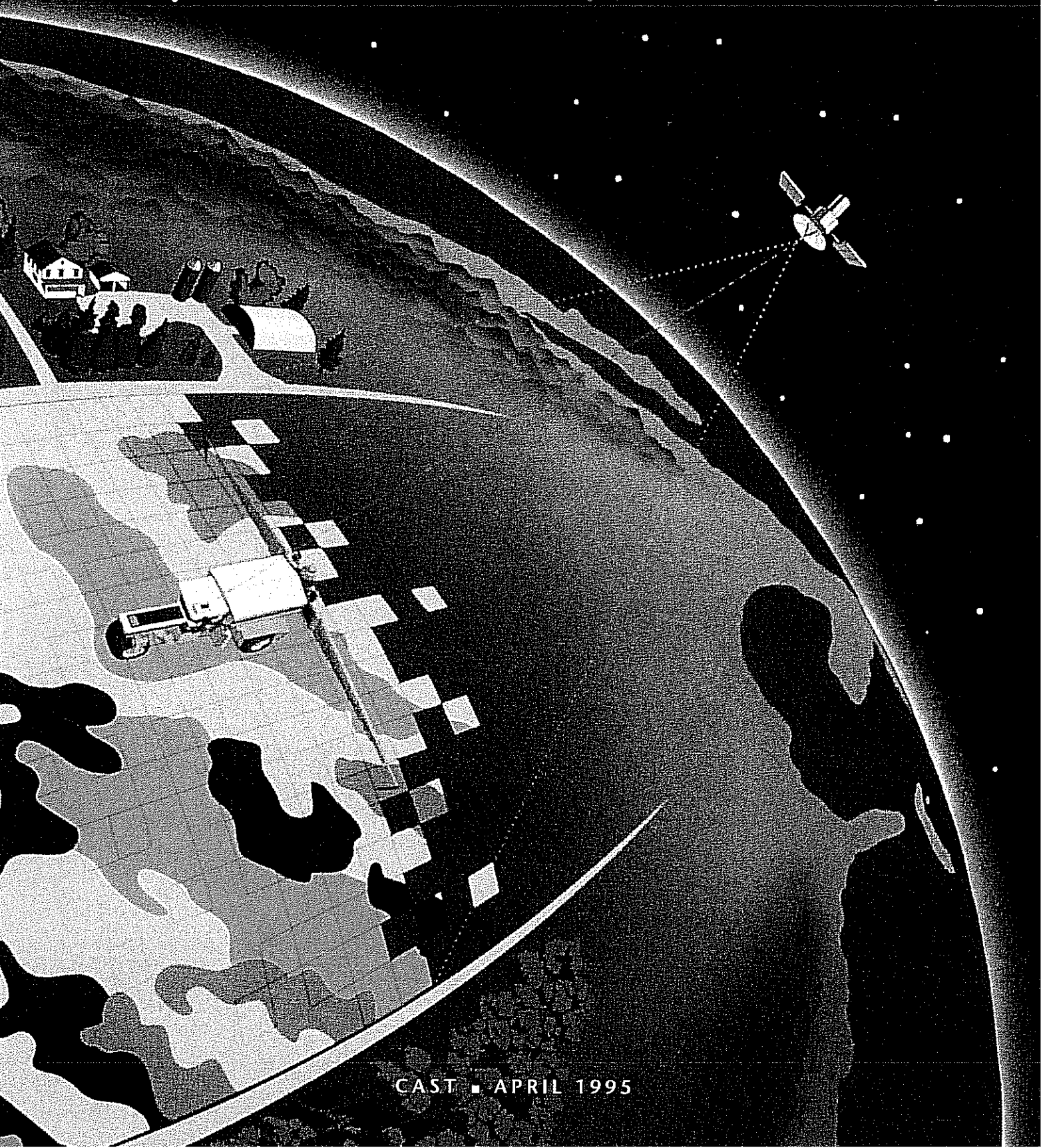
SUSTAINABLE AGRICULTURE

AND THE 1995 FARM BILL



Council for Agricultural Science and Technology

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The mission of the Council for Agricultural Science and Technology (CAST) is to identify food and fiber, environmental, and other agricultural issues and to interpret related scientific research information for legislators, regulators, and the media involved in public policy decision making. CAST is a nonprofit organization composed of 30 scientific societies and many individual, student, company, nonprofit, and associate society members. CAST's Board of Directors is composed of 47 representatives of the scientific societies and individual members, and an Executive Committee. CAST was established in 1972 as a result of a meeting sponsored in 1970 by the National Academy of Sciences, National Research Council.

