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REPORT TO THE
JOINT ECONOMIC COMMITTEE
BY THE COMPTROLLER GENERAL
OF THE UNITED STATES



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**Management Of Agricultural
Research: Need And Opportunities
For Improvement**

Department of Agriculture

The extremely complex and highly diversified agricultural research system in the United States has made notable contributions to the Nation's well-being. However, there is an increasing realization that an up-to-date national plan needs to be developed and maintained if the system is to be responsive to future critical problems and needs and if limited public dollars are to be used wisely. The Agricultural Research Service, the largest organization in the Federal-State research system, could improve its research through better planning, project selection, and review of ongoing work.

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COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

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The Honorable Richard Bolling
Chairman, Joint Economic Committee
Congress of the United States

Dear Mr. Chairman:

This is our report on the management of agricultural research which was done pursuant to a request from your predecessor. The report highlights the accomplishments and benefits of the highly diversified and extremely complex agricultural research system and the increasing realization that an up-to-date national agricultural research plan is needed if the system is to be responsive to critical future problems and needs and if limited dollars are to be wisely used. The report also highlights needs and opportunities for the Department of Agriculture's Agricultural Research Service to improve its research through better planning, project selection, and review of ongoing work.

The Department's comments have been incorporated in the report and its letter is included as appendix IV.

As agreed with your office, this report will be available for general distribution 2 days after issuance to you. At that time, we plan to send copies to the Secretary of Agriculture; the Director, Office of Management and Budget; and other Committees and Members of Congress.

Sincerely yours
James B. Stacks

Comptroller General
of the United States

D I G E S T

The extremely complex and highly diversified system of U.S. agricultural research has led to such things as improved crop seeds, improved livestock and poultry breeds, protein-fortified wheat and other grains, and the elimination of rickets by using ultraviolet light to supply food with vitamin D. While many of these contributions cannot be measured, they are reflected in such things as

- an abundant supply of food, fiber, and forest products for the American consumer;
- the large amount of U.S. agricultural exports;
- the improved nutritional value and quality of food available for human and animal consumption; and
- the elimination or control of dreaded diseases in both animals and humans.
(See p. 7.)

In fiscal year 1975, about \$826.5 million was spent for agricultural research by the organizations within the Federal-State system. (See p. 5.)

NATIONAL PLAN NEEDED FOR
GUIDING AGRICULTURAL RESEARCH

Notwithstanding its accomplishments, the planning for agricultural research has been fragmented and an overall national agricultural research plan has not been maintained. There is an increasing realization that a plan outlining policies, goals, objectives, and priorities needs to be established and kept up-to-date if the system is to be responsive to future critical problems and needs and if limited public dollars are to be wisely used. (See pp. 11 to 17.)

Tear Sheet. Upon removal, the report cover date should be noted hereon.

Legislation which would have required development and maintenance of a national agricultural research plan passed the House during the 94th Congress but was not acted on by the Senate. The 95th Congress is considering similar legislation. (See p. 17.)

Recommendation to the Secretary
of Agriculture

Whether or not the Congress enacts legislation requiring a national agricultural research plan, the Secretary of Agriculture should take necessary steps to have such a plan developed and maintained. (See p. 18.) The Department of Agriculture agreed that improvements were needed in long-range planning but did not take a position on this recommendation. (See p. 19.)

IMPROVEMENTS NEEDED IN AGRICULTURAL
RESEARCH SERVICE'S PLANNING AND MANAGEMENT

The Department's Agricultural Research Service, the largest research organization in the Federal-State system, needs to improve planning, selecting, and reviewing research under its control.

The Service was established in 1953 to consolidate most of the physical, biological, chemical, and engineering research then being done by the Department. It conducts basic, applied, and developmental research in the fields of livestock; crops; pest control; soil, water, and air resources; environmental quality; domestic and export marketing; use of agricultural products; food and nutrition; consumer services; rural and international development; and agriculturally related health hazards, including food safety.

During fiscal year 1976, the Service spent about \$290 million in carrying out its research activities. Of this, about 98 percent was spent on research done in-house. This research consisted of about 1,100 work reporting units (specified research work by locations) and about 3,100 individual research projects. (See p. 6.)

Planning research

Until recently, the Service placed most of its emphasis on short-range planning. Recognizing the need for better long-range planning, the Service began a revised planning system in fiscal year 1977 when it categorized its research under 67 national and 8 special research programs and developed a long-range planning document for each program area to be updated every 5 years. (See p. 20.)

The individual plans, while generally viewed by knowledgeable scientists as comprehensive and covering major problem areas, do not outline a strategy for being carried forward, including identifying relative priorities of program areas and of problems and needs within each program area.

Much of the technical and administrative data needed for developing that strategy was either unavailable, inaccurate, or fragmented. Service officials told GAO that the lack or fragmentation of information was a problem. (See pp. 21 to 23.)

Selecting research projects

In 1972 a panel of scientists from the Government and the academic community questioned the quality of some of the publicly supported agricultural research. GAO reviewed the Service's approval process and noted that it does not provide the controls necessary to prevent the selection of questionable research.

In fact, much of the Service's in-house research was selected without the reviewing officials having available to them

- enough information to assess its scientific and technical merits (see p. 25),
- agencywide criteria for assigning it priorities (see p. 27),
- technical advisors' assessments of its merits (see p. 28),

- initiators' certifications that it was coordinated with other ongoing work (see p. 29), and
- information on past research approaches or results that were counterproductive or unproductive (see p. 30).

Also, the Service does not have a formalized agencywide peer review system for judging the scientific and technical merits of research proposals. Critical reviews of research proposals by well-qualified peers are widely accepted by the scientific community as the most practical method for identifying research excellence. Many Service scientists and managers agreed with this. (See p. 31.)

Reviewing ongoing research

The Service reviews the technical and scientific aspects of individual ongoing research projects through various means. These include informal contacts between and among Service scientists and line and staff officials, annual reports and plans for its work reporting units, and formal program reviews and workshops. Because of various technical, administrative, and organizational shortcomings, however, the review process is not as effective as it could be to make sure that the Service's resources are being effectively and efficiently used. (See pp. 35 to 38.)

A Service work group suggested in September 1976 that the annual work reporting unit reports and plans include more technical information and be sent to technical advisors for tracking research progress. This suggestion has considerable merit. (See p. 39.)

Recommendations to the Secretary of Agriculture

To improve the overall quality and effectiveness of the Service's research, GAO recommends that the Secretary of Agriculture have the Service, among other things,

- identify and document the relative priorities of each national research program and of each problem and research need within the program areas (see p. 23),

--develop agencywide criteria and peer review procedures for assessing the scientific and technical merits of all research proposals (see pp. 32 and 33), and

--require that the annual work reporting unit reports and plans better document the technical aspects of active research projects and be reviewed by technical advisors (see p. 40).

Department comments

The Department substantially concurred in these recommendations and outlined actions the Service was taking to implement them. (See app. IV and pp. 24, 33, and 40.)

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ABBREVIATIONS

ARPAC	Agricultural Research Policy Advisory Committee
ARS	Agricultural Research Service
CRIS	Current Research Information System
GAO	General Accounting Office
NIH	National Institutes of Health
NPS	national program staff
NSF	National Science Foundation
USDA	U. S. Department of Agriculture
WRU	work reporting unit

CHAPTER 1

INTRODUCTION

On May 20, 1976, the former Chairman of the Joint Economic Committee asked us to review agricultural research programs with particular emphasis on the U.S. Department of Agriculture's (USDA's) Agricultural Research Service (ARS). More specifically, he asked that we (1) assess ARS's policies, procedures, and practices for planning research programs; coordinating research with other research efforts; selecting, monitoring, and evaluating ongoing research; and disseminating research results; and (2) recommend, if warranted, action needed to improve management functions to better insure quality and effective research. (See app. I.)

SCOPE OF REVIEW

Our review included an examination of the Nation's publicly supported agricultural research system and related legislation, organizations, regulations, financial data, and various reports, studies, and articles. As requested, we directed our review primarily to ARS's management functions. We did not assess research quality.

We reviewed ARS operations at (1) ARS headquarters in Washington, D.C., (2) its four regional offices in Beltsville, Maryland; New Orleans, Louisiana; Peoria, Illinois; and Berkeley, California, and (3) at 19 locations under the jurisdiction of 3 of the 4 regional offices. Our fieldwork was done between June 1976 and January 1977.

At those locations, we reviewed the policies, procedures, and practices used for planning and managing research and obtained and examined information on 91 active research projects within the following 7 of ARS's 67 national research programs:

- Breeding and production--corn, sorghum, and grain millets.
- Beef production.
- Control of water erosion, wind erosion, and sedimentation.
- Human requirements for nutrients.

- Management and use of precipitation and solar energy for crop production.
- Weed control.
- Insect control--grains, forages, sugar crops, and oilseeds.

We interviewed various ARS officials, including the Administrator, 4 assistant administrators, 13 national program staff scientists, 10 area and center directors, 42 laboratory chiefs and research leaders, 6 technical advisors, and 58 researchers. In addition, we discussed the quality and reputation of ARS's research and researchers and ARS's responsiveness to national agricultural problems with 47 knowledgeable agricultural officials outside USDA and 42 various users of research results. Among those we interviewed were scientists and administrators from several Federal agencies, including the National Science Foundation; land-grant universities; private foundations; and industry. We relied heavily on oral testimony by ARS officials in making our review because of the general lack of documentation maintained by ARS, especially on individual projects.

To assist us in developing the review approach and some standards for measurement, we used a panel of five consultants:

Dr. Byran T. Shaw, Retired
Former Administrator of the Agricultural Research Service

Dr. Coyt T. Wilson
Executive Associate Dean
Virginia Agricultural Experiment Station
Virginia Polytechnic Institute

Dr. C. Richard Shumway
Associate Professor of Agricultural Economics
Texas A & M University

Dr. B. W. Beadle, Vice President
Research and Development
Farmland Industries, Inc.

Dr. Robert L. Green, Acting Director
Maryland Agricultural Experiment Station
University of Maryland

We discussed the review approach and scope of work with ARS officials who agreed that the review would provide a fair assessment of the management of ARS research. In its comments (see app. IV), USDA said the report was constructive and offered worthwhile suggestions for improving ARS's managing and planning system. It agreed with most of our recommendations.

SCOPE OF AGRICULTURAL RESEARCH

Agricultural research covers a wide range of societal problems and needs. It involves gaining and applying knowledge to (1) biological, physical, and economic phases of producing, processing, and distributing farm and forest products, (2) consumer health and nutrition, and (3) social and economic aspects of rural living. USDA defines agricultural research as

- dealing with the discovery, combination, and synthesis of knowledge essential to continuing efficient production, marketing, and use of food, fiber, forest resources, clothing, and shelter under changing economic, social, and political conditions in the United States and the world;
- dealing with the protection of producers and consumers and with the wise use of natural resources;
- involving the elucidation of a broad spectrum of public policy alternatives and consequences for people on and off the farm; and
- including research designed to add basic knowledge that will advance these aims.

The diversity of agricultural research is further depicted by the almost 100 research problem areas (see app. II) which have been developed for classifying the research being conducted by the Federal-State research system. Examples of such areas are

- conservation and efficient use of water;
- control of insects, mites, snails, and slugs affecting field crops and range;
- genetics and breeding of forest trees;
- bees and other pollinating insects;
- reproductive performance of livestock, poultry, and other animals;

- improvements of grades and standards--crop and animal products;
- technical assistance to developing countries;
- food choices, habits, and consumption;
- human nutrition;
- causes of poverty among rural people; and
- fish and other marine life, fur-bearing animals and other wildlife.

ORGANIZATIONS INVOLVED IN PUBLICLY SUPPORTED AGRICULTURAL RESEARCH

Agricultural research is carried out or supported by a large number of Federal and State agencies. Federal agencies supporting agricultural research include

- USDA;
- National Bureau of Standards, Department of Commerce;
- National Oceanic and Atmospheric Administration, Department of Commerce;
- Department of Defense;
- National Institutes of Health, Department of Health, Education, and Welfare;
- Department of the Interior;
- Agency for International Development, Department of State;
- Department of Transportation;
- Energy Research and Development Administration;
- Environmental Protection Agency;
- National Science Foundation; and
- Tennessee Valley Authority.

In addition, agricultural research is supported by each of the 50 States, Puerto Rico, the Virgin Islands, Guam, and the District of Columbia.

