

## *Executive Summary*

### *The Case for Formula Funds: Strengthening Federal Program Funding for State Agricultural Experiment Stations*

The distribution of state agricultural experiment station (SAES) resources has undergone a dramatic shift in recent decades. The share of SAES funding from federal formula funds administered by the USDA--dollars that are allocated to individual states for agricultural research based in part on rural population and farm numbers--has decreased from 16 percent in 1980 to 9 percent in 2000. During that same period, USDA-administered competitive grant funding grew only 2 percent.

Although state appropriations have remained a dominant source of SAES funding, those resources also have declined, from 55 percent of total experiment station funding in 1980 to 50 percent in 2000.

This shift in funding takes place at a time when public officials are increasingly challenged to make the most of every dollar they invest, whether it's in education, infrastructure, welfare programs, or research. A study by Iowa State University and Yale University indicates that further shifting may not be in the best interest of farmers, consumers, or the U.S. economy.

The study noted that between 1970 and 2000, investment of public funds for agricultural research in state agricultural experiment stations at land grant universities contributed significantly to the increase in agricultural productivity, resulting in an annualized return to society of approximately 56 percent.

These benefits of publicly funded agricultural research date back more than a century. One of the landmark success stories occurred in the 1920s and '30s. Public investments in agricultural research and development paid for by state and federal governments led to the hybridization of field corn, a one-time switch from open-pollinated varieties to hybrids and a method for continuing a sequence of new hybrids, which increased yields from 40 bushels per acre then to more than 150 bushels per acre today.

More recently, Iowa State researchers, using the tools of modern molecular genetics, have identified the gene loci for litter size in swine, one of the most economically important traits. They also have developed a DNA test for litter size that farmers can use in breeding. These efforts are revolutionizing the production of swine, with significant impacts on increased farm productivity and economic returns, along with lower food (input) costs.

The returns on publicly funded agricultural research not only benefit farmers and consumers, but the environment as well. In the mid-1990s white flies, a common pest in

cotton, had developed a resistance to nearly all commonly used insecticides. In some areas, growers made eight to 12 insecticide applications per acre per year. Insect-growth regulators developed at the University of Arizona have proven to be safer, cheaper, and more effective, keeping production costs down and dramatically reducing the number of commercial chemical applications during the growing season, thus having a positive impact on the environment.

### **Distribution of Funds**

In 2000, 30 percent of agricultural research was performed in the public sector. Of that amount, 75 percent was conducted by the state agricultural experiment stations, with total funding for state experiment stations of \$2.23 billion. Federal formula funds comprised only 9 percent of this investment in agricultural research and development. At the same time, state agricultural experiment stations have been successful in obtaining non-USDA administered federal competitive grants and commodity check-off funds, along with industry and foundation grants and contracts. However, each of these fund sources comes with expectations that drive the research agenda in areas of interest to the donor, and leave the SAES research director with little say in directing research that might meet local needs.

Using a formal model of demand for research resources, the Iowa State-Yale study finds that as state agricultural experiment station budgets grow (or decline), there likely will be a corresponding large growth (or decline) in federal grant, private grant, and contract funding, and a small growth (or decline) in federal formula funding. The share of state appropriations is not expected to change.

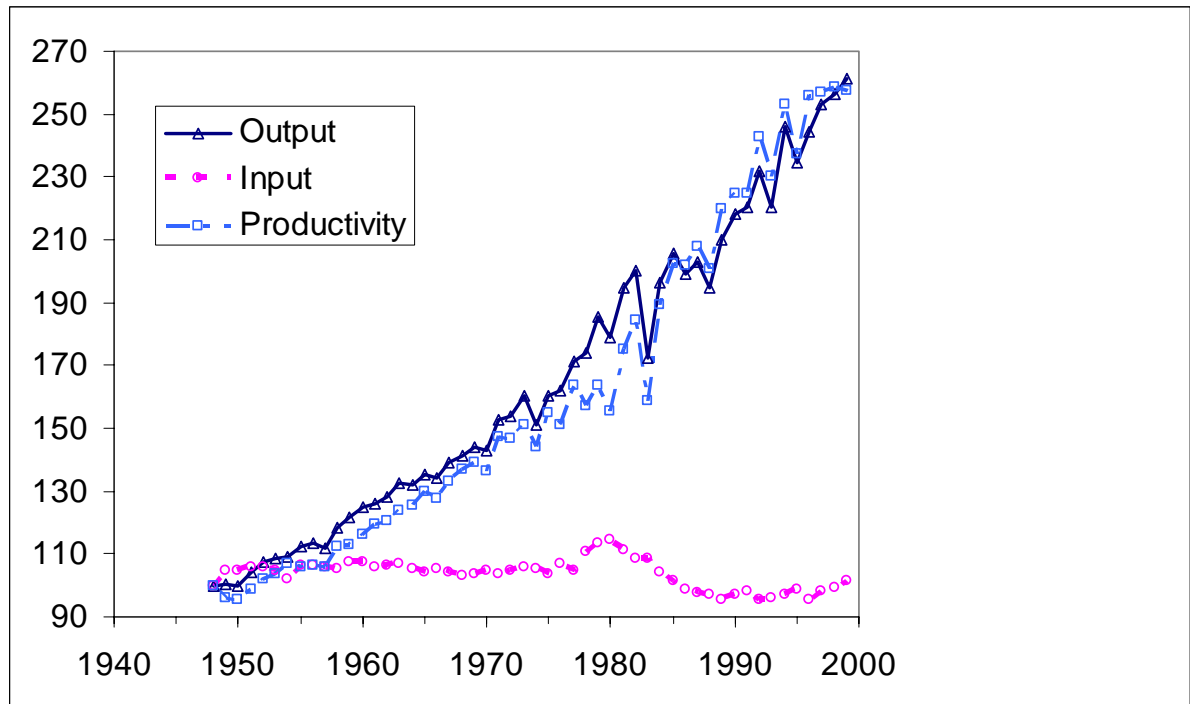
Population and local farm production patterns affect funding. States with a larger share of the U.S. farm population receive more federal grants and formula funds and state appropriations. Those that specialize in livestock, horticulture, and greenhouse agriculture also are more favorably positioned to receive federal support because they produce high-value agricultural products.

