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# Agricultural Research: Benefits and Beneficiaries of Alternative Funding Mechanism

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## **Disciplines**

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Beneficiaries of Alternative Funding Mechanism**

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Beneficiaries of Alternative Funding Mechanism**

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**Key words:** research, R&D, funding, innovations, science, agriculture

## **Agricultural Research: Benefits and Beneficiaries of Alternative Funding Mechanisms**

**by Wallace E. Huffman and Richard E. Just\***

The U.S. has developed a very successful R&D system for agriculture. It is a system having shared financing and performance. The federal government provides about 24 percent of all agricultural research funds, while state governments provide 16 percent and the private sector 60 percent. In contrast, federal agencies actually perform about 15 percent of the research, compared to 31 percent being carried out by state agencies and 54 percent by private businesses (Figure 1). Thus, the federal government and private sector transfer funds to state institutions for performing agricultural research.

Public expenditures on R&D are justified by the existences of large social (collective) benefits relative to private (one individual or company) benefits. The USDA, with its Agricultural Research Service (ARS) and Economic Research Service (ERS), performs most federal government's in-house agricultural research and the State Agricultural Experiment Stations (SAES)-vet med schools conduct most state agricultural research. The in-house USDA research is all federally funded, and its justification hinges on conducting research that benefits the nation and requires specialized resources. The SAES-vet med schools have federal, state, and private funding for research, and their justification hinges on conducting research that primarily benefits clientele residing in their respective states and secondarily benefits other states and the nation.

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Since 1980, the growth in agricultural research funds (in constant prices) has been largely in the private sector (about 3% per year), and a very slight increase in state and federal funds for agricultural research. With the 1996 agreement between Congress and the President to balance the Federal budget by 2002, federal agricultural research and other expenditures are getting close scrutiny. As the Federal Government shifts greater responsibility to the States for carrying out programs, many state governments are also scrutinizing expenditures. State agricultural research administrators are carefully weighing options and opportunities. The paper presents an analysis of alternative organization, management, incentive, and funding mechanisms for agricultural research under budget constraints, including some emphasis on the kinds of benefits that are generated and the groups that reap them. This paper builds on our earlier research, Huffman and Evenson (1993) and Huffman and Just (1994, 1995), and other research, including Fuglie et al. 1996.

### **Successful R&D and Economic Growth**

The potential nonrival or pure public good nature of knowledge and information is currently accepted to be a key attribute of the economics of research (R&D), technological change, and productivity growth. The empirical evidence, however, shows much of research to be an impure public good or nonrival but partially excludable, i.e., public or private research performed by one institution or agency spills over partially but not completely to other institutions or agencies. The extent of research spillovers, or positive externalities, is conditioned by the public or private source of the innovation and by the geographical, technical, geoclimatic, and cultural distance between producing institutions and potential user institutions. See for example Huffman and Evenson 1993, Byerlee and Traxler 1996, Evenson and Kislev 1975, Gollin and

Evenson 1996, Adams and Jaffe 1996, and Henderson and Cockburn 1996. For firms/producers to be assured of receiving benefits of R&D, some R&D activity must be undertaken in their area to produce local or impure public goods. This might not require more than low-power research of a screening and adaptive type.

Research institutions differ in their productivity by size and scope of activities undertaken. Sizeable research institutions are more productive than small ones because of economies of scope across their research programs arising from a diverse set of projects that can better capture internal and external knowledge spillovers and economies of scale arising from specialization of effort and sharing of fixed costs. See Henderson and Cockburn 1996 and Byerlee and Traxler 1996. Individual research programs within an institution, however, exhaust scale economies after a few scientists are employed. In contrast, huge research institutions face efficiency losses due to coordination problems, absence of external competition, and possible loss of touch with clientele needs.

