the enclosed envelope.***

SECTION II: AGRICULTURAL RESEARCH NEEDS

3. Which type of research is **most useful** to your association? *(Check one.)*

14 Food safety
40 Plant sciences
7 Technology transfer
3 Soil conservation
18 Integrated pest management
10 Marketing
2 Biotechnology
8 Forestry
4 Water quality
5 Nutrition
25 Animal sciences
40 Other (specify)

4. Who primarily performs the research most useful to your association? *(Check one.)*

13 This association
28 Agricultural Research Service
100 State land grant institutions
17 Industry
16 Other government agencies
13 Other non-government agencies
2 Don't know

5. Who is the primary funder of this research? *(Check one.)*

35 State(s)
58 USDA
39 Industry(s)
26 This association
9 Other federal agencies
16 Other
10 Don't know

6. How does your association use this research? *(Check all that apply.)*

185 To provide information to members
68 To conduct research
53 To lobby or advocate positions
47 To identify speakers for meetings
72 To facilitate workshops/meetings
50 Other

SECTION III: AGRICULTURAL RESEARCH SERVICE & STATE LAND GRANT INSTITUTIONS RESEARCH PROGRAMS

7. How effective has the research conducted at the **Agricultural Research Service** been in meeting the association's/members' needs? *(Check one.)*

44	Very effective
100	Somewhat effective
18	Neither effective or ineffective
15	Somewhat ineffective
8	Very ineffective
33	No basis to judge

8. How effective has the research conducted at the **state land grant institutions** been in meeting the association's /members' needs? *(Check one.)*

81	Very effective
95	Somewhat effective
10	Neither effective or ineffective
12	Somewhat ineffective
6	Very ineffective
14	No basis to judge

9. In your opinion, how adequate are the following aspects of the agricultural research program?

Aspects	Very adequate (1)	Somewhat adequate (2)	Neither adequate or inadequate (3)	Somewhat inadequate (4)	Very inadequate (5)	No basis to judge (6)	Missing (7)
1. Collaboration among federal, academic & industry researchers	43	83	23	22	18	27	2
2. Flexibility of funding mechanisms	5	47	40	38	34	52	2
3. Portfolio of research programs at the Agricultural Research Service	23	77	26	30	14	46	2
4. Portfolio of research programs at state land grant institutions	38	95	21	25	12	25	2
5. Coordination of research among state land grant institutions	17	64	38	41	15	41	2
6. Response by the Agricultural Research Service to changing research needs	22	72	25	37	20	40	2
7. Response by state land grant institutions to changing research needs	27	87	30	28	18	26	2
8. Other (specify)	2	2	1	4	7	3	199

10. In your opinion, are the following aspects of agricultural research at an appropriate level?

Aspects	No, too little (1)	Yes, about right (2)	No, too much (3)	No basis to judge (4)	Missing (5)
1. Federal funding for the Agricultural Research Service	97	60	9	48	4
2. Federal funding for state land grant institutions	124	44	8	38	4
3. State funding for land grant institutions	131	40	3	39	5
4. Amount of applied research conducted at the Agricultural Research Service	100	55	9	49	5
5. Amount of basic research conducted at the Agricultural Research Service	59	85	18	53	3
6. Number of Agricultural Research Service Labs	22	95	22	75	4
7. Number of state land grant institutions	14	142	16	43	3
8. Other (specify)	13	0	0	4	201

SECTION IV: DISSEMINATION OF AGRICULTURAL RESEARCH RESULTS

11. To what extent are you obtaining federal agricultural research results ***when you need them***? *(Check one.)*

17	To a very great extent
48	To a great extent
55	To a moderate extent
45	To some extent
28	To a little extent
23	No basis to judge/Do not obtain results
2	Missing

12. What are the primary ways by which you obtain information on the results of federal agricultural research? *(Check all that apply.)*

168	Publications
65	Workshops
98	Extension service
38	Industry representatives
26	Electronic means (e.g., internet)
120	Personal/professional networks
17	Other

13. The role of state extension services is, among other things, to disseminate research results to agricultural producers, processors, and other customers. In your opinion, how effective are the state extension services in carrying out this role? *(Check one.)*

42	Very effective
111	Somewhat effective
10	Neither effective or ineffective
27	Somewhat ineffective
10	Very ineffective
17	No basis to judge
1	Missing

14. In your opinion, what would be the most significant actions(s) that USDA or state extension services could take to improve the dissemination of its agricultural research results? *(Check all that apply.)*

95	Increased funding
62	Greater access to listing of publications
121	Better coordination between extension and industry field representatives
73	On line access to research results
38	Other

15. If you have additional comments please include them below.

This concludes the questionnaire. Thank you for your cooperation and assistance!