The primary mission of CAST is the publication of task force reports written by scientists from many disciplines. The CAST National Concerns Committee screens proposals from all sources and recommends to the board topics for approval as publication projects.

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Sustainable Agriculture and the 1995 Farm Bill

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The cover graphically depicts the latest technologies used in precision agriculture. Precision agriculture is a new sustainable farm management system that allows framers to manage each part of a field according to its own particular set of needs. Better management of field variability promotes optimum profitability, sustainability, and protection of the environment.
Precision farming utilizes soil sampling, geographic information systems (GIS) field mapping, on-board computers, global positioning satellite systems (GPS), variable rate and blend application, and yield monitors to identify and manage variability in fields. These technologies give farmers the most advanced tools to date to balance economic and environmental demands.

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Contents

Foreword

At the February 1994 CAST Board of Directors meeting, the board adopted a new Strategic Plan for CAST, which included among other approaches, CAST sponsored conferences and workshops. The board approved development of a conference targeting the 1995 Farm Bill. CAST thanks the Conference Steering Committee for planning and organizing the conference and the following groups who assisted in producing a successful conference: The American Society of Agricultural Engineers for providing support for arrangements and registration; AESOP Enterprises, Ltd. for assisting the Conference Steering Committee in identifying and contacting speakers for the program; and Shandwick Public Relations for providing media contacts.

Dr. Neville P. Clarke, Southern Region Agricultural Experiment Station, Texas A&M University, College Station, and Paula B. Ford, Southern Region SARE/ACE Program, Georgia Experiment Station, Griffin, served as cochairs of the report. The moderators and rapporteurs wrote summaries of their sessions, revised all drafts, and reviewed the proofs. The CAST Executive and Editorial Review committees reviewed the final draft. The CAST staff provided editorial and structural suggestions and published the report. The contents are a reflection of interpretations of speakers' comments by moderators, rapporteurs, cochairs, and editors. Papers provided by speakers are available on request. This report attempts to reflect comments and discussion of those who attended the meeting; other relevant viewpoints understandably may not be documented.

On behalf of CAST, we thank the cochairs, moderators, rapporteurs, and speakers who gave of their time and expertise to participate in the conference and to prepare this report as a contribution of the scientific community to public understanding of the 1995 Farm Bill issues. Also, we thank the employers of these individuals for making their time available at no cost to CAST. The members of CAST deserve special recognition because the unrestricted contributions they have made in support of the work of CAST have financed the preparation and publication of this report.

CAST thanks the following groups who provided additional financial support for the conference: American Crop Protection Association, Basic American Foods, DuPont Agricultural Products, Environmental Protection Agency, The Fertilizer Institute, General Mills, ISK Biosciences Corporation, Kraft General Foods, Monsanto Agricultural Group, National Pork Producers Council, North Central Regional Center for Rural Development, The Rodale Institute, Tennessee Valley Authority, U.S. Department of Agriculture Natural Resources Conservation Service, U.S. Department of Agriculture Research Education and Economic Division, and the W. K. Kellogg Foundation.

This report is being distributed to members of Congress, the U.S. Department of Agriculture, the Food Safety Inspection Service, the Centers for Disease Control and Prevention, the Congressional Research Service, the Food and Drug Administration, the Environmental Protection Agency, the Agency for International Development, Office of Technology Assessment, Office of Management and Budget, media personnel, and to institutional members of CAST. Individual members of CAST may receive a copy upon request for $25.00. The report may be republished or reproduced in its entirety without permission. If copied in any manner, credit to CAST would be appreciated.

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Interpretive Summary

The Council for Agricultural Science and Technology organized the conference *Sustainable Agriculture and the 1995 Farm Bill* to provide a forum for debating potential policy issues that Congress will be addressing soon. The conference consisted of six sessions, each with a keynote speaker and a panel representing a spectrum of viewpoints and interests likely to be involved in the genesis of the 1995 bill. Three key congressmen and several members of the administration also spoke. This document is a summary of the presentations and discussions at the conference.