An economically efficient organization of research requires (some) redundancy of effort, diversity of incentive schemes, and possible restraints on the interactions of researchers who are attempting to achieve the same innovation, advance in knowledge, or new product/process. In R&D, the "payoff" is most accurately described as the *best* of agents' outputs (and not the total combined output of agents). Although there is only one *best* output or innovation at a point in time, social welfare and principals (e.g., research administrators) will be better off over the long run if multiple agents (researchers) are assigned the general task of achieving a particular innovation. The reasons include an "insurance effect" of relative performance evaluation and a "sampling effect" because of uncertainty about each researchers output. The value of multiple

researchers or agents is generally increasing in both the variability of outputs across researchers/agents and the value of a success relative to the wage bill paid to researchers/agents (Levitt 1995). The sampling effect becomes more valuable when researchers' activities are not highly correlated, and are largest when they are independent. Also, see Evenson (1994) and Evenson and Kislev (1975) for an application of independent innovation searches as a model for improving crop varieties.

The amount of socially productive activity leading to real income and welfare in a free society is determined primarily by the relative returns to socially productive versus socially unproductive activities. When people are free to do so, they choose occupations that offer the highest returns on their abilities and time (see Murphy, Shleifer, and Vishney 1991), and when an occupation encompasses multiple tasks, they allocate their time based on relative returns, given their abilities (Singell, Lillydahl, and Singell 1996).

A critical issue is whether a country's most talented individuals choose to allocate their time to socially productive or unproductive activities (Murphy, Shleifer, and Vishney 1991). If the most talented individuals choose public or private R&D or private sector entrepreneurship as their occupation, they innovate and organize production to foster economic growth. Alternatively, if they choose an occupation of rent seeking, they are socially unproductive, i.e., they engage in redistributive activities but do not add to real output of the society. One could view rent seeking here as a tax on the profits of the private sector or on the public resources available for innovation. There is both "official" rent seeking, e.g., lobbying for special private interests, and "unofficial" rent-seeking through bribery, theft, favoritism, and litigation. Less talented individuals work for the more talented ones in productive or rent-seeking activities.

When a society provides large opportunities and rewards to rent seeking relative to R&D and entrepreneurial activities, it causes several things to happen. First, total output and per capital real income of the society is reduced. Second, the best (and average) talent of individuals engaged in innovation and production is reduced which may reduce the long-run growth rate. Third, the best (and average) talent of rent seekers rises which increase the effectiveness of rent seeking which is socially unproductive.

Sturznegger and Tommasi (1994) present an economic model showing the potential negative effects of allocating scientists' time away from innovation and toward rent-seeking activities when the distribution of research funds has a political component. They make the share of scientists' time that is allocated to innovation a choice (with the alternative of pursuing a fixed total quantity of public research funds by rent-seeking or redistributive activities). Given that public R&D funds can be allocated by any arbitrary formula that does not consume time of scientists, a rent-seeking allocation mechanism is wasteful. In addition, competitive-grant allocation schemes for research with highly uncertain outcomes tend to become subjective and not to exploit optimal diversity of approaches. The major opposing views are that competition is needed to select the best projects and lobbying may increase the total quantity of available research funds.

### **Funding Mechanisms: Types and Impacts**

The primary mechanism for funding/financing U.S. agricultural research are marketable intellectual property rights (IPRS), collection of taxes and allocation of part of the tax revenues to public research institutions/researchers, and contributions by private industry and commodity

groups to public research institutions/researchers. The benefits and beneficiaries of these funding mechanisms differ.<sup>1</sup>

### **IPRs and Private R&D**

Federal laws provide the mechanism for definition, enforcement, and transfer of IPRs. IPRs include patents, plant breeders' rights, seed and breed certificates, copyrights, trademarks, and trade secrets. For U.S. agricultural inventions, patents, plant breeders rights, and trade secrets have been especially important for investments in R&D by the private sector. Lets focus on patents which are applicable to embodied inventions. A holder of a U.S. patent is given the right to exclude others from the unauthorized use, sale, or manufacture of the product, process, or biological material. The right to exclude is limited to 20 years (from the time of application). The patent application must disclose or remove from secrecy the essential features of the invention so as to "enable" others to make or use the invention. Disclosure has two main purposes. In return for granting a monopoly ownership position to the inventor for 20 years, society establishes strong incentives for private sector R&D and the nature of the invention is revealed which facilitates knowledge exchanges (Huffman and Evenson 1993, ch. 5). The U.S. patent law exempts abstract or non-embodied ideas and concept from protection, so it is not useful for protecting/stimulating innovation in pretechnology and general sciences.