USDA estimates that about 95 percent of the publicly supported agricultural research is conducted by 5 USDA agencies--ARS, Economic Research Service, Forest Service, Farmer Cooperative Service, and Statistical Reporting Service; 56 State agricultural experiment stations; 15 schools of forestry; 16 land-grant colleges of 1890; and Tuskegee Institute. This group is known as the Federal-State agricultural research system.

Federal support of agricultural research administered by USDA began with the Organic Act of 1862 (7 U.S.C. 2201, et. seq.). Additional authorizing acts included the Hatch Act of 1887, as amended (7 U.S.C. 361a); the McSweeney-McNary Forestry Research Act of 1928, as amended (16 U.S.C. 581); the McIntire-Stennis Act of 1962 (16 U.S.C. 582a); and the act of August 4, 1965 (7 U.S.C. 450i). These and other acts authorizing Federal funds for agricultural research and the roles of the principal performing organizations are discussed in more detail in our April 9, 1976, staff study entitled, "Agricultural Research--Its Organization and Management," RED-76-92.

The following table shows, by source, the dollars spent in fiscal year 1975 for agricultural research by the organizations within the Federal-State system.

Organization	Research dollars expended in fiscal year 1975 by source						
	USDA (note a)	Other Federal agencies	Total	State Government	Industry	Other sources (note b)	Total
----- (000 omitted) -----							
USDA agencies:							
Agricultural Research Service	\$215,933	\$ 7,522	\$223,455	-	-	\$ 640	\$224,095
Economic Research Service	22,218	853	23,071	-	-	41	23,112
Forest Service	73,396	4,308	77,704	-	-	215	77,919
Statistical Reporting Service	660	-	660	-	-	-	660
Farmer Cooperative Service	1,264	-	1,264	-	-	-	1,264
Total USDA agencies	\$313,471	\$12,683	\$326,154	-	-	\$ 896	\$327,050
State agencies:							
State agricultural experiment stations	\$ 93,306	\$34,178	\$127,484	\$279,821	\$23,473	\$51,407	\$482,185
Forestry schools	2,007	1,065	3,072	4,868	554	878	9,372
Land-grant colleges of 1890 and Tuskegee Institute	7,769	58	7,827	-	-	42	7,869
Total State agencies	\$103,082	\$35,301	\$138,383	\$284,689	\$24,027	\$52,327	\$499,425
Total--All agencies	\$416,553	\$47,984	\$464,537	\$284,689	\$24,027	\$53,223	\$826,476

a Funds expended by USDA's Cooperative State Research Service for research administration not included.

b Product sales, local governments, professional societies, individuals, and other sources.

Note Due to rounding, totals may not foot and crossfoot.

Source: USDA's inventory of agricultural research.

AGRICULTURAL RESEARCH SERVICE

ARS, the largest research organization in the Federal-State research system, was established by the Secretary of Agriculture on November 2, 1953, under authority of Reorganization Plan No. 2 of 1953 and other authorities to consolidate most of the physical, biological, chemical, and engineering research done by USDA. Its overall mission is to develop new knowledge and technology to help insure an abundance of high quality agricultural commodities and products at reasonable prices and to provide for continued improvement in the standard of living of all Americans. ARS conducts basic, applied, and developmental research in the fields of livestock; crops; pest control; soil, water, and air resources; environmental quality; domestic and export marketing; use of agricultural products; food and nutrition; consumer services; rural and international development; and agriculturally related health hazards, including food safety.

ARS's research is tied into USDA's missions of agricultural production efficiency, agricultural marketing efficiency, agricultural exports, rural development, environmental improvement and resource development and use, consumer services and human resource development, food and nutrition, and foreign agricultural development. It is categorized under 67 national programs and 8 special programs (see app. III), about 1,100 work reporting units (WRUs) (specified research work by locations), and about 3,100 individual research projects.

In July 1972, ARS was reorganized to promote a multidisciplinary approach to research, increase responsiveness to new research problem areas, decentralize line decisionmaking, and increase capabilities for cooperating and integrating research programs with the State agricultural experiment stations. Before the reorganization, ARS research was carried out under the direction of several separate divisions. Currently, ARS, headed by an Administrator, is geographically decentralized into 4 regions, each headed by a deputy administrator, and 27 areas and centers, each headed by a director. Each WRU is headed by a research leader. ARS employs about 8,500 people, including about 2,700 scientists, to carry out its research programs at about 145 locations in 47 States and the District of Columbia. In addition, ARS has two overseas offices in Rome, Italy, and New Delhi, India.

During fiscal year 1976, ARS spent about \$290 million in carrying out its research activities. Of this, about 98 percent was spent on research done in-house.

CHAPTER 2

AGRICULTURAL RESEARCH ACCOMPLISHMENTS AND BENEFITS

AND THE ROLE OF THE AGRICULTURAL RESEARCH SERVICE

The accomplishments of agricultural research have been described as one of the miracles of the century. Improved fertilizers, seeds, irrigation, and chemicals and methods to control weeds, plant diseases, and insects have helped to increase yield for each crop acre over 60 percent since 1950. Improved breeds, breeding techniques, feeding plans, and chemical, biological, and other methods to control diseases and pests have increased the quality and quantity of livestock and poultry. During this period, agricultural output per man-hour has increased at an annual rate of about 5 percent, compared with about 2 percent for all nonfarm industries.

In March 1976, USDA reported that

- farmers today produce over 53 percent more crops on 6 percent fewer acres than did their fathers,
- 1 hour of farm labor today produces about 9 times as much food and other crops as it did in the 1919-21 period, and
- 1 farmworker now supplies enough food and fiber for 56 people--27 more than he could 10 years ago.

USDA also reported that agricultural scientists have made major contributions to society in fields other than food and fiber production. As examples, it reported that agricultural scientists had

- dramatically advanced the processing of protein concentrates from soybeans, peanuts, and cottonseeds;
- developed a process of fortifying wheat and other grains with extra protein;
- upgraded the protein value of grain through improved crop breeding practices;

- linked an insect vector (carrier) to the spread of disease;
- developed techniques for mass production of penicillin and, subsequently, other drugs;
- done research that led to the discovery of (1) niacin, the cure for pellagra, and (2) the importance of iodine in metabolism;
- discovered that vitamin D could be supplied by direct radiation of ultraviolet light, which resulted in the elimination of rickets in humans and animals; and
- discovered streptomycin, an antibiotic used in the treatment of tuberculosis.

Many of the benefits of agricultural research accomplishments cannot be measured. They are, however, reflected in such things as an abundant supply of food, fiber, and forest products for the American consumers; the relatively low cost the American consumer pays for food; the quantity of land needed to support an ever-expanding population; the improved nutritional value and quality of food available for human and animal consumption; the large amount of U.S. agricultural exports; and the elimination or control of dreaded diseases in both animals and humans.

To identify ARS's role in agricultural research, we asked ARS for a list of what it considered its most important research accomplishments. It provided 43. During the review, we obtained views from 37 officials outside USDA as to the importance of ARS's role in these accomplishments. While none of the officials could comment on ARS's role in all 43 accomplishments, collectively they generally viewed ARS as playing a major role in the accomplishments. Among the accomplishments ARS cited were the following:

- Marek's disease vaccine: The development of this vaccine is considered to be one of the most important breakthroughs in the history of poultry science. Also, because Marek's disease is a cancer in chickens, the vaccine is hailed as the most outstanding development in the virus-in-cancer field in the last decade or two. ARS estimates that worldwide use of the vaccine has resulted in savings of about \$180 million annually.

--Range improvement: Agricultural research has resulted in technology for eradicating undesirable brush and grass that reduce the production of desirable forages on 75 million acres of western rangeland. Eradication of creosote bush, tarbush, and chapparal plus reseeding with desirable grasses can increase production of grass from 10 pounds an acre to 750 pounds; eradicating mesquite increases grass production from 23 pounds an acre to 300 pounds; converting cheatgrass-infested land to wheat grass increases production from 50 pounds an acre to 1,950 pounds; and seeding abandoned land in the ponderosa pine zone increases production from 50 pounds an acre to 1,430 pounds.

--Soybean miracle: During the past three decades, soybeans have developed from a minor crop to a grain crop of vast importance. USDA scientists made many basic contributions to this transformation. One was the introduction of about 5,000 lines and varieties for breeding stock. Plant breeders, plant pathologists, nematologists, weed scientists, and chemists collectively have skillfully used genetic resources to literally remake the plant to meet the needs of growers and consumers in the United States and the world for soybeans and soybean products.

--Improved weed control technology: USDA scientists have played a major role in developing improved cultural, ecological, biological, chemical, mechanical, and integrated methods of weed control since 1940. This technology is currently used to reduce losses caused by weeds, resulting in annual production savings of \$2 billion. Also, reductions in weed control costs through improved technology results in annual net savings of more than \$500 million. Effective, safe, and economical chemical weed control practices are now used on about 200 million acres of crop and noncropland. About 50 percent of the total harvested crop acreage was treated with herbicides for weed control in 1975. Improved cultural methods of weed control are now used on more than 300 million acres of crops each year.

Other accomplishments in which ARS played a major role include

--the sterile male technique for control of insect pests,

--flame resistance for popular clothing fabrics,

--durable press cotton,
--frozen concentrated orange juice,
--commercial penicillin production,
--efficient irrigation systems, and
--the role of ribonucleic acid in protein synthesis.

CHAPTER 3

A NATIONAL PLAN NEEDED FOR GUIDING AGRICULTURAL RESEARCH

While the publicly supported agricultural research system has made major contributions in dealing with a wide range of societal problems and needs, there is an increasing realization that some overall policies, goals, objectives, and priorities need to be established and kept up-to-date if the system is to be responsive to critical future problems and needs and if limited public dollars are to be wisely used. Some attempts have been made to provide overall guidance but they have not completely filled the need.

Legislation which would have required development and maintenance of a national agricultural research plan passed the House during the 94th Congress but was not acted on by the Senate. The 95th Congress is considering similar legislation. (See pp. 17 and 18.)

AGRICULTURAL RESEARCH PLANNING IS FRAGMENTED

The agricultural research system is highly diversified, with each of the Federal and State agencies involved in the system being highly autonomous and, to a great extent, independently deciding on the research to be carried out. Some overall planning has been attempted but it has not solved the fragmentation problem and an up-to-date national agricultural research plan has not been maintained.

In 1966, at the direction of the Senate Committee on Appropriations, the Department of Agriculture and the State agricultural experiment stations developed a national plan for agricultural research. Among other things, the plan presented strengths and weaknesses in agricultural research, identified future problems facing agriculture and forestry, and projected resource needs for 1972 and for 1977.

Since then, however, this plan has not been updated to show major developments affecting agriculture, including (1) increased cost and possible future shortages of energy,

(2) increased emphasis on, and new requirements for, maintaining the environment, (3) increased emphasis on rural development, and (4) increased world demand for agricultural products.

In June 1969, the Secretary of Agriculture established the Agricultural Research Policy Advisory Committee (ARPAC) to provide central focus and oversight over agricultural research through the development of policy recommendations for planning, evaluating, coordinating, and supporting unified long-range agricultural research programs. The committee is comprised of (1) representatives from USDA and its various agencies, (2) the National Association of State Universities and Land-Grant Colleges, and (3) the Agricultural Research Institute--a nonprofit organization that brings together agricultural research managers from the Federal Government, the academic community, and industry. The national planning activities are carried out mainly by an ARPAC subcommittee known as the national planning committee.

While ARPAC has provided a forum for centralized planning, fragmentation has not been eliminated.

Since its inception, ARPAC has established separate national ad hoc groups to

- identify high-priority research needs for cotton;
- coordinate soybean research financed by Federal, State, and private sources;
- identify research needed to improve transportation for agriculture and rural America;
- provide a framework of proposed actions and policies within which the agricultural science community can move to meet its responsibility to minimize genetic vulnerability of major crops;
- report on the dairy-forage research programs and facilities in the United States;
- examine and appraise land-use issues determined to be important during the next 10 years and identify-- in priority order--social, economic, and biological decisions related to the identified issues;
- identify range and forage research needs for red meat production; and

--establish a definition of agricultural energy research and development, identify agricultural energy research problems and assign relative priorities, catalog and evaluate on-going energy research and development within the publicly supported agricultural research system, and recommend appropriate shifts in existing resources and new endeavors necessary to mount and sustain an effective national agricultural energy research and development program.

The ad hoc groups' reports, issued over several years, identify agricultural problems and needs and set research priorities within each of the areas studied. They do not, however, correlate research needs and priorities of each area with those of the other areas studied or of the many additional areas covered by the highly diversified research system. In essence, each report represents a national plan for the subject area studied at a specific time.

