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# Research, Extension, and Education Policy

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## Background

The present-day set of research-teaching-extension institutions serving U.S. agriculture and households have enjoyed relatively long lives. The leading institution is the land-grant university system with a legislatively mandated mission involving federal-state-local partnerships for research, education, and extension. The secondary institution is the USDA with the Agricultural Research Service and Economic Research Service engaged in agricultural research. The early political recognition that local climates, soils, and environments play an important role in determining the local research and extension needs of farmers and rural people enabled passage of the Land-Grant College Act of 1862, the Hatch Act for state agricultural experiment stations in 1887, and the Smith-Lever Act of 1913 for Cooperative Extension. These institutions had unusual designs that provided the capacity to evolve and change with local needs.

An effective organization of research and development (R&D) for agriculture is one where the final users of technology and information are part of a complex, integrated, and multi-layered structure of research, development, and information exchange (see Figure 1). A clear allocation of responsibilities between the public and private sectors, and between the states and national government are needed to obtain efficient use of resources and internalize externalities. Although private agricultural R&D has been growing much faster than public research over the past decade, the private sector will leave much to be done by the public sector.

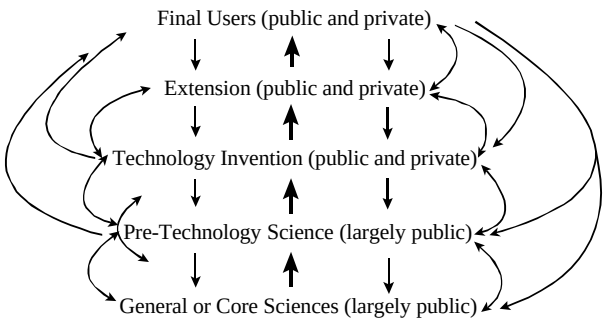


**Figure 1.. Organization of R&D for Agriculture – Complex, integrated, multi-level organization.**

Federal funds for agricultural research in constant dollars decreased at an average rate of 1 percent per year during the past decade (and for all research at 1.5 percent per year). Also, federal funds for non-agricultural research relative to agricultural research

have declined over the 1989-1991 period with the contraction of federally funded defense and energy research, but the ratio was stable over 1991 to 2000. State government funding of agricultural research grew at 2 percent per year over 1989-2000, thereby increasing the states' share of public funding of agricultural research.

# Issues

### Why Is Public Agricultural Research Important?

The supply of agricultural outputs is positively related to R&D stocks, and for more than two decades, the relative price of food and fiber has been decreasing which benefits consumers. R&D is a major reason for U.S. households having the lowest share of personal income spent on food (about 12 percent) for any country. Also, rightward shifting supply curves for U.S. agricultural products are a major factor for increasing the competitiveness of U.S. agriculture in the world export market. As U.S. consumers' concerns for food costs have lessened, other concerns have become visible, e.g., food safety, fat content, processing, and technology used to produce products. Although the demand for food is income inelastic, the demand for food safety, resource and environmental amenities, and for food processing is income elastic. Continued per capita income growth can be expected to provide a growing demand for research in these areas.

Major developments have occurred in science permitting genetic engineering through biotechnology and new information systems. These technologies hold interesting potential for farmers to reduce their costs of production and, eventually, for new and cheaper products for consumers. These technologies, however, have raised many new issues that need researching, e.g., effects of genetically modified (GM) inputs on the environment, effects of GM foods on human health, methods to assess web and internet information quality, and mechanisms to detect fraud and enforce contracts. Other technologies have raised broad environmental issues, e.g., effects on water and air quality and, ultimately, on human health.

Land-grant universities are testing new sources of funding — income from intellectual property sales enabled by the Bayh-Dole Act, exclusive arrangements with private sector firms, and federal competitive grant programs. These new institutional arrangements have income potential, but they weaken ties to traditional within-state stakeholders of land-grant universities. This holds potential risks over the long term.

### Change in the Historical State-Federal Partnership

Agricultural research and cooperative extension have historically been a federal-state partnership. Within the USDA, most research is conducted by the Agricultural Research Service (ARS) and the Economic Research Service (ERS), which obtain their funds for in-house research almost exclusively from Congress. The combined research budget of ARS and ERS decreased about 5 percent in real terms over 1988-97. The strongest justification for funding the USDA's own research is for conducting research that produces national (or international) public goods for agriculture, e.g., national environmental and resource issues, food safety and nutrition, and agricultural, community, and rural development policy. Some of these activities require highly specialized resources, with large fixed costs. The USDA may undertake certain types of nationally important pre-technology or basic scientific research needed for the agriculture and household sectors, but they are at a scientific locational disadvantage because they are not part of a major research university.

