

National Research Initiative Competitive Grants Program 3

Congress in FACTA authorized the National Competitive Research Initiative (known generally as NRI, but in USDA as the National Research Initiative Competitive Grants Program, or NRICGP). This pivotal action affirmed Congress' commitment to funding research for foundational knowledge through competitively awarded grants that would be initiated by researchers and reviewed by their peers. Such a commitment to competitive grants for USDA was first made in 1978, when Congress authorized USDA's Competitive Research Grants Office (CRGO), and appropriated \$15 million to start the program. The basis for the CRGO was due, in large part, to findings from the 1977 OTA report *Organizing and Financing Basic Research to Increase Food Production* that pointed out the need for a significant focus on basic research for agriculture (28).

Through FACTA, Congress expanded the competitive grants program and specified six high-priority research areas for NRICGP: plant systems; animal systems; nutrition, food quality, and health; natural resources and environment; engineering, products, and processes; and markets, trade, and policy. These six areas encompass virtually all topics relevant to the knowledge and research needs of the agriculture/

food/environment sector. To implement NRICGP, funding was provided for the first four areas in FY 1991 and for the last two areas in FY 1992. Consequently, there is now funding for competitive grants across the entire agriculture/food/environment spectrum. Congress also strengthened the peer-review and advisory oversight of the program; authorized funding for multidisciplinary research; authorized research on long-term mission-linked research problems and provided for developing the research capacities of institutions and individuals. The basis and the specific provisions for this program were derived to a large extent from the 1989 report of the Board on Agriculture/National Research Council (BA/NRC), *Investing in Research* (5).

The purpose of NRICGP is to provide the basic knowledge necessary to discover new principles and to serve as the basis for applied- and problem-oriented studies, just as fundamental research sponsored by National Institutes of Health (NIH) provides new principles and serves as the basis for applied studies and clinical work in the biomedical and health sector. Such "foundational knowledge" addresses the basic characteristics and interactions among biological, physical, and social phenomena—which, by their

nature, are generic and broadly relevant as the foundation for more applied studies.

Both the BA/NRC report and the Congressional language of FACTA also speak to “mission-linked research.” This research is composed of those studies—basic and applied—designed and carried out to make early connections to applied topics. This research was included in the original BA/NRC report to provide a place for studies that are more closely connected to mission applications, generically national in impact, and also have characteristics of fundamental studies providing foundational knowledge. They were included to strengthen the continuum from foundational knowledge to more applied studies. As another means for connecting the foundational research to application, the BA/NRC report specifically speaks to applications experts, including Cooperative Extension specialists, being involved in this mission-related research and in the related multidisciplinary research to allow for easier technology development, transfer, and application.

Like other federal extramural basic research programs, NRICGP specializes in proposals that are initiated by investigators and evaluated by peer review (also termed merit review) to assess their scientific quality and relevance to high-priority areas in the agriculture/food/environment sector. Only proposals that are relevant to the sector are funded through competitively awarded grants based on merit.

Congress specified in FACTA that NRICGP must allocate its funds so that mission-linked research is at least 20 percent of NRICGP (which means that fundamental research may comprise up to 80 percent of the research); multidisciplinary research is at least 30 percent of the program by 1993; and research and education strengthening is at least 10 percent. These requirements are extraordinarily strong, and

appropriate, for multidisciplinary research because of the multifaceted scientific dimensions of key research questions relevant to the agriculture/food/environment sector. The requirements further strengthen the intention of Congress that fundamental research is to be relevant to the major issues in the sector. The fact that up to 80 percent may be fundamental research emphasizes the urgent need for a wide range of foundational knowledge. In fact, if foundational knowledge were to be deemphasized, much of the value of NRICGP would be diminished or even lost.¹

NRICGP IN RELATION TO USDA'S RESEARCH PORTFOLIO AND THE FEDERAL EXTRAMURAL RESEARCH SYSTEM

NRICGP contributes significantly to and fits well with USDA's overall research portfolio as well as with the federal extramural research system. (“Research portfolio” means the several agencies and funding mechanisms within USDA that are responsible for research and their research programs.) The portfolio contains the *intramural* research programs of the Agricultural Research Service (ARS), Economic Research Service (ERS), and the Forest Service (FS). The portfolio also contains several *extramural* programs. A major component of these extramural programs is the partnership between USDA and the State Agricultural Experiment Stations (SAES), as well as the 1890 colleges, for conducting state- and college-initiated agricultural research. This research is funded by so-called formula funds—Hatch, Regional Research, Evans-Allen—that are allocated to SAES and the 1890 colleges. Another component of the portfolio is the program of special grants to support national and regional (and sometimes more local

¹ There is, of course, always a need for more mission-oriented research. However, there are a number of mechanisms and funding sources for mission-oriented research, including ARS, both federal and state elements of the SAES system, and private sector sources. NRICGP is the only mechanism and funding source that aims for foundational knowledge. It is reasonable to emphasize this focus, rather than sacrificing it to other focuses that are already emphasized by all other parts of the agricultural research enterprise. This contention is discussed further in the next section and in a later section.

and site-specific) research topics. In general these funds, too, go to SAES and 1890 colleges. Cooperative agreements and contracts are also available, usually between SAES and 1890 colleges with units of USDA.

NRICGP holds a distinctive place in USDA's overall research portfolio as a consequence of its emphasis on foundational knowledge and its openness to all qualified scientists. Other elements of the portfolio emphasize intramural research (ARS, ERS, and FS) and a combination of fundamental and applied research conducted largely in an intramural manner (the SAES system). NRICGP's role with regard to the agriculture/food/environment sector may, in fact, be compared with the role that NIH's extramural research program plays in relation to the biomedical and health sector. NRICGP may also be compared with the National Science Foundation (NSF) as a place for the nation's scientists involved in the biogeochemical, biological, environmental, and engineering sciences.

NRICGP fits well with USDA's programmatic issues. Its research applies throughout USDA's overall program, by virtue of the comprehensive coverage of the agriculture/food/environment sector afforded by the six priority research areas. It also fits well with contemporaneous issues such as sustainable agriculture and agricultural systems, water quality, global climate change, and genome studies, as evidenced by the incorporation of these research needs into its portfolio.

NRICGP provides distinctive advantages to USDA's overall research program. First, the competitive grants program of NRICGP is the major, often the only, means for federal funding of *any* qualified scientist—irrespective of institutional or disciplinary affiliation or local academic or research unit—to work on topics of direct interest to the agriculture/food/environment sector. This makes it possible for all qualified scientists with relevant research ideas to compete for funds and, if the funds are awarded, to participate in USDA's—and the nation's—research mission for agriculture, food and the environment. Second, because competitive

grants are for limited periods of time, they provide a strong, responsive mechanism for addressing priority topics and they provide major flexibility in focusing on national needs and priorities. Third, NRICGP provides a distinctive mechanism for research to complement formula- and state-funded state research and the long-term intramural research of USDA's agencies. NRICGP thus serves diverse national needs, along with USDA needs.

Funding for NRICGP has increased from \$46 million in 1985 (3.5 percent of the total USDA appropriations for research and education of \$1318.7 million) to \$103.1 million in 1995 (5.4 percent of the total appropriations of \$1,900.7 million). Irrespective of the rate of increase of funding for NRICGP in 10 years, the funding level is still only a small fraction (about 6 percent) of the total USDA research and education (and extension) budget.

Just as NRICGP provides a distinctive component in USDA's research portfolio, it also provides a distinctive contribution to the federal system for extramural research. The federal extramural research system has a number of components, depending on the agencies involved. It operates through several different, usually complementary mechanisms including: (i) investigator-initiated, competitively awarded, peer-reviewed grants; (ii) cooperative agreements; (iii) contracts; and (iv) major institutional relationships such as between universities and the Department of Defense (DOD), Department of Energy (DOE), National Aeronautics and Space Administration (NASA), National Oceanic and Atmospheric Administration (NOAA) laboratories and, of course, USDA. Among these agencies, competitively awarded grants to support investigator-initiated research are an especially important component of the federal extramural research system. This is the predominant mechanism used by NSF, to a large degree (about 80 percent) by NIH, and significantly by other agencies such as the Environmental Protection Agency (EPA) and DOE. They provide the most open access to research opportunities for scientists throughout the country,

regardless of institutional or disciplinary affiliation.

A key effect of Congress' reaffirmation of competitive grants for agriculture and expansion of CRGO to form NRICGP was to make it a more integral and significant participant in the overall federal extramural, competitive grants system long characterized and dominated by NSF and NIH. Valuably, Congressional actions make NRICGP—and USDA's mission—much more attractive to scientists outside the traditional agriculture research sector, just as the NIH program is attractive to scientists outside the biomedical sector. It thus provides for the widest participation of qualified scientists, irrespective of whether they come from the SAES system or from laboratories not at all associated with colleges of agriculture. All of this is appropriate and should, in the long run, provide the best science to help ensure the competitiveness and sustainability of the U.S. agriculture and food system.

IMPLEMENTATION

A number of key steps to implement NRICGP have been taken. These include (i) reflecting the FACTA purposes in the program's description; (ii) establishing key advisory mechanisms, including potential positive relationships between foundational knowledge and technology transfer; (iii) consulting broadly and regularly with user groups and stakeholders; (iv) collaborating with related federal agencies and research leaders; (v) taking steps to make the program more attractive to investigators by increasing the amount and duration of grant awards (for details, see a later section); and (vi) managing the program effectively and efficiently.

■ Purposes

The purposes specified by Congress for USDA's research are prominent in the program description for NRICGP, which "requires that research supported by NRICGP address, among other things, one or more of the...purposes." The guidelines to implement the purposes—sought

by Congress through the conference report for FACTA—are considered to be the specific program descriptions, priorities, and research areas presented in the annual program description.