In July 1975, ARPAC sponsored a national conference to identify research problems related to the Nation's capacity to meet domestic and international food needs. The conference participants, representing producers and processors of agricultural products, marketing firms, national farm organizations, farm labor groups, professional associations and societies, and Federal and State research and extension agencies, identified 1,011 important problems.

In follow-on action, ARPAC appointed an ad hoc group to review, evaluate, and recommend needed action on (1) the 101 most important problems--the top 10 percent of the 1,011 problems--and (2) other problems identified by the National Academy of Sciences' Board on Agriculture and Renewable Resources. (See p. 16.) The group assessed a total of 134 problems and made recommendations on such things as additional resources needed, where the research focus should be, and ways to better coordinate the research carried out by the performing organizations. For the other problems identified by the national conference, the group only stated that (1) most must be solved if the world food needs were to be met and (2) the current research on most of these problems should be continued and, in many cases, strengthened. The group did not identify the latter cases.

ARPAC also directed the establishment of four regional research planning committees--Northeastern, North Central, Southern, and Western--in 1971. The committees were given a great deal of freedom to organize and carry out their planning functions. They were permitted to charter up to

7 broad research program groups and as many as 47 task forces to assist in carrying out regional planning activities.

The regional committees, which developed different planning approaches, have made limited contributions to agricultural research planning from a national standpoint. For example, under crops, one of the seven broad research program groups, each regional committee organized its planning efforts differently, as follows:

- The Southern region established separate planning task forces for corn and grain sorghum; wheat and other small grains; rice; soybeans; peanuts; sugar crops; forage, range, and pasture; fruits and nuts; vegetable crops; natural beauty--plants to enhance the environment; and bees and pollinating insects.
- The Northeastern region established separate planning groups for fruits and for vegetables, each with subgroups on breeding, production systems, pest management, and marketing.
- The Western region established separate planning task forces for small grains, with emphasis on wheat; tropical agriculture, primarily food production; and seed production and technology.
- The North Central region established advisory committees for horticultural crops, field and forage crops, agricultural economics, agricultural engineering, entomology and economic zoology, and food science and nutrition.

Although in a few cases these groups provided input to the reports of the national ad hoc groups referred to on page 13, most of their work has been regional in scope. From July 1973 through October 1976, the various groups issued 41 separate regional planning reports. Each dealt with research needs and priorities in the particular region.

In addition to the groups within the Federal-State agricultural research system, outside groups have issued reports on agricultural problems and related research needs and priorities. For example, under a grant from the National Science Foundation, the Massachusetts Institute of Technology issued a report in December 1975 entitled, "Protein Resources and Technology: Status and Research Needs." That report identified 14 high-priority food-related research areas for support by the Foundation. Of these, the highest priority was assigned to research to (1) evaluate protein

requirements of humans, (2) improve existing biochemical and biological methods for evaluating protein quality, and (3) evaluate toxicological hazards associated with new protein sources and new protein processes.

Also, in response to a December 1974 request from the President, the National Academy of Sciences assessed the nature and magnitude of research designed to assist in coping with world food and nutrition problems. As part of that review, the Academy's Board on Agriculture and Renewable Resources issued a report in November 1975 entitled, "World Food and Nutrition Study, Enhancement of Food Production for the United States." The Board made specific recommendations in 10 research areas which it considered needed to be strengthened to meet short-term and long-term food requirements. The first three of these areas, which were considered high-priority, were photosynthesis, biological nitrogen fixation, and genetic manipulations of plants beyond those of conventional breeding methods.

Another report entitled, "World Food and Nutrition Study, The Potential Contributions of Research," issued in June 1977, included a recommendation that the United States increase its support for high-priority research identified within 22 research areas. These areas, which were not ranked as to priority, were:

- | | |
|---|--|
| --Nutrition--performance relations | --Irrigation and water management |
| --Role of dietary components | --Fertilizer sources |
| --Policies affecting nutrition | --Ruminant livestock |
| --Nutrition intervention programs | --Aquatic food sources |
| --Plant breeding and genetic manipulation | --National food policies and organizations |
| --Biological nitrogen fixation | --Farm production systems |
| --Photosynthesis | --Postharvest losses |
| --Management of tropical soils | --Market expansion |
| --Resistance to environmental stresses | --Trade policy |

--Pest management

--Food reserves

--Weather and climate

--Information systems

According to the report, these areas were selected because of the likelihood that important advances toward the broad goal of each area were feasible and would greatly contribute to improving the world food and nutrition situation.

OTHER ASSESSMENTS OF THE AGRICULTURAL RESEARCH SYSTEM

The agricultural research system has undergone two extensive reviews in recent years. The National Academy of Sciences' Board on Agriculture and Renewable Resources reviewed the system in conjunction with its above-mentioned assessment of the nature and magnitude of research designed to assist in coping with world food and nutrition problems. Also, during the 94th Congress, two Subcommittees of the House Committee on Science and Technology--the Subcommittees on Science, Research, and Technology and on Domestic and International Scientific Planning and Analysis--made an extensive review of agricultural research and development. As part of their review, the Subcommittees held special oversight hearings in June, September, and October 1975, during which scientists and other knowledgeable people from the Federal Government, the academic community, and private industry presented views on the system's strengths and weaknesses. The Subcommittees reported their findings, conclusions, and recommendations in August 1976. (House Committee on Science and Technology, 94th Cong., 2d Sess., special oversight review of agricultural research and development, Comm. print 1976.)

In each of these reviews, the agricultural research system was, for the most part, favorably viewed. The Board said that the success of the agricultural industry in this country indicated the relative effectiveness with which the separate components of the system had responded to the needs of the agricultural and food industry. The Subcommittees said that they found that the system had no present equal and had served the country well in helping it to meet domestic and international food needs.

Notwithstanding the system's merits, however, criticisms were raised on some of its aspects. For example, the Board said that the system did not place enough emphasis on fundamental research undergirding food production technology; was slow to incorporate such factors as energy, environment, and social, political, economic, and military constraints into its planning activities; and

underfunded important areas of research, such as human nutrition, nitrogen fixation, photosynthesis, and genetic manipulations of major crops. Some of these weaknesses were also cited by leading scientists during the Subcommittees' hearings. Both groups concluded that national policies and/or strategies were needed for strengthening the Nation's agricultural research programs.

The Board said that there was an urgent need to establish national goals and policies in food and nutrition research, including an improved institutional framework for reporting, observing, and managing the wide range of food-related research activities. It recommended establishing a national agricultural research policy advisory council, providing representation from, communication with, and consideration of the total agricultural research system, to devise national policies and strategies for strengthening agricultural research.

The Subcommittees said that the system, which shoulders much of the responsibility for the Nation's well-being, would benefit from guidance on critical policy issues related to its work. They said that trade-offs would always be necessary to fulfill the objectives of agricultural research within the prevailing economic, social, and political framework and that a clearly defined national policy for agricultural research was needed to help agricultural researchers make these decisions.

PROPOSED LEGISLATION WOULD REQUIRE
A NATIONAL PLAN BE DEVELOPED
AND MAINTAINED FOR AGRICULTURAL RESEARCH

As of July 22, 1977, the 95th Congress was considering several bills which would provide for the development and maintenance of a national plan for agricultural research. These included H.R. 78, H.R. 2223, H.R. 4863, H.R. 7171, and S. 248.

H.R. 78 and S. 248 would establish a National Agricultural Research Policy Advisory Board and require it to report to the President and certain congressional committees by January 31 of each year on its activities during the preceding fiscal year. The second annual report would include a long-range plan for agricultural research to be updated every 5 years.

H.R. 2223 and 4863 would require the Secretary of Agriculture to report to the President and the Congress by December 31 of each year on the Nation's agricultural research activities. The annual report would include a

5-year national agricultural research plan, updated annually, covering all phases of agricultural research. The plan would indicate overall present and future agricultural research priorities for both domestic and international agricultural needs.

H.R. 7171 would require the Secretary of Agriculture to report to the President and the Congress by December 31 of each year on the Nation's agricultural research, extension, and teaching activities. The annual report would include a 5-year national agricultural research, extension, and teaching plan, updated annually, covering all phases of the food and agricultural sciences. The plan would indicate overall present and future agricultural research, extension, and teaching and manpower development priorities for both domestic and international needs.

Bills similar to H.R. 78 and S. 248 (H.R. 11743 and S. 3549) were introduced in the 94th Congress, 2d Session. On July 26, 1976, the House voted 373 to 7 in favor of H.R. 11743. The Senate took no action on either bill.

CONCLUSIONS

The extremely complex agricultural research system, carried out and/or supported by a large number of Federal and State agencies, has greatly contributed to the Nation's well-being. To help insure that it is responsive to future critical problems and needs and that limited public dollars are wisely used, however, an up-to-date plan outlining national policies, goals, objectives, and priorities is needed.

Whether or not the Congress requires the development and maintenance of a national agricultural research plan, the Secretary of Agriculture should direct that a national agricultural research plan be maintained. ARPAC, which was established by the Secretary in 1969, could be assigned the responsibility for maintaining that plan. If it is, however, ARPAC would need to establish a more structured and centralized planning system to effect the coordination and continuity required to develop definitive national policies, goals, objectives, and priorities for the highly diversified agricultural research programs.

RECOMMENDATION TO THE SECRETARY OF AGRICULTURE

We recommend that, whether or not the Congress enacts legislation requiring a national agricultural research plan, the Secretary of Agriculture take necessary steps to have such a plan developed and maintained.

USDA COMMENTS AND OUR EVALUATION

USDA agreed that improvements were needed in long-range planning. (See app. IV.) It noted that a large number of Federal and State agencies were involved in agricultural research and said that a great deal of interagency planning and cooperation needed to be accomplished collectively under USDA leadership. It did not take a position on our recommendation but referred to some USDA, ARS, and ARPAC activities which it called "national planning efforts."

Our review of these activities showed that they do not provide for developing and maintaining an up-to-date national plan for agricultural research. We believe that these activities further support our positions that the planning for agricultural research is fragmented and that a more structured and centralized planning system is needed for guiding the extremely complex and highly diversified agricultural research system.

USDA said that, although the 1966 agricultural research plan had not been updated, specific programs have been updated. We recognize that national plans have been developed for certain research areas. However, as noted on page 13, the plans identify research needs and set priorities within each of the areas without correlating the needs and priorities of each area with those of other areas studied or of the many additional areas covered by agricultural research. The national plan, which we are recommending, should provide for such correlation.

CHAPTER 4

RESEARCH PRIORITIES SHOULD BE IDENTIFIED

AND DOCUMENTED TO ASSIST ARS IN PLANNING

AND MANAGING ITS RESEARCH

The Agricultural Research Service's long-range plans consist essentially of individual plans for 67 national and 8 special research programs. (See app. III.) The individual plans, while generally viewed by knowledgeable scientists as comprehensive and covering major problem areas, do not outline a strategy for being carried forward, including identifying relative priorities both of the 75 programs and of the problems and needs within each program. Further, much of the technical and administrative data needed for developing that strategy was either unavailable, inaccurate, or fragmented.

Although several factors, including staff specialization, the location of existing facilities, congressional direction, and the long-term nature of many research projects, affect ARS's planning flexibility, priorities must be set if ARS is to use its available and anticipated resources most effectively. Since scientist turnover in ARS could be as much as 40 percent over the next 5 years and scientists have a tendency to become highly specialized in finite areas (see pp. 22 and 23), assigning priorities to guide recruitment efforts during this period will be especially critical to the long-range direction of ARS research.

IMPROVEMENTS IN ARS'S LONG-RANGE PLANNING

Before our review, ARS had placed most of its emphasis on short-range planning and much less on long-range planning. Recognizing the need for better long-range planning, however, ARS has implemented a revised system (called MAPS) for managing and planning its research. This system implemented in fiscal year 1977, involves the categorization of ARS research under 67 national and 8 special research programs. Previously ARS research had been categorized under about 300 research activities.

For each of the 75 program areas, ARS developed a formal long-range plan documenting (1) the needed technologies that could reasonably be developed in 10 years or less within the current level of research effort, (2) the research approaches that could contribute to these visualized technologies, and (3) the consequences, both with and without the research planned. The plans, which ARS intends to update about every 5 years, were based on inputs from ARS scientists, administrators, and staff and from the Agricultural Research Policy Advisory Committee, other advisory groups, producers, agribusiness, other Department of Agriculture agencies, other Federal agencies, the Office of Management and Budget, and the Congress.