State Agricultural Experiment Stations are the dominant public agricultural research institution, and they are engaged in a wide range of research from the applied to pre-technology and basic/general sciences. Although their initial funding was heavily federal, state governments have become the source of a majority of SAES funding. However, regular federal appropriations continue to account for about 14 percent of the SAES system funding. Real non-grant funds (largely formula funding) through Hatch, Regional/Multistate, and other sources to the SAES system were roughly the same at the end of the

decade as at the beginning, but were larger than at mid-decade. Over the decade of the 90s, Cooperative Research, Education, Extension Service (CSREES) tried to move competitive grant programs forward in a variety of ways. This, however, led to a small increase in real research resources for the SAES system, and at the end of the period, these programs accounted for about 2.5 percent of the SAES system funding.

Given the long term historical developments of institutions and federal legislation dealing with funding of agricultural research, a debate continues on the advantages and disadvantages of alternative funding mechanisms, e.g., formula-funding, competitive grants, special grants/public earmarking, and cooperative agreements. Most of the regular federal appropriations for SAES research continue under some type of formula. Under formula funding, each state's share of the appropriation is based on a legislated rule, originating in politics needed to pass the original Hatch Act, the Amended Hatch Act (1955), and other legislation providing funding for agricultural research in state institutions. Since 1935, matching funding has been an important attribute of this funding, i.e., a state institution must at least match its regular federal appropriation with other research funds.

The USDA's competitive research grants program was first established in 1977 to address high-priority research areas identified by an advisory committee to the secretary of agriculture, but it was refocused in the mid-1980s on biotechnology and renamed the National Research Initiatives Competitive Grants program in the 1990 Farm Bill. This was to be a major research program with relatively large, long term grants on high-priority fundamental and mission-oriented research of the importance of biological, environmental, physical, and social sciences relevant to agriculture, food, and the environment. However, the program has evolved into a small-grants program providing short term funding. As such, it has especially high transactions costs, e.g., scientists' time for proposal preparation, evaluation, and rankings (associated with a low success rate) and administrative costs relative to the amount of funds distributed, and distorts scientists' time away from effort paid for under other SAES funding, e.g., state government funded projects. The introduction of new competitive grant programs, having new goals and guidelines, is an attempt to obtain more funds for competitive research programs for agriculture, but it has introduced added uncertainty about these programs as the Fund for Rural America received federal funding for only two years and then was unfunded for several years.[1] Then, the grant program for Initiatives for the Future of the Food System was started in 1998. The status quo in real funding for agricultural research and instability in federal programs for agricultural research can reasonably be interpreted as weakening the federal-state partnership for agricultural research.

**Accountability**

Accountability for use of federal funds for agricultural research is an issue dating back to the Hatch Act. In the late 1800s, systematic accounting procedures were first established, agricultural experiment station visits or reviews were conducted, and legitimate station research was defined (Huffman and Evenson, pp. 40). As land-grant universities developed better accounting systems and came under stronger state government oversight, the Office of Experiment Stations, or the Cooperative States Research Service, discontinued it emphasis on accounting procedures. However, it continued to require annual progress reports and financial reports, (e.g., the Current Research Information System (CRIS), established in 1968), and periodic departmental reviews. Furthermore, a large number of studies undertaken by economists have shown that the marginal real social rate of return to public funds invested in agricultural research in the United States is relatively high, e.g., in the range of 20-50 percent (see Evenson; Alston, Marra, Pardey, and Wyatt), which is large relative to alternative public investments.

During the 1990s, accountability for the use of federal funds has been a popular political theme. The

[1] To offset some of the adjustments anticipated, the Fund for Rural America was established as a new research program that focused on increasing international competitiveness, efficiency, farm profitability, environmental stewardship, and rural community enchancement. As another competitive grant program of the USDA, it initially competed with the NRI for congressional funding.

Government Performance and Results Act (GIPRA) of 1993 required strategic planning and annual program performance reporting for every agency of the federal government, including the CSREES which oversees the federal formula funding of agricultural research and extension of the land-grant universities (U.S. Congress 1993). This legislation was stimulated by concerns in the U.S. Congress for greater accountability to taxpayers for the performance of programs and a need for better planning of federal programs. Although significant attempts were made to implement its provisions for public agricultural research, it was a federal program that did not work well for public research.

Hence, the 1998 Agricultural Research, Extension, and Education Reform Act (AREERA), superseded GIPRA, and introduced a new form of accountability for research and extension. This act applies specifically to land-grant institutions receiving Hatch (research) and Smith-Lever (extension) formula funds from the federal government (U.S. Congress 1999). In carrying out the 1998 legislation, CSREES established goals for its next five-year plan and expected institutions receiving federal funding to conform. The goals were to establish: 1) an agricultural system that is highly competitive in the global economy, 2) a safe and secure food and fiber system, 3) a healthy, well-nourished population, 4) greater harmony between agriculture and the environment, and 5) enhanced economic opportunity and quality of life for Americans. The program pushed accountability by requiring "plans of work" by each institution for using federal funds, integrating research and extension activities (for roughly 25 percent of the funds), and implementing a process for obtaining stakeholder input concerning the uses of research, extension, and education formula funds. In addition, merit reviews of programs are required at least once every five years.