Thus with a patent an individual or company can use or license the use of an invention that is embodied in a product, process, or biological material (for 20 years). This gives the inventor a right to an income stream associated with the invention. The actual or implicit royalties are then part of the cost of the new product, process, or biological material using the invention.

Hence, demanders/purchasers of these new products, processes, and biological materials bear much of the cost and obtain a major part of the benefits of R&D protected by patents that are owned by the private sector. For example, Frey (1996) reports that the U.S. private agronomic and horticultural seed industry invested 81 percent of its 1994 R&D expenditures to development of varieties with anticipation of commercial sale.

Even with a strong legal system, patent owners share the benefits of their inventions. First, the final product, process or biological material embodied with the innovation must compete in the market with other products/processes materials. This means that there must be a perceived economic benefit of changing from old to new. Second, the pricing of the IPR must be such that a significant economic incentive exists for broad adoption of the innovation because this is the only way that large scale sales of a innovation can be obtained. Third, the process of obtaining an IPR results in revealing new information or knowledge which is available to other innovators in their work. Fourth, IPR has a limited life. Hence, purchasers/demanders of the products, processes, or biological material embodied with the innovation and other inventors share part of the economic benefits of a patent. Optimal patent enforcement and licensing does not stop all spillover effects.

Marketable patents cannot be used to directly reward innovations in the general and pretechnology science field. Also, they are not a socially effective reward for innovations that cannot be embodied in products where markets do not exist, e.g., attributes of environmental quality.

Invention exhausts potential for new discoveries unless advances in other areas of science are restoring or adding to the potential. It is generally accepted that research in the general and

pretechnology sciences provide the advances in knowledge that enhances or restores the potential for applied research and invention (Huffman and Evenson 1993). Because any private sector enterprise can expect to capture only a small share of the benefits from innovations in the general and pretechnology sciences, they will greatly underinvest from a social perspective in conducting or voluntarily contributing to the funding of this type research. The free rider problem grows rapidly as potential commercial beneficiaries increases (Olson; Cornes and Sandler).

### **Public Agricultural Research**

In the public sector, conducting research on agriculture is primarily an activity of U.S. Department of Agriculture and the state agricultural experiment stations (including colleges of veterinary medicine). See Huffman and Evenson (1993) for history leading to the establishment of these institutions with major agricultural research missions. A large share of this research is financed from states and federal tax collections. Taxes are a type of involuntary contribution.

**USDA.** Within the USDA, a very large share of research is conducted by the Agricultural Research Service (ARS) and the Economics Research Services (ERS). See Huffman and Evenson (1993, pp 30-39) for a discussion of the long-term evolution of the structure of research organized in the USDA. The funds for in-house research of the USDA are line items in the federal government's budget request and appropriation. The administrator of the USDA must define and discuss their budget before Congress. After hearings on the budget and reconciliation of differences between the House and Senate, Congress must eventually pass a budget and the President of the United States must sign it.

The strongest justification for funding the USDA's own research operation is for conducting research that benefits the nation and requires specialized resources. By specialized resources, I mean use of a large germplasm collection, a large investment in expensive research animals, or possibly use of large scale biological, environmental, or economic models. Having national benefits means that the research has positive spillover benefits to agricultural research conducted by all (or almost all) state institutions (e.g., SAES and Vet Med Schools), or broadly to private R&D for agriculture, or it provides useful information for national policy decision making for agriculture. What are indicators of meeting this mission? Is the USDA's in-house research relatively important to public policy decisions on the environment and natural resource issues, food safety and nutrition, community policy, and rural development? Is the USDA's in-house research relatively intense in basic and pretechnology science advances relative to the SAES? I do not have the evidence for the first indicator, but some evidence on the second is available.