The new program structure provides the framework for planning, reporting, evaluating, budgeting, and executing research. The Senate Committee on Appropriations has said that it agrees with the system's objectives and that use of the system could assist the Committee in its annual and long-range budget deliberations. It directed ARS to submit with its annual budget a detailed listing of each program showing (1) the prior, current, and budget year funding and (2) estimated requirements for 5 years beyond the budget year. 1/

ASSESSMENT OF THE ARS PLANS

During our review we asked knowledgeable scientists outside USDA to review and comment on the adequacy of the plans for the seven national research programs included in our review scope. (See p. 1.) For each program, we received comments from five to nine scientists, some of whom had previously provided input to ARS on program drafts. Generally the scientists said that the plans were very comprehensive and covered the major problem areas. However, some questioned whether ARS could accomplish all of the identified visualized technologies within the specified timeframes and resources. Others noted that the plans did not identify the relative priorities of the problems and needs discussed within each of the program areas.

We noted that ARS had not developed a strategy for implementing its plans, including the establishment of the relative priorities of the 75 program areas. We noted also that much of the technical and administrative data needed for developing that strategy was either unavailable, inaccurate, or fragmented. This data includes progress and

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S. Rept. No. 95-296, 95th Cong., 1st Sess., 12.

anticipated benefits of ongoing work; results and lessons learned on completed work; and personnel information, such as primary and secondary disciplines, experiences, training, and potential attrition by discipline and by location.

During ARS's 1975 Senior Staff Conference, an ARS work group on long-range planning said that not enough information was available to determine the relative priorities among the national research programs. Also, ARS officials told us that all of the information needed for effective long-range planning is still not available and much of the information that is available is fragmented and cannot be used without extensive analyses and manual consolidations.

According to ARS officials, copies of the national research program plans are given to ARS scientists and managers to inform them of how their work relates and contributes to ARS's overall missions, goals, and objectives and for their use in formulating and managing their work. Without knowing research priorities, however, ARS managers and scientists are not fully aware of the relative ranking of their research areas and are not in the best position to make short-range or long-range decisions on such things as the research projects to initiate and approve; the action to take on ongoing research; the hiring, training, and reassignment of scientists, technicians, and support personnel; the replacement of equipment; and the renovation of laboratories. According to one ARS headquarters official, ARS managers and scientists do not have a clear understanding of the relative priority of the research under their span of control and the lack of such knowledge adversely affects their decisionmaking abilities and causes morale problems.

Although each of the above decision areas is important and necessary for doing effective research and using available resources efficiently, the decisions made when career scientists are hired are very critical to the direction of ARS research.

Currently, ARS employs about 2,700 career scientists of varying disciplines to conduct about 98 percent of its research. Many of these scientists have become highly specialized in finite areas and, according to some ARS officials, it is difficult to get them to conduct research outside their primary areas of expertise or interest. Accordingly, the extent to which ARS can respond to changing research needs at any specific time is largely determined by the scientists it has.

ARS has projected that 40 percent of its scientists will be eligible for retirement within the next 5 years. Thus, although not all of the scientists may retire when eligible, ARS will have a good opportunity in the next few years to employ the complement of scientific disciplines needed to address new and different problems that will be facing agriculture in the future. However, unless ARS managers are told of the priority of future research needs, they may not hire the best people to do the research that will need to be done.

CONCLUSIONS

ARS's development of plans for its national and special research programs was an important and necessary achievement because visible and detailed plans are needed to guide individual decisions at all ARS operational levels. In the view of knowledgeable scientists from outside USDA, the programs are very comprehensive and cover the major problem areas within each subject area.

However, to enable ARS managers and scientists to be in the best position to plan and manage the research called for in these programs, ARS should identify and document the relative priorities, both of the 75 programs and of the problems or research needs within each program area. Also, ARS should determine what further technical and administrative information is needed and how the information can best be assembled for effective implementation of the long-range plans, including establishing research priorities. These efforts should help ARS to better estimate the long-range funding requirements directed by the Senate Committee on Appropriations.

Identifying and documenting research priorities could be very critical to the long-range direction of ARS research due to the large number of ARS scientists that will be eligible for retirement within the next 5 years. Since career scientists tend to become highly specialized in finite areas, it is important that the decisionmakers know the relative priorities of future research needs so that they may best decide on the expertise needed to fully address those needs.

RECOMMENDATION TO THE SECRETARY OF AGRICULTURE

We recommend that the Secretary of Agriculture direct ARS to identify and document the relative priorities of each national research program and of each problem and research need within the program areas and to assemble the information needed for effective implementation of its long-range plans.

USDA COMMENTS AND OUR EVALUATION

USDA concurred in our recommendation but noted that ARS had made some efforts to develop short-range priorities. (See app. IV.) It agreed, however, that there was a need for a systematic and documented approach to setting priorities to make sure that scarce resources are allocated to competing programs on the basis of needs and opportunities. USDA said that improvements could and would be made both in the process of establishing priorities and in communicating the results more explicitly and widely throughout ARS.

USDA said that ARS would address the need for a systematic and documented approach for setting priorities during its study to improve ARS's managing and planning system. That study, initiated by ARS in June 1977, is scheduled to be completed in September 1978.

USDA agreed also that better long-range planning was needed and said that it would be emphasized during the current ARS study. It also said that ARS was trying to assemble the information needed to effectively implement its long-range plans.

We believe that the actions initiated by ARS should help to improve its long-range planning system.

CHAPTER 5

IMPROVEMENTS NEEDED IN ARS'S PROCESS

FOR APPROVING INDIVIDUAL RESEARCH PROPOSALS

Although the Agricultural Research Service has in place many elements of an effective approval process for research proposals, some of these elements are either used inadequately, lacking scope, or not implemented agencywide. Much of ARS's in-house research has been approved without the reviewing officials having available to them (1) enough information to assess its scientific and technical merits, (2) agencywide criteria for assigning it priorities, (3) technical advisors' assessments of its merits, (4) initiators' certifications that it was coordinated with other ongoing or completed work, and (5) information on past research approaches or results that were counter-productive or unproductive.

Both administrative and organizational improvements are needed in ARS to enhance the effectiveness of the approval process and to provide assurance that research projects with the highest possible degree of scientific and technical merit are consistently approved and funded. One of these improvements could be an agencywide peer review system.

In 1972 a panel of scientists from the Federal Government and the academic community questioned the quality of some of the agricultural research conducted by ARS, State agricultural experiment stations, and other research organizations within the Federal-State research system. While we did not assess research quality, we noted that ARS's present approval process does not provide the controls necessary to prevent the selection of questionable research projects.

LIMITED INFORMATION ON RESEARCH PROPOSALS

An in-house research proposal is prepared by the researcher who will have the leadership role in the project and is reviewed, concurred in, or approved by officials at various organizational levels. These include, among others,

the research leader, the area director, the regional deputy administrator, and the cognizant national program staff (NPS) scientists.

ARS procedures require researchers to describe the objectives and approach of their research proposals within 1,600 characters, or about 20 typewritten, 80-space lines. In most cases, this limited documentation was all that was available in writing to ARS officials at the time they reviewed research proposals.

The 1,600-character limitation exists because the document used to formally approve research is the same one used to enter project information in the Current Research Information System (CRIS). This system, operated by USDA's Cooperative State Research Service and the State agricultural experiment stations, is automated and accumulates, in one place, management and scientific information on each of some 24,000 active research projects in the Federal-State system. As designed, the system is capable of handling only about 2,400 characters for documenting each project's objectives, approach, and future progress.

Our analysis of the documentation for the 91 research projects included in our sample showed that generally the research objectives and approach were written in broad and general terms and did not clearly state the problem that the research was to address, the justification for doing the research, and the "state of the art." Our consultants said that all of these factors were necessary components of a research project outline. Following is the description of one research project included in our sample.

OBJECTIVES: Improve sorghum and pearl millet yield, ease of harvest, insect and disease resistance by means of genetic and plant breeding research.

APPROACH: Grow and study in the field and greenhouse available sorghum and pearl millet germplasm having potential commercial and breeding value. Improve present germplasm by hybridization and/or selection to effect improvement of such crop characters as experience indicates most important. Conduct experiments which will advance the science of plant breeding, develop better hybrid sorghum and pearl millet seed production techniques, and reveal the inheritance of sorghum and pearl millet characteristics.

In discussing the 1,600-character limitation with ARS scientists and certain key officials who were responsible for

research proposals, we were told that the research planned cannot be adequately described within the limitation and that it cannot be critically assessed for its scientific and technical merits. We were also told that, in some cases, scientists intentionally wrote their proposals in nonspecific terms to avoid making available to others the details of their work and to give themselves flexibility in carrying out their research.

At some locations we visited, supplemental procedures had been implemented to require the scientists to better document the research proposals. For example, ARS's Northeastern region required the scientists to attach to the official approval document a supplement describing in more detail the proposal's objectives, approach, plan of work, technical justification, scientific references, and any cooperative work arrangements. At other locations, scientists were required to prepare work plans, describing in more detail the objectives, approach, and technical aspects of the proposals. In contrast to describing the objectives and approach within 1,600 characters in the official approval document, scientists may use several pages to do this in the work plan.

Several key officials within the approval process told us that detailed work plans were the best means to get scientists to adequately document the technical aspects of research to be done and should be an integral part of ARS's project approval process.

LACK OF AGENCYWIDE CRITERIA FOR EVALUATING RESEARCH PROPOSALS

Under ARS's decentralized management system, a very large number of ARS personnel are involved in project approval. In our sample of 91 projects, a total of about 42 research leaders, 10 area directors, and 7 NPS scientists shared the responsibility for evaluating research proposals and deciding their merits. These officials were making decisions on the basis of professional judgment and experience and were not documenting their rationale. Such a process does not provide for agencywide consistency in project selection and assurance that the highest priority research is approved.

We believe that, in selecting specific research projects for funding--both basic and applied research--the merits of the proposed projects should be evaluated on the basis of agencywide criteria and be fully documented to provide visibility for the decisions made. The criteria could include the following factors, weighed to show their degree of

importance and applicability for either basic or applied research.

- The extent to which the research addresses a research need in a high-priority area.
- The probability of success. (If applied research, the likelihood that the innovation will be used.)
- When the results are needed and how long the project will take to complete.
- The urgency of the research.
- How much project results, if successful, will contribute to the success of other research projects.
- The likelihood that research results will not be available elsewhere.
- The benefits of research results in relation to cost.
- The scientific and technical merits of the research and its contribution to knowledge.
- The capabilities of the researcher and facilities to carry out the research.

ARS has developed criteria, similar to those above, for evaluating research proposals that are to be funded through its extramural programs and for deciding high-priority research to be included in its annual budget for increased funding. Such research, however, represents less than 15 percent of the research funded each year.

The use of agencywide criteria for selecting all research would build a higher degree of competition into the approval process and be used to establish the priority of individual research proposals. Also, it would provide top ARS management better information on which to approve research. Under this approach, individual judgments would not be eliminated, but the approval process would be more structured, visible, and explicit.

TECHNICAL ADVISORS ARE NOT USED
EFFECTIVELY IN PROPOSAL ASSESSMENT

ARS has designated some of its most technically competent scientists as technical advisors to help promote and foster

scientific excellence and technical communications within ARS. At the time of our review, 334 scientists had been designated as technical advisors. This action was taken because of a technical void which had existed between the researchers and their supervisors since ARS's 1972 reorganization. In many instances, the supervisors--research leaders and/or area or center directors--are of different disciplines and have different experiences than the researchers under their span of control and are not fully capable of providing technical leadership in certain program areas.

The technical advisors, however, were not required by ARS procedures and generally were not being used to review research proposals for their scientific merits and to advise the approving officials of their findings. Several ARS officials agreed that the quality of ARS research should improve if technical advisors were required to assess the scientific and technical merits of research proposals. They said that technical advisors should be an integral part of the project approval process.

INITIATORS NOT REQUIRED TO
CERTIFY THAT PROPOSED RESEARCH
WAS COORDINATED WITH RELATED RESEARCH

Within the Federal-State agricultural research system there are about 24,000 active research projects. Information on each of the projects is included in the CRIS system. The information includes the title of the research unit; the names of the principal investigator, the performing organization, and any cooperators; and a brief description of the research project, including its title, objectives, approach, current progress, and the more important publications issued.

ARS instructions state that the following are among the primary considerations in formulating and reviewing research proposals:

- The proposed work is integrated and coordinated with related work of other USDA research agencies and the State agricultural experiment stations and provisions made as needed for joint or cooperative planning and carrying out of the research.
- The project, in the light of the best available information, does not unnecessarily duplicate the research of other USDA research agencies or that of other Federal, State, or private agencies.