Associations Responding to GAO's Questionnaire

Adopt-A-Farm-Family of America
Agricultural Cooperative Development International
Agriculture Council of America
Agricultural Research Institute
Almond Board of California
American Academy of Veterinary and Comparative Toxicology
American Bison Association
American Cranberry Growers Association
American Commodity Distribution Association
American Dairy Science Association
American Egg Board
American Embryo Transfer Association
American Farm Bureau Research Foundation
American Forage and Grassland Council
American Honey Producers Association
American Junior Shorthorn Association
American Livestock Breeds Conservancy
American Malting Barley Association
American Mushroom Institute
American National Cattle Women
American Oat Association
American Ostrich Association
American Phytopathological Society
American Pomological Society
American Seed Research Foundation
American Seed Trade Association
American Sheep Industry Association
American Society for Plasticulture
American Society of Agricultural Engineers
American Society of Agronomy
American Society of Animal Science
American Society of Plant Physiologists
American Sod Producers Association
American Soybean Association
American Sugar Cane League of the U.S.A.
American Veterinary Medical Association
American Vineyard Foundation
Apiary Inspectors of America
Apricot Producers of California
Association for Arid Lands Studies
Association of American Veterinary Medicine Colleges
Association of Applied Insect Ecologists
Association of Consulting Foresters of America

Atlantic Salmon Federation
Beef Promotion and Research Board
Beet Sugar Development Foundation
Bio-Dynamic Farming and Gardening Association
Bio-Integral Resource Center
Blue Diamond Growers
California Apricot Advisory Board
California Avocado Commission
California Avocado Society
California Canning Peach Association
California Cling Peach Advisory Board
California Dried Fruit Export Association
California Dry Bean Advisory Board
California Fig Advisory Board
California Grape and Tree Fruit League
California Pistachio Commission
California Prune Board
California Strawberry Advisory Board
California Table Grape Commission
Catfish Farmers of America
Catfish Institute
Center for Holistic Resource Management
Center for Plant Conservation
Center for Sustainable Agriculture
Certified Milk Producers Association of America
Chewings Fescue and Creeping Red Fescue Commission
Citizens for Alternatives to Chemical Contamination
Communicating for Agriculture
Community Farm Alliance
Conservation Tillage Information Center
Corns
Cotton Incorporated
Cranberry Institute
Crop Science Society of America
Cycad Society
Dairylea Cooperative
Demeter Association
DFA of California
Diamond Walnut Growers
Environmental Defense Fund
Eucalyptus Improvement Association
Farm Foundation

Farmland Industries
Florida Citrus Packers
Florida Department of Citrus
Florida Fruit and Vegetable Association
Florida Tomato Exchange
Forest Farmers Association
Georgia Peanut Commission
Grain Sorghum Producers Association
Grayson-Jockey Club Research Foundation
Hawaiian Sugar Planters' Association
Henry A. Wallace Institute for Alternative Agriculture
Hop Growers of America
Idaho Potato Commission
Institute of Food Technologies
Interamerican Confederation of Cattlemen
International Alliance for Sustainable Agriculture
International Apple Institute
International Association of Aquaculture Economics and Management
International Banana Association
International Center for the Solution of Environmental Problems
International Llama Association
International Plant Propagators Society
International Pumpkin Association
International Society of Citriculture
International Society of Tropical Foresters
International Tree Crops Institute U.S.A.
International Weed Science Society
Josephine Porter Institute for Applied Bio-Dynamics
Land Institute
Lawn Institute
Metropolitan Tree Improvement Alliance
Michigan Apple Committee
Micro Development Corps
National Animal Damage Control Association
National Aquaculture Council
National Arborist Association
National Association of Animal Breeders
National Association of State Foresters
National Board of Fur Farm Organizations
National Broiler Council
National Cattlemen's Association
National Corn Growers Association

National Cottonseed Products Association
National Council of Commercial Plant Breeders
National Council of Forestry Association Executives
National Environmental Satellite, Data, and Information Service
National Farm-City Council
National Farmers Union
National Food Processors Association
National Grange
National Institute for Science, Law, and Public Policy
National Institute on Park and Grounds Management
National Milk Producers Federation
National Onion Association
National Peanut Council
National Pork Producers Council
National Potato Council
National Potato Promotion Board
National Prairie Grouse Technical Council
National Roadside Vegetation Management Association
National Saanen Breeders Association
National Sunflower Association
National Swine Improvement Federation
National Trappers Association
National Turkey Federation
National Watermelon Association
National Wild Turkey Federation
National Woodland Owners Association
Natural Resources Defense Council
New England Small Farm Institute
New England Wild Flower Society
New Jersey Asparagus Industry Council
North American Deer Farmers Association
North American Strawberry Growers Association
Northeast Organic Farming Association
Northwest Farm Managers Association
Northwest Fruit Exporters
Northwest Horticultural Council
Organic Foods Production Association of North America
Pacific Coast Canned Pear Service
People-Plant Council
Piedmontese Association of the United States

Pineapple Growers Association of Hawaii
Plains Cotton Growers
Point Foundation
Potash and Phosphate Institute
Poultry Breeders of America
Poultry Science Association
Produce Marketing Association
Professional Plant Growers Association
Public Lands Council
Purebred Dairy Cattle Association
RAFI-USA
Raptor Research Foundation
Red and White Dairy Cattle Association
Red River Valley Sugarbeet Growers Association
Renewable Natural Resources Foundation
Rocky Mountain Llama and Alpaca Association
Rodale Institute
Rodale International
Roses Incorporated
Ruffed Grouse Society
Sheep Industry Development Program
Society for Range Management
Society of Commercial Seed Technologists
Sod Growers Association of Mid-America
Soil and Water Conservation Society
Soil Science Society of America
Southeastern Peanut Association
Southeastern Poultry and Egg Association
Sun-Diamond Growers of California
Sunkist Growers
Sunsweet Growers
Supima Association of America
Sweet Potato Council of the United States
The Wildlife Society
United New Conservationists
University of Minnesota[42]
U.S.A. National Committee of the International Dairy Federation
U.S.A. Plowing Organization
U.S. Beef Breeds Council

[42]This is an individual not representing an association.