Frey (1996) presents evidence on the relative allocation of resources to agronomic and horticultural plant improvement by the USDA-ARS and SAES for 1994. He uses three investment categories which are roughly equivalent to pre-technology (plant breeding research), applied (germplasm enhancement), and developmental (cultivar development) research. The USDA-ARS allocates 40% of its research to the first category versus 30% for the SAES, and the USDA-ARS allocates 12% to the last category versus 41% for the SAES (see Frey 1996, Table 4). Clearly the USDA-ARS is much less intensely investing in cultivar development, which is largely producing local public and private goods. We, however, would also like some direct evidence on intensive use of innovations, e.g., citation patterns of patents and publications of

USDA scientists versus agricultural scientists in state research institutions. More hard evidence on the benefits and beneficiary of USDA in-house research relative to its cost is needed before major changes in the scale of USDA in-house research are made, e.g., before the in-house research resources are allocated to other federal research programs.

The USDA has expanded its research efforts to some extent through joint ventures. These include the use of cooperative agreements, which are jointly funded and performed research between USDA and SAES-vet med schools, and cooperative research and development agreements (CRADAs). A CRADA is a research agreement between a federal research unit and a private company (or other nonfederal institution) involved in the development and commercialization of specific technology. The principal objective of CRADAs is to link pre-technology research capacity of federal laboratories with commercial research and development expertise of the private sector. The agreement describes the responsibilities and contributions of each partner and assigns rights to intellectual property. Fuglie et al. (1996) reports that the USDA has entered into more than 500 CRADAs with private firms after they were first authorized by Congress in 1986. Joint public-private ventures tend to raise issues of undue conflicts over sharing of or access to knowledge, which I will return to later.

**SAES and Vet Med Schools.** The state agricultural experiment stations (and vet med schools) receive funds from federal, state, and private sources. For our discussion of benefits and beneficiaries, it is useful to disaggregate as follows: (1) regular federal sources (CSREES/CSRS-administered), (2) contracts, grants, and cooperative agreements with the USDA and contracts and grants with non-USDA federal agencies, (3) state government appropriations, (4) private sources (commodity groups, private industry, and private foundations), and (5) other sources.

The cost of (1) and (2) is borne by federal taxpayers and of (3) is borne by payers of state taxes. The cost of (4) is borne by private groups. Over the period 1960 to 1995, the notable trends for SAES revenue are a steady decline in the share of regular federal funds through 1990, a rise in the share of other federal government research funds, a rise in the share of funds from private sources, and a decline between 1990 and 1995 in the share due to state government appropriations (see Table 1). State government appropriations continue to account for about 50 percent of SAES funds.

A debate continues on the advantages and disadvantages of regular federal funds, for example formula funds, public competitive grant funding, public ear-marked funds, and private contract funds for SAES research. A major part of regular federal funds are formula funds. Formula funding of state agricultural research, where states share federal funds based on a legislated rule, originated in the politics needed to pass the original (1887) and amended Hatch Act (1955) legislation. However, to obtain formula funds, states must at least match the federal formula funds with other research funds. Thus, if a state accepts federal formula funds for SAES research it agrees to spend at least twice the formula amount on agricultural research. This has been a strong inducement for states to help support agricultural research. The research agenda is set by SAES directors whose primary clientele reside in their respective states. With formula funding, the federal government has no real input into the choices of research projects undertaken by SAES scientists.<sup>2</sup>

Several advantages of a formula-distribution of research funds are: no opportunity or reward to interstate rent-seeking activity to affect the distribution, an implied guarantee of relatively stable or predictable federal support(subsidy) to states for their SAES, and low

administrative cost of the program which falls largely on administrators and not scientists. A disadvantage is that the marginal (social) benefit from federal funding for SAES research is unlikely to be equal across states. Also, the choice of projects to be undertaken is also under state control (e.g., by the SAES director and scientists) and not national control. The requirement of 25% of the Amended Hatch funds be allocated to regional research, however, is a legislative mechanism to encourage SAES directors to include research possessing significant interstate spillovers into their portfolio of projects, or to see benefits beyond their own state boundaries.