1 Legislation

Given the current political climate, the commodity stabilization and price support focus of previous farm bills likely will be redirected toward programs emphasizing global competitiveness, market forces, and environmental management. The principles that agricultural systems must be environmentally, economically, and socially sound were held by most participants, regardless of their specific interests in the agricultural system. There was substantial discussion of whether in the new farm bill the term *sustainable* should be abandoned in favor of a set of other descriptors that might define more neutrally the goals common to the interests of most parties. Most conferees agreed that the rhetorical distinction between *conventional* and *sustainable* agriculture should be limited and that the thrust of the new farm bill should be on broad goals and principles.

2 Conservation

Support programs should not dissuade farmers from adopting practices that enhance the environment. Substantial debate ensued over whether commodity support programs have contributed to the increasingly bimodal structure of agriculture and to the vertical integration of agricultural enterprises.

It was agreed that conservation programs merit government support. They should be targeted at environmentally vulnerable areas—a determination that should be based on ecosystems and watersheds instead of on individual fields. Research and education efforts should focus on whole-farm systems and on farming's impact on the ecosystem. The 1995 Farm Bill should review and coordinate related programs and foster the leveraging of state and local funds for environmental protection.

The federal government should create a broad definition of *sustainable agriculture* and design agricultural policies to achieve related goals. The definition used to develop policy should take a systems approach, placing land-use practices in a whole-farm and ecosystem context.

For farmers to be both competitors in the global economy and stewards of the natural resource base, the 1995 bill should encourage innovation and responsiveness to market forces as well as environmental integrity. Programs should provide flexibility and incentives for farmers to adopt agricultural practices and to develop systems protecting the environment and increasing profitability. Alternative crops and value-added processing of traditional commodities also should be areas of focus.

3 The Environment

The farm bill and related legislation should integrate and consolidate overlapping environmental regulations, and regulations should be replaced, where appropriate, with incentives. Environmental regulations, especially those involving significant compliance costs, can have a disproportionately negative effect on small producers.

Research should focus on the identification of indicators of environmental sustainability and on the ongoing development of environmentally sound management. Funds might be made available for agricultural service providers to instruct farmers in whole-farm systems and ecosystem management.

4 Rural Development

The importance of vital rural communities, which depend on strong agricultural sectors, was a point of

agreement. Rural development must include opportunities for nonagricultural growth. A significant portion of the farm population relies on off-farm income, making the development of local enterprises key to the development of many rural communities. Locally owned value-added agricultural enterprises may have the potential to provide employment opportunities and to increase net farm income.

For long-term viability, rural communities will need to diversify economic activity beyond supporting production agriculture. The federal government's role in supporting the development and maintenance of rural community infrastructure is unsettled due to the current budget deficit. New strategies will be needed in the next century to ensure the survival of rural communities.

5 Research and Education Agenda

Areas of importance relative to the environment, nutrition and food safety, processes and products, economic and social issues, animal systems, and plant systems are, respectively, as follows:

1. conserving and enhancing resources and biodiversity, recovering and using water resources, and developing resource management decision systems;
2. enhancing food safety, targeting optimal nutrition, and designing and promoting healthy foods;
3. converting by-products, enhancing food quality, and developing nonfood products;
4. empowering people economically and socially and enhancing agricultural markets, competitiveness, and rural development;
5. developing integrated and sustainable animal production systems and enhancing genetic diversity, biological performance, and well-being; and
6. sustaining productivity, developing alternative plant management systems, clarifying fundamental plant processes, and improving genetic techniques.

Executive Summary

Introduction

The Council for Agricultural Science and Technology (CAST) organized the conference *Sustainable Agriculture and the 1995 Farm Bill* to provide a forum for debating an array of policy issues that Congress will be addressing soon. A departure from CAST's usual approach of providing reports on contemporary issues, the conference was intended to identify key issues and perspectives, to facilitate consensus, and to provide timely input for those developing the 1995 Farm Bill.

The conference was attended by more than 200 people representing diverse backgrounds, perspectives, and agendas. It was organized to deal with a set of sustainable agriculture issues, e.g., (1) conservation, (2) environmental protection, (3) rural development, and (4) related research and education agendas. An introductory session considered the legislative evolution of sustainable agriculture and its likely status in the forthcoming farm bill.