U.S. Feed Grains Council
U.S. Trout Farmers Association
U.S. Wheat Associates
Valley Fig Growers
Vinifera Wine Growers Association Walnut Marketing Board
Wheat Quality Council
Wholesale Nursery Growers of America
Wild Canid Survival and Research Center - Wolf Sanctuary
Wildlife Information Center, Inc.
WI Rural Development Center
World Aquaculture Society

Priority Setting in the Land Grant System

Planning and priority setting in the land grant system are carried out at each of the experiment stations and through regional and national land grant associations. Each experiment station develops its own plans and priorities on the basis of the agricultural needs of stakeholders within its state—the primary funder. Each regional association of experiment station directors develops plans focusing on cooperative research among neighboring states, with input from stakeholders and partners within the region. The national organization, the Experiment Station Committee on Organization and Policy (ESCOP), under the auspices of the National Association of State Universities and Land Grant Colleges, develops a plan with national and regional priorities representing the consensus of experiment station priorities, with input from stakeholders and partners throughout the United States.

ESCOP's strategic planning subcommittee (whose 12 members include 9 from land grant universities and 3 from CSREES) develops a strategic plan every 4 years, with biennial updates. In support of the development of the 1994 plan, ESCOP held 12 2-day national conferences of customers to develop recommendations on directions and priorities for research. Each conference involved 10 to 20 leaders from national organizations, including producer and commodity groups, processing and manufacturing industries, and environmental and consumer groups. In addition, more than 500 organizations representing customers and professional/scientific societies were invited to submit written recommendations on research needs and opportunities. These inputs were consolidated to form about 150 statements on research directions, which were used as input to the planning workshop that followed.

The 3-1/2 day planning workshop involved approximately 100 participants, including about 80 scientists and research administrators from the state agricultural experiment stations; 7 from ARS; 12 from USDA's Cooperative State Research Service; and others from USDA's Extension Service,[43] the Forest Service, the Extension Committee on Organization and Policy, and professional societies. The workshop produced a set of 22 research priorities, each with four to six research objectives.

The directors of experiment stations ranked these 22 priorities according to their perception of national importance. ESCOP's 1994 plan provides the average rankings, with all regions voting the top priorities to be

[43]USDA's Cooperative State Research Service and Extension Service were combined and reorganized as CSREES.

(1) conserving air, soil, and water; (2) increasing the use of integrated and sustainable production systems; and (3) enhancing food safety.

Description of Oregon Invests—Oregon State University's Research Database

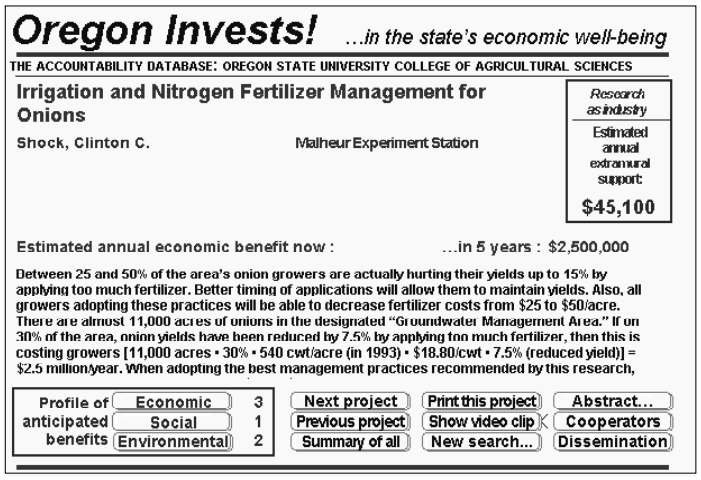
To provide a tool for accountability and communication to its state legislature and taxpayers, the Oregon Agricultural Experiment Station developed a database—Oregon Invests—to describe the potential effects of its agricultural research projects. The database ties the station's mission—to conduct research in the agricultural, biological, social, and environmental sciences for the economic, social, and environmental benefit of Oregon—to local economies, food safety, the environment, and other public concerns.

Each project's potential economic, social, and environmental effects are described and ranked from –3 to +3. For example, a project that leads to reduced pesticide use may rank "3" environmentally, "-1" economically (because increased monitoring adds to growers' costs), and "1" socially (because it reduces farmworkers' exposure to toxic chemicals). The economic effects are measured by the net annual benefits to producers both currently and in 5 years.