The instructions, however, do not require that the initiator of a proposal certify that the proposed research has been coordinated with other ongoing or completed work.

Of the 49 researchers we interviewed on this matter, 29 told us that they did not use CRIS to help identify related research because:

- Project information is out-of-date.
- Project information is either too limited, brief, or general to be of any use.
- It takes too long to make a retrieval.

In January 1975 a subcommittee of the Agricultural Research Policy Advisory Committee reported (1) deficiencies in CRIS similar to those the researchers identified and (2) a general lack of awareness among scientists about the capabilities of CRIS. The subcommittee made 22 recommendations, most of which were directed at improving the quality and use of CRIS.

In the latest (October 1976) status report on the implementation of the recommendations, the Director of CRIS reported that several steps had been or were being implemented to improve the quality of stored information and to better serve its users. We did not review CRIS or the adequacy of the corrective actions. However, in our opinion, the system should be used by ARS researchers for coordinating research proposals with related work because it will identify such things as the research area, the principal investigator, and the important publications.

LACK OF INFORMATION ON PAST WORK
THAT WAS NOT PRODUCTIVE

ARS does not require its scientists to document negative research findings and usually they are not documented and disseminated. Accordingly, other researchers and reviewing officials usually do not have information available to them on past research approaches and results that were counter-productive or unproductive.

ARS officials told us that negative findings should be documented and disseminated to other scientists because they represent valuable lessons learned and could help other researchers to better plan and carry out their research. One ARS official estimated that about 50 percent of all research work resulted in negative findings.

AN AGENCYWIDE PEER REVIEW SYSTEM
WOULD IMPROVE THE QUALITY OF ARS RESEARCH

Critical reviews of research proposals by well-qualified peers are widely accepted by the scientific community as the most practical method for identifying research excellence. Such reviews, particularly for basic and long-range research, can improve quality of research proposals, reject poorly conceived and insignificant proposals, and act as a deterrent to research duplication.

The National Institutes of Health (NIH) and the National Science Foundation (NSF), two large Federal research organizations, place a great deal of reliance on panels or groups of qualified scientists to assess the merits of research before approval. Their systems have been highly praised in recent years. In an April 1976 report, a biomedical research panel, appointed by the President, concluded that peer reviews were one of NIH's most valuable management tools. Also, in January 1976, the Subcommittee on Science, Research, and Technology of the House Committee on Science and Technology, after conducting oversight hearings on NSF's peer review procedures, concluded that no method superior to peer review had been found for judging the scientific merits of basic research proposals. The Subcommittee said that appropriate peer review procedures generally led to the support of proposals in a high-quality range.

ARS does not have a formalized agencywide peer review system, although various forms of peer review were used at some of its locations. The Northeastern Regional Office required that all new research proposals--research that does not continue or follow-on existing work--be reviewed by a peer panel, selected by the researcher preparing the proposal. Regional officials told us that the merits of this system had not been formally assessed but that they thought it had resulted in better planning by researchers, better documentation of proposals, and improvement in the overall quality of research within the region. Peer reviews were also being used at Clay Center, Nebraska; at the Southern Research Center, New Orleans, Louisiana; and at the Southern Weed Science Laboratory, Stoneville, Mississippi.

In our opinion the implementation of an agencywide peer review system would better insure the selection of quality research within ARS. Many ARS officials and scientists agreed with this opinion. The director of ARS's program analysis and coordination staff, although expressing some concern about the time and cost which could be involved,

told us that peer reviews would have a positive influence on research quality. Further, several area directors and regional program planning and review officials said that peer review was a good management tool and provided for a high-quality technical review of research proposals. Also, 38 of the 41 scientists who commented on peer review said that they would be receptive to a peer evaluation of their research proposals.

We visualize that the 334 technical advisors and other qualified scientists from within ARS would be the nucleus for an effective peer review system. They should be augmented, as necessary, by qualified scientists from other USDA research agencies, State agricultural experiment stations, other public and private universities, and industry. The use of technical advisors in such a system should provide for more effective use of their technical abilities and better foster scientific excellence in ARS research.

CONCLUSIONS

ARS needs an effective research approval process to insure that research projects that will best enable the achievement of ARS's objectives and goals are approved. Although ARS has many elements of an effective approval process in place, some elements are either used inadequately, lacking scope, or not implemented agencywide. Administrative and organizational improvements within ARS, such as adequate documentation for use in approving research proposals, agencywide criteria for review of project proposals, technical advisors being required to review proposals, researchers being required to certify that proposed research was coordinated with related research, information on unproductive past work, and implementation of an agencywide peer review system to provide for technical assessment of research proposals, could enhance the effectiveness of the approval process.

RECOMMENDATIONS TO THE SECRETARY OF AGRICULTURE

We recommend that the Secretary of Agriculture require ARS to

- better document research proposals to facilitate critical assessments of the scientific and technical merits;
- develop agencywide criteria for reviewing project proposals;

- make the technical advisors an integral part of the project approval process by requiring that they review research proposals for scientific and technical merit and document their determinations;
- modify procedures for initiating research projects to require researchers to certify, before approval, that CRIS has been searched and that the proposal has been coordinated with ongoing or completed research projects;
- have researchers document and disseminate negative research findings; and
- develop agencywide peer review procedures for assessing the scientific and technical merits of all research proposals. Technical advisors, other qualified ARS scientists, and qualified scientists from other USDA research agencies, State agricultural experiment stations, other public and private universities, and industry should be involved in the peer review system.

USDA COMMENTS AND OUR EVALUATION

USDA substantially concurred in our recommendations and outlined actions ARS was taking to implement them. (See app. IV.) It agreed that the technical aspects of research proposals need to be better documented and said that ARS would carefully examine the cost effectiveness of a more detailed project selection system--particularly the amount of paperwork and scientist time that could be involved--as part of the study to improve its managing and planning system.

USDA said that ARS would develop agencywide criteria for reviewing research proposals and that the factors listed on page 28 would be considered. It also said that ARS was reexamining the roles and functions of its technical advisors for assessing the merits of research proposals and that a firm policy on this matter would be developed after ARS's October 1977 senior staff conference.

USDA said that, although further improvements were needed in CRIS before it would be adequate for eliminating unnecessary research duplication, ARS had revised its procedures for initiating research proposals to encourage its scientists to use CRIS for coordinating their proposals with other research. USDA did not say, however, whether the scientists would be required to certify that CRIS had been searched. It said that ARS scientists were trained and motivated to do original work and that ARS depended on

its scientists to keep abreast of what their peers were doing. We believe that a certification requirement is needed to assure ARS that its scientists are aware of all research related to their proposals because many of the ARS scientists we talked to were not using CRIS to help stay abreast of related research.

USDA agreed that properly designed and executed research projects that do not generate new knowledge or potentially useful technology should be documented. It said that ARS would study this matter and take appropriate steps, if necessary, to document these results. USDA agreed also that a more uniform project selection system was needed within ARS. It said that ARS would evaluate the need for an agencywide peer review system, as well as the roles, responsibilities, and authorities of its line and staff officials, during its study to improve the managing and planning system.

USDA noted that too much paperwork could stifle innovativeness and creativity which are the fundamental building blocks for scientific discovery. We agree that the degree of paperwork should be fully considered in implementing these recommendations.

CHAPTER 6

REVIEW AND EVALUATION OF ONGOING

RESEARCH NEEDS IMPROVEMENT

The Agricultural Research Service uses various means for reviewing and evaluating the scientific and technical merits of individual ongoing research projects. These include informal contacts between and among scientists, research leaders, area and center directors, technical advisors, and national program staff scientists; annual reports and plans for the work reporting units; and formal program reviews and workshops. Because of various technical, administrative, or organizational shortcomings, ARS's review process is not as effective as it could be to make sure that ARS resources are being effectively and efficiently used.

INFORMAL REVIEWS

ARS relies heavily on informal contacts between and among its scientists and line and staff officials for reviewing technical and scientific aspects of individual ongoing projects. We observed the following shortcomings in those reviews.

First, as noted on page 29, many of ARS's research leaders and area or center directors were not fully capable of providing technical leadership in certain program areas under their span of control.

Second, ARS had designated research leaders as the first level of supervision but had not clearly delineated their duties and responsibilities. We were told that, as a result, the research leaders were carrying out their supervisory roles in varying degrees. For example, one area director said that only 4 of the 10 research leaders under his control had fully accepted their supervisory responsibilities.

Third, technical advisors were not required by ARS procedures to review the technical and scientific merits of ongoing work and usually were not performing this function unless requested. Many of the scientists and some area directors we interviewed said that they had never requested

a technical advisor to review the research under their span of control. Moreover, several ARS officials told us that technical advisors were not authorized additional travel funds to carry out their advisory duties. One technical advisor said that, because of insufficient travel funds, he would not make a trip as a technical advisor unless it could be tied into his own research work.

Fourth, although the NPS scientists are responsible, among other things, for making onsite reviews of research projects, the frequency of such reviews and how they are to be carried out are not specified by ARS procedures. We found instances where NPS scientists made several visits to the same location during a 1-year period and other instances where no visits had been made. Of the 58 scientists we interviewed, 13 said that their cognizant NPS scientist had not made an onsite review of their current work.

Fifth, except when an NPS scientist makes significant observations during an onsite review or has suggestions for improvements, there are no ARS-wide requirements for documenting informal reviews and generally the results were not documented. Accordingly, the frequency or extent to which the technical and scientific merits of the ongoing research projects are reviewed and the extent to which appropriate actions are taken as a result of such reviews cannot be measured.

Sixth, we observed that about 20 percent of ARS's scientists had very low publishing rates. Although there could be other reasons for some scientists' low publishing rates, this could indicate that low quality research was being done and that the review system was not as effective as it should be for identifying such research. According to our consultants, a scientist should be expected to publish one technical bulletin or one article in a reputable scientific journal each year. ARS officials agreed that this was an acceptable standard. For the period 1972 through 1976, we scheduled the number of articles published by about 1,400 scientists who had been employed by ARS for the 4-year period. We found that, during the 4 years, 118 scientists, or about 8 percent, had not published an article in a scientific journal; 98, or about 78 percent, had published only one article; and 74, or about 5 percent, had published two articles.

WRU REPORTS AND PLANS

ARS requires that the progress and future plans of its research be summarized and reported annually for each

of the about 1,100 WRUs. Each WRU report and plan, prepared by the research leader and scientists conducting the research, is to identify:

- The national research program objectives to which the research is directed.
- Other ARS locations where research is being conducted which complements or supplements the same national program objectives.
- The plan of work to be followed to accomplish the specified objectives.
- The names, grades, and titles of the scientists assigned to the WRU and the amount of time spent in the current fiscal year and the estimated amount of time to be spent in the next fiscal year.
- The research projects contributing to the WRU.
- The amount and source of funds expended in the current fiscal year and estimated to be spent in the next fiscal year.
- The planned duration of the WRU.
- The progress made in the current fiscal year toward achieving the research objectives.
- The need for and planned use of additional funds.

The reports and plans are reviewed by managers and staffs at the area, regional, and national levels.

Our review of about 80 WRU reports and plans showed that the documented progress and plan of work varied greatly in length and degree of specificity. The range was from two sentences to several pages.

We asked seven area directors whether the present reports and plans were adequate for meaningful technical reviews of ongoing research. Five said that they were not adequate, one said that a limited assessment could be made, and one said that they were adequate. ARS headquarters officials told us that the WRU report and plan was designed primarily for administrative control purposes and not for assessing the technical aspects of ongoing research.

PROGRAM REVIEWS AND WORKSHOPS

ARS procedures, while providing for formal program reviews and workshops, do not require that all research programs be periodically reviewed through these means.

ARS defines program reviews as in-depth, multidisciplinary reviews of research on a given commodity, function, or resource. They may cover all or part of a research program of a particular facility at a location; all or part of a research program at a given location; or all similar research being conducted in a production area, regional area, or nationwide. Each program review team is to include representatives from the national program staff, the program analysis and coordination staff, and the office of the regional deputy administrator. They may also include representatives from other USDA research and action agencies, State agricultural experiment stations, and industry. Recommendations stemming from a program review can have impacts ranging from minor to major changes in program direction, resource allocation, and facility operation.