The conference consisted of six sessions, each with a keynote speaker and a panel representing a spectrum of viewpoints and interests likely to be involved in the genesis of the 1995 Farm Bill. Opportunities for panel interaction and audience participation were provided. Four key members of Congress and the administration spoke on farm bill issues. The seventh and final session addressed research and education implications of prior discussions.

Moderators and rapporteurs of the seven sessions prepared summaries of the presentations and discussions for those who will be drafting the 1995 Farm Bill.

1 Sustainable Agriculture and the Legislative Process

A Changing Environment

The November 1994 elections, which took place as the conference was being planned, dramatically changed the framework against which the 1995 Farm Bill will be crafted. Several prominent changes include proposals by both political parties and the administration to

1. decrease the budget deficit;
2. eliminate unnecessary regulations and unfunded mandates;
3. decentralize programs by shifting decision making responsibility from federal to state and local government;
4. lower funding levels for traditional commodity and price support programs and to improve the responsiveness of agriculture to market forces; and
5. shift priorities to focus on the need for increased funding of research and educational efforts that help farmers improve global competitiveness.

Given this political climate, the commodity and price support emphasis of previous farm bills likely will shift in favor of programs emphasizing global competitiveness and market forces. Additionally, the 1995 Farm Bill likely will emphasize market mechanisms and incentives instead of regulations as means of protecting the environment.

Agreement on General Principals Despite Differences Regarding the Mechanisms to Achieve Goals

This conference revealed a growing consensus that the general principles of sustainable agriculture, i.e., that agricultural systems must be environmentally, economically, and socially acceptable, are shared by most individuals within the agricultural system. However, the mechanisms and processes used to achieve these goals occasioned substantial debate. For instance, there was substantial and unresolved discussion of whether the term *sustainable* should be abandoned in favor of a set of other descriptors more neutrally defining the goals shared by most parties. A widespread belief among conferees was that for these goals to be achieved, the rhetorical distinction between *conventional* and *sustainable* agriculture

had to be limited and that the thrust of the new farm bill should be those broad goals and principles held by all interested parties.

2 Conservation Issues

Commodity Support Programs Producing Mixed Results

Although commodity support programs have had a beneficial impact on stabilizing supplies and farmer income, several participants noted that the results of such programs have not always been consistent with the environmental goals of sustainable agriculture. A consensus emerged that support programs should not dissuade farmers from adopting cost effective practices such as crop rotation and green manuring, both of which enhance the environment. Significant debate ensued over whether commodity support programs have contributed to the increasingly bimodal structure of agriculture and to the vertical integration of agricultural enterprises. This is an issue resonating among those who believe that the social agenda of sustainable agriculture mandates special attention to small or medium-sized family farms. As with other social issues surrounding sustainable agriculture, no consensus was reached.

Adequate Funding Targeted to Meet Conservation Goals

Most agreed that conservation programs are worthy of government support. Many conservation programs not only conserve traditional agricultural resources but also preserve wildlife and other natural resources, thereby benefitting all of society. For this reason, federal support of the programs should continue. So that their cost-effectiveness can be improved, however, these programs should be targeted at environmentally vulnerable areas—a determination that should be based on ecosystems and watersheds instead of individual fields. To provide the guidance needed to develop appropriate programs, research and education efforts should focus on whole-farm systems and on the environmental impact of farming and ranching at the ecosystem level. Additionally, the drafters of the 1995 Farm Bill should review and coordinate related programs and foster the leveraging of state and local funds available for environmental protection.

Redefinition of the Government's Role

Although debates over the definition of *sustainable agriculture* most likely will continue for years, the federal government can play a leadership role by creating a broad definition acceptable to most parties in the debate, and by creating agricultural policies designed to achieve the goals articulated in the broad definition. Many participants noted that any definition used to develop agricultural policies should take a systems approach placing land-use practices in a whole-farm and ecosystem context, as compared with current policies focused on specific practices, which tend to neglect the important interactions between agriculture as a whole and the environment.

