

Purposes of the Agricultural Research and Extension System | 2

Congress has long evinced interest in the effectiveness of the agricultural research and extension system. It has placed particular stress on high-priority national issues that it has previously identified, and on securing research results and applications (outcomes) that address those issues. Accordingly, Congress took the strong step in FACTA of specifying purposes that “[f]ederally funded agricultural research and extension programs shall be designed to, among other things, accomplish....” These purposes are to:

1. “continue to satisfy human food and fiber needs;
2. enhance the long-term viability and competitiveness of the food production and agricultural system of the United States within the global economy;
3. expand economic opportunities in rural America and enhance the quality of life for farmers, rural citizens, and society as a whole;
4. improve the productivity of the American agricultural system and develop new agricultural crops and new uses for agricultural commodities;
5. develop information and systems to enhance the environment and the natural resource base

upon which a sustainable agricultural economy depends; and

6. enhance human health:

- by fostering the availability and affordability of a safe, wholesome, and nutritious food supply that meets the needs and preferences of the consumer; and
- by assisting farmers and other rural residents in the detection and prevention of health and safety concerns.”

In expressing these purposes, the Congress was also careful to note they are “[s]ubject to the varying conditions and needs of States.”

Further, to encourage early implementation of the purposes, the Congressional conference managers stated their intention “that the Secretary establish guidelines to ensure that the purposes expressed. . .are reflected in the priority setting processes for research and extension programs such that projects consistent with these purposes are emphasized and each of these purposes is advanced by the research and extension program in its entirety...[emphasizing]...that it is not their intent that this statement of purposes be used to prohibit any research or line of inquiry.”

Several observations about the FACTA purposes are in order. First, they emphasize agricul-

tural sustainability (both environmental and social) and rural social and economic concerns. This is a new emphasis for the farm bill and for the agricultural research system, even though sustainability has been intrinsic to a number of initiatives during the past 15 years (such as those concerning integrated pest management and water quality).

Second, the purposes embrace explicitly the entirety of the agriculture/food/environment¹ sector. This is a major departure from the previous single-minded emphasis on increasing agricultural production.

Third, the purposes focus on relevance by emphasizing several major contemporary issues in the agriculture/food/environment sector, including environmental and natural resources “upon which a *sustainable agricultural* [emphasis added] economy depends”; economic and quality-of-life issues for rural America; new crops and new uses in relation to productivity of the agricultural system; competitiveness of the food production and agricultural system; and human health, nutritious food, and prevention of health concerns. These issues are further emphasized by individual subtitles and sections of FACTA. For example, subtitle B addresses two central components of sustainable agriculture: sustainable use of environmental and natural resources, and the social and economic quality of life for rural communities. Subtitle G addresses new uses and products, and section 1605 establishes a technology assessment board to relate research results to technology transfer and application. Congress is clearly stressing its belief that federally funded agricultural research and extension programs should be concerned with the entirety of the agriculture/food/environmental

sector, not just the agricultural production and productivity components.

Fourth, the purposes lead to accountability. Congress wants these purposes to be implemented *operationally* as rapidly and fully as possible throughout the federally funded agricultural system, including the state programs that receive federal funds such as the SAES and CE systems. This is illustrated by the conference managers’ specific intention that the Secretary establish guidelines to make priorities consistent with the purposes and to emphasize projects consistent with the purposes. Taking the purposes and the guidelines together, it is reasonable to conclude that Congress is especially interested in seeing useful results from federally funded research, in ensuring that these results be applied to major issues, and in seeing that USDA is responsive to the directions and interests of Congress. In short, Congress wants USDA to be accountable.

Fifth, the context for focusing on purposes has expanded substantially since FACTA was passed. Purposes for the research program are emphasized in at least three additional actions. The Government Performance and Results Act (GPRA), designed to increase the effectiveness of the federal government, also involves research and hence the purposes for research. It further embodies the concepts of targeted goals, expected outcomes, and accountability. The report on research by the Office of Science and Technology Policy, *Science in the National Interest*,² strongly emphasizes fundamental research as it relates to national competitiveness (18). In turn, this relates directly to the agricultural research enterprise. The companion report by OSTP, *Technology for a Sustainable Future*,³ bears directly on the purposes for agricultural research (19). In the past few months, the Under

¹ The term “agriculture/food/environment” sector is used throughout this report. It is an umbrella term that refers to the entire agricultural production system—including inputs, production and activities at the farm and processing levels, and outputs; the associated food production, processing, and distribution system; and the environmental aspects of both.