■ Advisory Mechanisms

A three-part advisory system has been established for NRICGP. For its part, USDA has established NRICGP's board of directors. It is chaired by the Under Secretary for Research, Education, and Economics and composed of the administrators of ARS, CSREES, and ERS, the Deputy Chief for Research of the FS, the director of the National Agricultural Library, and the chief scientist of NRICGP. The board establishes internal operating policy for NRICGP, including approval of the annual program description and request for proposals. The board has the added advantage of integrating USDA's research agencies—especially ARS, ERS, FS, and the CSREES—more closely with the program.

The National Research Initiative Competitive Grants Scientific Advisory Committee is authorized through a USDA regulation. A similar committee was established for the predecessor Competitive Grants Program, starting in 1978. The purpose of the committee is to provide recommendations on the scope and focus of the programs carried out by NRICGP to meet the goals and mandates of Congress. The committee may also advise the Secretary on NRICGP regarding matters such as programs, policies, priorities, operating procedures, and desirable corrective actions needed. The committee is to comprise twelve scientists broadly representative of the disciplines and research areas of NRICGP, and its membership is selected by the administrator of CSREES and approved by the Secretary of Agriculture (through the Under Secretary for Research, Education, and Economics) and by the White House.

The regulation provides for the committee within the limits authorized for USDA, and it requires the committee to be reauthorized by USDA every two years. The committee first met in August 1992. However, it was not reautho-

rized in January 1993 after its first two-year term. After a hiatus, the committee was reauthorized in 1994. The chief scientist has now identified candidates for the 12 positions, including two alternates, and made recommendations for the committee. Although the reactivation and forthcoming appointments are commendable, this kind of hiatus is unacceptable. There is no obvious substantive reason why the committee is subject to recurrent two-year authorization by USDA. A distinctly preferable system would be to have the committee authorized indefinitely, with provision for its termination for cause. Further, its members should be appointed on a “rolling basis,” with staggered three-year terms to provide for overlap of membership and consequent continuity.

The third advisory relationship was established by Congress through FACTA, consistent with its interest in technology development and transfer. Congress provided that the Secretary “may consult with the Agricultural Science and Technology Review Board, established by Section 1605 of the Title, regarding policies, priorities, and operations” of NRICGP from the perspective of technology evaluation and transfer. This consultation has not been done to date, in part because this board, formed in September 1992, has focused on its own mandated responsibilities (2, 24).

As the relationship between foundational knowledge and technology assessment function is contemplated, caution is urged in expecting too many direct relationships between results from research funded through NRICGP and technology transfer more generally. Technology transfer² is an intrinsically difficult matter. In relatively rare instances, the technologies derive directly from fundamental research. Generally, technology transfer occurs most readily and often from the more applied, developmental research that characterizes other parts of the USDA’s portfolio. The purpose of NRICGP is to

furnish the foundational knowledge that makes possible this applied and developmental research. Nonetheless, the relationship between the board and NRICGP should be made as expeditiously as possible.

■ Stakeholder Relationships

In organizing NRICGP, USDA has been consulting with outside groups, including commodity organizations, senior representatives of scientific societies, and advocates of sustainable agriculture. For example, USDA convened Users Workshops in FY 1991 covering seven different subject areas and in FY 1993 covering nine subject areas. In the process, there were consultations with more than 200 industry, scientific, and related user groups and stakeholders. In addition, USDA focused specifically on concerns that sustainable agriculture, and particularly its social dimensions, were not adequately represented in NRICGP’s first program solicitations (7). These concerns were relevant because (a) funds were limited in the start-up appropriation for FY 1991; and (b) the social science and rural development components, both important for sustainable agriculture, were not funded by Congress until FY 1992. Item (b) has been addressed. Currently, there is significant funding awarded for grants that are directly applicable to these areas (such as \$14.7 million in FY 1994 for sustainable agriculture), in addition to much of NRICGP portfolio which is also relevant to them. Also, the program staff gave specific attention to stakeholders in sustainable agriculture, meeting regularly with them and including at least one representative in each workshop.

There is obviously value in sustaining the ongoing connection between NRICGP major user and stakeholder groups through these workshops and the scientific community through the Scientific Advisory Committee. Both should be firmly established as features of the program and kept in continuous use.

² For a discussion of agricultural research and technology transfer policies, see *Agricultural Research and Technology Transfer Policies for the 1990s*, Office of Technology Assessment, U.S. Congress, 1990.

Collaboration with federal agencies. A key, productive part of implementation of NRICGP has been its collaboration with related federal agencies. Because of its purpose and method for providing rigorous peer review, NRICGP is a major participant, along with other agencies, in several significant interagency programs and has established positive rapport and regard among related federal extramural granting agencies. These interagency programs include the Plant Biology Program; the Global Change Program; and *ad hoc* discussion groups of mutual, multi-agency interest such as plant molecular biology and microbial physiology. For example, USDA together with DOE and NSF established by cooperative agreement in 1992 the Joint Program on Collaborative Research in Plant Biology. NRICGP, along with DOE and NSF, provides the merit review of research proposals for the program.

This collaborative approach continues. For example, in FY 1995, a new program on Terrestrial Ecosystems (TECO) was established jointly among NRICGP, DOE, NASA, and NSF. In the collaborative Global Change research program, USDA has the lead responsibility for establishing the UV-B monitoring network. NRICGP is specifically responsible for funding development of the sensitive instrumentation required. There have been recent discussions among NRICGP, DOE, and NSF about mapping the entire genome of *Arabidopsis*, a plant widely used in fundamental plant biology research.

There are also several collaborative programs between NRICGP and USDA agencies. For example, for USDA studies on the plant genome, ARS and NRICGP collaborate, with NRICGP being the lead agency for merit review of proposals. USDA has a memorandum of understanding with EPA and the Food and Drug Administration (FDA) regarding integrated pest management (IPM), and NRICGP's responsibility is providing relevant foundational knowledge. Further, NRICGP programs relevant to IPM are closely coordinated with other IPM programs in USDA (22). Regarding water quality, there is a joint program between NRICGP and the special grants water quality

program in CSREES, with each partner providing one-half the funding. The program is administered by a single scientist.

In all of these examples, NRICGP's chief scientist and program directors and their counterparts in other agencies—such as NSF, NIH, EPA, and DOE—have collaborated to discuss areas of mutual interest, determined how to create a unified program among the agencies consistent with the separate agency missions, and determined the best strategies for collectively funding qualified proposals. The directors of these agencies also jointly consider the effectiveness of the administration of their peer review procedures. These collaborations provide for greater effectiveness within the overall federal effort in these research areas of interest to two or more agencies, and the partnerships that result provide substantial leverage of funds and interests of the agencies.

The value of these collaborative programs is that they provide for larger grants, often required for success in these subject areas; permit significant training components to be done concurrently with the research, thereby providing additional leverage and value of funding; and allow networking to develop work among scientists that would otherwise be forgone (22). These advantages would be difficult or impossible to attain with single-agency approaches. The effectiveness of these collaborative programs is significant, as judged by NRICGP program staff and as shown by the continued development of these programs.

These relationships of NRICGP with related programs of other agencies, and of USDA, are commendable and should be sustained and expanded as opportunities occur.

Ensuring the program's attractiveness and usefulness for research scientists. A crucial aspect of implementing the program is providing sufficient funding for individual awards to ensure the program's attractiveness and utility. CRGO suffered substantially from having too little funding for too many high-quality requests. In an effort to provide at least some funding for a broad spectrum of proposals, the level and dura-

tion of funding for individual grant awards was substantially less than for either NSF or NIH. This disparity between CRGO (and also NRICGP more recently) and cognate programs in NSF and NIH, for often equivalent kinds of research, hindered the attractiveness of the program to scientists. As funding for NRICGP has increased, USDA has endeavored to increase the amount of awards and lengthen their duration, making the program more attractive to the best scientists and providing for more coherent research programs. However, the relative insufficiency of funds makes it difficult to realize this goal in any significant way. (Because of the importance of this issue, it is discussed in more detail in a later section.)

Internal management of the program. The internal management of NRICGP is comparable to that of the highly successful NSF and NIH extramural grants programs, and the program's staff have regularly sought advice from those programs to supplement their own experiences. Panels of scientists with demonstrable stature in their fields evaluate and rank the proposals in terms of scientific quality and relevance to the long-term sustainability of agriculture (broadly defined). The scientists are apprised, as part of their instructions, of the importance of research for sustainable agriculture and the "relevancy criterion" that all research must be relevant to sustainability if it is to be eligible for funding.

The panels provide their advice on quality and relevance to the chief scientist through the program officers, who make the funding decisions based on funds available. The chief scientist gives final approval. All proposals within a program area—irrespective of whether they are single- or multidisciplinary, mission-linked, or research strengthening³—are evaluated by a single panel of scientists who themselves represent a range of disciplines. Only the funded proposals are classified into these categories, and then only after all review is done. As necessary, proposals

may be shifted from one program to another because of the topic and with the concurrence of the principal investigator. Only the proposals that have both high scientific quality and relevance to the program description and the long-term sustainability of agriculture are funded. The one caveat to this system is that it may at times be difficult to evaluate multidisciplinary proposals if the panel does not contain sufficient expertise in the dimensions of the proposed research, or if the scientists take a too-narrow view of the subject and try to force a single-discipline perspective on an inherently multidisciplinary problem or approach. The NRICGP staff are aware of this issue and work to ensure adequate breadth of review.

Overall, implementation of the program is positive and productive.

■ Funding

Funding of NRICGP warrants attention from different, but complementary perspectives: (i) appropriations in relation to authorizations; (ii) sufficiency of funds for the established program; (iii) relevance of the funding to program priorities of USDA; (iii) earmarking; and (iv) attitudes within the agricultural research community to funding of NRICGP. The key issue of whether NRICGP is relevant to contemporary issues in the agriculture/food/environment sector is specifically addressed in the next section.

