UNIVERSITY OF MINNESOTA

INTERNATIONAL AGRICULTURAL PROGRAMS

and INTERNATIONAL SERVICE for NATIONAL AGRICULTURAL RESEARCH (ISNAR)

AGRICULTURAL RESEARCH POLICY SEMINAR

APRIL 15-25, 1985

Proceeding for Modules I and II

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JULY 1, 1985

AGRICULTURAL EXTENSION SERVICE

SCIENCE AND AGRICULTURE

From the beginning of American agricultural development, science and technology have been major forces in improving production efficiency. Shifts in power sources -- human to horse to mechanical -- were the major changes until the early 1940's.

The post-World War II period saw the first full phase of scientific agriculture. The key factors were the development of hybrid crop strains, widespread use of pesticides and herbicides, improved nutritional and medical practices in animal husbandry, and the increased use of energy and fertilizers. Concurrent with these changes in farming practices, producers adopted modern business management methods. As a result, each farmer, along with related sectors, now feeds and clothes 79 people here and abroad -- up from only 17 at the turn of the century.

Today, the United States is a recognized world leader in agricultural production. The agricultural system, including related input and marketing components, generates about 20 percent of the nation's gross national product and employs 23 percent of the U.S. labor force. Because of the diversity and efficiency of this system, American consumers spend only about 16 percent of their disposable income for food.

Remarks by Dr. Orville G. Bentley, Assistant Secretary of Science and Education, U.S. Department of Agriculture, at a Seminar on Agricultural Research Policy, Minneapolis, Minnesota, April 15, 1985.

American agricultural products are highly competitive in world markets, and their sale represents 18 per cent of our total exports, contributing substantially to the balance of payments. As an industry, American agriculture has had a high rate of growth in productivity -- a rate more than three times as high as that of the non-farm business sector of the economy since World War II.

In the 1970's, U.S. farm prosperity seemed assured. But today, not everything is as healthy in the farm sector as expected, nor is the outlook as bright as it once was for expanding markets.

A significant increase in the value of the dollar -- relative to other world currencies -- and expanded world production tend to place some U.S. farm exports at a competitive disadvantage. These market changes, and their subsequent impact on commodity prices, have been major factors in lowering farm land values in the U.S. The credit crisis now facing the nation's farm belt can be traced in large part to these developments and high interest rates relative to inflation.

What can be done to turn this situation around? The Administration and several others suggest that U.S. agriculture must become more market-oriented and rely less on federal support programs.

This program is outlined in the 1985 Farm Bill submitted to Congress. We expect these proposals to be discussed extensively in coming months by the Executive Branch, Congress, and industry as the new Farm Bill is shaped. Rather than commenting further on that matter at this time, I will direct my comments to the role of science and education in addressing these and other farm issues.

Need for New Technologies

For the next decade and on into the next century, the economic viability and international competitive position of U.S. agriculture will depend heavily on gains in productivity -- that is, reducing production costs and providing higher quality goods and services, including more value-added products for the export market. The combination of traditional research methods and the new biotechnology techniques offers tremendous potential for improving the competitive position of U.S. agriculture.

New and improved animal technologies point to faster growth rates, less feed per unit produced, increased disease resistance, and more offspring per animal. Animal diets can consist of more forages and crop by-products, and be supplemented with minerals, vitamins, amino acids, and other nutrients.

With the use of biotechnology techniques and conventional plant breeding, crops will have increased resistance to disease, insects and nematodes. Variation in temperature, water availability, and competition from weeds will have less effect on new, more resistant varieties of food and feed grains, fruits, vegetables, and fiber and tree crops.

One of my colleagues succinctly described what we are doing this way: "We are laying out a blueprint for biotechnologies that have potential payoffs for agriculture now and in the future."

Among the many forces that are creating a need for changes in approaches to agriculture and the development of new technology, these come immediately to mind:

* Statistics tell us that food consumption patterns are changing. Indications are that the public has a growing appreciation for the relationship of dietary regimens, good health, and physical fitness. In addition, scientific and etiological data suggest a possible relationship between the onset of certain chronic disease conditions such as hypertension, diabetes, and cancer and what and how much we eat.

  These developments suggest increased emphasis on the study of nutrition per se, and how meeting nutritional needs should relate to production and processing of food and food products.

* There are increasing concerns about the continued availability of the soil and water resource base. Improved resource-saving technologies need to be incorporated into current production practices. What resource use patterns are consistent with sustained agricultural uses over time?