Linking Traditional Commodity Programs to Conservation and Market Forces

A consensus emerged that for farmers to be both competitors in the global economy and stewards of natural resources, the 1995 Farm Bill should provide policies encouraging farmers to be responsive to market forces and innovative. The 1995 Farm Bill programs should provide flexibility and incentives for farmers and ranchers to adopt agricultural practices and to develop systems that are environmentally sound and profitable. Several participants suggested that alternative crops and value-added processing of traditional commodities should be areas of focus for the forthcoming farm bill.

3 The Environment and Sustainable Agriculture

Simplifying, Consolidating, Decentralizing, Deregulating, and Providing Incentives for Environmental Protection

Farmers, ranchers, foresters, and natural-resource managers share with consumers an interest in the development of an agricultural system that meets the food and fiber needs of society while protecting agricultural and natural resource bases. But the current mood toward federal regulation seems to be that whereas the federal government should outline broad environmental protection goals and indicators, state and local governments should have the flexibility to determine the most appropriate mechanisms by which to achieve these goals. Most participants agreed that the farm bill and other related legisla-

tion should consolidate overlapping environmental regulations and that regulations should be replaced, when appropriate, with incentives.

Regulation's Impact on the Structure of Agriculture

Environmental regulations, especially those involving significant compliance costs, can have a disproportionately negative impact on small producers. Although granting exemptions for small producers may alleviate this impact, the consensus seemed to be that the 1995 Farm Bill should focus on the use of incentives to foster adoption of environmental practices, rather than on federally imposed regulations. Compliance incentives have the added benefits of rewarding producers for innovation and of allowing them to respond quickly to shifting market forces.

Regulations Based on Current Science

Regulations prescribing specific practices usually inhibit technological change that could improve the environment. Regulations therefore should not be tied to specific practices but instead should focus on environmental goals and producer performance. Research should focus on the identification of indicators of environmental sustainability and on the ongoing development of environmentally sound management practices. Several conference participants suggested that funds be made available to train agricultural service providers (employees of the Extension Service, the Natural Resources Conservation Service, and other organizations) to educate farmers regarding whole-farm systems and ecosystem management.

4 Rural Development and Sustainable Agriculture

A Divisive Social Agenda

Although generally agreeing on the importance of the social aspects of agriculture, participants were divided about issues surrounding the structure of agriculture and rural communities. Specifically, attempts to shift the focus of sustainable agriculture to small or medium-sized farms resulted in a debate over whether the goals of sustainable agriculture were applicable to larger enterprises. Additionally, the issue of vertical integration, especially within the poultry and the swine industries, proved contentious. It is likely, given the political overtones of these debates, that social issues will continue to divide interested parties. On the other hand, the importance of vital rural communities, which depend on strong agricultural sectors, was a point of agreement.

Rural Development Expanding Its Scope Beyond Agriculture

Although a strong agricultural economy is vital to the development of rural communities, rural development also must include opportunities for growth within the nonagricultural sector. Specifically, a sizeable portion of the farm population currently relies on off-farm income, making the development of local enterprises key to the development of many rural communities. Several participants noted that local value-added agricultural enterprises have the potential both to provide employment opportunities and to increase net farm income.

Rural Development Emphasizing Local Empowerment

The importance of local control and empowerment in development activities was recognized widely. Many participants suggested that the 1995 Farm Bill provisions for rural development allow for local control and flexibility in development activities that encourage community innovation in rural development strategy instead of imposing or encouraging federal strategies. Research and education programs should focus on the interaction between the social and the environmental aspects of sustainable agriculture and should provide opportunities to explore methods of community development.

5 Agricultural Research and Education Agenda

The Environment and Natural Resources

The quality of air, soil, and water resources is critical to the well-being of the biosphere, and the societal value of protecting natural resources must be expressed in terms much broader than economics. Research will provide the knowledge and the technology needed to diminish contamination of ground and surface waters, to address the problem of bay and estuary contamination, to decrease soil erosion, and to ensure that agricultural and forestry operations are not associated with unacceptable air quality degradation.

Ecosystem research is needed to foster agricultural and forestry production that is environmentally sound, economically viable, and socially acceptable; to promote health and productivity of forests, rangelands, and aquatic systems; and to provide an aesthetic, wholesome, healthy environment with improved recreational opportunities. Research also is needed to develop more economically and ecologically viable methods of converting and using water. Methods of recycling waste materials in food and fiber production systems not only mitigate the disposal problem but enhance the effective use of natural resources. There is a growing need to clarify the social and environmental consequences of resource management decisions.