Appropriations and authorizations. One of the most significant implementation actions for NRICGP was Congress's action in FACTA to authorize NRICGP at \$500 million dollars. This increases seven-fold the authorization of \$70 million provided by the 1985 farm bill. In addition, Congress authorized a phasing schedule (FY 1991, \$150 million; FY 1992, \$275 million; FY 1993, \$350 million; FY 1994, \$400 million; and FY 1995, \$500 million).

³ Research strengthening refers to a portion of the grants allocated to those universities that have not received the same proportions of federal funding as more established institutions.

The appropriations record is substantially less positive. Appropriations for NRICGP programs have indeed more than doubled in the past six years (\$43.1, 73, 97.5, 97.5, 103.1, and 103.1 million for FYs 1990–1995, respectively; see table 3-1). This is about 6 percent of the total USDA budget for agricultural research and education. But these increases fall far short of the amounts authorized in FACTA. They are significantly less than is required to meet priority research needs and than is merited by the number of proposals which can appropriately be funded (based on the relatively low proportion of high-quality proposals for which funds are available). For example, NRICGP cannot even fund all of the “high-priority” proposals in several of the program areas and must limit its funding only to those that are “outstanding.” This is discussed further in the next section.

Funding of meritorious proposals was made even more difficult during the past two years because of earmarks (see discussion below) and set-asides required by law for Small Business Innovation Research (SBIR, 2 percent) and biotechnology risk assessment (1 percent of biotechnology-related research). Administrative costs are set by law at 4 percent in 1995. Thus, of the approximately \$103 million available in recent years, only about \$91–\$96 million has been available for actual grants to investigators.

Furthermore, growth of the program has stalled at about \$100 million for four consecutive years (FY 1992–95). As a result, NRICGP appears to be languishing at this level and is in serious danger of failing to meet both the need for its research and also the promise for its program.

This funding situation raises the obvious issue of where, and how, to secure additional funds for NRICGP, particularly in the stringent budget climate of 1995–96. One approach is to recognize that additional funding for NRICGP results in a zero-sum scenario wherein funds from other parts of the agricultural research portfolio are redirected into NRICGP. This proved deleterious to all parties in the late 1970s, and it is not a fea-

sible alternative because the other programs provide critical support for research in other dimensions of agricultural research.

Another approach was outlined in 1989 with the initial formulation of the program in *Investing in Research* and mentioned again in the 1994 BA/NRC review of NRICGP (6). According to this rationale, much new foundational knowledge is necessary to serve as the basis for sustaining productivity along with increasing availability of environmentally sustainable cost-effective technologies for all producers, large and small. Without this knowledge, American agriculture will languish. On this basis, then, the source of additional funds for NRICGP could reasonably come from either (or both) of two sources. One source would be inside the current agricultural research system. This means other programs will have decreased funds, as mentioned above, with ensuing problems. Alternatively, the budget mark can be increased, with the increase to be funded from other funds within the federal budget. For example, a policy could be established to use some of the downsizing of the agricultural commodity support programs for funding a portion of this foundational research. The rationale for this action is that the results will lay the basis for subsequent productivity or profitability increases to offset the economic losses from the support programs (and also to increase the viability of non-supported programs). The discussion later in this report on patterns and policies for supporting agricultural research, and delineating public and private responsibilities for the research, bear directly on this key policy issue.

Sufficiency of funds for NRICGP. Sufficiency of funds can be addressed by examining at least seven characteristics: need for the program; interest in the program; demand in relation to quality; sufficient funding for individual awards; availability of the program to the widest possible pool of qualified investigators; sufficiency of coverage of the priority research areas; effect of funding on risk-averseness in making awards; and the management challenge of using funds by the program in a cost-effective manner.

TABLE 3-1: U.S. Department of Agriculture Research Budget
Fiscal Years 1987–1996 (million dollars)

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996*
ARS	518.4	552.7	578.2	602.3	640.9	681.4	680.2	706.1	707.8	704.3
CSREES	293.7	303.1	310.6	326.6	373.3	414.4	415.0	425.3	414.6	414.1
NRICGP	40.7	42.4	39.7	38.6	73.0	97.5	97.5	103.1	103.1	130.0
AMS	2.5	2.6	2.7	4.2	4.8	4.7	4.9	4.8	4.8	4.8
APHIS	4.9	6.6	11.3	13.0	15.7	16.7	14.7	19.2	19.1	18.9
ERS	44.9	48.3	49.6	51.0	54.4	59.0	58.9	55.2	53.5	54.7
FAS	4.2	1.5	1.3	2.3	2.6	1.5	1.5	1.4	1.4	1.4
FS	126.7	132.5	138.3	150.9	167.6	180.5	182.7	193.1	199.7	203.8
NASS	3.4	3.6	2.9	2.8	3.2	3.6	3.9	3.9	3.6	3.7
RBCD	2.7	2.7	2.7	3.4	2.8	8.0	9.6	11.4	9.9	19.2
TOTAL	1042.1	1096.0	1137.3	1195.1	1338.3	1467.3	1468.9	1523.5	1517.5	1554.9

* Executive Branch request to Congress, ARS–Agricultural Research Service

CSREES–Cooperative State Research, Education, and Extension Service, NRICGP–National Research Initiative Competitive Grants Program

AMS–Agriculture Marketing Service, APHIS– Animal and Plant Health Inspection Service

ERS–Economic Research Service, FAS–Foreign Agriculture Service

FS–Forest Service, FGIS–Federal Grain Inspection Service

NASS–National Agriculture Statistics Service, RBCD–Rural Business and Cooperative Development

SOURCE: U.S. Department of Agriculture Budget Office, 1995.

There is a strong need for NRICGP, because there is clearly a major need for its foundational knowledge. Fundamental understanding is still lacking for the central biological and biogeochemical processes involved in critical elements of agricultural production, food safety and nutrition, and related environmental quality and conservation of natural resources. For example, fundamental molecular and cellular biology, along with genetics and physiology and biochemistry, are crucial to understanding the biological basis for nitrogen fixation, the cellular and molecular biology of pathogenesis, natural mechanisms of disease resistance in plants and animals, and systems ecology and management in emerging areas such as sustainable agriculture. Without this fundamental knowledge the desired advances necessary for environmentally sustainable productivity and for increasing productivity to meet increased food and nutritional needs cannot be met.

The interest of qualified scientists in the program is also evident. For example, each major increase in appropriations to the earlier Competitive Research Grants Office and now to NRICGP

has resulted in a corresponding, and quite proportionate, increase in the number of proposals (for instance, for 1978–84, an average of 842 proposals for an average of \$16 million appropriation; for 1985–90, an average of 1632 proposals for an average of \$42.4 million appropriation; for 1992–94, an average of 3084 proposals for an average \$100.1 million appropriation) (14).

The quality of proposals that has accompanied the increasing interest in the program has remained consistently high, as shown by the generally same proportion of all proposals receiving high ranks by panel reviewers (7). Senior staff of NRICGP estimate, based on evaluations by panel reviewers, that another 25 percent of the proposals could be funded without diminishing quality. One area had about 35 percent of the proposals in the outstanding and high-quality categories; because of funding constraints, only 18 percent (about one-half of these highly qualified proposals) could be funded.

Sufficient funding of individual awards is an important, but difficult and problematic, issue for the program. The constancy of quality of proposals for funding and the increasing interest in the

program has not been matched by available funds. To illustrate the problem, the total award amount, total number of grants, the average size of awards in major grant categories (excluding the strengthening, multiagency, and solar UV-B grants, because of their wide variation in award amounts), and their average duration are shown in table 3-2.

Not only have appropriations been substantially less than authorized (as already noted), they have not been sufficient to fund qualified proposals to appropriate levels and durations. For example, the average amount of the total award was \$117,295 for FY 1991, with an average duration of 2.22 years (\$52,836/year) and \$137,256 for FY 1994 (\$58,804/year). These awards are little more than the awards for FY 1988 for the previous program (\$50,000/year⁴) (5). Even in 1988, the USDA competitive grants awards were only 72 percent of comparable NSF awards (and 32.5 percent of NIH awards, which would be expected to be higher because of the higher animal and related research expenses, on average) (5). In 1995, the NSF average awards for Biological Sciences were for a three year duration and at \$83,000 per year (8). This means NRICGP awards have declined to about 55 percent of comparable NSF awards. Thus, on the critically important issue of funding of individual awards—in terms of amount of award and duration—the program is woefully inadequate, especially in comparison to the closely related comparison programs in NSF and NIH, and little improvement has been made between the earlier Competitive Research Grants program and NRICGP; the reason for this, of course, is the lack of funding and the desire by both Congress and the NRICGP management to cover all subject areas, even with the limited funds available.

It may be questioned why the award amounts and duration are less than they should be. The reason is the strong desire of the NRICGP staff to involve as many scientists as possible in the

program, even with the disadvantage of limiting their funding. Until the appropriations are significantly increased (difficult in these budget times) or the amounts and durations of awards increased (undesirable within the current level funding because of the resulting decreased number of awards), the sufficiency of funding for awards will be especially difficult for the program.

Furthermore, and reinforcing the problem of amounts per award, the multidisciplinary awards for the same period average \$144,736 and last 2.4 years. This duration is virtually the same as for single-investigator awards. As regards the amount of the awards, if there are three investigators per award, the funding per investigator is slightly less than single-investigator awards. Even if there are only two principal investigators, the funding is only nominally more than single-investigator awards. These terms are a substantial disincentive for multidisciplinary work, which is difficult even when funding is adequate. To encourage multidisciplinary work there could be a premium provided for doing it, not just an equality, which is itself a *disincentive* because of the difficulties involved. It is increasingly recognized that multidisciplinary work is highly desirable and useful for addressing the multifaceted research questions confronting the agriculture/food/environment sector. This kind of financial disincentive is not consistent with the goal of attracting scientific talent to address them.