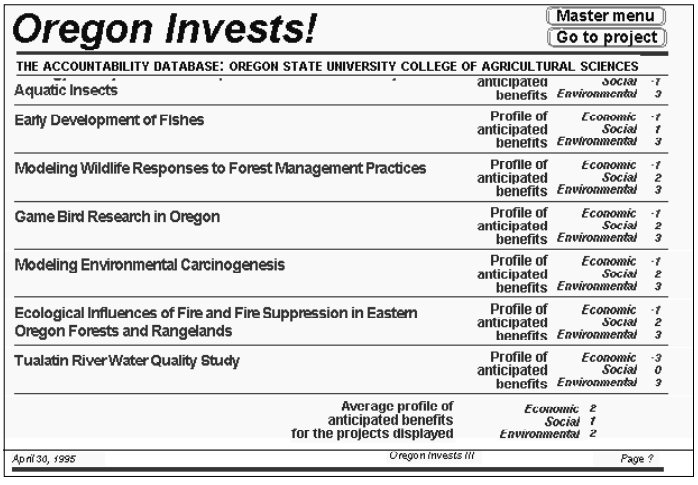
Additional database fields include geographic areas potentially affected by the research, general descriptions of projects, cooperators, researchers, and methods of dissemination. Figure V.1 illustrates four sample screens from the database. The database has information on about 300 projects. The station plans to make the database, which can be loaded on a laptop computer, accessible via the Internet in 1996. It also plans to incorporate outcomes of extension programs.

Figure V.1: Sample Screens From the Oregon Invests Database

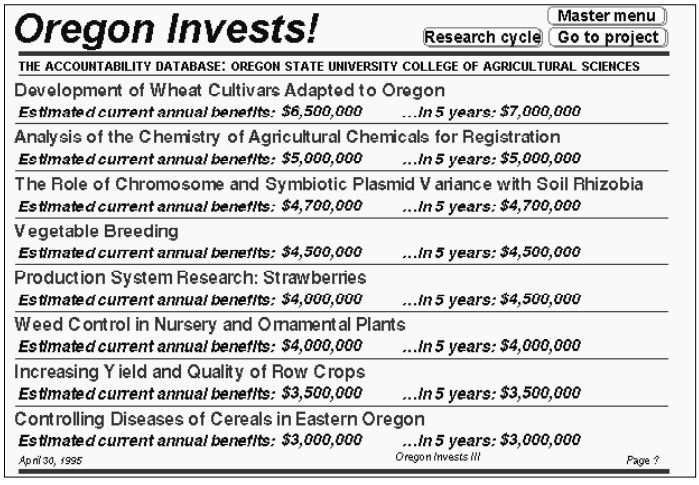
A. Projects are typically first displayed on this screen, which provides the project's title, an abstract describing the project, and the names and organizational units of the researchers.



B. This screen proides information about a project's potential economic consequences.



C. This screen summarizes the anticipated economic, social and environmental consequences of each project, based on a score of -3 to +3. It also shows profiles for each project and calculates the average profile for groups of projects.



D. This summary shows anticipated economic benefits of each selected project.

USDA's Research Advisory Committees

Committee	Establishment and purpose	FY 1994 funds	FY 1994 meetings	Membership	Reporting requirements
Agricultural Biotechnology Research Advisory Committee	Departmental committee to provide external scientific advice to USDA and an opportunity for public participation in the development of public policy on agricultural biotechnology.	$33,876	One full committee meeting; 1 working group meeting.	15 members who are primarily scientists and represent universities, industry, research institutes, and environmental groups.	No formal report required. However, committee has published performance standards for biotechnology research.
Agricultural Science and Technology Review Board	Established by the 1990 Farm Bill to provide technology assessment of current and emerging public and private agriculture research and technology transfer initiatives.	$38,126	Two meetings.	11 members who represent private foundations, agricultural research and technology-transfer firms, nonprofit organizations, land grant universities, and three USDA agencies.	Annual technology assessment report on current and emerging technologies that advance the six purposes of research stated in title 16 of the 1990 Farm Bill.
Animal Health Science Research Advisory Board	Established in the National Agricultural Research, Extension, and Teaching Policy Act of 1977 to advise the Secretary of Agriculture on the implementation of animal health and disease research programs.	$14,353	One meeting; prior to this meeting, the Board had not met since 1990.	12 members including representatives of 4 federal agencies, 4 university members, 3 livestock and poultry organizations, and one organization concerned with the well-being of animals.	No formal report required. Provides minutes with Board recommendations to the Secretary of Agriculture.
Committee of Nine	Authorized by the Hatch Act in 1946, which requires that cooperative regional research projects must be approved by the Committee of Nine.	$21,101	Three meetings (one by conference call).	Nine members, including 8 agricultural experiment station administrators and one administrator of home economics research. The members are elected by their peers.	No formal report required. Provides an annual report with recommendations to the Secretary of Agriculture.

(continued)

Committee	Establishment and purpose	FY 1994 funds	FY 1994 meetings	Membership	Reporting requirements
Dietary Guidelines Advisory Committee	Inter-departmental committee of USDA and the Department of Health and Human Services (HHS) to review the latest dietary guidelines and revise the guidelines for the next edition.	$21,822	One meeting.	At most, 11 members familiar with current scientific knowledge in the field of human nutrition.	HHS and USDA are required to jointly issue dietary guidelines every 5 years. This Committee reviews the last edition, makes any revisions needed, and prepares the first draft.
Forestry Research Advisory Council	Established by the McIntire-Stennis Act of 1962 and required by the Agriculture and Food Act of 1981 to provide advice on the McIntire-Stennis Cooperative Forestry Research Program and the Forestry Service research program. The Council also advises the Secretary of Agriculture on the apportionment of funds for the McIntire-Stennis program.	$13,924	One meeting.	20 members representing forest industries, public forestry agencies, non-governmental groups, and forestry schools.	Annual report to the Secretary on regional and national research planning and coordination of forestry research within the federal and state agencies, forestry schools, and the forest industries.
Joint Council on Food and Agricultural Sciences	Established in the National Agricultural Research, Extension, and Teaching Policy Act of 1977 to bring about more effective research, extension, and teaching in the food and agricultural sciences by improving planning and coordination of these activities. The Joint Council represents the views of various groups who comprise the food and agricultural science and education system.	$96,847	Two meetings.	At least 21 members who represent organizations or agencies that conduct or assist in conducting programs of research, extension, and teaching in the food and agricultural sciences. In addition, the Joint Council has four regional councils and four national committees (structured around functional areas) that include approximately 160 people.	Two reports are required: (1) an annual report that includes priorities and progress made toward accomplishing the priorities; and (2) a five-year plan for food and agricultural sciences, updated every 2 years. However, the Joint Council no longer updates this plan because of budgetary constraints.