Nutrition, Food Safety, and Health

The U.S. Centers for Disease Control and Prevention estimates that more than 6 million cases of foodborne illness resulting in 8,000 deaths occur annually, at a total cost of about $5 billion. Research is needed to improve methods of identifying the causes and the costs of foodborne diseases and of detecting, assessing, and controlling them.

Costs associated with the four major chronic diseases linked to inappropriate diet now approach $145 billion annually. Research is needed to determine optimal nutrient intakes, as well as the role of dietary factors in the development and the prevention of obesity and chronic diseases. Manipulation of existing foods and design of new ones can improve the growth and productivity of Americans and can decrease their susceptibility to disease. New technologies applied to agricultural products offer unprecedented opportunities to respond to consumer demands for healthy diets. The economic and the behavioral obstacles to adopting healthy food habits consistent with U.S. dietary guidelines and with the food guide pyramid also must be identified to aid the monitoring of food composition and food intake as bases for effective nutrition policy and food assistance programs.

Processes and Products

New and improved food and nonfood uses for waste products will contribute to economic development and will benefit the environment. Understanding the structural and functional relationships among various components of foods will facilitate control and enhance food quality during processing, storage, distribution, and preparation for consumption.

Clarification of the chemical composition of agricultural and forestry products can provide the basis for innovative or improved industrial processes and products. Agricultural nonfood industries have the potential to breathe new life into rural communities; to provide existing industries with alternative oils, fuels, and base materials; and to produce new consumer products.

Economic and Social Issues

Analysis of domestic and international markets is essential for increased trade and sustained farm incomes in an environment of decreased federal spending for agriculture. More than one-fourth of Americans live in rural communities, and this proportion is increasing. If rural America is to remain a productive contributor to the U.S. economy, as well as a preferred home to many citizens, the factors constituting a viable community must be understood.

Those unable to cope with a changing environment as a result of their educational deficiencies and/or poverty create a drain on revenues and rob the nation of productive capacity. Research will generate the information needed for decision making and bring about more effective economic and social policies to resolve societal problems.

Animal Systems

Research is needed to identify the interrelationships within quantitative models that will translate into management models increasing efficiency, sustainability, and profitability. Use of modern molecular genetics, improved understanding of the physiological and metabolic functions under genetic control, and a combination of molecular and quantitative genetic techniques offer unparalleled opportunities to improve animal systems.

Food animal disease results in $18 billion in lost revenues annually, and in the current era of modern transportation and high mobility the possibility of importing exotic animal diseases poses an economic threat of even greater proportions. Research will use the exciting new tools of modern biology to explore new methods of detecting and preventing animal disease and will develop methods by which to measure animal well-being objectively and to evaluate the factors contributing to it.

Plant Systems

Protecting useful and life-sustaining plants from insects, diseases, nematodes, and weeds is critical to

maintaining food and fiber quality and to enhancing U.S. farm productivity and international competitiveness. Research efforts will increase to protect against pests throughout the production, storage, processing, and marketing components of the food chain. Research should be accelerated in the use of predators, parasites, competitors, pathogens, attractants, repellents, insect sterility, pest resistance, culture, improved pesticides, application technology, and area-wide management strategies. While synthetic pesticides are a primary means of controlling pests, more research is needed to improve these methods so that they are more effective and environmentally benign.

The need to provide technology allowing managers to use interactive management systems also is growing. Research is needed to improve production stability and to optimize profits, to decrease erosion and to restore soil quality, to protect threatened and endangered species including wildlife, and to protect fragile ecosystems such as wetlands; in short, to provide the fundamental knowledge needed to develop site-specific adaptive applications of new knowledge in a total system context. Research also is needed in a systems approach that examines the management of organic resources, manure, sludge, and crop rotation.