These amounts and durations for grant awards raise a fundamental question which should be forthrightly resolved as early as practicable:

“To what extent should the NRICGP continue with these current award amounts and durations *or*, alternatively, to what extent should the amounts be raised to be, for example, comparable to NSF awards in amount and duration?”

Raising the amounts and durations to NSF levels would make NRICGP directly comparable to NSF and thus provide opportunity (in terms of research program support) for all scientists to

⁴ The amount includes indirect costs of 14 percent.

Priority Research Areas	1991			1992			1993			1994		
	Total \$ awarded ^a (000)	Total number of awards	Average award size ^b (\$) ^c	Total \$ awarded (000)	Total number of awards	Average award size (\$) ^c	Total \$ awarded (000)	Total number of awards	Average award size (\$) ^c	Total \$ awarded (000)	Total number of awards	Average award size (\$) ^c
Plants	33,180	NA	96,897	37,795	360	110,539	37,608	371	106,952	37,211	378	103,169
Animals	18,960	NA	154,247	23,622	156	167,426	23,519	156	168,983	21,068	149	157,421
Nutrition, Food Quality and Health	3,792	NA	126,400	6,142	51	130,673	6,134	49	133,742	6,766	49	149,171
Natural Resources and Environment	13,272	NA	118,663	17,008	143	137,940	16,994	146	127,277	20,647	169	129,682
Processing for Value-Added Products	NE	NE	NE	3,780	29	139,751	3,777	32	133,583	5,598	44	144,322
Markets, Trade and Development	NE	NE	NE	3,792	38	104,629	3,782	36	110,087	3,410	33	107,545
Agricultural Systems	NE	NE	NE	NE	NE	NE	NE	NE	NE	1,930	11	175,442
Total	69,204		117,295	92,139	777	126,998	91,814	790	124,846	96,630	833	137,256

SOURCE: Annual reports of the U.S. Department of Agriculture, National Research Initiative Competitive Grants Program. Research areas of the NRICGP in FY 1994: correspond to those in FACTA, Agricultural Systems was added by USDA.

NA, not available. NE, not established.

^a Includes all awards, including for strengthening, multi-agency, and solar UV-B
^b Does not include awards for strengthening, multi-agency, and solar UV-B because of their variation in size. Year, number, and average duration for the included awards: 1991, 592 awards, 2.22 yr; 1992, 675, 2.14; 1993, 704, 2.1; and 1994, 743, 2.35.

^c Includes indirect (research support) costs of 14% of total award amount.

participate in the fundamental research mission for the agriculture/food/environment sector equivalent. This would have the effect of research for this sector being as attractive for its segment of researchers as NIH is for its segment of researchers. Achieving this would be a distinct advantage for the sector. If this were done, however, within the current appropriation levels, it would also have the effect of reducing by about 25 percent the researchers who would be funded⁵ and, inevitably, of reducing the scope of coverage of the program. The tradeoff, then, is larger award amounts and durations (and thus more appeal to more investigators, with an expected further increase in quality of proposals) versus breadth of coverage and funding of the largest reasonable number of investigators.

This dilemma can probably be most efficaciously resolved by determining, first, if the amounts and durations per investigator are equivalent to those for NSF (and NIH, in the case of animal and clinical studies) investigators in the cognate fields. If so, then, *as additional appropriations may become available*, over a moderate period of 3–5 years the amounts and durations could be increased incrementally (to increase attractiveness) *along with* increase in the number of grant awards (to broaden coverage of the priority research areas). The key for success is to increase appropriations to the program. Without such an increase, the program will be frozen into its current, truncated state; there are few, if any advantages of that for the program or for the nation’s needs in the agriculture/food/environment sector.

As already pointed out, one of the aims of the program is to involve investigators throughout the scientific community—irrespective of the institutional affiliations, home departments, or disciplinary specialties of the scientists—in research questions especially relevant to the agriculture, food, and environmental sector. In addi-

tion, it is the aim of the program to make it attractive and available to those in the SAES and land-grant university systems. This has occurred (see table 3-3). The program has received proposals from investigators from traditional and nontraditional institutions (see table 3-3 for definitions) in almost exact proportions (79:21) for each of the past 10 years; only 1994 showed a slightly larger proportion of proposals from the nontraditional institutions (76:24). During this time, the program appropriations increased from \$46 million to \$103 million. Thus, as the funding increases, scientists from both traditional and nontraditional institutions are comparably attracted to it in proportional number. Equally positive has been the relative success of scientists from the two institutional types. Each has been funded to almost exactly the same extent (averaging 23.4 and 22.7 percent, respectively, over 10 years). This shows both comparable quality and competitiveness from scientists from the two institutional types.

These results have clear implications: NRICGP appeals much more strongly to scientists from traditional institutions than nontraditional (79:21 preference). Scientists submitting proposals are equally competitive irrespective of type of institution. Scientists from both types of institutions are comparably and proportionately attracted to the program, irrespective of funding level (the average amount and duration of grants has been generally constant throughout this period). A major way to involve more scientists from the nontraditional institutions is to increase appropriations. But, caveats are also in order. For example, it is quite possible that scientists from nontraditional institutions might be even more attracted to the program if average grant awards and durations were increased, given the “award sensitivity” of certain investigators, and given the relatively different award structures between the NRICGP and NSF (and NIH) programs.

⁵ Calculated using data provided by the NRICGP office in determining the appropriation levels required if NRICGP grants were to be equal in direct costs to NSF grants.

TABLE 3-3: NRICGP Award Distribution by Institution, Fiscal Years 1985–1994

Year	Traditional institutions ^a			Nontraditional institutions ^b			Total	Percentage from traditional
	Requested	Funded	Percentage funded	Requested	Funded	Percentage funded		
1985	2,054	342	16.7%	530	104	19.6%	2,584	79%
1986	1,562	374	23.9	424	104	24.5	1,988	79
1987	1,280	279	21.8	365	84	23.0	1,645	78
1988	1,230	292	23.7	318	78	24.5	1,548	78
1989	1,120	280	25.0	278	51	18.3	1,398	80
1990	1,363	316	23.2	391	66	16.9	1,754	78
1991	2,122	456	21.5	536	121	22.6	2,658	80
1992	2,342	624	26.6	537	148	27.6	2,879	81
1993	2,295	629	27.4	590	159	23.8	2,885	80
1994	2,666	634	23.8	837	199	23.8	3,503	76

SOURCE: U.S. Department of Agriculture, National Research Initiative Competitive Grants Program Office, 1995

^a Traditional institutions include: 1862 Land Grant, 1890 Land Grant, Other Federal Research Laboratories, State Agricultural Experiment Stations, USDA/S&E Laboratories, and Veterinary Schools/Colleges.

^b Nontraditional institutions include: individuals, private nonprofit, private-for-profit, private universities/colleges, and public universities/colleges.

As already emphasized, it is important for the health of the agriculture/food/environmental sector to attract the widest possible pool of investigators to do research relevant to the sector, to make them part of the knowledge generation system for the sector, just as has been done for the biomedical sector. So far, notwithstanding the several elements of USDA's research portfolio, the nation's scientists are not substantially attracted to or invited to participate in research for the agriculture/food/environment sector. NRICGP is the best, often the only, mechanism for doing this for the sector, just as NIH has been able to attract an exceptionally broad and talented pool of scientists for the biomedical sector.

The funds available are not sufficient to provide adequate and to fund adequately the qualified proposals for them. This is illustrated by the lower award amounts and duration, as discussed above; by the modest proportion of proposals that can be funded (21–27 percent during FY 1990–94⁶) and the inability to fund another 25 percent of the proposals judged to have high

quality which merit funding; and the pressing need for this foundational research (22).

Thus, it is concluded that the funds available for NRICGP are distinctly insufficient for the overall program. This works to the detriment of the goals of the program, increases the frustration and lowers the productivity of participating scientists, and makes obtaining the necessary foundational knowledge more difficult and attenuated. None of this benefits the quality or security of the research system for the agriculture/food/environmental sector.

Some have suggested⁷ that the decreasing availability of federal funds for competitive grant programs in the face of continued scientist interest and high-quality proposals is leading to a risk-averseness in making awards, with more risky and innovative research being funded proportionately less than more established approaches and subjects. Program managers for NRICGP do not believe that is occurring for this program. In addition, NRICGP specifically includes a program area for strengthening

⁶ From Annual Reports of the NRICGP.

⁷ See for example, *Washington Post*, 25 December 1994.

research capacity for institutions that have traditionally not received the same proportions of federal funding as more established institutions. These awards are of the riskier type, given institutional capacity and less grant-experienced investigators. From 11–19 percent of the program’s awards have gone to these institutions, testifying to the willingness of the program to take these risks conditioned only by the same criteria as for all proposals (quality of the proposed research and its relevance).

As a management issue, it is important that additional funds be used by the program in a cost-effective manner. The program has “lean” staffing levels (17 scientists for \$100 million of grants) and it economizes on administrators (having only three directors to manage six program divisions and the agricultural systems, and, in addition, one program director for the SBIR program). This compares favorably with other federal agencies. Even with this economical approach, because of the way work is deployed, it is estimated that current staff could handle an additional \$25–50 million of funding. Thus, when funding for the program has been increased, there has been no difficulty managing the increased workload, including review of proposals and making timely allocations. Thus, “rate of absorption” of additional funds is not an issue.

Earmarking. Earmarking has unfortunately become part of NRICGP, and must be addressed with a view to its elimination. As context for this discussion, it is important to consider the rationale for the program. NRICGP has a very strong focus of connecting fundamental research and the resulting foundational knowledge to the missions of USDA and the contemporaneous issues facing the agriculture/food/environment sector. It does this in several key ways: the disciplinary yet mission-linked focus of its priority research areas; the cross-cutting programmatic themes that embrace these issues; the major emphasis on multidisciplinary research and mission-linked research (at least 30 and 20 percent, respectively, of the research funding must go to these two areas) along with the foundational research; the social and economic aspects of the sector, includ-

ing rural life and development; and the major provisions in NRICGP for incorporating knowledge and technology transfer and their practitioners, including Cooperative Extension personnel, into the research programs. Further, the NRICGP staff in its implementation of the program has continuously emphasized in its announcements and in its review practices the need for relevance of the program to these issues. For all of these reasons, the program is closely and prudently connected to the issues of the sector, while emphasizing the necessary foundational knowledge that is broadly applicable to them. Thus, it cannot be reasonably concluded by any objective assessment that NRICGP is ignoring the needs of the agricultural sector and needs to have earmarks placed on its programs so that it pays adequate attention to those needs.