(continued)

Committee	Establishment and purpose	FY 1994 funds	FY 1994 meetings	Membership	Reporting requirements
National Agricultural Cost of Production Standards Review Board	Established by the Agriculture and Food Act of 1981 to review USDA's cost of production methodology and the adequacy of the parity formulae.	$37,911	Two meetings.	Of the 11 members of this board, 7 must be engaged in the commercial production of each of the program crops and in 1 or more of the other various major agricultural commodities. Three members must be knowledgeable about cost of production, and one member will be from USDA. The major geographical production areas of the major agricultural commodities must be represented on the Board.	Annual report on its activities to the Secretary of Agriculture and congressional agriculture committees.
National Agricultural Research and Extension Users Advisory Board	Established by the National Agricultural Research, Extension, and Teaching Policy Act of 1977 to provide independent advisory opinions on food and agricultural sciences. The Board represents the views of the users of agricultural research and extension.	$93,539	Two meetings.	21 members primarily from the private sector.	Two reports are required: (1) an annual report concerning the allocation responsibilities and levels of funding among federally supported research and extension programs; and (2) an annual appraisal of the President's proposed budget for food and agricultural sciences. However, the Board no longer prepares the latter report because of budgetary constraints.

(continued)

Committee	Establishment and purpose	FY 1994 funds	FY 1994 meetings	Membership	Reporting requirements
National Genetic Resources Advisory Council	Established by the 1990 Farm Bill to advise the Secretary of Agriculture and Director of the National Genetic Resources Program on the activities, policies, and operation of the program. The Council's primary task is to provide advice on acquiring, preserving, and distributing genetic resources of life forms important to American agriculture.	$7,826	One meeting.	The Secretary of Agriculture appoints at most nine members that include scientists and leaders in fields such as public policy and trade. There are also numerous ex officio members of the Council that include top officials from USDA and several federal science organizations.	No formal report required.
National Nutrition Monitoring Advisory Council	USDA and HHS joint council required by the National Nutrition Monitoring and Related Research Act of 1990 to provide scientific and technical advice on the development and implementation of the coordinated National Nutrition Monitoring and Related Research Program and the Ten-Year Comprehensive Plan for National Nutrition Monitoring and Related Research Program.	$19,649	One meeting.	Nine members, five appointed by the President and one each appointed by the Speaker of the House of Representatives, the minority leader of the House, the President pro tempore of the Senate, and the minority leader of the Senate.	Annual report to the Secretaries of Agriculture and HHS on the Council's recommendations for enhancing scientific and technical quality of the comprehensive plan and coordinated program.
National Sustainable Agricultural Advisory Council	Established by the 1990 Farm Bill to provide general advice to the Secretary of Agriculture on research and extension for sustainable agriculture.	$13,947	One meeting.	At least 16 members with knowledge of sustainable agriculture including federal, land grant university, and private sector members.	Annual report to the Secretary on sustainable agriculture policy recommendations.

(continued)

Committee	Establishment and purpose	FY 1994 funds	FY 1994 meetings	Membership	Reporting requirements
Science and Education National Research Initiative Advisory Committee	Departmental committee to advise the Secretary of Agriculture concerning the administration of the Science and Education National Research Initiative to assure that research is carried out on the highest priority areas with the widest participation by qualified scientists.	$7,729	No meetings; this committee last met in 1992.	Members are scientists drawn from government, industry, and academia.	No formal report required.

Note: The status of some of these committees is uncertain, pending final resolution of the Federal Agriculture Improvement and Reform Act of 1996.

Comments From the U.S. Department of Agriculture

Note: GAO comments supplementing those in the report text appear at the end of this appendix.

DEPARTMENT OF AGRICULTURE
OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20250

MEMORANDUM

To: Robert A. Robinson
Director, Food and Agriculture Issues
Resources, Community, and Economic Development Division
General Accounting Office

From: Karl N. Stauber
Under Secretary
Research, Education, and Economics

MAR 13 1996

Date: March 13, 1996

Subject: Draft Report on Agricultural Research -- (GAO/RCED-96-92, 150890)

Summary

See comment 1.
See comment 2.
See comment 3.

The report accurately describes the research program expenditures within the Agricultural Research Service and the Cooperative State Research, Education, and Extension Service. The value of the report is limited by the lack of specific recommendations. The survey that appears to justify some of the conclusions is limited in value due to statistical weakness and the failure to survey farmers, ranchers, and extension personnel. Nor does the report reflect any discussion with the U.S. scientific leadership, the agricultural sciences, or the general sciences.