ARS defines workshops as problem-solving or research-planning meetings or seminar-type sessions covering a specific subject matter area which may be function- or commodity-oriented in nature and national, regional, or local in scope. The objectives of workshops are to review and clarify the "state of the art" in a field or discipline, to identify problem areas, to coordinate research plans, and to provide opportunities for scientist-to-scientist interchange. They are planned, conducted, and attended by scientists with expertise in the field or discipline under review with inputs as needed from ARS line managers and staff.

We observed that program reviews and workshops were conducted by ARS on a selective basis and only covered a small part of its research programs in any one year. For example, during fiscal year 1976, ARS conducted seven workshops and two program reviews. One workshop covered a part of the research in one of the seven national research programs included in our review scope. ARS officials said that the low number of program reviews and workshops in fiscal year 1976 was due to the involvement of the NPS scientists and other headquarters officials in developing the 75 national and special research programs. They said that 38 program reviews and workshops have been held or are planned in fiscal year 1977.

REVIEW AND EVALUATION OF INDIVIDUAL
RESEARCH PROJECTS COULD BE IMPROVED
THROUGH THE WRU REPORTS AND PLANS

In September 1976 an ARS work group on improving the quality, timeliness, and use of ARS reports suggested that the research progress statement for the WRU report and plan include more technical information and be sent to technical advisors for tracking research progress. We agree with this suggestion. To serve this purpose, ARS would need to establish better guidelines and minimum requirements for guiding the preparation of these documents. As noted above, we observed wide variances in the individual WRU reports and plans we reviewed.

The use of the WRU report and plan for technical reviews would help to (1) insure that all research projects are periodically reviewed for technical and scientific merits, (2) make better use of the expertise of technical advisors in the review process, and (3) identify the research projects that should be scheduled for onsite reviews by NPS scientists and technical advisors. According to the National Academy of Sciences, critical onsite review of individual research projects is commonly accepted by the scientific community as the primary basis for ensuring a quality research effort and a wise use of resources.

CONCLUSIONS

ARS needs a more effective system for periodically reviewing and evaluating the technical and scientific aspects of individual ongoing research projects to ensure high quality research programs and wise use of resources. ARS uses various means for reviewing its research but, because of technical, administrative, or organizational shortcomings, these reviews were not as effective as they could have been. Improvements, such as documenting the results of informal reviews, expanding the scope of the WRU report and plan to include more technical aspects, and requiring technical advisors to review the WRU reports and plans, would enhance the review process.

RECOMMENDATIONS TO THE SECRETARY OF AGRICULTURE

We recommend that the Secretary of Agriculture require ARS to:

- Document all important findings, conclusions, and recommendations resulting from informal reviews of individual research projects. ARS now requires only that the NPS scientists document such matters.

- Redesign the WRU reports and plans to permit an assessment of the technical aspects of active research projects.
- Require that the WRU reports and plans be reviewed by the cognizant technical advisor to assess the technical and scientific merits of the ongoing projects and to identify those projects that should be scheduled for onsite reviews.

USDA COMMENTS AND OUR EVALUATION

USDA said it substantially agreed with our conclusions and outlined actions ARS was taking to implement our recommendations. (See app. IV.) It said that ARS was

- developing guidelines for documenting important findings, conclusions, and recommendations resulting from informal reviews of individual research projects;
- improving the WRU reports and plans to permit a better assessment of the technical aspects of ongoing research projects; and
- considering establishing a requirement that the WRU reports and plans be reviewed by the cognizant technical advisor.

We believe that full implementation of these actions will improve ARS's system for reviewing and evaluating ongoing research.

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JOHN R. STARK,
 EXECUTIVE DIRECTOR

Congress of the United States
 JOINT ECONOMIC COMMITTEE

(CREATED PURSUANT TO SEC. 5(a) OF PUBLIC LAW 394, 78TH CONGRESS)

WASHINGTON, D.C. 20510

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May 20, 1976

B-133192

The Honorable Elmer B. Staats
 Comptroller General
 United States General
 Accounting Office
 411 G Street
 Washington, D. C. 20548

Dear Mr. Staats:

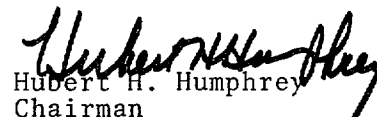
I would like the General Accounting Office to review agricultural research programs with particular emphasis on the Agricultural Research Service (ARS). The review should include an assessment of ARS's policies, procedures, and practices for planning research programs, including the establishment of objectives and the setting of priorities within established objectives; coordinating research with other agricultural research efforts, both nationally and internationally; selecting, monitoring, and evaluating on-going research; and disseminating research results.

If warranted by the review, I would like for your report to include recommendations on how ARS may improve its management functions to better insure the quality and effectiveness of its research programs.

If there are any questions concerning this request, please contact Mr. George Tyler of the Joint Economic Committee staff at 224-5171. I appreciate your help in analyzing this important and complex area.

Best wishes.

Sincerely,


 Hubert H. Humphrey
 Chairman

- I. INSURE A STABLE AND PRODUCTIVE AGRICULTURE FOR THE FUTURE THROUGH WISE MANAGEMENT OF NATURAL RESOURCES
- Appraisal of Soil Resources
 - Soil, Plant, Water, Nutrient Relationships
 - Management of Saline and Sodic Soils and Salinity
 - Alternative Uses of Land
 - Conservation and Efficient Use of Water
 - Efficient Drainage and Irrigation Systems and Facilities
 - Watershed Protection and Management
 - Economic and Legal Problems in Management of Water and Watersheds
 - Adaptation to Weather and Weather Modification
 - Appraisal of Forest and Range Resources
 - Biology, Culture, and Management of Forests and Timber-Related Crops
 - Improvement of Range Resources
 - Remote Sensing
 - Research on Management of Research
- II. PROTECT FORESTS, CROPS, AND LIVESTOCK FROM INSECTS, DISEASES, AND OTHER HAZARDS
- Control of Insects Affecting Forests
 - Control of Diseases, Parasites, and Nematodes Affecting Forests
 - Prevention and Control of Forest and Range Fires
 - Control of Insects, Mites, Slugs, and Snails on Fruit and Vegetable Crops
 - Control of Diseases and Nematodes of Fruit and Vegetable Crops
 - Control of Weeds and Other Hazards to Fruit and Vegetable Crops
 - Control of Insects, Mites, Snails, and Slugs Affecting Field Crops and Range
 - Control of Diseases and Nematodes of Field Crops and Range
 - Control of Weeds and Other Hazards of Field Crops and Range
 - Control of Insects and External Parasites Affecting Livestock, Poultry, and Other Animals
 - Control of Diseases of Livestock, Poultry, and Other Animals
 - Control of Internal Parasites of Livestock, Poultry, and Other Animals
 - Protect Livestock, Poultry, and Other Animals from Toxic Chemicals, Poisonous Plants, and Other Hazards
 - Protection of Plants, Animals, and Man from Harmful Effects of Pollution
- III. PRODUCE AN ADEQUATE SUPPLY OF FARM AND FOREST PRODUCTS AT DECREASING REAL PRODUCTION COSTS
- Genetics and Breeding of Forest Trees
 - New and Improved Forest Engineering Systems
 - Economics of Timber Production
 - Improvement of Biological Efficiency of Fruit and Vegetable Crops
 - Mechanization of Fruit and Vegetable Crop Production
 - Production Management Systems for Fruits and Vegetables
 - Improvement of Biological Efficiency of Field Crops
 - Mechanization of Production of Field Crops
 - Production Management Systems for Field Crops
 - Reproductive Performance of Livestock, Poultry, and Other Animals
 - Improvement of Biological Efficiency in Production of Livestock, Poultry, and Other Animals
 - Environmental Stress in Production of Livestock, Poultry, and Other Animals
 - Production Management Systems for Livestock, Poultry, and Other Animals
 - Bees and Other Pollinating Insects
 - Improvement of Structures, Facilities, and General-purpose Farm Supplies and Equipment
 - Farm Business Management
 - Mechanization and Structures Used in Production of Livestock, Poultry, and Other Animals
 - Noncommodity-oriented Biological Technology and Biometry
- IV. EXPAND THE DEMAND FOR FARM AND FOREST PRODUCTS BY DEVELOPING NEW AND IMPROVED PRODUCTS AND PROCESSES AND ENHANCING PRODUCT QUALITY
- New and Improved Forest Products
 - Production of Fruit and Vegetable Crops with Improved Acceptability
 - New and Improved Fruit and Vegetable Products and Byproducts
 - Quality Maintenance in Storing and Marketing Fruits and Vegetables
 - Production of Field Crops with Improved Acceptability
 - New and Improved Food Products from Field Crops
 - New and Improved Feed, Textile, and Industrial Products from Field Crops
 - Quality Maintenance in Storing and Marketing Field Crops
 - Production of Animal Products with Improved Acceptability
 - New and Improved Meat, Milk, Eggs, and Other Animal Food Products
 - New and Improved Nonfood Animal Products
 - Quality Maintenance in Marketing Animal Products
- V. IMPROVE EFFICIENCY IN THE MARKETING SYSTEM
- Improvement of Grades and Standards--Crop and Animal Products
 - Development of Markets and Efficient Marketing of Timber and Related Products
 - Efficiency in Marketing Agricultural Products and Production Inputs
 - Supply, Demand, and Price Analysis--Crop and Animal Products
 - Competitive Interrelationships in Agriculture
 - Development of Domestic Markets for Farm Products
 - Performance of Marketing Systems
 - Group Action and Market Power
 - Improvement in Agricultural Statistics
 - Improvement of Grades and Standards of Forest Products
 - Supply, Demand, and Price Analysis--Forest Products
- VI. EXPAND EXPORT MARKETS AND ASSIST DEVELOPING NATIONS
- Foreign Market Development
 - Evaluation of Foreign Food Aid Programs
 - Technical Assistance to Developing Countries
 - Product Development and Marketing for Foreign Markets
- VII. PROTECT CONSUMER HEALTH AND IMPROVE NUTRITION AND WELL-BEING OF THE AMERICAN PEOPLE
- Insure Food Products Free of Toxic Contaminants, Including Residues from Agricultural and Other Sources
 - Protect Food and Feed Supplies from Harmful Microorganisms and Naturally Occurring Toxins
 - Food Choices, Habits, and Consumption
 - Home and Commercial Food Service
 - Selection and Care of Clothing and Household Textiles
 - Control of Insect Pests of Man and His Belongings
 - Prevent Transmission of Animal Diseases and Parasites to Man
 - Human Nutrition
 - Reduction of Hazards to Health and Safety
- VIII. ASSIST RURAL AMERICANS TO IMPROVE THEIR LEVEL OF LIVING
- Housing
 - Individual and Family Decisionmaking and Resource Use and Family Functioning
 - Causes of Poverty Among Rural People
 - Improvement of Economic Potential of Rural People
 - Communication and Education Processes
 - Individual and Family Adjustment to Change
 - Structural Changes in Agriculture
 - Government Programs to Balance Farm Output and Market Demand
- IX. PROMOTE COMMUNITY IMPROVEMENT INCLUDING DEVELOPMENT OF BEAUTY, RECREATION, ENVIRONMENT, ECONOMIC OPPORTUNITY, AND PUBLIC SERVICES
- Alleviation of Soil, Water, and Air Pollution and Disposal of Wastes
 - Outdoor Recreation
 - Multiple-use Potential of Forest Land and Evaluation of Forestry Programs
 - Fish and Other Marine Life, Fur-Bearing Animals and Other Wildlife
 - Trees to Enhance Rural and Urban Environment
 - Culture and Protection of Ornamentals and Turf
 - Improved Income Opportunities in Rural Communities
 - Improvement of Rural Community Institutions and Services

NATIONAL AND SPECIAL RESEARCH PROGRAMS1. MISSION

Agricultural production efficiency

GOAL

New knowledge to increase productivity

NATIONAL RESEARCH PROGRAMS

Breeding and production--fruits, nuts, and specialty crops
Breeding and production--vegetables
Breeding and production--florist and nursery crops
Breeding and production--corn, sorghum, and grain millets
Breeding and production--wheat, oats, barley, rice, and other small grains
Breeding and production--cotton
Breeding and production--tobacco
Breeding and production--soybeans, peanuts, and other oilseed crops
Breeding and production--sugar crops
Breeding and production--forage crops for hay, pastures, and other uses including turf
Improved vegetation and management practices for range
Introduction, classification, maintenance, evaluation, and documentation of plant germplasm
Physiological and biochemical technology to improve crop production
Crop pollination and honey production
Production and harvesting equipment and methods
Insect control--fruits, vegetables, nut trees, and nursery stock
Cotton and tobacco insect control
Insect control--grains, forages, sugar crops, and oilseeds
Noncommodity research for insect control
Biological agents for pest control
Crop disease control and noncommodity research on plant pathogens and nematodes
Weed control
Agricultural chemicals technology for crop production and modification