The response of the land-grant universities has generally been to abolish the old SAES project system (which contained more than 11,000 projects). Each of these projects was carried out by one or a small set of scientists over a three to five year horizon, and the scientists were held locally accountable for progress reports and outputs. The typical response by the agricultural experiment stations has been to define a few, large umbrella projects which fit under the goals of the new legislation and cover many scientists. For each of these umbrella projects, a very brief summary report (relative to standards of the past) of achievements and impacts, numerical counts of categorized outputs, and a few success stories are being reported.

The fundamental problem with federal accountability for research is that it fails to come to grips with the unusual attributes of research as a productive activity. First, the R&D payoff is the "best" of scientists' outputs, rather than their total outputs. Second, the research production process is subject to a large amount of ex ante uncertainty. Third, asymmetric information exists in that each scientist has better information about how he allocates his effort and on his ability than does his research or federal accountability administrator. Given ex ante uncertainty in research production, it is impossible for research or accountability administrators to accurately infer effort from observed output. Fourth, research administrators are in a better position to bear risk associated with risky research projects than scientists, but scientists are being asked to bear increasing amounts of research risk. These are complex issues in the management of science that need addressing.

# Policy Options and Consequences

Several alternative policy options exist for research, extension, and education. These options and their consequences are listed below.

Honor the original land grant university partnership by stabilizing federal formula funds for research and extension to at least protect the purchasing power of formula funds against inflation, or increase the formula funds.

- Consequences for farmers and agribusinesses
  - — Maintain access to new technologies and management tools across all firm sizes.
  - — Obtain greater production efficiency, added product quality, new products, and new market options.
  - — Contribute to viability of small farms and agribusinesses.
- Consequences for consumers
  - — Have access to lower cost food, fiber, and energy.
  - — Benefit from greater food safety and enhanced nutrition of foods.
- Consequences for taxpayers
  - — Required to make involuntary contributions through taxes, but obtaining high rates of return on public funds invested in agricultural research, extension, and education.
- Consequences for the environment and rural communities
  - — Block-granted formula funds expand the capacity of state universities to address locally and regionally specialized research, extension, and education issues associated with public policy issues like environmental quality and rural development, for which private entities have no incentive to undertake.

Stabilize and maintain a single federal research and extension grant mechanism under the National Research Initiative format to encourage sizeable competitive grants and multi-organizational consortia across Land Grant Universities, Agricultural Research Service, Economic Research Service, and the National Agricultural Statistics Service, to address core national and international issues.

- Consequences for farmers and agribusinesses
  - — Obtain collective access to basic scientific knowledge.
  - — Obtain new markets for specialized agricultural products, e.g., carbon credits.
  - — Obtain access to tools for compliance with environmental regulations.
- Consequences for consumers
  - — Obtain greater consumer security for the American food system.
  - — Improved confidence in the American food system.
  - — Observe and participate in a transition of rural communities.
- Consequences for taxpayers
  - — Orderly flow of research, education, and information with higher returns on public investment due to a lower cost organization structure.
  - — Direct public funds to both important national and local issues.
- Consequences for the environment and rural communities
  - — Focus public resources on public good knowledge of environmental improvement and rural community transition.
  - — Obtain more efficient use of public knowledge investments.

Honor the original land grant university partnership, and recognize that the federal partner plays a small financial role relative to the state partner, and by replacing federal program plans of work and annual progress reports, as well as sub-accounting for multi-state and integrated project categorization of work, with a simple five-year comprehensive review. These reviews would be similar to an accreditation review, attempting to answer the question: "Does this land grant university perform research, extension, and education in a responsible manner in accordance with the land grant partnership mission?"

- Consequences for farmers, agribusinesses, and consumers
  - — A clearer focus on issues relevant to their regional climate and economy, rather than following a nationally led agenda.
- Consequences for taxpayers
  - — Reduced overhead cost of continuous, specific project review, and numerous planning and evaluation functions. Every state must maintain a significant investment in staff, operating support, and travel for

program planning and evaluation focused on federal reporting.
  - — Greater attention to local and regional issues, rather than on a national agenda. This respects the greater state investment in research and extension.
- Consequences for the environment and rural communities
  - — Greater customer focus on local and regional environmental and rural community solutions.Eliminate federal funding of agricultural research.
- Consequence for farmers and agribusinesses
  - — Less basic and applied research discoveries from which to develop new technologies.
  - — Greater demands for direct contributions to public agricultural research funding.
  - — Development of new technologies driven more heavily by the private sector.
  - — Less public information available on performance of new technologies.
- Consequences for consumers
  - — Less food safety research, and less confidence in the American food system.
  - — Less environmental research.
  - — Less focus on transition of rural communities.
- Consequences for taxpayers
  - — Reduced federal tax burden, but increased state tax burden for agricultural research.
  - — Lower social rate of return to federal expenditures.
- Consequences for the environment and rural communities
  - — BackgroundReduced public information on environmental and rural community issues.

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