Chapter V

Roles of Research Participants

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Food and agricultural research in the United States is supported by the public and private sectors. The major participants in the public sector are the U.S. Department of Agriculture (USDA) and the State agricultural experiment stations (SAES), although sizable investments are also made by a number of other Federal agencies. In addition, certain non-land-grant universities—including those publicly and privately financed–have substantial food and agricultural research programs supported by public funds. Also, but to a lesser degree, the 1890 land-grant colleges and Tuskegee Institute are research participants.

Research participants in the private sector include foundations, industry, and industry associations. In some areas of activity, their financial investments exceed those of the public sector.

All of these participants—public and private—represent major forces in the U.S. food and agricultural research system. Their particular roles, however, have never been fully articulated. In some cases, the relationships among them are somewhat complicated and controversial. This segment of the OTA assessment presents an analysis of the roles of participants in the national agricultural system and identifies the relevant issues that need to be considered in improving the system.

U.S. DEPARTMENT OF AGRICULTURE

The genesis of food and agricultural research in the public sector lies in Federal legislation enacted in the second year of the Civil War when USDA was created. It was given broad authorization "To acquire . . . useful information on subjects concerned with agriculture in the most general and comprehensive sense of the word . . . ." Isaac Newton, first Commissioner of Agriculture, was directed to acquire and preserve all information concerning practical and scientific agriculture by conducting experiments. As outlined in chapter 111 of this report, the research base of USDA broadened over the years, and more intensive and varied research programs were enacted so that by the beginning of the 20th century, USDA had taken the lead in the most effective emphasis on farm production research the world had ever seen.

The 15 years immediately following World War II were marked by continuing changes for strengthening USDA and State research in order to keep pace with and guide the rapidly modernizing U.S. agriculture. This period also was marked by the USDA reorganization in 1953, which not only had serious repercussions on the functions and capabilities of USDA research but also disrupted Federal/State relationships (Moseman, et al., 1981).

USDA's Changing Role

The next 20 years—from 1960 to 1980—comprised an era of rapid change in which USDA's role in food and agricultural research became altered by the impact of social forces on research priorities. These forces, combined with numerous assessments of research, have had a cumulative effect of reshaping the national agricultural system and capabilities.

The unsettled situation in USDA research in the 1950's and somewhat similar conditions in other Federal agencies led indirectly to an investigation by President Kennedy's Science Advisory Committee (PSAC) into the capability and quality of research in the

Federal Government. As a result, a panel of PSAC conducted a review of science and agriculture that focused primarily on USDA (Science and Agriculture, 1962).

The panel's recommendations were generally constructive and positive; however, the review was conducted within an environment that was somewhat critical and hostile toward USDA. One of the main reasons for this situation was that no member of the panel had any active experience in USDA/State research programs that had major impacts in advancing agriculture in the previous three decades.

Among the few recommendations that were adopted was the appointment by Secretary Freeman of a USDA committee on agricultural science. The makeup of this committee, the membership of the PSAC agricultural panel, and the attitude of the White House Office of Science and Technology combined to reflect a low esteem of research in USDA. Also reflected was the viewpoint that university personnel should have a dominant role in planning and directing USDA research.

Nevertheless, a number of significant steps were taken under Secretary Freeman in 1963: a) greater emphasis was placed on upgrading and expanding USDA and State research facilities; b) funds were increased for the study of pesticides; c) a concept developed that Beltsville should be increasingly concerned with basic research; and d) administration of grants to State experiment stations and coordination of State/Federal research were once again placed in the hands of a separate agency—the Cooperative State Research Service—comparable to the old Office of Experiment Stations.

In 1969, Secretary of Agriculture Clifford Hardin requested the National Academy of Sciences/National Research Council (NAS/NRC) to appoint a committee to: a) evaluate the quality of science in agricultural research, b) ascertain gaps in agricultural research and make appropriate recommendations, and c) ascertain the extent to which scientists in the basic disciplines relate their research to agriculture and the extent to which they contribute to the basic sciences. The committee was chaired by Dr. Glenn S. Pound, dean and director of the College of Agricultural and Life Sciences, University of Wisconsin. Oddly, the committee was heavily dominated by personnel from the land-grant universities (primarily bench scientists), despite the fact that it was supposed to review USDA research as well as that of State stations.

Although the committee said it found many excellent programs, together with well-trained scientists and sensible research, it also found reason to believe that much of agricultural research was outmoded, pedestrian, and inefficient. A careful and unprejudiced reading of the NAS committee's report discloses many constructively critical analyses and recommendations that would serve to strengthen the national agricultural system. (Further discussion of the Pound report is given in ch. IV of this report.)