Pest control equipment and methods
 Dairy production
 Beef production
 Swine production
 Production of sheep and other animals
 Poultry production
 Structures, equipment, and systems for livestock
 production
 Control of cattle diseases--infectious, non-
 infectious, and parasitic
 Control of swine diseases--infectious, non-
 infectious, and parasitic
 Control of sheep and other animal diseases--
 infectious, noninfectious, and parasitic
 Control of poultry diseases--infectious, non-
 infectious, and parasitic
 Diagnosis and control of foreign animal diseases--
 development of improved methods for the diagnosis
 and control of foot-and-mouth disease and other
 foreign animal diseases
 Toxicology and metabolism of agricultural chemicals
 and poisonous plants
 Control of insects affecting livestock

2. MISSION

Agricultural marketing efficiency

GOAL

Research for new products and processes and for
 reducing marketing costs

NATIONAL RESEARCH PROGRAMS

Technologies for food and feed uses--fruits and
 vegetables
 Technologies for food and feed uses--field crops
 Technologies for food and feed uses--animal
 products
 Technologies for industrial uses--plant and animal
 products
 Technologies for fiber uses
 Technologies for marketing--fruits, vegetables,
 seeds, nursery and floral products
 Technologies for marketing--field crops
 Technologies for marketing--livestock and animal
 products

Technologies and facilities for marketing across
commodities
Technologies for marketing--insect control

3. MISSION

Agricultural exports

GOAL

Develop commercial agricultural markets through
promotion, representation, and research

NATIONAL RESEARCH PROGRAMS

Products to increase exports
Systems for overseas marketing

4. MISSION

Rural development

GOAL

Housing assistance in rural America to increase
the supply of adequate housing and to promote
ownership

NATIONAL RESEARCH PROGRAMS

Research on housing

5. MISSION

Environmental improvement and resource development
and use

GOAL

Land and water resource improvement to maintain
and improve the quality of environment
and the natural resource base, and to enhance
the development of rural communities

NATIONAL RESEARCH PROGRAMS

Reduction of salt damage to crops, soils, and
waters

Improve irrigation and drainage of agricultural
 land
 Tillage practices for improving soil properties
 and crop growth
 Management and use of precipitation and solar
 energy for crop production
 Reclamation and revegetation of land areas
 disturbed by man
 Utilize, manage, and conserve soil fertility
 for increased production and nutritional
 quality of plants and animals
 Preventing pollution of and improving the quality
 of soil, water, and air
 Control of water erosion, wind erosion, and sedi-
 mentation
 Conserve and manage agricultural water resources

6. MISSION

Consumer services and human resource development

GOAL

New knowledge to reduce health hazards and improve
 family living

NATIONAL RESEARCH PROGRAMS

Chemical residues and additives in food and feed
 Safe products and processes
 Natural toxicants and microbial toxins
 Control of insects affecting man
 Family use of resources

7. MISSION

Food and nutrition

GOAL

Food and nutrition research and information
 services

NATIONAL RESEARCH PROGRAMS

Food composition and improvement
 Human requirements for nutrients
 Food consumption and use

8. MISSION

Foreign agricultural development

GOAL

Research to help countries accelerate their agricultural development process and to improve markets for U.S. agricultural commodities

NATIONAL RESEARCH PROGRAMS

Special foreign currency research (special project)

Tropical and subtropical agricultural research and training (special project)

OTHER SPECIAL NATIONAL RESEARCH PROGRAMS

Pilot testing of alternative methods for pest control

Minor use pesticides

Genetic vulnerability

Production and control of narcotic plants

Energy research using pass-through funds

Remote sensing



AGRICULTURAL OFFICE OF ADMINISTRATOR
RESEARCH SERVICE

OF UNITED STATES
DEPARTMENT OF
AGRICULTURE

WASHINGTON, D.C. 20250

JUL 21 1977

Mr. Henry Eschwege, Director
Community and Economic
Development Division
U. S. General Accounting Office
Washington, D. C. 20548

Dear Mr. Eschwege:

We have reviewed the draft of the proposed GAO Report to the Joint Economic Committee entitled "Management of Agricultural Research: Opportunities for Improvement." We appreciate having this opportunity to review and comment on behalf of the Department before the final report is issued. Our response is attached.

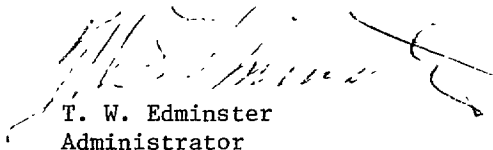
Our response is presented in three parts or levels. Part I provides a brief summary of our overall comments and assessments. Part II addresses main issues and recommendations. Part III relates largely to miscellaneous points, many of which add further information and Agency views on matters of detail. It is our view that the first two points are candidate comments for inclusion in the final report, while the third part serves to provide the GAO team with additional information and views, mainly on points of detail.

In balance, we substantially agree with many of the issues and recommendations in the report and note a strong correspondence between these and the steps ARS has taken to carefully examine and improve existing systems and procedures for managing agricultural research as a planned second phase of our new Management and Planning System (MAPS). We also note and have responded to the GAO recommendation concerning the need for a National agricultural research plan encompassing the publicly supported agricultural research system in the U. S.

This response has been cleared with Assistant Secretary Cutler's office and the Office of Audit.

If you have comments or questions about our response, we will be pleased to discuss them with you or your staff.

Sincerely,



T. W. Edminster
Administrator

Enclosures

UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Research Service

I. OVERALL ASSESSMENT AND COMMENTS^{1/}

The overall assessment and conclusion drawn by the Agricultural Research Service (ARS), USDA, from this GAO Report is that it is constructive and offers some worthwhile suggestions for improving the Agency's planning and managing system. The GAO team has identified a number of research management practices and procedures that are not as effective as we would like them to be. The Agency views this experience of working with the GAO team as one that will lead to a beneficial effect on the Agency since it involved many discussions and assessments of the reasons for and results of existing procedures at the same time the agency has been reexamining its planning and management procedures and systems. ARS is moving in stages to implement fully its reorganization in 1972 and the first phase of a Management and Planning System (MAPS) recently developed. This is being done as a part of an orderly plan designated as phase II (ARS MAPS II) which is designed to sharpen planning and management systems and procedures and fully implement its new program structure and 67 National Research Programs and 8 Special Research Programs. We feel it is significant to note several areas of special emphasis in the Agency's current effort to strengthen planning and management, research: (1) more complete integration of research program and administrative management functions, processes, and systems; (2) strengthening the Agency's program planning, review and evaluation processes; (3) examination of the effectiveness of the research project system; (4) means of coordinating program reviews with other agencies and the State Agricultural Experiment Stations; (5) reexamination of a Project Management System; and (6) policy analysis with emphasis on strategic and long-range planning. We are pleased that the results of the GAO study correspond so closely with corrective actions the Agency has underway at this time. These and other areas being examined are shown in the attached memorandum dated June 13, 1977. The Core Group will have a main points outline October 1, 1977 and a complete management and planning system report September 1, 1978.

Historically, publicly supported food and agricultural research agencies have been judged primarily on the basis of the quality of their products (research results). Consequently, we have placed less emphasis on the process than on the product. We are becoming increasingly aware of the importance of the process whereby the research product is achieved. We agree with the view that the process can be improved and we are working to that end. We feel that the process should not be emphasized, however, at the expense of the product.

We appreciate the recognition the GAO team has given to the achievements and role of the Agricultural Research Service. The text states, "The accomplishments of agricultural research have been described as one of the miracles of the century." We feel it is indeed and are proud that ARS is an important part of this publicly supported agricultural research system, a system that has been extensively reviewed and assessed in recent years, just as it should be. We

^{1/} Comments on behalf of the Department by the Agricultural Research Service on a draft of a proposed report by GAO entitled "Management Research; Opportunities for Improvement."

think it is important to note that our own assessment of these recent reviews lead us to the conclusion that virtually every report containing recommendations for change or improvement also applauded the past and present achievements in agricultural research in the U.S. For example, a recent report concluded that the recognized strengths in the present publicly supported agricultural research system include: (1) an integrated system of basic and applied research performance with a highly effective delivery system through extension programs, (2) a system that combines good qualities of decentralization, such as adaptive research specific to needs at locations, and centralization, such as research on highly contagious diseases like Foot and Mouth Disease in cattle, (3) substantial productivity gains in agriculture and forestry, and (4) high returns on investments.

We are also pleased to note that the GAO team gives recognition to significant changes and improvements that are being effected in ARS research management. These stem from a major reorganization in 1972 to facilitate multi-disciplinary research and decentralization of research management, and more recently the establishment of the ARS Management and Planning System (MAPS) which provides a new program structure and 67 National Research Programs and 8 Special Research Programs.

Main points in the GAO Report with which the Agency agrees there is need for improvement include: (1) long-range planning, (2) the process for reviewing and approving individual research proposals, (3) the Agency's existing technical advisor's program and system, (4) the use of peer review for both research proposals and evaluating ongoing work, and (5) the Agency's present Work Reporting Unit Report and Plan system. The GAO Report should be beneficial to the Agency's present effort to improve these systems and processes.

There are several points in the GAO Report about which we have some concern. (1) In calling for "a National agricultural research plan," no recognition is given to such present national planning efforts as the Department's program structure of Missions, Goals and Programs; the ARPAC guided regional/national planning and projecting system and; ARS' recently developed National and Special Research Programs. (2) While agreeing that procedures for identifying priorities can be improved, we feel the Report fails to recognize and give credit to the Agency's present and useful priority setting efforts. (3) We are concerned about the impact full implementation of all GAO recommendations involving documentation could have on paperwork requirements. This could lead to an overly mechanistic approach to research management which could have the effect of stifling innovation and creativity which are the fundamental building blocks for scientific discovery.

Specifically, greater or improved documentation is called for in the following areas: (1) individual research proposals, (2) results of reviews of individual research proposals by technical advisors, (3) certification that CRIS has been searched prior to approval of research proposals, (4) reporting of negative findings, (5) results from informal reviews, (6) use of peer review procedures, (7) relative priorities, and (8) improve WRU Annual Reports and Plans. Most of this documentation would have to be done by scientists. Thus our concern is about the extent of documentation and paperwork that could result in the aggregate.

One additional point of concern is with the variation in the scope of the Report. The title, by identifying ARS leaves the impression that the study is specific to ARS. Chapters 2, 4, 5 and 6 appear to relate specifically to ARS. Chapters 1 and 3, appears to address the publicly supported agricultural research system at large, although mainly the Department. These variations in span of coverage present difficulties in reviewing and responding to the report. ARS cannot plan or conduct its programs as if it were the only public organization engaged in agricultural research. There are 10 Federal agencies supporting or conducting research related to agriculture. Every State has one or more institutions engaged in agricultural research. ARS's priority setting and planning procedures must be related to these other activities. ARS, as it continues to strengthen its management, will consider the programs of these other organizations and develop cooperative efforts with them as much as possible. However, it is in this broader area of interagency planning and cooperation that a great deal needs to be accomplished, not by ARS alone, but by the publicly supported agricultural research organizations collectively under USDA leadership. We believe the GAO report could have put more emphasis on this need.

Finally, it is emphasized that we substantially agree with a very large number of the issues raised and recommendations made in the GAO Report and appreciate having this as input to our substantial effort already underway to address these and other planning and management processes and systems we wish to improve. Thus we are pleased to see the high degree of correspondence in the areas the Agency has taken steps to improve and those appearing in the GAO Report. We are fully prepared to examine the results of the final Report and to the extent possible utilize the recommendations as inputs into the Agency's reassessment of its management and planning activities already underway.

II. COMMENTS ON SPECIFIC ISSUESGAO Recommendation - (National Plan Needed for Guiding Agricultural Research)

"We recommend that, if the Congress does not enact legislation requiring a national agricultural research plan, the Secretary of Agriculture take steps necessary to have such a plan developed and maintained." The GAO Study goes on to report "There is an increasing realization that a plan outlining overall policies, goals, objectives, and priorities needs to be established and updated from time-to-time if the system is to be responsive to critical future problems and needs and if limited public dollars are to be wisely used."

ARS Comments

This recommendation calls for "National" plans to encompass the publicly supported food and agricultural research system in the United States. This and the general content in Chapter 3 of the GAO Report transcends the immediate responsibility of ARS which is, however, a large component of the system.