Land grant universities cannot always look to private companies to make up the shortfall in research dollars. Private companies are primarily interested in investments in research and development that result in a competitive advantage for products or services, and thus corporate profit. As a result, many areas of investigation that are important to society would be neglected without publicly supported agricultural research. For example, private companies have been reluctant to invest in the development of new varieties of wheat, calling the investment unprofitable because the varieties are not hybrids and the rate of improvement has been slow. However, land grant universities in the Great Plains states, in cooperation with USDA-ARS, have developed a steady stream of new wheat varieties with significant benefits to both producers and consumers.

### **Impact of Research on Agricultural Productivity**

Thanks in large part to public-sector research, total U.S. agricultural output, consisting of all crop and livestock products, grew at an annual rate of 2.1 percent per year from 1970 to 1999 (Fig 1).

**Figure 1. U.S. total farm output, farm input, and total factor productivity, 1948-1999 (1948=100).**



Also between 1970 and 1999, total U.S. agricultural input (including equipment, land, labor, fertilizer, etc.) declined 0.1 percent per year. This has been possible due to rapid technical or productivity change that resulted from public and private research and development.

### **Maintain the Funding Blend**

The current blend of federal formula and state appropriations, as opposed to federal competitive grants, contracts, and cooperative agreements, provides SAES directors with considerable flexibility in using the resources and providing direction for research programs that meet local and regional needs. Directors have the advantage of building reputations with state clientele and their scientists, which tends to increase the efficiency of the public agricultural research organization. Generally, state legislatures expect their land grant universities to spend state appropriations on finding solutions to local problems. Failure of state agricultural experiment station directors to deliver on discoveries needed locally will likely result in a future weakening of state legislative support.

Some officials have suggested reducing federal formula funds for experiment station research. One option is to offset the reduction of federal formula funds with increases in competitive grant programs, although Congress has been reluctant to pursue this scenario. Furthermore, the Iowa State-Yale study shows such a shift would lower agricultural

productivity in general and benefit only five states while reducing funds for the remaining 45. In six states (Kentucky, Massachusetts, New Hampshire, South Carolina, Vermont, and West Virginia) the decline in funding would exceed 10 percent.

When research is funded by federal competitive grants and contracts, the research agenda is set by the funding agency and decisions are based on proposals rather than completed projects. In addition, the federal competitive grants programs do not pay for research proposal writing, so the risk of federal research grant programs is borne by the competing scientists or their institutions and the somewhat distorted incentive structure increases transactional costs, while lowering the scientists' productivity. Furthermore, federal funding agencies tend to fund less than 100 percent of funded research project costs, so other funds, most notably state-appropriated or federal formula funds, are used to subsidize research sponsored from outside the state.

Social scientists have periodically noted that public agricultural research, cooperative extension, farmers' education, private agricultural research, infrastructure, and government all contribute to productivity change. Over the past two decades a number of studies have examined the effect of public investments in agricultural research and development and all have demonstrated a positive and significant impact on agricultural productivity. This is thought to be, in part, because the state agricultural experiment stations have a long-term focus on addressing local problems. As a result, the positive reputation earned through these long-term relationships creates strong incentives for discovery.

### **Conclusion**

Until 1980, 70 percent of state agricultural experiment station funding came from federal formula funds and state government appropriations, both of which are relatively unrestricted. Today that percentage has fallen to about 59 percent. Due to the nature of research, a long lag exists from the initial investment in a project to the time when useful discoveries result. To be more precise, the impacts of investment in public research on agricultural productivity have been shown to have a lag pattern of 9 years of rising impacts, 5 years of high and constant impacts before fading over the next 19 years. It is easy to overlook the important role of timing in public agricultural research. If for some reason, current investments would drop to zero, research benefits would continue for some time, at a reduced rate, but it would be very difficult for future research to ever catch up on past foregone discoveries. Hence, it is critical to maintain or even increase funding for public research, given the large dividends paid on addressing local problems and issues. In research, lost time is difficult to recover.

Furthermore, between World War II and 2000, the prices of food in the U.S. fell by 1 percent per year, relative to other inputs into household production. In the recent past, U.S. agricultural productivity has exceeded productivity in other sectors, so real agricultural output prices have declined. Farmer's benefit when their crop and livestock prices fall less than costs, and consumers benefit from lower food prices. The end result is that continuous and strong public funding of agricultural research and development have paid large rewards to the American economy in improved consumer welfare and the

standard of living for all Americans, while placing U.S. agriculture in a more competitive positions worldwide. The case for increased federal formula funding is strong.