The USDA's competitive grant program (CGP) was started in 1977 to address high-priority research areas identified by an advisory committee to the Secretary of Agriculture. In the mid-1980s it took a biotechnology focus, and since 1990, it has been focused on basic science for agriculture--the National Research Initiative. The size of the USDA's Competitive Grants Program expanded significantly during the late 1980s and early 1990s.

With the USDA's CGP, the research agenda is set at the national level, and scientists across a broad range of institutions compete for the funds.<sup>3</sup> Proposals are prepared by scientists; they are reviewed by a small set of field specialists, and then a panel of scientists rank the proposals. The highest rated proposals by the panel are awarded research funds.

The goal of the CGP is to produce innovations that have broad usefulness to agriculture (i.e., a national as opposed to a local public good). However, the program has some undesirable effects. Significant research sources are invested in proposal preparation and evaluation, and these come from other resources, for example, "uncommitted" federal formula or state government research funds. Additional transactions costs are imposed when grant awards do not cover the resource cost of completing a "funded" project. Some state directors and research

administrators favor and others disapprove of the direction set by federal competitive funds and the leveraging which these funds often require. In addition, CGP is open to potential rent seeking behavior by scientists and state research administrators, and "peer panels" tend to impose too much homogeneity of approaches or to require too much preliminary research evidence. A socially good national research funding mechanism for research in basic and pretechnology science should not unload the riskiness of scientific discovery on other institutions or funding mechanisms.

State government appropriations are the single largest component of funds for the SAES system as a whole and for most states. The decision-making and administrative process for bringing an experiment station's budget before its state legislature differs across states (see Huffman and Evenson 1993, pp. 221-22). The economic reason that state governments fund SAES research is to produce local public benefits that can only be obtained from a locally on-going agricultural research institution, i.e., there are Iowa-specific agricultural research benefits made possible by having an on-going institution like the Iowa agricultural experiment station. In particular, Iowa clientele cannot expect to obtain the same benefits from research conducted in Illinois, Minnesota, Nebraska, Missouri, Wisconsin or South Dakota. Also, many of the Iowa producers are in direct competition with producers in other states (and countries).

The private sector allocates about 10 percent of its agricultural R&D funds to SAES-vet med school research. These come as research contracts or grants largely for innovations to benefit a private firm or a particular commodity group (i.e., private goods) and not for general social usefulness (public goods). Open sharing of R&D results is seldom in the private sector's interest, and it is generally in the best interest of private firms to seek exclusive rights to

innovations from projects that they fund in public research institutions. With private sector funding of SAES-vet med school research, private sector interests may also redirect public resources (e.g., uncommitted state and formula funds and use of services of publicly paid for fixed capital in research equipment, facilities, plots, and herds) to the pursuit of private interests and greatly change the composition of innovations produced. These issues are emphasized by Huffman and Just (1995) and Lyons, Rausser, and Simon (1996). The long term outcome could be a reduction in the willingness of state and federal tax payers to fund public agricultural research.

### **Some Empirical Evidence**

Although there are a number of theories about effects of funding mechanisms for public agricultural research, the empirical evidence remains thin. We, however, have been working to quantify and test some of these ideas.

We examined the possible effects of changing the funding mechanism for SAES research on its economic impacts/benefits. We (Huffman and Just 1994) tested and rejected the hypothesis that grant, contract, and cooperative agreement funded public agricultural research are equally productive as federal formula and state funded public agricultural research for increasing state agricultural productivity. Our results did not provide any evidence that public or private grant, contract, or cooperative research was more productive than federal formula or state funded research. In particular, increasing the share of federal formula and state funded research increases state agricultural productivity.