USDA research administrators, in a move unrelated to the Pound report, in 1972 announced a reorganization of research functions in USDA. The major thrust was to assign line-operating authority to the field under four regional deputy administrators. The national program staff, which formerly had responsibility for one, or a few, commodities or program areas, was suddenly expected to properly manage a broad scope of research programs. This led to an inability to maintain an in-depth understanding of the work under way, since the national program staff was isolated from line research functions and responsibilities,

Role Strengthened

In an effort to strengthen the role of USDA and more effectively coordinate its activities, the 95th Congress, in enacting the Food and Agriculture Act of 1977, designated USDA as the principal agency of the Federal Government for agricultural research, and directed the Secretary of Agriculture to coordinate all agricultural research, extension, and teaching

activities conducted or financed by Federal funds.

Specifically, the act describes the research role of USDA as including the following:

- to fulfill the needs of farmers and consumers by focusing its resources on problems of national interest and concern;
- to participate with other sectors of the agricultural research system in planning, coordinating, and executing national and regional programs;
- to conduct research and development (R&D) programs to meet international needs as determined by U.S. Government policy and the increasingly global nature of production agriculture;
- to conduct basic and applied human nutrition research necessary to assess and improve the nutritional quality of human diets; and
- to develop human nutrition information and education programs and deliver this information to the public.

The act of 1977 designates USDA as the lead agency of the Federal Government for agricultural research, extension, and teaching in the food and agricultural sciences. * It also gives guidance on strengthening the coordinating activities of USDA, but little guidance is given to the role of USDA v. the SAES.

The law also provided that the Secretary of Agriculture establish within USDA a Joint Council on Food and Agricultural Sciences and a National Agricultural Research and Extension Users Advisory Board. The progress of these two advisory groups is discussed in chapter VII of this report.

*This excludes the biomedical aspects of human nutrition concerned with diagnosis or treatment of disease.

STATE AGRICULTURAL EXPERIMENT STATIONS

The origin of the role of the SAES under the Hatch Act of 1887 and subsequent legislation has been documented in chapter 111 of this report.

As a part of the land-grant university in each State, SAES researchers often play a vital role in the training of scientists. Many SAES researchers have joint appointments with the university. They may teach, which allows students to learn the latest in agriculturally important knowledge and skills directly from scientists who are discovering and perfecting this knowledge. And they may also direct graduate student research. This close arrangement between researcher and student makes it possible to obtain relatively inexpensive but capable staff assistants and at the same time provide the added function of training additional scientists.

Although the SAES still retain their traditional focus in serving farmers and the agricultural sector of their States, their role has been modified by a number of factors in the past two decades. The Research and Marketing Act of 1946 increased Federal funds to the States on a formula basis and made provision for regional research by the SAES with Federal funds. In 1965, the Special Research Grants Act authorized grants to the State stations, other public institutions, and individuals to perform research on problems of concern to USDA. In some respects, this act introduced chances for duplication of effort, but at the same time, it offered a vehicle for concentrating special efforts on commodity-based problems or problems of special interest groups, thus largely avoiding earmarking of formula funds to special interest concerns.

Title V of the 1972 Rural Development Act was another attempt to emphasize an area of special concern—namely, the economic and social problems of rural people and communities. This program, however, has not received significant funding,

Title XIV of the 1977 Farm Bill also became a vehicle for authorizing a variety of special-

interest programs. Most important of these are:

- institutionalizing research and extension in the 1890 land-grant colleges and Tuskegee Institute, whose participation in USDA funding really began in the early 1970's;
- placing greater emphasis on food and nutrition research and extension in USDA in cooperation with the States; and
- authorizing competitive grant programs in research to all colleges and universities, Federal agencies, and private institutions.

Two factors that are modifying roles of State stations—changes in funding and management—deserve special discussion in this assessment.

Funding

One of the sources of funding for the SAES is Federal funding on a formula basis. This provides funds to the States on the basis of, among other things, size of rural population, number of farms, etc. States with large rural populations, therefore, tend to receive more Federal grant money than those with lesser numbers of farmers. This formula uses the same principle—population size—that determines the number of Representatives in Congress to which each State is entitled. It is a principle deeply rooted in the founding of our country and expresses one aspect of the philosophy of "government by the people."

Over the years, as the purchasing power of both Hatch and State funds declined, scientists and administrators sought new funding sources. To a certain degree, Congress furthered this trend by appropriating funds for special and competitive grants.