² See especially the emphasis on basic research, the value of basic research for understanding plant disease infection, and the importance of research for a safe and nutritious food supply.

³ See especially the compatibility between science for environmental remediation strategies and agricultural and environmental research areas.

Secretary for Research, Education, and Economics has presented five emphases for USDA's research and education program that align quite closely with the six purposes for research and the seven criteria for sustainable agriculture established by Congress in FACTA.

IMPLEMENTATION OF THE PURPOSES

The Secretary has not established guidelines for USDA overall, and individual research units have not established them for their programs. However, some actions have been taken with regard to individual agencies.

■ Agricultural Research Service (ARS)

ARS, with about 36 percent (\$679.2 million) of the total federal agricultural research and extension appropriation for FY 1994 (\$1,885.7 million), is a major part of the federal research portfolio⁴ (30). ARS incorporated the FACTA purposes into its six-year implementation plan. The plan also sets forth ARS policies that ensure a focus on the purposes, including operating practices, setting of research priorities, and reward systems. ARS believed it had adequately met the Congressional expectations for the agency to establish guidelines to implement the purposes. However, some in Congress and others outside USDA did not consider the ARS action sufficient. A significant impediment to establishing these guidelines was a lack of clarity concerning what was meant by "guidelines." ARS is now addressing this issue by realigning its program planning, priority-setting, budgeting, project selection, resource allocation, accountability, and reporting systems with GPRA and customer service requirements. Also, ARS is adopting the FACTA purposes as its strategic planning goals and as the basis for stating expected outcomes and performance measures. This process also embodies the five priority research areas established by the Under Secretary for Research, Education, and Economics.

The new ARS strategic plan is expected to be completed in 1996 (15).

Program guidance within ARS means setting performance goals that are measurable and quantifiable, and to use a meaningful and measurable method for pursuing the intent of the purposes without stifling creativity and productivity. ARS is also determining how to prepare an integrated approach for addressing the purposes, the five priorities of the Under Secretary, and the requirements of the GPRA. In addition, there is some potentially very useful work under way to integrate ARS and state agricultural experiment stations (SAES) planning and operations more effectively. This work is discussed further in the following section.

■ Cooperative State Research, Education, and Extension Service (CSREES)

CSREES is the direct successor to the former Cooperative State Research Service. Its principal responsibility is managing and overseeing the federal/state partnership for agricultural research, education, and extension in close collaboration with the SAES, the state cooperative extension services, and the land-grant colleges of agriculture. This partnership was first established through the Morrill Act of 1862, and then effectuated more specifically through the Hatch Act of 1887 (for agricultural research), the Second Morrill Act of 1890 (which aimed to involve the historically black colleges and universities in agricultural research and education), the Smith-Lever Act of 1914 (for extension), and subsequent acts. Because of these extensive research responsibilities and relationships outside USDA, CSREES is the department's principal extramural research agency. In addition, CSREES is responsible for the National Research Initiative Competitive Grants Program (NRICGP), which is USDA's principal extramural, competitive grants agency (see Chapter 3).

CSREES receives about 17 percent (\$325.2 million in the formula and special grants category).

⁴ These and other data in this section are based on requested data of USDA as well as published data.

ries) of the federal research portfolio; it receives another \$103 million for competitive grants. The state land-grant and related institutions that receive these funds play a very large role in the national agricultural research and education portfolio, when all funds are considered: they receive more than \$2 billion from a variety of federal, state, and private sources. Of that figure, \$648.5 million is from federal funds (for FY 1993), and of these federal funds, \$399.0 million comes from USDA. The remainder comes from other federal grant programs, including those run by the National Institutes of Health and the National Science Foundation. Given the small proportion of funding from USDA for state and land-grant partner research and extension, the department plays a significant support, but not necessarily an agenda-determining, role (17).