To obtain further evidence on the size of transactions costs and the distribution of benefits from research, we participated in a survey of Land-Grant agricultural (SAES) scientists. With these data, we have quantified the size of transactions costs of research relative to total SAES scientists time allocated to research. In 1995, when about 30 percent of SAES funds were obtained from grants and contracts, 28 percent of scientists time was allocated to proposal preparation, proposal evaluation, and communicating with funding agencies an attempting to affect the interest of funding institutions (see Table 2). This left 78 percent of scientist time for actually doing the research. Hence, we judge transactions costs to be a significant issue in evaluating funding mechanisms.

Scientists in the survey were asked to give their *perceived* distribution of benefits from projects funded by state government, federal government, and private industry. For state government funded research, 63 percent of the benefits were perceived as going to clientele in their state, 28 percent to people and groups in other states, and 9 percent to others (see Table 3). For federal government funded research, the distribution as 44 percent to clientele in their state, 40 percent to people and groups in other states, and 16 percent to others. For private industry funding, the distribution was 30 percent to people in their own state, 55 percent to the company providing the funds, and 15 percent to others. Hence, a strong contrast in the distribution of perceived benefits of SAES research by scientists across major funding sources exists, and a relatively large share of perceived benefits of state government funded research goes to local clientele and of private industry funding research goes to the company providing the funding. These results provide additional evidence that shifting the distribution of SAES funding more heavily to private industry will significantly change the distribution of benefits of SAES research.

The motivation of scientists is also important to understanding the consequences of alternative organization of SAES research. Using the survey of Land-Grant scientists, we tested the hypothesis that SAES scientists *perceive* the rewards to (1) contract and grant research and (2) other research (including federal formula and state government funded) to be the same (see Table 4). The types of rewards that were examined were (1) recognition of administrators, (2) professional reputation, (3) personal satisfaction, and (4) increasing your own resources. For both types of research, the reward with the highest rating was "personal satisfaction" and the reward with the second highest rating was "professional reputation." A test of the null hypothesis that the perceived rewards had the same rating could not be rejected at the 5 percent significance level for the first three types of reward. However, for "increasing your resources," the hypothesis of equality of rating was rejected. The reward of "increasing your own resources" received a higher rating for contract and grant research than for other SAES research. Hence, some differences in perceived rewards by SAES scientists exist for contract and grant funded research and for other research support.

Our results and discussion suggest that the reward structure of SAES scientists is not simple, and recent empirical research by Singell, Lillydahl, and Singell (1996) support our conclusion. They examined the allocation (shares) of faculty working time to teaching, research, and service for a random sample of 8,000 faculty in 480 U.S. four-year colleges and universities in 1987. The types of institutions ranged from premier public and private universities to small private colleges. The main conclusions of their paper are that the incentive structure of a university and normal life-stage/cycle position of the faculty play major roles in the time allocation of faculty. Furthermore, the attributes of a faculty tend, not too surprisingly, to reinforce the

primary “mission” of the university at the time that they were hired, i.e., universities tend to select for particular attributes when they hire faculty and these attributes are on average in agreement with the institutional mission. An important implication is that the mission of a university in the past significantly conditions the response that a university can expect from its faculty to new incentives and a new mission in the future.

### **Conclusion**

We have examined some of the alternative systems for funding and conducting agriculture research and their impacts on resource use, benefits, and beneficiaries. The U.S. environment is one of a market economy, gradual strengthening of intellectual property rights to innovations, and a possibly shrinking role of the federal government in funding agricultural research.