Grant funds provide resources for high-priority research to further the programs of USDA. The Secretary may make grants up to 5 years for either competitive or special research grants. Al] colleges, universities, Federal agencies, and private institutions are eligible for competitive research grants. While the law provides for flexibility in the determination of the specific research efforts for competitive grant funds, the intent was that the following types of research be given priority consideration:

1. basic research aimed at the discovery of new scientific principles and techniques that may be applicable in agriculture and forestry;
2. research aimed at the development of new and innovative products, methods, and technologies relating to biological nitrogen fixation, photosynthesis, and other fields that will improve and increase the productivity of agriculture and forestry resources;
3. basic and applied research in the field of human nutrition; and
4. research to develop and demonstrate new, promising crops, including guayule and jojoba.

In the special research grants program the law authorizes the Secretary to make grants without regard to matching funds to:

1. land-grant colleges and universities, SAES, and all colleges and universities having a demonstrable capacity in agricultural research, as determined by the Secretary, to carry out research to facilitate or expand promising breakthroughs in knowledge; and
z. land-grant colleges and universities and SAES to facilitate or expand State-Federal research programs that promote: a) excellence in research, b) development of regional research centers, or c) the research partnership between USDA and such colleges or SAES.

Proponents of formula funding saw the introduction of competitive grants as an eroding force on the clout of land-grant universities and their agricultural experiment stations. Others reasoned that excellence in food and agricultural research might very well exist in institutions other than those in the land-grant system.

One mechanism provided by Congress that lent further justification to seeking wide participation in the program was the provision for a peer-review system of research proposals to further guarantee excellence in performing the research. The World Food and Nutrition Study under the aegis of NAS endorsed the competitive grant system, as did the OTA report Organizing and Financing Basic Research To Increase Food Production (1977).

Management

The shift to special and competitive grants as a means of funding research has had several effects when compared to formula funding. First, formula funds do not pay overhead costs; most grants do. For a given level of funding, this reduces the amount available to research scientists, It does, however, make possible more direction of research to specific needs. Second, the availability of special and competitive grants encourages faculty members to seek such outside funds. The director of the SAES frequently has little opportunity to exert management or program guidance on these programs. This has positive and negative connotations. Often, the research has little significance to local or State problems. Third, the individuals who make decisions on funding under the grant system are not always accountable to legislative and agricultural interests.

Relationships between USDA and SAES at the administrative level are unnecessarily competitive and in some cases destructive (Moseman, et al., 1981; Knutson, et al., 1980). But of even greater significance is the effect of the dispersal of USDA research resources and authorities and the resultant substantial autonomy in regional and area offices. This situation represents a degeneration of the operational and coordinating functions that traditionally have been carried out by USDA for national and regional programs.

OTHER FEDERAL AGENCIES

At least 10 Federal agencies other than USDA fund or conduct some kind of food and agricultural research. These include the Departments of Commerce, Defense, Energy, Health and Human Services, Interior, and State; Agency for International Development; Environmental Protection Agency; National Science Foundation (NSF); and Tennessee Valley Authority (TVA). No accurate figures are available for the extent of dollar investment in food and agricultural research by these agencies. Some of the budgets are quite large; others are very small and are actually advisory in nature.

In most instances, food and agricultural research conducted by these Federal agencies is considered complementary to that of USDA; overlapping efforts are not thought to be great. Because the mechanism for coordination with USDA as the lead agency is not functioning well, however, the degree of overlap and coordination cannot be determined at this time. In some cases, the research program is the type that either is inadequately covered by USDA or is more suited to the mission of the other agency, The food research program of the Department of Defense is a good example of the latter type, since it deals with providing a wholesome and nutritious food supply to servicemen and servicewomen under field and military-base conditions. TVA conducts research on development of fertilizers because both USDA and most of the private sector discontinued such activity nearly 20 years ago.

To improve coordination of the research activity of USDA and the other 10 Federal agencies involved in food and agricultural research, Congress mandated the establishment of the Committee on Food and Renewable Resources (CFRR).* The committee,

*This was authorized under the National Agricultural Research, Extension, and Teaching Policy Act of 1977 and established under FCCSET.

which is chaired by USDA, "is to review Federal research and development programs relevant to domestic and world food production and distribution, promote planning and coordination of this research in the Federal Government, and recommend policies and other measures concerning the food and agricultural sciences for the consideration of the Council. "

The purpose of CFRR is to increase the overall effectiveness and productivity of Federal R&D efforts in the areas of food, nutrition, and renewable resources. The committee is charged with improving planning, coordination, and communication among Federal agencies; developing and updating plans for Federal research programs; collecting, compiling, and disseminating information on food and renewable resources research; and preparing reports describing activities, findings, and recommendations of the committee.