Some funds appropriated to NRICGP have been earmarked for specific issues and interests, in direct contradiction that these funds be awarded to the best science in high-priority areas relative to agriculture. Earmarking to fund local, specific research and/or facilities issues has long been a feature of Congressional appropriations for USDA’s overall research portfolio. Earmarking makes the insufficiency of funds for NRICGP all the more onerous. Earmarking reduces the funds that can be competitively awarded to the fundamental studies for which NRICGP is specifically and predominantly designed. Significantly, earmarking substitutes contemporaneous, usually short-term political judgments for long-term scientific judgments of mission relevance and scientific merit. Two kinds of earmarks have occurred: administrative and Congressional.

In FY 1994 the Secretary of Agriculture earmarked \$2.5 million to the U.S.–Israel Binational Agricultural Research and Development (BARD) program. This was the first time this kind of earmarking had been done by the administration of USDA. For FY 1995 Congress seized on this precedent and itself earmarked \$2.5 million for BARD within NRICGP, dividing the funding among the NRICGP program categories.

Congress in FY 1995 earmarked \$8,113,000 of the NRICGP appropriation for three *new issue- and management-oriented programs*—water quality, integrated pest management, and pesticide assessment. Prior to this time, funds had been appropriated to the six research program areas authorized by FACTA. This earmark originated in FY 1994 when Congress shifted more than \$9 million to NRICGP while subtracting the same amount from a combination of the special grant funds for the generic, national programs for regional water research, regional IPM, National Pesticide Impact Assessment Program (NPIAP), and Global Change research.

To try to keep these FY 1994 funds as much as possible within the principles of NRICGP under these compromised circumstances, the NRICGP staff created four mission-linked programs—water resources assessment and protection (for water quality research), biological control (for IPM research), assessment of pest control (for NPIAP research), and UV-B monitoring; placed them within the relevant research priority divisions (Plants and Natural Resources and Environment) of NRICGP; solicited proposals for them and managed the proposals in the normal way; and made awards for work in these categories by using the normal peer-review process followed by competitively awarded grants. Interestingly, because the NRICGP office had already established “cross-cutting program areas” for both water quality and integrated pest management, and because UV-B monitoring fits neatly into the Natural Resources and Environment research area, earmarking these funds in 1995 was not even necessary.

The NRICGP management staff has been effective in connecting the program to contemporary issues in the agriculture/food/environment sector. Given this, simply registering Congressional intent to ensure work in these areas would very likely have been sufficient. Notwithstanding the positive efforts by NRICGP, the earmarking of these funds is an ominous portent because it provides a precedent for dividing these funds into issue-focused project funding. This defeats the purpose of

NRICGP to support fundamental studies and, especially, to have an organized, managed integrity of the six program areas.

As noted at the outset, and as a final policy perspective, this earmarking is incongruous because of the unusually strong emphasis given by NRICGP to the issues and problems of the agriculture, food, and environment sector. To a large degree, NRICGP conceptually is a hybrid between the foundational programs of NSF and the applied research programs throughout USDA and its participating state institutions. Ironically, this mission-orientation of this program could be its “Achilles heel.” This open connection of NRICGP with issues of the sector could, indeed, provide a quiet, convenient entry point and rationale to shift this largely foundational knowledge program to applications-oriented research. If that were to happen, the value of the program would be lost. And if the foundational purpose of the program were lost, it would be prudent to abolish the program rather than create an unnecessary redundancy with existing programs and simply leave a void in the foundational research area.

Attitudes toward NRICGP. A number of attitudes toward NRICGP are positive and supportive, while some are less so. Taken together, and recognizing that concerns can easily diminish support for appropriations, this mixture of attitudes contributes to the languid funding of NRICGP.

Some of the positive and supportive attitudes include the following. The positive response among research scientists has been strong and consistent, both in terms of submitting high-quality research proposals and in their advocacy for NRICGP. A wide range of commodity and user groups were early supporters of the proposals leading to NRICGP, and a number have continued their support, such as the wheat growers. Similarly, the SAES directors have steadily supported NRICGP, along with other elements of the agricultural research portfolio in their annual budget recommendations made through the National Association of Land Grant Colleges and State Universities. But it must be observed that

none of this support has taken on the force and immediacy found for support of biomedical, physical science, engineering and related programs such as for global climate change. Until that kind of impact is felt, support for NRICGP is likely to continue to be viewed as tepid or unimportant. In the face of this, the value of NRICGP in advancing science is amply demonstrated in a number of ways, one of which is illustrated during 1994–1995 by nine cover stories in *Cell*, *The Plant Cell*, *Nature*, and *Science*—four of the most significant peer-reviewed journals for biological research—featuring research funded by NRICGP.

Of particular importance, Congress has consistently supported NRICGP. Further, Congress has recently been emphasizing basic research of the type that characterizes NRICGP. It is also giving steadily more attention and emphasis to competitively awarded research funding, of the kind that also characterizes NRICGP. And Congress has appropriated regular increases in NRICGP's funding to its current level of about \$100 million. Congress has not, though, responded positively to increases proposed by both Bush and Clinton administrations for additional appropriations (up to \$130 million for FY 1996).

There are also some less-than-positive aspects of support for NRICGP. Funding by Congress, as already noted, has not increased in the past three years. This is particularly disturbing given the erosion of purchasing power caused by level funding, making it particularly difficult for NRICGP to meet the objectives set for it by Congress itself. Funding earmarks, some by Congress and others by the administration, have further eroded NRICGP and show less than full support for the program. The positive support by the agricultural research sector is not as enthusiastic as might be expected. For example, and as already noted above, the NRICGP is included in the annual NASULGC recommendations as just one of several recommendations; while this may be appropriate given that all elements of the research portfolio are important, it being but one of several items does little to demonstrate the

crucial importance of NRICGP. Some have criticized NRICGP, both directly and indirectly, because it does not specifically include Cooperative Extension. The criticism is not justified. NRICGP—in both the BA/NRC report and in the Congressional language of FACTA—specifically speaks to multidisciplinary and mission-linked studies, each of which relate directly to Cooperative Extension; further, both the BA/NRC report and managers of NRICGP encouraged Cooperative Extension to be part of multidisciplinary research teams, thereby further incorporating user perspective in the research and expediting application of research results. There is also the concern by both agricultural research and extension leaders that funding NRICGP competes with other funding, such as formula funding.

There are at least four distinct actions that are appropriate for the research/extension community and USDA. First, advocates for agricultural research and extension, including its leadership, must continuously understand and articulate the importance of foundational knowledge for the agriculture/food/environment sector, along with the more applied and specific research and application. Second, there must be comparable recognition that the overall research (and extension) portfolio is complex, that each element is important *including* NRICGP, and that support is needed for NRICGP, particularly because it is still a new, emerging program. Third, as a corollary, it is essential that the emphasis on NRICGP continue to be on foundational knowledge, that the emphasis not shift to applied studies on contemporaneous issues. Fourth, USDA and specifically the NRICGP staff should continuously show the relevance of NRICGP's knowledge development to topical issues. This should be done by illustrating the relationships between its studies and the issues and by continuously examining its portfolio to ensure that synergistic connections to agriculture/food issues obviously exist within its grant programs and awards. USDA's work to date in these regards has been effective, but it should also be continued and intensified.

■ Relevance of NRICGP to Issues in Agriculture

The relevance of NRICGP to major issues and challenges in the agriculture/food/environment sector is a key factor for establishing and evaluating the success of the program. NRICGP is relevant to the issues confronting agriculture when assessed by at least four criteria: (i) the central value of foundational knowledge for addressing key agricultural challenges; (ii) a central element in USDA's diversified research portfolio; (iii) the quality of the research proposed that is directly relevant to the challenges; and (iv) its direct relevance to key topical issues such as sustainable agriculture.

Value of foundational knowledge. The purpose of the program is to provide foundational knowledge by conducting fundamental research that establishes new principles, understanding, methodologies, and mission-linked research that aims at solutions to contemporary problems but that is also broadly applicable and thus has characteristics similar to fundamental research. As noted earlier, the priority research areas of NRICGP embrace the breadth of knowledge needs for the agriculture/food/environment sector. For example, the molecular and cellular biology, biochemistry, and physiology necessary for understanding insect and pathogen damage and control is addressed within the plant, animal, the environment areas; the biology and control of food-borne pathogens is addressed in the plant and nutrition areas; the understanding of biological and physical properties necessary for creating new products and processes is addressed in the plant, animal, and engineering/new products areas; and the social and economic analyses necessary to sustain rural communities are studied in the markets, trade, and policy area. Put another way, one of the most significant challenges in U.S. agricultural research is developing the knowledge needed to change from resource-based to knowledge-based agricultural production systems. In a very real sense, the program is directly relevant to the issues and challenges of the U.S. agricultural system.

Central element in USDA research portfolio. The program is a central, integral element in the overall federal and USDA research portfolio for the agriculture/food/environment sector. The program emphasizes foundational knowledge. For example, NRICGP funds plant breeders to understand the mechanisms of genetic variability and its usefulness in plant structure and disease resistance. But the program does not fund plant breeding; that is the responsibility of other parts of the portfolio and the private sector. As noted earlier, other elements of the portfolio include ARS, with its emphasis on basic and applied research that is nationally relevant; SAES and land-grant colleges of agriculture and allied subjects which do basic and applied research and focus on locally and regionally specific issues as well as generic national issues; the nationally applicable special grants which address major current issues; ERS and FS which emphasize economics and forest-related questions, respectively; and the Cooperative Extension system, which emphasizes developing applications and extending them to users, often in cooperation with SAES and ARS researchers. In addition, the private sector is a major research contributor, generally emphasizing technology development and application. NRICGP provides foundational knowledge relevant to all of these research participants. Each of these has its special roles to play. None can succeed well absent the others. The program is a key central element of this diverse research portfolio.