Major Concerns

1. Priority Setting

National Research Initiative

See comment 4.

Regarding priorities for the National Research Initiative (NRI), the report indicates that the allocation of funding among the six NRI research areas has changed little between 1992 and 1994. However, the NRI has no discretion to move funds between the research areas since funding for these categories of research is directed by Congress through agricultural appropriation line items.

See comment 5.

The report does not recognize that the research priority-setting process of the NRI is consistent with recommendations in a 1989 report from the National Academy of Sciences entitled, *Investing in Research, a Proposal to Strengthen the Agricultural, Food, and Environment System,* reaffirmed in a 1994 report, *Investing in the National Research Initiative*. The current priority-setting process involves 1) the identification of high-priority areas of research in accordance with the agency's mission and recommendations from stakeholders, customers, congress, and the scientific community; 2) the publication of a program description and request for proposals (RFP) within these high-priority areas and extended broadly to the scientific community to assure the widest participation of eligible U.S. scientists; and 3) the selection of the most meritorious proposals for funding based on competitive merit review. Merit includes both scientific quality and relevance of the proposed research to the program description.

Funds awarded by the NRI to scientists at land-grant universities and the Department's intramural research agencies, namely, ARS, Economic Research Service, and the Forest Service, not only support the high-priority areas identified by the NRI, but also directly support the priorities defined by these research universities and agencies. The NRI mechanism of funding allows for the simultaneous "top-down" identification of broad areas of research based on national priorities and "bottom-up" investigator-initiated proposals of actual research based on emerging and changing fields of science. The advantages of this particular funding mechanism as one of a portfolio of USDA funding mechanisms are 1) flexibility in responding to new and emerging problems and opportunities; 2) a quality check on the proposed science; 3) valuable feedback to the investigator by way of peer review and panel reports; and 4) availability of funds to help scientists do more science within the scope of both the high-priority areas broadly defined by the NRI and the priorities set by the performing organization.

Another feature of the NRI not commonly recognized is its flexibility to both cause and respond to changes scientifically within the Congressionally mandated research areas broadly identified as plants, animals, natural resources and the environment, food safety and human nutrition, adding value to agricultural products, or rural development. While the proportion of funds used to support any one of these research areas is determined by Congress, the kind of research conducted within these areas changes significantly over time because of technological breakthroughs and new scientific concepts. The actual decisions on funding are made through consensus rankings by panels of scientific peers working at the frontiers of science and engineering within these broad research areas relevant to agriculture, food, and the environment.

Agricultural Research Service

See comment 6.

The report focuses largely on the Agricultural Research Service (ARS) infrastructure as an impediment to flexibility and implementing new priorities. We disagree with this finding. For example, ARS has the ability to redeploy resources quickly to solve serious problems in agriculture and the food industry. Our research effort by scientists at Clay Center, Nebraska developed a rapid test that can assess the presence of microbial contaminants on carcasses. In the longer term ARS advances in developing genetic maps of livestock will provide the bases for the production of animals that are inherently resistant to diseases, parasites and food borne pathogens. Recently, an ARS plant molecular geneticist at the Plant Gene Expression Center in Albany, California isolated the "N" gene which may yield clues about how plants fend off their

attackers. This is a major discovery that will reduce growers' and gardeners' reliance on chemicals. The state-of-the-art Plant Gene Expression Center was designed and retrofitted within the existing Western Regional Research Center at Albany, California.

2. Uneven Attention to Social Sciences and Natural Resources

See comment 7.

The report explicitly excludes, for most analysis, research conducted by the Economic Research Service (part of the Research, Education, and Economics mission area at USDA) and the Forest Service. However, the report includes social science in the portfolio of research supported through CSREES (about 8 percent of agency funds support economics, marketing, sociology, family and behavioral sciences) and forestry, natural resources, and related work supported by CSREES and ARS.

Coordination of social science research is an important Departmental priority for both extramural and intramural efforts. In CSREES programs, social sciences are the base for research on farm management, rural community development, family economic well-being and related problems, as well as a part of interdisciplinary efforts in technology assessment, risk analysis, and adoption and diffusion projects. In the case of internal Departmental programs, ERS and ARS scientists are seeking opportunities to serve constituents and address priority problems such as food consumption patterns and technology transfer.

The report does not review the Forestry Research Advisory Committee which the Department recharted in 1994 to assure joint priority setting and advice to the Forest Service and CSREES, nor other efforts through the National Science and Technology Council to link USDA agencies to government wide priorities.

3. Lack of Attention to Extension

See comment 8.

The GAO report references extension as part of the U.S. agricultural research system, and includes Federal funding for state and county delivered extension programs. The report does not address the scope of extension programs, the priority setting process in extension, and most important to the stated purpose of the GAO analysis, the role of extension in the research priority and planning process. As the primary link to research users, extension programs are critical not only to delivering research-based guidance to producers and consumers, but also serving as source of customer information essential to research planning.

The Administration-initiated and Congressionally-supported reorganization of USDA in 1994 linked research, extension, and economics programs, in part to assure a feedback loop between agricultural science and public education programs. By failing to assess the role of extension in research program planning and priority setting, the report ignores a primary connection to customers. The Department recognizes the special need for mission-focused research to be based on ongoing feedback from users and considers the Federally-supported extension system to be a critical element in listening to customers.