Some implications for policy. The private sector should be permitted to carry out research that it wants to with minimal direct competition from the public research institutions. The public research institution should focus on producing advances in general and pretechnology science that ultimately may be complementary to private R&D activities and conduct applied research in areas where the innovations are socially beneficial but no private market exists, e.g., minor crops, food safety, environmental quality. The sharing of the public agricultural research mission between the USDA and state institutions needs re-examining for balance. State agricultural research institutions have a fairly diverse source of funding types, but state taxpayers continue to account for 50 percent of the agricultural research resources. The source of funding and/or the type of funding mechanism does affect the types of benefits/impacts of agricultural research conducted by state institutions. Care is required in managing these resources efficiently and balancing social and private interests.

**Endnotes**

1. See Wright (1983) for general discussion of invention incentives and Alston, Norton, and Pardey (1995) for a review of methods for evaluating impacts of agricultural research.
2. For example, in the 1887 Hatch Act, each qualifying state was to receive annually \$15,000 to help support a state agricultural experiment station. In the Amended Hatch Act (1955), several pieces of federal legislation dealing in funding state agricultural experiment stations, including the original Hatch Act, were consolidated. A new formula or allocation rule was established: 20% of each year's federal SAES appropriate is divided equally among states, 26% is allocated according to a state's share of the farm population, 26% is allocated on a state's share of the national rural population, and 3% is allocated to administrative cost. The legislation also required that 25% of the appropriation be allocated to regional research.
3. In 1995, 69.6% of the USDA-Competitive Grant Awards were to scientists in land-grant universities and half of this total was to SAES scientists.

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Table 1. Distribution (%) of sources of revenue for U.S. state agricultural experiment stations, 1960-1995.

| Sources of revenue                                                      | Year  |       |       |       |
|-------------------------------------------------------------------------|-------|-------|-------|-------|
|                                                                         | 1960  | 1980  | 1990  | 1995  |
| Regular federal funds                                                   | 21.6  | 17.0  | 14.0  | 15.1  |
| Other federal government research funds                                 | 7.6   | 11.4  | 12.1  | 15.1  |
| State government appropriations                                         | 58.2  | 55.5  | 55.0  | 50.5  |
| Private industry, commodity groups and private foundations <sup>a</sup> | 7.0   | 9.2   | 13.2  | 14.0  |
| Other                                                                   | 5.6   | 6.9   | 5.7   | 5.3   |
| Total all sources                                                       | 100.0 | 100.0 | 100.0 | 100.0 |

<sup>a</sup> This is the amount received from industry and "other nonfederal" sources, excluding state appropriations and product sales.

Source: USDA, CSRS and CSREES, Current Research Information System, *Inventory of Agricultural Research*, various years.

**Table 2. Allocation of research time by SAES scientists, 1995.**

| Uses of time                                                  | Share of time (%) |
|---------------------------------------------------------------|-------------------|
| Proposal preparation                                          | 13.4              |
| Proposal evaluation                                           | 5.5               |
| Attempting to affect the interests of<br>funding institutions | 2.6               |
| Communicating with funding agencies                           | 6.5               |
| Doing research                                                | 72.0              |
| <b>Total</b>                                                  | <b>100.0</b>      |
|                                                               | <b>N = 581</b>    |

Source: "Modern Agricultural Science in Transition: A Survey of Land-Grant Agricultural Scientists," University of Wisconsin, 1995.

**Table 3 . Perceived distribution (%) of benefits by SAES scientists from their research funds received from selected sources, 1995.**

| Source <sup>1</sup>   | Clientele in your state or people in your state | People and groups in other states | Company providing money | Other | Total |
|-----------------------|-------------------------------------------------|-----------------------------------|-------------------------|-------|-------|
| 1) State government   | 63.2                                            | 27.7                              | -                       | 9.1   | 100.0 |
| 2) Federal government | 43.8                                            | 39.7                              | -                       | 16.5  | 100.0 |
| 3) Private industry   | 29.8                                            | -                                 | 54.9                    | 15.3  | 100.0 |

<sup>1</sup> Each respondent was asked "For your research funds by (source), what would be your assessment of the distribution of research benefits from these projects across the following groups?" The federal government source reference included Hatch, USDA Cooperative Agreements, and other federal grants and contracts. The private industry source reference included commodity groups, corporations, etc.