Quality of research. Quality of the research is increased by its peer evaluation and by seeking and insisting on connection to the issues of the sector. Various indicators have already been discussed and include: use of the criteria of scientific merit and relevance to issues for both peer review of proposals and award allocations; user and stakeholder workshops; scientific advisory committees; program announcements and panel composition that recognize the relevancy criterion; cross-cutting themes; openness to including additional topics in the program areas, such as soils and soil biology, which are closely related to resource productivity and protection.

All of this is commendable and should be continued. This insistence on relevance is further enforced by the specific inclusion of multidisciplinary research (required to receive not less than 30 percent of the funds) and specific opportunities for connection of the research to the extenders and applicers of research by encouraging their participation in the multidisciplinary research and in the category of mission-linked research (required to receive not less than 20 percent of the funds in FY 1993 and thereafter).

Direct relevance to key topical issues. NRICGP is directly relevant to key topical issues in the agriculture/food/environment sector. NRICGP secures this relevance to these issues by its subject area comprehensiveness; its requirement of relevance—along with scientific merit—for grant awards; its inclusiveness of and responsiveness to topical issues, such as biological control, water quality, and global change; guidelines for and management of proposal review and grant awards; and the continuing relationships of the program staff with users and stakeholders. This is demonstrated by the average of 75 percent (in a range of 66–83 percent) of all NRICGP funds during FY 1991–1994 allocated to cross-cutting themes—strategic areas—which, themselves, are broad categories of topic issues (discussed in a later section).

Sustainable agriculture provides an illustrative example. It has intrinsic importance as a research area and paradigm for the overall agriculture, food, and environmental sector, including rural areas. Reflecting this, Congress in FACTA requested that “the Secretary of Agriculture shall ensure that grants [from NRICGP]...are, where appropriate, consistent with the development of sustainable agriculture” (Title XVI, Sec. 1615, (b) (j)). Sustainable agriculture is defined in FACTA and discussed in chapter 4.

Clearly, sustainable agriculture needs foundational knowledge for all its facets. NRICGP’s emphasis is such foundational knowledge. Examples of this needed knowledge include understanding the organismal and environmental biology of soil-borne organisms; understanding and using biological methods of pest

management; understanding analytically the social and anthropological relationships between humankind and the land and water resources, and the factors that provide for self-sustaining rural communities; and understanding the *system* of sustainable agriculture and how the components interact.

NRICGP relates directly to sustainable agriculture. NRICGP staff review all proposals to determine their relevancy to the long-term sustainability of agriculture in general and to sustainable agriculture in particular. Estimates for FY 1995 awards are that at least \$16 million of NRICGP’s roughly \$100 million budget will relate *directly* to core sustainable agriculture issues such as helping rural communities, sustaining natural resources, and decreasing the dependency of U.S. agriculture on pesticides. More than \$14 million of the FY 1994 NRICGP research grants related directly to sustainable agriculture. Much more research also relates, such as molecular mechanisms of virus movement through plant tissues and resistance genes to bacterial pathogens, two discoveries that lie at the center of natural mechanisms for pest management in sustainable agricultural systems. Both, incidentally, have been featured as lead research findings in leading international research journals.

Some have sought to establish a sustainable agriculture relevancy protocol for research supported by USDA. Because foundational research is, by definition, research that aims to discover underlying principles permitting understanding of fundamental phenomena and is usually broadly applicable across a spectrum of more applied problems, it follows that relevancy protocol, for sustainable agriculture or other specific management or production systems, are not especially useful or appropriate for NRICGP. This was, indeed, the consensus view of a broad spectrum of scientists and policy analysts gathered to consider research supportive of sustainable agriculture (11). The review of NRICGP by the Board on Agriculture reached a similar conclusion (6).

Proposals relevant to sustainable agriculture must, like all proposals for funding by NRICGP, be investigator-initiated: responsibility for their content is with the investigators proposing the research. Thus, it is the responsibility of the investigators to ensure the proposals contain sufficient social, economic, cultural, rural development (and also biological) aspects to meet the research needs. The program judges the proposals on their scientific merit and relevancy; it does not try to force a particular form of relevancy, which would be antithetical to the usual traditions of investigator responsibility and freedom.

In addition to all of the above, the NRICGP staff have taken a number of steps to ensure that research for sustainable agriculture is intrinsic to NRICGP. This has included lengthy discussion with advocates for sustainable agriculture to understand and incorporate their concerns; specific inclusion into NRICGP's call for proposals and instructions to peer reviewers of the FACTA definition of sustainable agriculture; FACTA's emphasis on research to advance sustainable agriculture; and incorporation of relevance of proposed research to the long-term sustainability of agriculture into the proposal evaluation factors. Workshops with users and stakeholders have also included an emphasis on sustainable agriculture.

■ Relationships between Program Areas and Funding

It is important that there be supportive relationships between the program areas and the funding available. Within the limited funds, this appears to be the case. These relationships can be addressed in at least five ways: (i) financial coverage of the priority research areas; (ii) responsiveness to new issues and related research questions; (iii) cross-cutting themes in relation to the priority research areas and the issues of contemporary agriculture; (iv) multiple

disciplines and priority research areas; and (v) capacity for funding the mix of multidisciplinary and mission-linked grants.

Financial coverage of priority research areas. FACTA authorized six high-priority research program areas, represented organizationally by the current six divisions of NRICGP. Each has now received funding, with funding for processing for value-added products and markets, trade, and rural development starting in FY 1992 (see table 3-2). Financial coverage of all the areas is commendable. However, the amounts are insufficient for the program's scope and importance, as documented in the previous section. For example, the size and duration of awards is already less than desirable for individual grants; further, the appropriations are insufficient to fund all of the highest priority proposals and to attract even more of the nation's scientists to the program. To give some estimate of the shortfall in funds for adequate coverage of the six areas, just based on current interest of scientists, NRICGP staff have estimated that providing grant awards comparable to NSF and to fund the same highest priority proposals would have taken an additional \$24 million in FY 1994.⁸

As noted earlier, NRICGP senior staff estimate that the next 25 percent of the proposals (after those already funded) could be funded without any reduction in quality of proposals funded, bringing to about 48 percent the submitted proposals worthy of being funded. Further, relative to plant systems and animal systems, the four other priority research areas of natural resources and environment; nutrition, food quality and health; markets, trade, and rural development; and processing for added value are substantially underfunded.

Although there is financial coverage of the priority research areas, the funding for the areas is not sufficient either to fund all qualified proposals or to provide proportionate funding for the

⁸ Estimates by NRICGP staff factoring in the differences caused by the NRI overhead rate of 14 percent and an NSF overhead rate of 50 percent on direct costs. Thus, a \$100,000 NRI award (with 14 percent overhead rate) is comparable to a \$129,000 NSF award (with a 50 percent rate).

six areas based on funding for the areas of plant and animal systems.

Responsiveness to new issues and related research questions. There have also been significant additions to NRICGP, especially in FY 1994.

Agricultural systems research, a multidisciplinary, mission-linked program that relates to ecological and socio-economic principles and practices in agriculture (such as integration of field-farm-watershed and production-processing-marketing studies), was added as a program element in 1994. It was established by the NRICGP staff because they realized that some areas of key importance to sustainable agriculture, and to agriculture and environment more generally, were not given sufficient emphasis by the extant program categories. Specifically, there was determined to be insufficient opportunity for funding research that was multidisciplinary. Although not a division as an organizational unit, the agricultural systems category is listed equivalent to other program areas to emphasize the importance of it for the entire program (14).

Soil biology and ecosystems were established in 1994 as programs within the natural resources and environment division; the ecosystems program was expanded to include aquatic ecosystems.

This steady development of NRICGP is commendable. However, new program areas cannot be added unless additional funding is provided. Without additional funding, the NRICGP will be threatened with too many grants of limited duration and funds, two problems that plagued the earlier competitive grants program.

Cross-cutting program areas. Because the primary purpose of NRICGP is to fund foundational research *in relation to the missions* of USDA and the agriculture/food/environment sector, NRICGP is also managed to provide coverage of major “cross-cutting program areas” that address contemporaneous issues and concerns. A significant portion (ranging from 66 percent in FY 1992 and 1993 to 88 percent in FY 1994) of the grant awards are directly related to these issues and concerns (see table 3-4). It is also true that results from other fundamental

TABLE 3-4: Award Distributions of NRICGP by Cross-Cutting Program Areas, Fiscal Years 1991–1994

Program Area	1991		1992		1993		1994	
	Awards	\$ (000)						
Plant Genome	77	10,500	95	12,309	91	12,126	104	11,739
Forest Biology	53	6,428	57	7,164	50	6,340	52	6,993
Global Change	79	9,059	83	9,400	86	9,218	93	10,575
Sustainable Agriculture	76	7,059	97	10,640	100	10,142	102	14,668
Animal Genome	27	4,526	33	5,661	26	4,096	25	3,908
Animal Health	53	8,870	72	11,213	69	10,693	75	9,964
Water Quality	33	4,369	37	4,629	33	4,325	54	7,395
Food Safety	NI	NI	NI	NI	31	3,973	28	4,343
Integrated Pest Management	NI	NI	NI	NI	NI	NI	153	15,611
Total awards to program areas	398	50,811	474	61,016	486	60,913	686	85,196
Total awards to entire NRI	590	69,204	777	92,139	790	91,814	833	96,630
% in cross cutting		73%		66%		66%		88%

SOURCE: U.S. Department of Agriculture, National Research Initiative Competitive Grants Program Office, 1995.
NI, not identified.

studies will, over time, be directly relevant to these areas, as the principles they elucidate form the basis for applied research and direct applications. Based on the amount of funds directly related to cross-cutting program areas, research funded by NRICGP is obviously relevant to contemporary issues in agriculture.