We wish to note several points which relate to this recommendation, particularly in view of the reference to a plan as consisting of "policies, goals, objectives, and priorities..." (1) The Department maintains and uses in planning and budgeting a structure of Missions, Goals and Programs to which the programs and activities of individual agencies link. (2) ARS has an extensive national research plan of 67 National Research Programs which describe the Agency's 10-year goals and objectives, plans for achieving goals and objectives, and information to support program and policy assessment and the identification of priorities. (3) A State-Federal agricultural research planning system is sponsored by ARPAC and led by its National Planning Committee and four Regional Planning Committees. Through this effort, regional and national research programs are developed, along with five-year projections for each of approximately 45 Research Programs. (5) ARPAC has also appointed a group which is currently active in examining strategies for the publicly supported agricultural research system.

The GAO Report refers to the Long Range Study of 1966 and notes that this plan has not been updated to reflect major developments since then including energy, environmental quality, rural development and world demand for agricultural products. This study has not been updated. However, many specific programs have been updated as to needs and priorities. Much has been accomplished in reviewing and assessing the energy issue including development of a national program for energy in September, 1976 entitled: "A National Program of Agricultural Energy Research and Development," development by ARS of a Special Research Program on energy, and development by ARS of a Modified Project Management System for handling pass-through funds from ERDA.

The Department has been especially responsive to the research needs to support environmental quality. During the period 1966-75 funds to support environmental improvement increased 267%, the largest percent increase of nine major goals. This added emphasis on research in support of the environment was achieved through redirections and additional appropriations.

GAO Recommendation - (Identify and Document Relative Priorities)

"We recommend that the Secretary of Agriculture direct ARS to identify and document the relative priorities of each national research program and of each problem and research need within the program areas and to assemble the information needed for effective implementation of its long-range plans."

ARS Comments

We feel it proper that the GAO Report place emphasis on priorities and the need for communicating these results more explicitly and widely throughout the Agency. We fundamentally agree with this GAO position and feel that we can and will improve the process of establishing priorities and the communication of these results to key people throughout the Agency. We appreciate that the GAO team views the ARS development of national and special research programs as "...an important and necessary achievement..." and that "The programs are, in the view of knowledgeable scientists from outside USDA, very comprehensive and cover the most significant problem areas within each subject area."

We interpret this recommendation on priorities to mean the need for a systematic and documented approach to setting priorities for the main purpose of insuring that scarce resources are allocated to competing programs on the basis of needs and opportunities. We assume it is not intended to mean a one to N ranking of large and complex programs of research, a process we question. In the context of this interpretation of priorities, we feel improvements can and will be made. This too is under study as a part of MAPS II. Our objectives are to identify the relative cut-off points where all National Research Programs are equally important relative to costs and potential benefits.

Assuming all research is important, the less of it done, the more important it becomes. Because of severe funding constraints over recent years during which the constant dollar budget of ARS has been declining, virtually all programs are either seriously underfunded and/or are supported by funds earmarked by higher authorities.

While recognizing that methods for determining priorities can be improved, we believe the GAO team may not have fully appreciated the progress ARS has made in developing an effective and useful system of priorities. The general strategy for developing priorities is set forth in a statement entitled: "Determining and Using Priorities in ARS," November 24, 1975.

Steps taken in developing current priority guidelines included: 1) an extensive review of issues and priorities from outside sources, 2) an assessment of Departmental and Agency policies, 3) a review of all ARS National Research Programs and Technological Objectives, 4) a staff workshop to develop tentative priorities, 5) fine-tuning of priorities by the Administrator's top staff, and 6) release of ARS priorities to guide the agency for the planning period from January 1977 to January 1978. This listing of priorities consists

of 13 major thrust areas and 48 important subthrusts. They are used as guidelines for managers and scientists to follow in redirecting current resources and in developing the FY 1979 budget.

Additionally, we note the general agreement on key issues and strong consensus on research priorities that currently exists throughout the publicly supported agricultural research system in the U.S. This was further emphasized by the follow-up work group to the Kansas City Conference which showed that ARS has 75% of its funds in support of the top 50% of high priority areas.

We agree with the emphasis given in the GAO Report on long-range planning. Long-range planning was the theme of the ARS Senior Staff Conference in 1974 (Future Needs and Issues in Agricultural R&D). It was the subject of a "Futures Report" by the Program Analysis and Coordination Staff in October 1974. While the NRP's and SRP's are not in and of themselves long-range planning documents, they provide an informational base for long-range planning. The predecessors of NRP's, ARS Research Activities, which were developed in 1967, also described research objectives for planning periods up to 10 years. Continued and additional emphasis will be given to long-range planning as a part of the MAPS II Core Group study.

With regard to the information needed for effective implementation of long-range plans, we agree that further improvements are required and improvement efforts are underway in this area. Principal attention is being given to the integration of administrative or resource data with program information. The Program and Resource Information System (PARIS), developed in 1975 and further refined since that time, was the initial step in this direction. Attention is now being given to better integration of the Position/Resources Management System with the program information systems such as CRIS and the WRU Reports and Plans to provide a package of program reporting and resource planning information.

GAO Recommendation - (Process for Approving Individual Research Proposals)

"We recommend that the Secretary of Agriculture require ARS to:

- better document research proposals to facilitate critical assessments of the scientific and technical merits;
- develop agency-wide criteria for reviewing project proposals;
- make the technical advisors an integral part of the project approval process by requiring that they review research proposals for scientific and technical merit and document their determinations;
- modify procedures for initiating research projects to require researchers to certify, before approval, that CRIS has been searched and that the proposal has been coordinated with ongoing or completed research projects;
- have researchers document and disseminate negative research findings; and
- develop agency-wide peer review procedures for assessing the scientific and technical merits of all research proposals. Technical advisors, other qualified ARS scientists, and qualified scientists from other USDA research agencies, State Agricultural Experiment Stations, other public and private universities, and industry should be involved in the peer review system."

ARS Comments

Better Documentation of Research Proposals - We substantially concur in this recommendation. We also note the recognition by the GAO Report of many elements of an effective approval process within the present research project system. Our main concern about a more detailed research project system lies in the amount of paperwork involved and time required on the part of scientists in the Agency to develop detailed research projects. Before implementing such a system, the Agency desires to carefully examine the potential cost-effectiveness of such a system and will do so as a part of the MAPS II study.

Criteria for Reviewing Project Proposals - We concur in the recommendation to improve criteria for reviewing project proposals. The criteria identified beginning on page 34 of the GAO Report will be considered. Similar criteria are used by the Agency in reviewing ongoing and proposed research. In developing improved criteria for this purpose, we wish to avoid an overly structured approach which would be costly and time consuming, so we may limit the number of criteria to less than the nine suggested in the GAO Report.

Technical Advisors (TA's) - We are currently reexamining the role and function of the Agency's relatively new Technical Advisor's system and its interaction with the project review and approval process. These issues, which will be discussed in some depth at the Senior Staff Conference in October 1977 and which are being examined by the MAPS II Core Group, will be resolved and a firm policy on the Agency's approval process for research projects and the roles of Technical Advisors will be developed. We anticipate that there will be a role for TA's in connection with the technical review of project proposals.

Certification that CRIS Has Been Searched - The GAO Report cites the subcommittee report to ARPAC of January 1975 in which 22 recommendations were made for improving the quality and use of CRIS. We strongly endorse the recommendation to ARPAC which the Agency was very much involved in developing. As a point of concern, we feel that the CRIS system needs to be further improved and this must be done on a national basis before strict reliance on a CRIS search will be a sufficiently useful means of eliminating unnecessary duplication.

As a point of emphasis, we feel that CRIS, with its system limitations and complexities of participating organizations, cannot provide complete project data for eliminating unnecessary duplication. However, we do believe a CRIS search can have some merit and have included the following statement in the new ARS Instructional Manual for Preparing CRIS Documents (currently at the printers): "Scientists should make a search of CRIS for information on related CWU's whenever they initiate a new project."

In the final analysis, we depend greatly on the desire of scientists to keep abreast of what their peers are doing and to avoid duplication. Scientists are trained and motivated to do original work.

Documentation of Negative Findings - Reference is made to "lack of information on past work that was not productive" where it is stated that "ARS does not require its scientists to document negative research findings and usually they are not documented and disseminated."

We interpret negative results used in the GAO Report to mean research resulting from properly designed and executed projects but which do not generate new knowledge or potentially useful technology. In other words, the results of the experimental experience of "digging dry holes." We agree that such results should be documented in progress reports, at least briefly. We feel that research results should be documented in annual or progress reports in all instances where new or otherwise useful knowledge can be provided that may be of benefit to users and/or other scientists. We will examine this recommendation and take appropriate corrective actions if necessary.

Peer Review Procedures for Assessing the Scientific and Technical Merits of Proposals - We note with interest the recommendation that the Agency develop an agency-wide peer review procedure for assessing scientific and technical merit of all research proposals and that technical advisors and other qualified scientists should be involved in the peer review system. We concur in the need for seriously examining this approach and have taken steps to initiate this examination. The MAPS II Core Group has been asked to examine "the utility and feasibility of the peer review process in establishing and reviewing research programs and projects...determine if a more thorough review process is required prior to initiation of research and if this should involve a system of peers; for example, TA's, RL's, ARS and non-ARS scientists, etc?"

As the GAO team recognized, ARS has experimented with a peer review system in the Northeastern Region and at a number of locations throughout the country. In some of these reviews, supplements to the CRIS projects have been used as a basis for more detailed documentation of research proposals. We now conclude that a more uniform research project system is needed throughout the Agency, and we are prepared to examine the possible need for a more detailed research project system than is represented currently in CRIS work units. This too is a part of the MAPS II Core Group study which has been used to "examine the roles, responsibilities, and authorities of staff personnel and line managers in the selection and approval of projects... examine in-depth the appropriateness of the Agency's present research project system(s)."

We do wish to indicate, however, that we have concerns and reservations about the cost-effectiveness of highly structured peer review techniques, a point noted in the GAO Report. We wish to make certain that such a process is not overly structured and that it not divert excessive amounts of time of top scientists in the Agency from research work.

GAO Recommendation - (Review and Evaluation of Ongoing Research)

"We recommend that the Secretary of Agriculture require ARS to:

- document all important findings, conclusions, and recommendations resulting from informal reviews of individual research projects.
- ARS requires only that the NPS scientists document such matters;

- redesign the WRU Report and Plan to permit an assessment of the technical aspects of active research projects; and
- require that the WRU Reports and Plans be reviewed by the cognizant technical advisor to assess the technical and scientific merits of the ongoing projects and to identify those projects that should be scheduled for onsite reviews."

ARS Comments

We substantially agree with the GAO Report conclusions that ARS should work toward improvements in the review and evaluation of ongoing research programs. The GAO Report correctly notes that we use a number of techniques in carrying-out review and evaluation of ongoing programs. We have since the reorganization in 1972 experimented with this process. In 1973 and 1974, emphasis was given to program reviews and workshops. Then during 1975 and 1976, less emphasis was given to reviews and workshops of necessity because of the effort required on the part of headquarter's staffs and particularly NPS in developing national and special research programs. Program reviews and workshops are now being reemphasized.

Document Important Findings, Conclusions, and Recommendations Resulting from Informal Reviews - Significant points identified in informal meetings with research scientists should be documented. Also, it might be beneficial to document many of these informal contacts. We agree that there have been many instances where this has not been done adequately. In developing guidelines for this documentation process, however, we want to avoid making a fetish of documentation to the point it discourages the spontaneity of discussions.

Redesign the WRU Report and Plan to Permit Technical Assessment - Steps are being taken to improve the WRU Reports and Plans. Additionally, steps have been taken to initiate a more systematic "tracking" process whereby each year progress will be recorded toward meeting objectives in the annual national research program reports, approximately half of which have been completed as of July 1, 1977.

Steps taken or planned to strengthen WRU Reports and Plans include: 1) providing feedback on quality and content to originators, 2) provisions for modifying the format and design annually, 3) provisions to consolidate WRU Reports into National Research Program Reports, and 4) plans to report progress each year in a way to facilitate tracking technical plans and objectives.

Review of WRU Report and Plans by Technical Advisors (TA's) - We concur in the GAO Report and will seriously consider establishing procedures whereby TA's can work in concert with NPS scientists in assessing the scientific and technical merits of ongoing projects. Many Technical Advisors presently review Annual WRU Reports and Plans. We feel this practice should be uniformly followed and note that the Agency is moving in this direction.

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