Source: "Modern Agricultural Science in Transition: A Survey of Land-Grant Agricultural Scientists," University of Wisconsin, 1995.

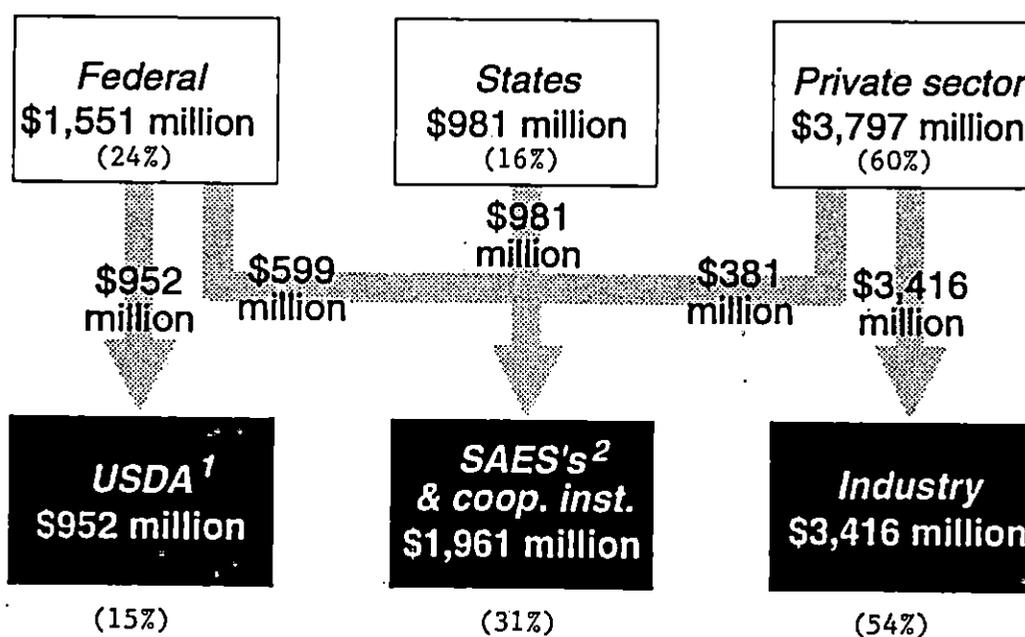
Table 4. Perception of rewards to SAES scientists from (i) contract and grant research and (ii) other research conducted since 1990, 1995<sup>1</sup>

| Reward Type                   | Contract and grant research | Other research | Ho: Equality (5% sign level) |
|-------------------------------|-----------------------------|----------------|------------------------------|
| Recognition of administrators | 3.15                        | 2.94           | not rejected                 |
| Professional reputation       | 4.03                        | 4.00           | not rejected                 |
| Personal satisfaction         | 4.42                        | 4.41           | not rejected                 |
| Increasing your resources     | 3.80                        | 3.26           | rejected                     |

<sup>1</sup> Scientists were asked to rate the importance of each reward type on a scale of 1 to 5, with a 1 being "not important or not needed" and a 5 being "very important or essential."

Source: "Modern Agricultural Science in Transition: A Survey of Land-Grant Agricultural Scientists," University of Wisconsin, 1995.

**Figure 1**  
**Sources and flows of funding for agricultural research in 1992**



<sup>1</sup> Includes research by Agricultural Research Service, Forest Service, Economic Research Service, and National Agricultural Library.

<sup>2</sup> SAES's are State agricultural experiment stations; coop. inst. include the 1890 schools, forestry schools, and veterinary schools.

Sources: Economic Research Service. Data for Federal and State research expenditures derived from USDA, *Inventory of Current Research*; data for private sector/ Industry research expenditures estimated from Klotz, Fuglie, and Pray (1995).