Multiple disciplines and priority research areas. Research challenges for the agriculture/food/environment sector involve, to a large degree, topics that must be addressed in a multidisciplinary fashion. Research is often done, for good reasons, from the perspective of single investigators, from the perspective and using the methodologies and paradigms of a single discipline. However, this is inherently limiting in addressing the more multifaceted dimensions of key phenomena in the sector, such as pathogenesis, environmental stress, prey-predator interactions, environmental and landscape biology, and ecosystem phenomena. For these reasons, multidisciplinary research was given specific and distinctive emphasis in the original BA/NRC report and in the Congressional authorization of NRICGP.

A specific concern is sometimes raised regarding the role of economics in research areas. The markets, trade, and rural development program area is obviously relevant to economic issues. Further, certain biogeophysical and technology areas are also directly relevant, such as ecosystems (especially if dealing with optimization and natural resource valuation issues) in relation to value-added questions. Some have urged that social scientists, and specifically economists, must be part of certain kinds of proposals. Such a mandatory requirement is inappropriate. The entire philosophy of a competitive grants program is to provide opportunity for grants, and study, within a program area, contingent upon having high-quality proposals that have relevance, rather than strictures on what disciplines must, or must not, be included. It is of course true that the highest quality and relevance might, indeed, require economics as part of the analysis or participation by economists on the research

team (as might be true for multidisciplinary proposals), but this is best established by the review process, not as a stricture at the beginning. Interaction is forced only in the agricultural systems program, and even then the disciplines or subjects are not specified.

A caveat is in order, however. Desirable as this peer-driven system is, it is essential that peer review of the proposals involving multiple disciplines involve scientists from those disciplines—and especially scientists who are expert in multidisciplinary work. For example, when social science topics are part of a biologically oriented proposal, social science disciplines should be involved in its review, along with the requisite natural science expertise, to ensure that the social science components are considered fully by experts in those fields, not by other scientists making judgments on their behalf.

It is thus evident that the present system provides ample opportunity for investigators to form into teams as necessary and that there is ample opportunity, specifically, for social scientists to participate in a broad range of research areas. Further, the peer-review process is appropriate for determining the relevance and quality of proposals where social science is, or could advantageously be, an integral part of the research plan.

Capacity for funding the mix of multidisciplinary and mission-linked research. FACTA specifies that not less than 10, 20, and 30 percent of NRICGP funds, respectively, for FY 1991, 1992, and 1993 and years thereafter, are to go to multidisciplinary research; not less than 20 percent to mission-linked research; and not less than 10 percent for research and education strengthening. Table 3-5 shows that USDA has distributed the funds generally consistent with this intent. This is noteworthy, considering that appropriations have not increased or even closely approximated the authorization levels for the program, and it is especially significant because the increase in percent of multidisciplinary grants included in FACTA was predicated based on corresponding increases in funding.

TABLE 3-5: Award Distributions of NRICGP by Research Dimension, Fiscal Years 1991–1994

Research Dimension	1991		1992		1993		1994	
	\$ (000)	%	\$ (000)	%	\$ (000)	%	\$ (000)	%
Basic Fundamental	50,985	74	64,501	70	61,911	67	60,677	63
Mission-linked	18,219	26	27,638	30	28,903	33	35,955	37
Multidisciplinary	19,781	28	22,872	25	31,513	34	26,345	27
Single discipline	49,723	72	62,267	75	60,301	66	70,287	73
Research Strengthening	7,450	0	16,053	186 *	17,152	209 *	16,874	211 *

SOURCE: U.S. Department of Agriculture, National Research Initiative Competitive Grants Program Office, 1995.

*Number of grants

■ Implementation Issues

NRICGP is running well, given the constraints of funds and the high and varied demands on it. Major changes in its operational features are not necessary. There are, however, several related issues that must be considered. Some have already been considered earlier, but only briefly. Others, such as a proposed strategic research and applications plan, are derived by synthesis from a number of observations and are discussed at greater length.

Understanding and emphasizing the role of fundamental research, foundational knowledge, and competitively awarded research grants for the agriculture/food/environment sector, including contemporary issues. As already noted, there is a continuous need to make clear the contribution of foundational knowledge and fundamental research (including the more basic aspects of mission-linked research) for all aspects of the sector. This applies especially for contemporaneous issues such as sustainable agriculture and social and economic quality of the rural and farming sector. This requires diligence and initiative by the scientific community as a whole, and not just by the NRICGP staff. It also requires understanding and confidence by advocates of topical issues.

Consistent with this, there is increasing support in Congress and nationally for sustaining (even increasing) federal support for fundamental research; for determining and then focusing what the federal government should support, in relation to what the states and private sectors

should rightfully support; for cutting “pork barrel” projects away from federal funding; and for making grant awards through competitive processes, whether for fundamental or mission-linked research.

Understanding the role of NRICGP in securing foundational (and related mission-linked) knowledge within the portfolio of research for the agriculture/food/environment sector. NRICGP is one of the major elements in the portfolio in securing this foundational and related mission-linked knowledge. It is not the only element: ARS, ERS, and FS, and key elements of the overall SAES program, are other elements. But NRICGP is a key element, particularly because it is the major entry point for *all* the nation’s scientists to participate in research for the sector. Further, NRICGP cannot stand alone. Its work must be an integral part of the fundamental-applied research continuum; and it must also be related to applications. Both are accommodated in NRICGP because of the emphasis on multidisciplinary and mission-linked research.

Establishing unified strategic research and applications plans for contemporary issues. One of the challenges for the overall research and applications/extension portfolio for the agriculture/food/environment sector is the need for connecting and expeditiously applying research results from across the sector to key, vexing national challenges. The most obvious way to meet this challenge is to create a unified strategic research and applications plan for key contemporaneous issues. Such a plan would identify the key knowledge development questions, and

hence the several research and application elements, needed to address an issue. The plan would describe how the research and application elements would be combined and integrated meaningfully to take advantage of comparative strengths and expertise, and link research results to desired applications outcomes and preferred mechanisms. A crucial component of the plan would be to identify desired outcomes and anticipated time frames. Funding, including relevant federal funds, for dealing with a specific issue could then be optimized for application within the context of the overall strategic plan. Recent examples of such federal funding have been those for pest management, sustainable agriculture, genome research, and water quality.

Fundamental research and foundational knowledge may be expected, usually, to be part of this. Thus, NRICGP would usually be a part of these plans along with the other relevant elements of the research portfolio, including usually ARS, SAES, the private sector, and often other cognate agencies (such as, for example, EPA, the U.S. Geological Survey, ERS, and FS). Similarly, the extenders of knowledge and technology transfer entities would be a part, including especially the Cooperative Extension system and various USDA agencies.

The purpose of the plans would be to show how all elements fit into a comprehensive strategy designed to “deliver the goods” to major issues and what their principal contributions would be expected to be. The purpose of such plans would *not* be to specify how (largely) autonomous researchers and extenders would function. At present, there is no evidence of such strategic plans, except informally and through traditional ways of working among the elements.

These plans would be an effective venue for addressing the key question: Is the current system for dealing with contemporary issues adequate, or is a holistic, focused approach preferred? It is certainly incorrect, unreasonable, and unwise to ask any single part of USDA’s overall research program—such as NRICGP—to carry by itself a preponderant share of the research burden for a particular topic. This nar-

row focusing on to just one part of the folio—either NRICGP or another—is especially inappropriate because so many different components apply to a single issue. It is important to harness all of them. It is more appropriate to ensure, first, that the various dimensions of the topic are covered by one or more elements *within the various USDA research programs* and, second, that there are no gaps or unnecessary redundancies and duplications of research coverage. This means, for example, that the foundational questions have a place in the NRICGP portfolio *and* that relevant priorities are also established for other elements of the portfolio (ARS, states, cooperators). Applied research results should be drawn from throughout the overall USDA program (and from others agencies and sources, where relevant knowledge is available), integrated, and transferred to the relevant applications and the user organizations. The key role for Cooperative Extension in this knowledge and technology transfer process is very important and must not be underemphasized. Taken as a whole, this would result in an integrated, strategic research and applications plan where knowledge and technology transfer is connected interactively with the research process. Put differently, all elements of the research and applications portfolio could be considered together and function collaboratively in relation to key issues and each would have its own place in the issues.

It might be argued by some that such a strategic plan is already in place, especially with the array of federal-state cooperative arrangements, collaborations between ARS and SAES scientists, and relationships among scientists. Many observers, as evidenced by the persistent critiques of the agricultural research system, would argue otherwise. The planning done by the SAES and extension systems approximate in certain ways these plans, but they are not inclusive of all elements of the portfolio. The planning of the Joint Council does not address the agency focuses for the proposed strategic plans.

It might be argued by others that such planning must be (or at least preferably should be) from the “bottom up,” from the scientists and

extenders, not imposed from “top down.” Establishing research approaches and specifying research plans is most appropriately done by scientists and evaluated and decided upon (for specific funding, for example) by scientific peers. No one else has the expertise or insight to evaluate the quality and methodologies of a research plan. This kind of planning should always be from the “bottom up.” However, establishing issue areas for emphasis is partly, but not solely, a scientist’s responsibility. It is very much a “top down” obligation for those charged with larger social responsibilities, such as research managers, experiment station directors, Congress, and society as a whole. Similarly, establishing a strategic research and applications plan is a responsibility for these persons, combined with the expertise and insight of the scientists and extenders and applicers. In any event, developing these plans would very much involve the research and application practitioner/leaders relevant to the issues, so they would be, to a large extent, “bottoms up.”