CFRR has not yet satisfactorily fulfilled its role (OTA letters of inquiry to Federal agencies, 1980). As of early 1981, CFRR did not have a classification of the food and agricultural research conducted or funded by these agencies nor the amount of funds allocated for such research. It does not yet actively coordinate interagency activities. One reason is that the committee is a relatively new feature within a well-entrenched bureaucracy. Furthermore, it needs more specific, highly defined objectives to be more effective, And finally, the committee does not have the authority of individual agencies that might be addressing the same problems from more authoritative positions.

THE 1890 LAND-GRANT COLLEGES

In 1890, Congress passed an act that granted to certain Negro colleges and universities the same privileges as those provided by the Merrill Act of 1862. However, as discussed in chapter III, equitable funding of the 1890 institutions, including Tuskegee Institute, has been a problem. It was not until 1972 that they received significant funding for research and extension by congressional act. Under the Food and Agriculture Act of 1977, these institutions acquired expanded authority and responsibility. Although they are funded almost wholly by Federal agencies, they are cooperating with the SAES on certain regional projects.

The role and functions of the 1890 land-grant institutions include:

- meeting the needs of those people whom the system was designed to serve;
- focusing sharply on needs of people who have been disadvantaged by systems and circumstances over which they have no control;
- using unique methods to assist "hard-to-reach" clientele;
- maintaining a well-structured educational system through teaching, research, and extension; and
- providing educational programs that prepare individuals to function intelligently in a democratic society.

According to the chairman of the Association of Research Coordinators of the 1890 Schools, "the most pressing deficiency of the 1890 Schools in fulfilling their obligation in food and fiber research is pauperized laboratory facilities" (OTA letter of inquiry, 1980).

NONLAND-GRANT UNIVERSITIES

For the purposes of this report, the term "nonland-grant university" encompasses two kinds of institutions: a) private universities such as Harvard and Stanford that conduct research which may have implications for food and agriculture but whose main direction is elsewhere, and b) public State universities such as the California Polytechnic State Universities or Texas Tech University that have clearly identified food and agriculture programs including research.

Historically, nonland-grant universities have not been considered as part of the traditional U.S. agricultural research system, nor have they had specific legislation or Federal funds for agricultural research. As late as 1977', Congress reaffirmed the role of USDA as the lead agency in U.S. agricultural research and charged it with coordination functions identifying specifically the traditional agricultural research institutions. So, in general, the nonland-grant universities, from the congressional standpoint, seem to be outside the traditional agricultural research system. * Congress has, however, recognized their capability as research institutions, and they have been funded through such agencies as the National Institutes of Health, NSF, etc. Further, Congress has also recognized their potential value to U.S. agricultural research. The special grants program makes provision for those with recognized agricultural research capabilities, and the competitive grants program makes all of them eligible to compete for such grants.

*This includes public State universities which receive funds from State legislatures for teaching and training of agriculturalists, but not for agricultural research.

Private Universities

Many of- the private institutions conduct in-depth research in the basic sciences of chemistry, physics, mathematics, etc., which form the basis of most biological research on which agricultural research is founded. Many have strong departments in such sciences as plant physiology, entomology, animal physiology, etc. (as do many land-grant universities), but their research usually is more basic and may have no immediate application to the solution of practical food and agricultural problems. Such research, however, frequently provides many of the breakthroughs so important to the continued advances of agricultural research. Their resources and expertise should be considered as valuable resources to the U.S. agricultural research system and used as funds and interest permit.

Private universities, unlike the public State universities which receive substantial State support, receive no general Federal or State assistance and support their scientific research almost entirely from government grants, endowments, and corporate contracts. A relatively small group—about 36 institutions—account for about 60 percent of total Federal research expenditures in universities. The chief barrier to the performance of sizable amounts of agricultural research in these universities is lack of resources and the fact that status and reward within science disciplines put strong pressure on performing basic, rather than applied, research.

Because the paucity of agricultural research in private universities is largely a consequence of the status and reward structure in scientists' professions, it is not likely that funding alone can make significant changes. A frequently made charge, where the only

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control is through grant funding, is that large amounts of money for agricultural research made available to basic scientists will often be directed to different types of research (Lewontin, 1980).