CSREES has not promulgated guidelines to implement the FACTA purposes. Nor has it done an analysis to determine how relevant the purposes are to the federally funded research projects for which it is responsible. However, because of the long-standing partnership between USDA and the states, and because of USDA's fiduciary responsibilities for these federal funds, which are allocated to the states, CSREES has long taken a strong, active role in planning and managing the funds and in assisting the planning and management of programs funded by them.

This is reflected in actions CSREES has taken, and is initiating, that relate directly and indirectly to the purposes and guidelines of the research title. First, instructions have been sent to the directors of the SAES and State Cooperative Extension programs requesting that their federally funded programs be consistent with the purposes. Second, the purposes have become central to several aspects of research planning and collaboration. For example, a strategic agenda for CSREES-related extramural research programs is being prepared consistent with the purposes. Third, the SAES Strategic Planning Committee is interested in using the same general areas of the ARS six-year plan for its own strategic plan-

ning. If this takes place, the relationship between SAES and ARS planning has the virtue of establishing planning and programmatic relationships between two central elements of USDA's research system—which in turn provides a significant opportunity for programmatic integration and collaboration that has heretofore not been possible. Fourth, the four regional associations of SAES directors are in process of setting priorities for regional research programs. Fifth, to bridge gaps between program and purposes, an effort is under way to bring together strategic planning for the state system and CSREES, to provide a common response to the GPRA. And sixth, attention is being given to linking outcomes, and performance indicators for them, to the purposes.

If this system can be established and operated, ARS, the SAES, and the extension systems could jointly establish major outcomes (to meet the FACTA purposes and address key national issues) and identify the performance indicators (and hence the programmatic work) necessary to achieve the outcomes. Such a move would augur well for a more integrated system and focus attention on outcomes and performance. Present plans are to focus on a set of major issues of national concern.

■ National Research Initiative Competitive Grants Program (NRICGP)

The NRICGP accounts for about 6 percent (\$103 million) of total federal funding for agricultural research. The NRICGP staff have included the FACTA purposes in their program announcements. The instructions to applicants for NRICGP grants, and to reviewers, make it clear that all research funded by the NRICGP must be relevant to the long-term sustainability of agriculture. Further, the NRICGP has evaluated its research grants to determine the extent to which they meet the purposes established by Congress. All of the research is believed to apply directly to those purposes. Chapter 3 on the NRICGP provides additional information and perspective.

■ Economic Research Service (ERS)

The research of ERS totals 2.9 percent (\$55.2 million) of the federal funding for agricultural research. Virtually all of it is allocated for intramural studies. No evident actions have been taken to directly address the Congressional purposes.

■ Forest Service (FS)

The FS research budget comprises about 10 percent (\$193.1 million) of the total agricultural research budget. Virtually all of this is spent intramurally. No evident actions have been taken to directly address the Congressional purposes.

Clearly, guidelines to implement the Congressional purposes have been established in a haphazard fashion. More certainly could have been done. However, the real issue is to what extent the purposes have been met. Given the constraints of this study's design and duration, it has not been possible to make an analytical determination of the extent to which the purposes have been met, or to what extent the emphases for federally funded agricultural research have changed. Some changes have obviously occurred. One good example is the increased emphasis on sustainable agriculture throughout USDA's programs and activities. Specifically, all competitive research grants administered through the National Research Initiative Competitive Grants Program (also authorized in FACTA) must be relevant to the long-term sustainability of U.S. agriculture, in addition to being of high scientific merit.

Rather than focusing on the reasons why guidelines were not established, the next section addresses the key issues of relevance and accountability in terms of the characteristics and context of the research enterprise, and in terms of how Congress' intentions might be put into action.

RELEVANCE AND ACCOUNTABILITY: KEY CHALLENGES AND PERSPECTIVES

In the purposes for the research title of FACTA, Congress clearly gave high priority to relevance

and accountability for the federal agricultural research and extension system. Implicitly, Congress expressed its dissatisfaction with the lack of attention given by the system, at least prior to 1990, to major issues affecting the nation's agricultural and food system, including the vitality and quality of rural communities and economic life.