* During the past century, converging scientific, economic, and technological developments have led to growing public concern over the effects of these developments on human health and quality of life. Such changes have prompted vigorous debate over the enforcement and adequacy of our laws and regulations. How do we effectively monitor unwanted contaminants in our food supply? How do we evaluate the safety of genetically-engineered microbes which may be used in food processing or production? And how do we evaluate low-level carcinogenic risks from multiple sources? These are but a few of the scientific questions facing us today.

* The United States has extensive acreages of forest and range resources -- 71 per cent of our total land area. These resources provide jobs, wood, wildlife, water, forage, and energy -- plus an array of recreational opportunities. As with annual crops and domestic farm animals, improved forests and range technologies can increase yields, better protect the resource, reduce input costs, and enhance the quality of the products -- all to meet changing demands of domestic and foreign customers.

As agriculture becomes more dependent on sophisticated technologies to produce and process food and fiber products, it will take increasing effort to sustain the effectiveness of those technologies. This is an area with several names -- maintenance research, productivity-sustaining research, protective research, and defense-of-gains research, among others.

The concept of maintenance research applies to many aspects of agriculture -- from plant breeding to work on soil and water resources, pest control, and livestock production. Just like buildings and equipment, technology depreciates in usefulness and must be continually updated.

Research investigations and the people who perform them are inexorably linked. We can't have one without the other. There is a growing need for highly trained scientists in such fields as cellular and molecular biology and systems analysis, who also understand the unique needs of agriculture.

Several reports issued recently give evidence of a growing awareness among educators that we had better be alert to the curricula changes that are needed in our colleges and universities if we are to meet the growing demand for highly trained, skilled expertise in plant, animal and other sciences.

The "Chronicle of Higher Education" recently qucted Alexander W. Astin, president of the Higher Education Research Institute at the University of California, with this warning: "Too often colleges and universities have focused on financial problems instead of issues as the quality of teaching, learning, and active student 'involvement' in the educational process." Others are beginning to echo similar charges, and I, for one, believe it is a healthy sign.

We needn't look far to find evidence of industry's recognition of the need to work with universities in research and development and the application of new technologies. Such linkage is decidedly a trend.

There are far too many new alliances and partnerships between universities, federal agencies and private industry for me to list here. You know many of them well. Discussion of their assistance in utilizing scientific advances was the focus of a forum at the National Academy of Sciences early this year.

Concerning Surpluses --

Because this nation enjoys an abundant supply of agricultural products, we occasionally hear opinions expressed that research causes surplus, or is ahead of its time. Or with a plentiful supply of food and fiber products, someone will ask, "Why spend money on research?" The premise on which these statements are made is not valid.

As I mentioned earlier, a major premise of agricultural research is to sustain and improve productivity growth. Improved productivity of off-farm inputs, labor, and natural resources is the key to a profitable and competitive agriculture. It is absolutely vital to a healthy industry.

Surpluses are basically a marketing problem which research attacks by improving product quality and reducing product cost -- the most important factors in expanding market shares. Research continually provides options for current management and production practices. Consequently, changing research policy during periods of surplus or scarcity is counterproductive, because research requires a long-term commitment.

The International Community

The United States has a long and enviable record of sharing its resources and knowledge with other countries in a continuing effort to promote economic stability, reduce poverty, and solve world food programs.

While international programs in the agricultural sciences make up a very complex system, U.S. agriculture has the basic ingredients to assure a role of leadership. These ingredients include:

* A strong and viable U.S. agricultural science system.
* A solid and proven university-USDA relationship.
* An effective partnership with the private sector.
* Policies which articulate and emphasize scientific cooperation.
* Experience in a wide range of international cooperative activities.

There are many reasons why cooperation with the international scientific community pays real dividends. Exchanging knowledge and training programs provides a foundation for better <u>trading</u> partnerships. And the U.S. keeps abreast of new developments in other countries.

There are other issues facing scientific agriculture, but those we have mentioned are enough to indicate that we are in the midst of exciting times.

The agricultural sciences are going through a transition period. The changes have implications for education in agriculture at the baccalaureate and graduate levels.

There is a new sense of interdependence among the sciences, especially in biology as it relates to agriculture in the public sector. There is an equal excitement over the potential for innovation and development of new products in the private sector that will find widespread application in agriculture.

For these reasons, the interaction of universities, federal research laboratories, and industry is being explored in an effort to find productive and mutually beneficial bases for endeavors and greater cooperation. Interaction of the clientele with the publicly-supported research and education programs in the U.S. has been one of our strengths.

With the introduction of new and sophisticated scientific developments and innovations, we anticipate that these relationships will grow and become a more important element of what we know as the "federal/state, public/private sector" partnership that makes up the U.S. research and education, food and fiber production system.

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