Nevertheless, there are a number of scientists in private universities who would carry out relevant agriculturally related research if they had the funds to do so. For example, there are engineering, chemistry, and business schools at these universities that could conduct product development and management studies in agriculturally related areas. An expanded competitive grants program in agriculture would be helpful in funding such projects and perhaps in beginning to give legitimacy to agricultural research in private universities. Such a program should be in the hands of a peer-review system so that the criterion of excellence and relevance could be enforced in spirit as well as in letter.

Public State Universities

This group includes about 180 institutions in 19 States; 58 of them have agricultural programs. These 58 institutions perceive their roles as providing teaching, research, and public service to their regions and States in accordance with guidelines set forth by State legislatures. Compared with SAES, these institutions are small. Most of them have become involved in food and agricultural research during the last 30 years and their research is concentrated mainly on local problems. A 1979 survey showed that State appropriations provided 30 percent of their total research funds; associations and private grants, about 39 percent; Federal sources other than USDA, 21 percent; and USDA and land-grant universities provided the rest (Smallwood, 1980).

Generally there has been little coordination among the land-grant universities, USDA, and the nonland-grant State universities, The primary deterrent to cooperation has been a lack of format for exchanging information or for planning and communicating. This situation improved somewhat with the passage of the Food and Agriculture Act of 1977 and the establishment of the Joint Council on Food and Agricultural Sciences. Furthermore, most of these nonland-grant universities have no Federal or State charter for research, thus making financing difficult except for competitive grant activities.

RESEARCH IN THE PRIVATE SECTOR

Foundations

Foundations award grants to performers of agricultural research. There are some 400 American philanthropic foundations that award grants of $5,000 or more (Hildreth and MacLean, 1981). The nature and purpose of the grants vary with the interest and purpose of the granting foundations. Three of the largest foundations are Ford, Rockefeller, and Kellogg. Of these, only Rockefeller is sponsoring agricultural research related to U.S. agriculture. Although the Ford Foundation has supported agricultural research since 1950, it has gone primarily to programs in the developing countries, rather than to grant recipients in the United States. Interests of the W. K. Kellogg Foundation have been concentrated in extension, outreach, and training areas.

Compared with the quantity of funds available to the performers of agricultural research from public sources, the amounts provided by foundations are indeed modest. The decision to make each grant is based on policies established by the individual foundation's governing board. Each foundation seeks to be at the forefront of the areas chosen for emphasis. As such, these grants, while modest, may well play a significant role in the continuing development and adjustment of the performers of agricultural research to meet the emerging problems in food and agricultural science.

Private Enterprise

Food and agricultural industries contribute significantly to the productivity and efficiency of American agriculture in a number of ways: a) invention, improvement, and manufacture of farm machines; b) selection and improvement of crop plants and animals; c) development and production of a wide range of agricultural chemicals such as insecticides, fungicides, fertilizers, antibiotics, etc.; d) processing, preservation, and production of animal feed and human food; and e) development and improvement of a wide variety of farm structures.

Accurate figures on the size and scope of industry's input to agricultural research, as discussed in chapter IV, are unavailable, although several attempts have been made in the past to determine this information. In 1966, the Agricultural Research Institute (ARI) conducted an extensive survey of 825 private companies that were known to have agricultural research programs. Only 40 percent of the companies responded. The results indicated that the private sector was expending about $460 million annually for agricultural research. Of this amount, 9 percent went for basic research, 50 percent for applied, and 41 percent for engineering and development. Major fields of interest in industry research at the time of the survey were chemicals, feed, pesticides, fertilizers, and machinery (Moseman, et al., 1981). Food research was concentrated largely on product development and food processing.

In 1976, ARI attempted to update the 1966 data, but the response to questionnaires again was not wholly satisfactory. Of the 240 companies reporting, total R&D expenditures were $575 million. ARI felt the survey returns were insufficient to justify extrapolation to the entire industry, so the results were presented on the basis of only those companies reporting. A new factor turning up in the 1976 survey was that many companies were spending sizable amounts for "defensive research"—i.e., research required to meet Government regulations or undertaken in defense of existing products (Moseman, et al., 1981).

Although different segments of the agricultural industry perceive their roles differently, most of them are generally motivated by economic reasons. If management can foresee a profit from their research efforts, funds are set aside for the research program. In many cases, industry research results in payoffs for both the farm sector and consumers.