The way Congress chose to focus on relevance and accountability was by setting out six purposes for the federally funded agricultural research and extension programs and by asking that USDA guidelines be promulgated to ensure that the purposes would be implemented. Both purposes and guidelines are essential first steps. But a number of questions arise: Are purposes and guidelines sufficient? Are they optimal approaches? Why has there been only limited implementation to date, and what are we to make of it? And how can the future be considered?

Altering the direction and management of research and application—in this case, to achieve certain purposes and ensure accountability—is a challenge under any circumstances. In meeting this challenge, a number of contextual factors and characteristics intrinsic to any research enterprise must be considered and dealt with. Some of these include (i) duration and momentum of research; (ii) the importance of purposes and guidelines, and their limitations; (iii) context and characteristics of the agricultural research system itself; (iv) the dichotomy of top-down versus internal direction.

■ Duration and Momentum of Research

Research has a long-term flow, and it cannot be abruptly stopped and started without sacrificing results and progress. Scientists and their managers are understandably loath to waste resources and time in a start-stop, start-change way, particularly given the long investment and start-up times usually demanded by good research. Thus, there is a built-in lag in conversion from one research direction to another, and significant transition times are often required.

■ Purposes and Guidelines: Importance and Limitations

Specifying purposes for a research enterprise is important. Guidelines for efficacious management to achieve the purposes are appropriate. Good management requires both. However, no matter what their specific intentions and how well intended, purposes and guidelines must inevitably be written broadly. Such broad directives ensure that opportunities to explore the full dimensions of a topic are not lost, and provide for individual creativity and innovation. With regard to agricultural research, purposes and guidelines could address a range of issues: much of traditional agricultural production, productivity, and cultural practices research fits with sustainable agriculture, and much of the entomology, plant pathology, and pest management research fits with biological control of pests. It would not be difficult for individual investigators and managers to believe, accurately to them, that their current work and future directions fit well within such purposes and guidelines. However, others outside the research system may not believe that such broad interpretations adhere sufficiently to stated purposes. There is the very real possibility of unproductive confusion and even contention.

■ Context and Characteristics of the Current Agricultural Research System

For the agricultural research system—broadly defined—there are a number of key contextual factors that bear directly on the efficacy of purposes and guidelines.

First, the system is highly decentralized and multifaceted, incorporating a number of major research agencies. This decentralization, both inside and outside USDA, is an impressive feature of the system. It also makes adhering to centrally established purposes and guidelines difficult at best. Further, the land-grant research partners are major participants in the federal agricultural research system. They receive their funding from state, private, and other sources, in addition to federal funds (which are usually only

a small fraction of their research budgets). These diverse funding sources from outside the federal government add to the complexity of this decentralized system.

Second, appropriations for USDA (\$1,885.7 million) are less than one-half of the overall funding of the agricultural research system. It is not obvious that the small fraction of federal funds in the state and land-grant partners research programs can have a predominating influence on those programs, both because of the amounts and also because of the longstanding discretion accorded state and land-grant research and extension program managers.

Third, the agricultural research and extension system is to a large degree user-based. Both traditional and more recent user and stakeholder groups have a deep, longstanding claim on the system. Any efforts to transform so that it adheres more closely to purposes and guidelines must also take into account the need to transform user and stakeholder expectations.

Fourth, there is an unusually broad array of functions intrinsic to and embedded in the federal agricultural research and extension system. These functions range from the most basic research (such as genome studies, mathematical biology, and secondary products of plant metabolism) to the most applied and developmental studies (such as testing and applying of new design and manufacturing principles for devices, machines, and products). Furthermore, the applications function is embedded strongly in the cooperative extension system, which itself is closely attached to, and often inseparable from, the research function. This “ingrained intimacy” of function is one of the exceptionally strong attributes of the agricultural research system. It also tends to thwart efforts to adhere to purposes and guidelines and other management directions.