Minor Concerns

Comments on Survey Methodology and Results

See comment 9.

The methodology used in the GAO customer service survey to assess the perceived effectiveness of agricultural research appears to have been very straight forward. A sampling frame was developed consisting of a list of associations dealing with food and agricultural issues from the 1995 Encyclopedia of Associations. Since individual producers and extension agents were not represented on the frame, some degree of coverage bias could result if these individuals have differing perceptions of the effectiveness of agricultural research than do the associations.

From this sampling frame, 499 associations were selected for a nationwide mail survey. It is unclear from the report whether all (or just a sample) of the associations were included in the mail-out. If it was a sample survey (as opposed to a census) then the sample design is especially important. More detail on the sample design is needed in the report.

See comment 10.

The high nonresponse rate of 56 percent is of concern. There was no mention in the report about how the nonresponse was distributed (i.e., whether there was differential nonresponse by type of organization) or whether any follow-up effort was made to reduce the overall level of nonresponse. Instead, one disclaiming sentence stated, "The responses from these associations cannot be generalized to other users of agricultural research." The report then continues with extensive analysis that may or may not be representative of the target population of all customers of agricultural research. While the results are anecdotally interesting, it's important to bear in mind their limitations. With the potential for coverage bias and, especially, this high level of nonresponse, the results are statistically vulnerable.

See comment 11.

It's unclear exactly how many associations are represented in Figures 2.1-2.5. There was a screening question (# 2) on the customer service questionnaire that ended the interview for anyone not familiar with the federal agricultural research program. The report fails to specify how many, if any, of the 218 organizations returning the survey were screened out by this question. Figures 2.1-2.5 depict information that would only have been reported by the respondents that passed this screening question, but since only percentages are displayed in the figures, there's no indication of how many samples they represent. The sample sizes underlying the results charted in Figures 2.1-2.5 need to be indicated in the report.

See comment 12.

It is not clear what useful guidance one would draw from figure 2.2, "Types of research most useful to respondents." Mainly, it reflects who was surveyed. For example, in a rough attempt to classify the respondents, 32 percent were clearly related to crop production, 13 percent to livestock/veterinary, 13 percent to conservation/environment, and 3 percent to forestry groups. Thus, it is not surprising that the survey found that the most useful research was plant sciences (23 percent), that animal sciences and conservation (IPM+ water quality+ soil conservation) research were each useful to 14 percent, and that forestry research was useful to only 5 percent of respondents.

See comment 13.

While the report discusses concerns and problems that have been identified in other efforts, it makes no new attempt to empirically verify whether the identified problems lead to reduced research effectiveness. The chapter also discusses current efforts within USDA to improve

management of research. It highlights the lack of a Department-wide agenda to guide priority setting while noting that the REE area is engaged in a strategic planning exercise to provide such a guide. The report generally adopts the idea that better centralized planning will provide improved research effectiveness. A clearer description of research goals and monitoring progress toward success may well be useful. However, any amount of strategic planning or goal monitoring will improve research effectiveness only if equal or more attention is paid to recruiting and retaining top scientists, peer review of research, and obtaining the best scientific guidance on program direction.

See comment 14.

While the report focuses on institutional methods for assuring that high priority research issues are addressed through the science programs of USDA and its cooperators, the primary elements in research planning and conduct -- scientists and research leaders -- are scarcely mentioned in the report. The goals of the USDA research programs reflect critical problems in agriculture, natural resources, human health and nutrition, rural development, and related issues: the science brought to bear on these problems is driven by researchers who routinely communicate with one another, and who have a vested interest in conducting important, influential, and in the case of agriculture, problem-solving work. An essential part of effectively managing a priority-driven research program is developing and utilizing the creativity of individuals and teams of scientists. This requires a portfolio of approaches to conducting and supporting research which ensure both continuity of programs and innovation, and it requires scientific involvement in the priority setting process.

The following are GAO's comments on USDA's March 13, 1996, memorandum.

GAO's Comments

1. We believe that recommendations are not necessary at this time since USDA is developing plans and has initiated actions to address the major problems identified in the report. While we believe that USDA's initiatives have the potential to address these problems, more time will be needed to assess their impact.

2. GAO surveyed a universe of 492 food- and agriculture-related associations, and the report clearly states that the survey results cannot be generalized to all research customers. Nevertheless, we believe that the information we obtained from the 218 organizations responding to our questionnaire (including organizations representing farmers and ranchers) provides valuable insights on how customers value agricultural research and extension. Furthermore, we supplemented the survey by obtaining anecdotal information on customers' views in interviews with farmers, ranchers, and extension personnel (among others) in seven states.

3. During the course of our review, we held numerous discussions with individuals and groups of experts and leaders in the U.S. agricultural research community, including USDA's Under Secretary and Deputy Under Secretary for Research, Education, and Economics; the Administrator, ARS; the Acting Administrator, CSREES; the Chair, National Association of State Universities and Land Grant Colleges' Board on Agriculture; the Executive Director, National Research Council's Board on Agriculture; deans, department heads, and extension specialists located in the schools of agriculture in the eight states we visited during our review; and officials from various commodity and food- and agriculture-related public interest groups and research and policy institutions. Our discussions with these individuals covered a broad range of issues, including the adequacy of priority setting for publicly funded agricultural research, the extent to which agricultural research is meeting the needs of potential users, how effectively research results are being disseminated, and the role of research evaluation in improving accountability. The views of these experts and leaders were integral in our assessment of USDA's approaches to planning and setting priorities. We have added further details to chapter 1 concerning the individuals and groups with whom we met.