In recent years, the Office of Management and Budget (OMB) has adopted a policy of determining which research areas should be performed primarily by industry. OMB has done this with the concurrence of USDA and with little or no discussion with industry itself. The assumption by OMB of the authority to determine unilaterally what work should be done by industry has resulted in less cooperation from industry and in the omission of some necessary types of research. OMB judgments have little effect on the types of research industry undertakes. A result of this situation is that there are certain areas of research in which both agriculture and the consuming public are not being served as they should. One of these areas is the post-harvest technology research program (Irving, et al., 1981).

Although there are mixed views about USDA conducting post-harvest technology research, industries are generally in agreement with each other that much of this type of research should be performed by the public sector (USDA, 1979). Some of the critical elements in such research are reducing energy consumption in food processing, extending product shelf life, reducing transportation and storage costs, and minimizing processing losses. It is doubtful that the private sector is capable of doing the complete research needed in this area. Basic principles of post-harvest technology should be researched by the public sector for the benefit of consumers. In turn, industry should follow through on adaptive R&D as needed (Moseman et al., 1981).

Another area in which agriculture is not being fully served is that of improving efficiencies on farms through mechanization research. This was most clearly stated by Secre-

tary of Agriculture Bergland who declared that no Federal funds (excluding Hatch funds) should be used for this purpose if it displaced labor. Since the major part of agricultural mechanization has resulted from industry efforts, it is likely that such a USDA policy would adversely affect small industry types that would have insufficient financial resources for developing more effective farm equipment for specific crops and specific localities.

The above policies are viewed by some as leading toward a concentration of R&D in the hands of larger industrial corporations. Thus, small companies and small farms—which are supposed to be helped by USDA policy—are left without the help they should have. Basically, then, it is important to recognize that private industry contributes a substantial amount to research and technology development in the United States.

Those that have their own research programs tend to view their role in R&D primarily from a business investment standpoint. They conduct research in areas of interest to the company and in areas which may give it proprietary advantages. Much of the research conducted by agribusiness has general use and is of great value to the public, but agribusiness cannot be depended on to conduct a wide array of research in any given area. It is likely that industry might underinvest in research if the public sector were conducting similar research, It is difficult for the public sector (and probably for the industrial firms themselves) to anticipate the exact research area and the effort that will be expended on research of importance to agribusiness. Therefore, the public sector must maintain a research effort commensurate with public interest in such areas.

The greatest need seems to be a wider interchange of ideas at the planning level among USDA, SAES, and industry, The primary needs, therefore, appear to be communication, mutual respect, and a recognition that the solution of food and agricultural problems is of national importance and must be approached on a cooperative basis.

ROLE OF SAES AND USDA

During the early history of the development of the SAES there was concern about the relationship of the research stations to the land-grant colleges, There was an even greater concern about the acquisition of Federal funding through USDA for support of SAES, free from excessive domination by the Federal Commissioner of Agriculture. The Hatch Act of 1887 resolved many of these issues and provided for a high degree of autonomy by the individual States in designing and conducting research.

Additional legislation providing support for the establishment and strengthening of the SAES clearly recognizes the stations as distinct entities in the land-grant colleges. In the early years, the SAES were concerned almost totally with State and local research problems. However, as they grew and additional acts were passed by Congress providing wider use of funds, their research broadened to include regional, national, and international activities,

Meanwhile, USDA has developed a wide range of research laboratories, stations, and activities that not only includes national, regional, and international activities but at times involves strictly local problems.

This broad base for application of Federal and State resources to research problems has led some, including Congress, to question the degree of research planning and coordination that exists, especially at the top levels of administration. There seems to be considerable duplication of effort and vying for funds. The question of research priorities continues to be a subject of disagreement—basic v. applied,

commodity v. discipline, marketing v. production, etc.—and Congress and other interested groups have increasingly been concerned.

Most agricultural research administrators —whether SAES, USDA, or other—recognize there is not unanimity of thought in how best to manage and carry out U.S. agricultural research and the appropriate roles of the various actors for an effective and efficient research system.

Organization and Facilities

James Kendrick, vice president for agricultural and university services, University of California, recently suggested a plan to revitalize our agricultural research system and at the same time strengthen the partnership between Federal and State educational institutions. He said:

> The core of this plan would be a USDA-developed National Research Institute for Agriculture and Food Sciences. Founded with the very best of facilities and scientific expertise, the Institute should be established with a goal of making it the world's foremost center for basic research in agriculture and food science. It should provide support and stimulation which no other organization or agency could duplicate. It should have the capacity to attract the most competent scientists and specialists, not only for permanent affiliation, but also for short-term projects. As an integral and indispensable part of this plan, the Institute should establish a number of prestigious resident professional fellowships in the agricultural and food sciences, to be offered annually on a competitive basis to the scientific community at large.
>
> As important as such an Institute would be to our future basic research needs, it should not be expected to satisfy the total requirements for a comprehensive research program, The diversity in both commodities and geography which characterizes U.S. agriculture makes the problem too complex for a single-program approach. Regional USDA programs and State agricultural research, teaching, and extension activities must also be maintained and strengthened if we are to move from theory to practice without undue delay.