Fifth, just as the functions extend across a broad range, so do the disciplines involved in the agricultural research system. They range from fundamental molecular and cellular biology, mathematics, chemistry, and physics to ecology, environmental biology, and soil and geosciences to the classically agricultural disciplines for the

plant and animal sciences, including the pest protection-oriented disciplines. Meshing all of these disciplines to align with purposes and guidelines is difficult, at best, absent a guiding construct that involves them meaningfully in specific directions.

Sixth, the planning system for the agricultural research system is a combination of planning for the intramural research agencies (such as ARS, ERS, and FS), the extramural competitive grants program (the NRICGP), and the extramural agencies (such as the state agencies and land-grant partners). Program planning for the first two has traditionally been more directed as to areas, program focuses, and resource allocation than the last (the state and land-grant partners). This befits the relative autonomies of the three parts. However, even the planning for the state and land-grant partners is more planning for emphases for funds acquisition (which is centralized through USDA's budget) rather than for fund allocation (which is decentralized at the state and land-grant levels). This basic dichotomy does not encourage program planning consistent with federal purposes.

■ The Dichotomy of Top-Down Versus Internal Direction

A serious organizational challenge is whether efficacy in research best comes from top-down direction or from internal direction. Top-down direction of a research program, such as established by purposes and guidelines, is necessary but not sufficient. Although it may be satisfying to managers, top-down direction is less than optimally effective with scientists who are primarily self-motivated. Alternatively, internal direction can run the risk of flowing slowly over time to projects that, while interesting, may be neither important nor contribute to overall purposes and goals. A creative combination of the two approaches is most appropriate.

Given this array of context and characteristic for the research enterprise, the challenge then becomes how best to encourage and reinforce the direction of research and application consistent

with the purposes of FACTA. The key issue is philosophical, and it strikes to the very heart of the successful research enterprise:

To what extent should a central research management agency, the Department [USDA] in this case, specify or write guidelines as to how and on what major research and extension is to be done ("top down" direction) as contrasted with the extent to which scientists and appliers/ extenders should be provided incentives and encouragement so they can choose their own directions within established policy parameters ("bottom up" direction)?

The aim must be to set up a system of clear directions—coupled with strong, attractive *incentives and benefits* for the participants—that *empower persons* to work toward established goals. One caveat must be that research programs need to be based on and suffused with fundamental research providing foundational knowledge, and with the opportunity and encouragement to stimulate creativity and innovation, no matter where they may lead.

APPROACHES TO ACCOMPLISHING PURPOSES

Different approaches can be considered for meeting the purposes established by Congress. One approach is for the research and extension enterprise to continue as it has been. Given the strength of Congress' conviction that change is desired, the status quo would not seem to meet Congress' agenda.

A second approach is to adjust and modify the current programs in the belief that continuous improvement, always laudable, is sufficient. Given the intentions and interests of Congress, this also seems insufficient.

A third approach, intended by Congress, is to establish guidelines to encourage and guide pursuit of the purposes. Such guidelines could and should include a number of useful and valuable mechanisms, such as creating program plans and convening program performance reviews that address the elements of the research enterprise overall and also the key dimensions established

in the purposes; using review and approval systems for new projects that would encourage or require adhering to the purposes; and making hiring and resource allocations based on the purposes. Even though such guidelines involve top-down direction, they are also good management practices. However, if there is not a clear structure of priority and direction within which these guidelines are implemented, then much of this emphasis will be for naught. More than guidelines is needed.

A fourth approach is to establish a clear set of operational program goals and objectives within a strategic context. Operational goals and objectives are necessary to guide specific decisions. A strategic context is necessary to ensure adequate long-term direction and to identify and secure the roles and opportunities for participation from all participants in the agricultural research and extension enterprise. This approach also has top-down characteristics, but it has the distinctive value of establishing priorities, and providing financial incentives that reflect a broad, societal view. It has the disadvantage of being forced on an organization with its own pre-existing momentum and culture, and with slow and long response times.

For this approach to be optimally effective, it is essential that goals and objectives within a strategic context be established through direct involvement, and ultimate concurrence, of major programmatic leadership from the scientist-applier/extender community. Scientists and appliers/extenders should be directly involved in developing the plans and guidelines to be used. They will then have the maximum opportunity to understand, be acclimated to, and provide their own perspectives on how to achieve the most efficacious response.