4. We agree that the NRI program has minimal discretion to move funds among its six broad research areas, and this situation was recognized in

the draft USDA reviewed. However, as our report states, the NRI program establishes and manages specific research priorities within these broad areas. For example, NRI program staff recently decided to reduce the number of research priorities funded each year by the NRI. As a result, in fiscal year 1996, USDA did not request project proposals for "biological control research," one of the 27 priorities in the NRI program.

5. We recognize that NRI's process for setting research priorities is generally consistent with the recommendations of the National Academy of Science. However, this does not alter our findings that the NRI program (1) lacks performance goals and indicators and (2) does not comprehensively evaluate the outcomes of its research programs. We believe such tools are necessary to measure program performance and enhance accountability. In fact, in 1994 the National Research Council's Board on Agriculture found that USDA had done little to track the output of the NRI program and recommended that USDA systematically evaluate the program's performance.

6. Our report states that ARS' infrastructure is one of four factors that limit USDA's ability to shift research resources. The limitations created by ARS' infrastructure have been corroborated by ARS officials and in agency documents. For example, ARS' most recent implementation plan, published in 1991, cites several factors that limit ARS' resource allocation and the kinds of research it conducts. Included among these factors is the need for costly facilities and equipment that are problem-specific.

7. We concur that the research conducted by ERS and the Forest Service has an important place in the portfolio of publicly funded agricultural research. However, as agreed with the requesters, we focused our assessment of USDA's priority-setting processes on conditions at ARS and CSREES—the Department's principal research agencies—and on the efforts of the Office of the Under Secretary, Research, Education, and Economics. Similarly, although we reviewed documents relating to the National Science and Technology Council, we did not evaluate its efforts since this was outside of the agreed-upon scope of this review. We do, however, provide an overview of the purpose, membership, and reporting requirements of the Forestry Research Advisory Committee in appendix VI.

8. Our report does not assess the role of extension in USDA's processes for setting research priorities for two reasons: First, USDA research officials—including the Under Secretary for Research, Education, and

Economics and the Deputy Administrator, ARS—cited the Congress and commodity and interest groups as having the greatest influence on its priority-setting processes; the extension services were not included as having major influence on these processes. Second, a detailed evaluation of the extension services was beyond the scope of this assignment. As agreed with our requesters, we addressed extension by providing (1) an overview of the overall system—including the extension component—and (2) the views of users of agricultural research on how effectively research results are being disseminated by the extension services. As stated in our report, however, extension does play a major role in disseminating research results and related information to the public.

9. See GAO comment #2.

10. To increase the response rate to our questionnaire, we mailed and telephoned reminders to all nonresponding associations. We added information to the report's methodology section on our nonresponse followup.

11. The number of associations responding to each question is listed in appendix II.

12. We do not draw conclusions from figure 2.2—we are merely providing descriptive information on the areas of research viewed most useful by the survey respondents.

13. We concur with USDA on the value of empirical verification of the impact of identified problems on the effectiveness of its research. Such verification could well provide an additional impetus in USDA's efforts to address the long-standing concerns about inadequacies in its research planning and priority-setting processes. However, as discussed in our report, neither ARS nor the NRI program has incorporated performance goals or indicators into its research programs. Without these tools, it is extremely difficult to evaluate the performance or the effectiveness of USDA's research programs. In fact, USDA itself does not comprehensively evaluate the outcomes of its research programs. In 1994, the National Research Council's Board on Agriculture recommended that USDA systematically evaluate its research investment across all four of its research funding areas. USDA believes that its upcoming strategic plan will address these issues. We fully support its efforts to improve research evaluation and accountability.

Relatedly, we continue to support the need for agencywide strategic planning to guide the efforts of USDA's research agencies. Our support for strategic planning does not mean that we endorse centralized direction for individual research projects (which is not a part of strategic planning), but rather that USDA establish Department-level mission objectives and strategies for achieving clearly defined goals. Furthermore, as discussed in our report, we believe that research planning and priority setting should be done within the context of USDA's overall research portfolio. Finally, we do not dispute the importance of recruiting and retaining top scientists, peer review, and scientific guidance on program directions. However, we continue to believe that without effective strategic planning, priority setting, and research evaluation, even the most talented scientists conducting research of undisputed scientific merit cannot be assured that their research is addressing the areas of greatest need and does not duplicate research being conducted elsewhere within USDA's research portfolio.

14. We do not dispute the important role of individuals in developing and implementing research programs. However, to meet our requesters' needs, we focused our efforts on assessing USDA's processes for planning and establishing research priorities—the issue of staff development and its role in research implementation was peripheral to these issues.

Major Contributors to This Report

Jerilynn B. Hoy, Assistant Director
Teresa F. Spisak, Project Leader
Jerry W. Coffey
Ruth Ann Decker
Kelly Ervin
W. Fred Mayo
Beverly A. Peterson
LaSonya R. Roberts
Carol Herrnstadt Shulman
Leigh M. White
Dale A. Wolden

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