The PSAC panel of 1962 recognized the importance of having a strong and reputable national agricultural research center commensurate with the stature of U.S. agricultural research in international agriculture. The continued reluctance of USDA in recent years to support research facilities or staffing at the Beltsville Research Center has rendered the center less effective in furnishing research leadership and scientific inputs. It has also reduced the efficiency of conducting research at this location because of inadequate technical and support staff (Science and Agriculture, 1962).

The location of new laboratories and allocation of more resources to Beltsville, as contrasted with alternate locations, requires a sense of conviction on the part of the leadership of SEA as well as a commitment to research by the Secretary of Agriculture (Pound, 1980). The USDA library was erected at Beltsville, Md., in the mid-1960's when the Secretary of Agriculture took the position that "the location of USDA research facilities would not be determined by the White House staff, OMB, or others, but by the Department" (Moseman, et al., 1981).

The justification for strengthening other national and regional research stations and laboratories is that these facilities exist, they were designed to serve national and regional requirements, and they should be put to good use in meeting the needs of USDA and the SAES in improving the Nation's agriculture.

A major factor in the close cooperation of USDA and the SAES has been the association of research staff working either in Federal laboratories or in State-owned facilities at the cooperating SAES. This has been basic in maintaining strong cooperative relations and in sustaining mutual respect of the cooperating partners and should be given high priority in future strengthening of the national agricultural system.

Partnership Difficulties

Don Paarlberg, at the 1980 Agricultural Outlook Conference, made the following statement:

> The need for some degree of relatedness in the various agricultural research undertakings is clear.
>
> The Agricultural Experiment Stations are perhaps unique among the tax-supported research institutions. They were set up nearly a century ago, when the prevailing mood was more individualistic than it has recently become. Modern macro concepts had not been invented. The States were more important then. Central direction was anathema. Volunteerism and cooperation were in vogue. The experiment stations reflected their times. Traditionally, decision-making was shared among the clientele groups, the individual researcher, his department head, his director of research, his dean, the university president, the State legislature, and the Congress. With formula funding, the Department of Agriculture had limited input,
>
> The recent surge of tax-supported research in fields other than agriculture and in agencies other than the experiment stations is the product of different times: more central direction, more team activity, more macro and less micro, more concern about externalities, less emphasis on the criterion long used by the land grant colleges–efficiency.
>
> There is now an effort, on the part of those who provide the Federal funds, to bring the experiment stations and agricultural research generally into the modern setting, with more central direction, to have it conform to the current mood. The experiment stations, with their proud history, understandably resist this effort.
>
> Some form of leadership is essential. Strong central direction and coercion are repugnant for a number of good reasons. A loose voluntary cooperative type of guidance is desirable. The accepted though much scorned word for this is "coordination." It must be exercised if the research community is to appear to the appropriations committees as something other than a group of bureaucratic self-seekers. Who should supply this coordination? In my view, the Science and Education Administration of the Department of Agriculture should exercise the coordinating role, with input from the directors of research at the experiment stations and other institutions with research capability in agriculture.
>
> The Department of Agriculture is central, it is directly involved in the acquisition and distribution of Federal funds, and it comes closer to perceiving the broad public interest than does any other unit in the system. The exercise of this role is extremely difficult. An experienced administrator will take on this role with some reluctance, as an exercise of responsibility, not assertively, as an expression of power (Paarlberg, 1980).

Emery Castle, in an address to the National Association of State Universities and Land-Grant Colleges in November 1980, said:

> Federalism is undergoing constant evaluation on many fronts but the unique historic relationship between the USDA and the land-grants has evolved into a set of institutional relations that are unrivaled in complexity. The question should be faced squarely as to whether the historic partnership between the USDA and the land-grants remains viable. The Food and Agriculture Act of 1977, the numerous constituencies that must be served by USDA, together with the multiple ties between higher education and the Federal Government, raise questions as to whether the partners still are marching to the same drummer. What happens during the next four years probably will decide whether the point of no return on the road to dissolution of the partnership has been passed, or whether recent events will be viewed only as a series of family spats, not unlike a political party's national convention—a necessary prelude to battle against a common enemy (Castle, 1980).