This approach makes a key contribution by providing a comprehensive basis for making allocation decisions that support the purposes and provide incentives for participation in the necessary research. If resources are not applied to priorities, the exercise is hollow. Guidance language for this decision process can be general and provide for internally directed responses.

Alternatively, it can be more tightly drawn and focus more attention on key issues and topics. Each approach provides for internalized incentives—that is, scientists can make their own decisions about participation. Focusing attention and commitment has the advantage of effecting more rapid change.

Unfortunately, given the highly decentralized and variegated nature of the agricultural system, it is unlikely that such a broad, comprehensive approach can be fully effective, at least in addressing key contemporary issues of the kind Congress has emphasized. Something more is needed.

A fifth approach addresses both the operational and strategic planning requirements outlined above, while emphasizing key contemporary issues. This approach can create “unified strategic research and applications/extension plans” for key contemporary issues of major national interest. The plans would be both strategic (focusing on what direction, how different parts of the system participate, with what expectations) and operational (focusing on how resources are deployed and for what purposes). This approach combines breadth of scope and thinking—of inclusiveness of the entire research system—with the specificity of focusing on pressing national issues.

Strategic plans focused on key contemporary issues (for instance, one plan per issue) would outline (and specify to the extent possible) the applications and associated information and knowledge needs useful for addressing the issues, identify the sources and means for securing those needs and resulting applications, and propose the best form for applying the knowledge to address the issues. All elements of the agricultural research portfolio, and the extension and application agencies as well, would have identifiable roles and responsibilities in these plans. To the fullest extent practicable, the agencies would be integrated and coordinated with one another to achieve optimal leverage of resources and cost-effectiveness. This approach is further addressed in the chapter on the

National Research Initiative Competitive Grants Program.

An obvious advantage of this approach is that respective roles and responsibilities for national issues would be clear. Possible shortcomings of this approach are that it smacks too much of central planning and direction, and predicts in advance what should be done to achieve success. The latter is useful when technologies and methods are ready to be applied or can readily be developed. It is rarely useful—and is, indeed, usually counterproductive—in the research enterprise. The former can be done with prudent, careful, nonobtrusive coordination combined with some financial resources.

These last two approaches go beyond stating purposes and establishing guidelines. They address the central issue: guidance for allocating funds. If funds are not allocated to priorities, it is not entirely possible to plan and posit direction.

A sixth approach is to expand significantly the concept and practice of competitive grants programs to address the major issues of interest. Competitive grants focus attention by rewarding high-quality ideas with funding that attracts strong, active researchers. Indeed, the record from the biomedical research arena shows that such grants have garnered unusually strong and long-term attention from top scientists. A major virtue of competitive grants is that they are probably the most effective mechanism for securing rapid response and alignment of direction and purpose with scientist interest *and* they do it in a manner consistent with the principles that ani-

mate the best scientists—pursuing their own intellectual directions in their own way. A problem with competitive grants is that they are not long enough for scientists to complete a full body of work to address a problem. They also do not usually provide for the long-term work on biological systems that is often required for agricultural, environmental, and ecological topics. In spite of the oft-voiced frustration of scientists that “grantsmanship” and the repeated preparation of proposals takes too much time, the careful refinement of ideas within a competitive environment should improve research direction and conception. Notwithstanding some obvious deficiencies with competitive grants, they are an attractive approach for addressing major contemporary issues.

A seventh approach is to incorporate an accountability mechanism into guidelines, so that management and outcomes can be evaluated in a regular, ongoing, systematic manner. The guidelines would outline and/or describe how accountability and relevance are to be measured and evaluated. The emphasis would be on after-the-fact evaluations, most usefully in connection with future allocations of funds and other resources. They would complement evaluations made at the outset of research.

Each of these approaches have their advantages. Combining them preserves the advantages and obviates the disadvantages. Thus, as a prospectus for the future, each of these approaches should be used and combined appropriately into an overall program.