In making the strategic plans, the six priority research areas established by FACTA should be used as the template and framework for setting out the research needs. The research needs can be further correlated with the cross-cut areas established by NRICGP, which themselves directly relate to the great proportion (80–85 percent) of the NRICGP program. The reasons for using the priority research areas are several: the six priority research areas cover the entirety of research relevant for the agriculture/food/environment sector; they have proved effective and workable as a framework for planning and managing research programs; they relate to major issue (cross-cutting) areas; and they correspond well to the purposes for USDA’s research as set forth by Congress.

Sustaining the emphasis on foundational knowledge. It is not appropriate to force NRICGP into funding applications-oriented research, such as sustainable agriculture research. Other programs have been established for that (such as the Sustainable Agriculture Research and Education program), and other

organizations are more appropriate for that (such as the SAES system and Cooperative Extension). Conversely, it is not appropriate to ask issue-related research, such as that for sustainable agriculture, to carry major fundamental research responsibilities (even though there is much intermixing in both cases). Such issue-specific research is more appropriately funded separately, as it currently is.

Specific comment should be made about the proportion of mission-linked research to be funded by NRICGP. As noted earlier, mission-linked research was included in the original formulation of NRICGP. This was done to provide a place for studies that more closely connected to mission applications having characteristics of fundamental studies. This strengthens the continuum from foundational knowledge to more applied studies. Inclusion of mission-linked research was not meant to take from or be preponderant over fundamental research.

The initial amount of 20 percent for mission-linked research was believed appropriate to make the connections but not diminish the emphasis on foundational knowledge. More than 20 percent (such as 30–50 percent) of mission-linked research would be inappropriate and destructive to the purpose of NRICGP. It would be inappropriate because there are many places in the research portfolio where mission-linked work is emphasized (including the ARS, SAES, and special grants) and because NRICGP is the only place in the portfolio that emphasizes foundational studies in relation to all of the nation’s scientists. And it would be destructive because there is already insufficient funding in NRICGP to cover its priority research areas and fund qualified proposals.

Sustaining the openness of NRICGP to all qualified scientists. A major feature of NRICGP—and a major advantage of it for USDA’s mission—is NRICGP’s openness to all qualified scientists, to providing opportunity for all these scientists to participate in addressing the agriculture, food, and environmental challenges of the nation. There is no evident threat to this feature of NRICGP. However, nothing should be

done to diminish this important feature. Major actions need to be taken to expand further these opportunities.

Expanding the means for addressing the research and technology needs of the future. At present a number of mechanisms are available for addressing these needs, several of which have been emphasized by the BA/NRC report and NRICGP as established by Congress in FACTA. These mechanisms emphasized in NRICGP include multidisciplinary research (in addition to the single disciplinary research which justifiably continues as a dominant mode), bringing extenders into the research programs (as in the mission-linked studies), and strengthening research capacity. FACTA also gives desirable emphasis to technology transfer and encourages positive relationships between, for example, NRICGP, SBIR, and the AARC (Alternative Agriculture Research and Commercialization Center, discussed in another chapter). Creation of strategic research plans would be helpful in addressing these future needs. All of this should continue to be emphasized. In addition, conducting multidisciplinary research and addressing multidiscipline and multispecialty issues such as sustainable agriculture, pest management, and water use and quality are relatively new approaches for researchers in the agriculture/food/environment sector. It is reasonable that continuing, special attention be given to improving ways to evaluate research for them, such as by expanding peer review of research proposals to include panels with expanded technical expertise and/or user and stakeholder expertise.

Emphasizing purposes and guidelines. Although the purposes for research established by Congress in FACTA are already part of research proposal solicitation and peer review by NRICGP, it is important to continue to emphasize them because they are national policy.

Relating to stakeholders and clientele. As already emphasized in several ways, this is a key challenge for NRICGP, just as it is for any program. Continuing and expanding stakeholder and

client relationships, and particularly for commodity and rural economic development constituencies, is a major challenge for NRICGP, made easier by the major work it has already done.

Reexamining the organizational location of the NRICGP office. It is reasonable that an agency establish its own organizational and management system for its programs. However, it is also reasonable to examine the organizational location of NRICGP within USDA. The program is administratively located within the Cooperative State Research, Education, and Extension Service (CSREES). This location is appropriate in the sense that the CSREES funds *extramural* research (in contrast to the ARS as an *intramural* research agency) and because NRICGP is cooperative with the participating research organizations and that many of those are in the state agriculture/food research and extension systems (the primary agencies in the CSREES). Also, these beneficiary organizations should thus have a strong sense of the importance of the program and be strong stewards for its effective management and equally strong advocates for its continuance.

However, the mission of NRICGP very much transcends both ARS and CSREES. It relates to *all* scientists doing fundamental research and related mission-linked research. It relates to the entirety of the responsibilities of the Under Secretary for Research, Education, and Economics. Indeed, it goes beyond the Under Secretary's responsibility within USDA because it also relates to the FS, Natural Resources Conservation Service, the Animal and Plant Health Inspection Service, and other units of USDA, and to myriad scientists not directly within agricultural units *per se*. As such, it is not wholly appropriate for the program to be within a single research agency of USDA (such as CSREES or ARS). Rather, a more appropriate location to remedy this situation is to have it be a separate, independent office reporting directly to the Under Secretary.

■ Financial Issues

Resolving affirmatively several key funding issues is essential if NRICGP is to flourish as intended.

Resuming continued growth of the appropriations. The upward financial growth of the program must be continued, irrespective of external budget strictures, if there is to be even the possibility of securing the necessary foundational knowledge critically needed by the sector in the foreseeable future. There is much obvious need and, as Chapter 6 shows, research is a wise financial and public investment, given the high returns on the investment. This requires that Congress meet more closely, and preferably exceed, the funding increases requested by the Administration.

Increasing the proportion of funding to key areas. All of the priority research areas need additional funding. In particular, though, as additional appropriations are made, the proportion of funding should be increased for the research areas of markets, trade, and rural development; nutrition, food safety, and health; and processing for value-added products. Nutrition, food safety, and health is a particularly important area. Funding was provided for the other two areas after NRICGP was started, and thus their funds are limited. Furthermore, these latter two areas relate directly to key national issues: the social and economic vitality of rural communities and new products and processes. The extent of additional funding should be determined by NRICGP staff relative to the quality of proposals.

Stopping earmarks. Earmarking has been discussed in earlier sections, as has the view by some that NRICGP can be seen as a source of discretionary funds. Both should be stopped, as matters of national policy and in fairness to the critical needs for which NRICGP was designed.

Topical, contemporaneous issues are very important, such as sustainable agriculture, water quality, genome research, and pest management; internationally oriented research could also be included, given global concerns for food security and its effect on U.S. agriculture. However, it is

inappropriate to redirect funds for fundamental research (NRICGP) away from generating essential foundational knowledge especially when other funds and mechanisms are already available for the intended research. Further, earmarking by USDA or Congress is contrary to best practices for research grants and antithetical to a peer-reviewed program where the reviews are based on the merits of scientific quality and relevance to the issues. Indeed, NRICGP has strong evidence that scientists are, themselves, strongly responsive to the topical issues relevant to their research. For example, with the emphasis on food safety in the FY 1994 proposal solicitation, the proportion of proposals and of grant awards for work on *E. coli* in food increased several-fold compared with the FYs 1991–93.

Increasing collaborations with other federal agencies. The collaboration between USDA's NRICGP and cognate programs in other agencies, such as NSF and DOE, is commendable. It should be continued and expanded to other agencies, such as Department of the Interior and EPA, where the interests of those agencies and USDA are similar. This mutual interest of related departments leverages the effect of federal funding, and encourages more effective and efficient federal funding. As additional funds become available, these collaborations should be increased.

Discriminating between national special grants programs and NRICGP. There are a number of areas appropriate for nationally focused special grants programs which bring basic and applied research (sometimes with extension involvement) to bear on key national issues. These areas and issues include sustainable agriculture, water quality, pest management, and the like. The emphasis of these mission-linked and often applied programs is compatible with the emphasis for NRICGP. But these mission-linked issues ought not to be subsumed by NRICGP. They should be placed inside other programs or into special grants. Being clear about objectives for the special grants programs, and having realistic expectations for what the outcomes will be from their funding, is impor-

tant. That clarity is obscured when special grants are blended with NRICGP, as has been done by some of the earmarks. It would be better for both the special grants and NRICGP to have the two programs—and the issues to be addressed—kept organizationally separate, along with seeing them as interactive elements in the strategic research plans discussed in the previous section.

Rationalizing indirect (research support) cost rates. At present there is one set of research support (indirect) cost principles and rates for NRICGP and another for all the other federal competitive grants programs. There is no policy reason why this should continue. The principles and rates for NRICGP should be the same as for the related federal programs. The reasons for this different rate may be understandable because of several distinctive features: USDA's longstanding partnership with state agricultural experiment stations; a long history of collaborative and cooperative arrangements; and the interest of faculty and their research managers in securing as much money as possible for research, and not providing for the necessary research infrastruc-

tural support. Those reasons may still be valid for formula funds to SAES and to cooperative agreements. But NRICGP grants are not in either category. Further, just as the lack of growth of appropriations for NRICGP by Congress is retarding the future of the program, the capping of the research support (indirect) cost rate at the arbitrary rate of 14 percent has made substantial difficulty for non-federal research partners. Indeed, this capped rate, which is far below the recovery of even nominal indirect costs, has effectively chilled, and in some instances precluded, the participation by scientists who are most at the leading edge of the foundational knowledge which the program seeks. Furthermore, the 14 percent has little bearing on actual conditions; it is simply a calculated rate from nominal ARS research administration costs. A more appropriate rate would be to follow current practice for other agencies, which involves capping administrative cost recoveries and conducting the normal indirect research cost negotiation process for all other costs, and Congress could so specify.