Funding and Roles

Many comment that the problem is a result of the continuing tight budget and that all problems would be solved if only there were enough money. While undoubtedly the problems are exacerbated by a continuing tight budget, this is only a superficial answer. The facts are that at the administrative level, there is, in a general sense, no agreement on the

roles of the SAES and USDA, and until there is some understanding and agreement of the roles of these two primary public actors in U.S. food and agricultural research, there can be no effective agreement on overall cooperation in the very important aspects of U.S. agricultural research. Effective cooperation between any two people, organizations, or nations requires agreement on the subjects on which to cooperate and on the roles of each, and each must cooperate from a base of relative strength. To an outsider of the system, it does not appear that this should be a difficult task if the actors can realistically evaluate their roles, strengths, and responsibilities in an atmosphere free of bureaucratic considerations.

Federal formula funds allocated to the States are used primarily to supplement funding of State programs designed to solve problems of State and local needs. The director of the SAES is accountable for all such funds going to the State experiment station. Most of these programs contribute to solving problems of regional and national importance, but Federal formula funds do not have regional or national problem solution as their primary objective, nor is priority determined by such needs.

State legislatures appropriate funds to their SAES to solve State and local problems. Again, accountability for their expenditure usually lies with the director of the SAES. Undoubtedly, most State research has contributed to the solution of regional and national problems, but such contributions have been adjuncts to solving State and local problems. It is also common for two or more States to pool resources to work on regional problems of common interest to them. But even in these instances, control and accountability are not centralized in any one person or institution.

Hence it appears that under the present system, it would be difficult for one or several SAES to plan and conduct a full effective program responsible for the solution of regional or national problems even though they may contribute significantly to the solution of such problems. Some SAES directors do not agree with this statement, but they have yet to devise a plan that would give assurance to the contrary.

Federal funds are allocated to Agriculture Research (AR) primarily for problems of regional or national importance, where the nature or magnitude of the problem is such that a single State cannot provide the resources for its solution and where there is some regional or national concern for the problem, or from an industrial standpoint where the risk is too high or demanding for any one industrial component. AR programs include those involving resources and activities that are jointly developed by AR and SAES. AR also has responsibility for servicing the research needs of action agencies within USDA. AR is accountable to the executive and legislative branches of Government for the administration and national coordination of such programs.

It appears that insofar as Federal formula funds are concerned, the role of the SAES should be primarily concerned with State and local problems and those problems of a regional, national, or international nature that are an extension of their State and local problems. Insofar as special grant or other grant funds are concerned, SAES should compete on their ability to perform the needed tasks effectively.

AR should concentrate on agricultural problems important to the Nation that no one State or private group has the resources, facilities, need, or incentive to solve and those research programs as required to fulfill the stated objectives of Congress, the President, and the Secretary of Agriculture. AR should carry out its role by working as a partner with SAES to achieve complementarily and, through cooperation with private universities and industry, to coordinate its own contribution to achieve national goals most effectively. This should be done with effort by both USDA and SAES to collaborate when appropriate in such a way to assist the research performance and respect the integrity, role, and decisionmaking responsibilities of the institutions.

PRINCIPAL FINDINGS

- There is a role for a strong national USDA research program. This role has been carried out in the past by USDA and Federal funding to SAES. Historically, the USDA role was associated with broad regional, national, and international activities. The role of SAES, insofar as Federal funds are concerned, has been primarily for local, State, and regional problems. These roles are becoming confused.

- Grant funds provide resources to further the programs of USDA. SAES, nonland-grant universities, and others compete for these funds on the basis of their interest in and ability to do Federal research. This is a desirable aspect of the total research effort.

- The Committee on Food and Renewable Resources has not yet satisfactorily fulfilled its role, This is because it is a relatively new feature in a well-entrenched bureaucracy; it needs more specific, highly defined objectives; and it does not have the authority of individual agencies that might be addressing the same problems from more authoritative positions.

- Under the 1977 Food and Agriculture Act, the 1890 land-grant institutions participate in research and receive most of their funds from Federal resources. They have pressing needs; one of the more important is improved facilities. Coordination with the rest of the system is less than adequate.

- The private sector tends to view its role primarily from a profit potential. It conducts research in areas of interest to the companies and in areas that may give them proprietary advantages. There are significant research areas of interest to the public that are not receiving and will not receive adequate research attention if left to the private sector,

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