Session I Sustainable Agriculture and the Legislative Process

Moderator: Charles R. Krueger, Associate Dean, College of Agricultural Sciences, The Pennsylvania State University, University Park

Rapporteur: Jonathan Haskett, Duke University, Durham, North Carolina in cooperation with Beltsville Agricultural Research Center, U.S. Department of Agriculture, Agricultural Research Service, Beltsville, Maryland

Introduction

From modest beginnings in the Food and Agricultural Act (FAA) of 1977 through the targeted programs of the Food, Agriculture, Conservation and Trade (FACT) Act of 1990, sustainable agriculture has been addressed by farm bill legislation. Although the term *sustainable agriculture* was not used in the FAA of 1977, concerns about the loss of small farms led to the creation of research and extension programs targeted at helping the small farmer. This was the only programmatic inclusion of its kind in the bill. Sustainable agriculture came into its own with the Food Security Act (FSA) of 1985, which authorized funding for the Low Input Sustainable Agriculture (LISA) program, the Conservation Reserve Program (CRP), Conservation Compliance Program, and Sodbuster and Swampbuster provisions. To date, however, the most extensive sustainable agriculture provisions have occurred in the 1990 FACT Act. These include Sustainable Agriculture Research and Education (SARE) programs, conservation and environmental provisions, and rural development provisions. Although the terminology has evolved, a thread of continuity is evident, and discussions shaped by the previous bills can help to guide proposals intended to shape the newest legislation.

The 1990 FACT Act

Programs

Chapter 1 (Title 16, Subtitle B, Chapter 1 of the 1990 FACT Act), entitled the Best Use of Biological Applications (BUBA), is a research and extension provision to be administered by the Cooperative State Research, Education, and Extension Service (CSREES) of the U.S. Department of Agriculture (USDA). This provision replaced the LISA program set forth in the 1985 FSA. Chapter 2, entitled the Integrated Management Systems, is a research and education provision administered by the Extension Service of the USDA and includes provisions for research developing and promoting integrated crop management (ICM) and integrated resource management (IRM) systems. Chapter 3, entitled the Provision of Education and Training Programs in Sustainable Agriculture Techniques, also is to be administered by the Extension Service.

The 1990 legislation reauthorized and expanded the CRP and added new programs such as the Wetlands Reserve Program and the Water Quality Incentives Program to the conservation title. A number of new environmental provisions requiring increased

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Session 1: Sustainable Agriculture and the Legislative Process

Moderator: Charles R. Krueger, The Pennsylvania State University, University Park
Rapporteur: Jonathon D. Haskett, U.S. Department of Agriculture, Agricultural Research Service, Beltsville, Maryland

"Setting the Stage: The Evolution of Legislation Language to Address Sustainable Agriculture Issues"

Speaker: Terry L. Nipp, AESOP Enterprises, Ltd., Washington, D.C.

Panel Discussion: "Sustainable Agriculture and the Development of the 1985, 1990, and 1995 Farm Bills"

John Haberern, Rodale Institute, Emmaus, Pennsylvania
Ferdinand Hoefner, Sustainable Agriculture Coalition, Washington, D.C.
John Keeling, American Farm Bureau Federation, Washington, D.C.
Christopher A. Novak, National Pork Producers Council, Washington, D.C.
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farm planning and pesticide record keeping also were included. The Council for Environmental Quality was created within the USDA, and increased agency cooperation between components of the U.S. Department of Agriculture, e.g., Soil Conservation Service, Forest Service, etc., was mandated, as was the creation of state councils for rural development.

Debates

Although one of the most contentious issues was the definition of *sustainable agriculture*, there also was concern among commodity groups and sustainable agriculture advocates about the emphasis of chapters. To address animal production issues, commodity groups favored funding Chapter 2, but sustainable agriculture advocates felt that these issues are adequately addressed within the context of Chapters 1 and 3.

Outcomes

Implementation issues arose after passage of the 1990 FACT Act, and included division of funds between chapters and mechanisms for the distribution of Chapter 3 funds. Sustainable agriculture advocates maintained that integrated farm management provisions were useful to only a small number of farmers because of a lack of knowledge and training within relevant agencies. The same advocates argued that guidelines for implementation of sustainable agriculture research and extension programs needed to be developed. Many issues regarding funding and implementation of the sustainable agriculture provisions of the 1990 FACT Act remain in dispute.

Key Issues

Funding for Agricultural Research and Education

There is a broad consensus that funding for agricultural research and education needs to be preserved and enhanced in the 1995 Farm Bill. Concerns have been raised that essential research programs will suffer as action is taken to meet budgetary goals. Market forces cannot be relied on to stimulate the necessary research in the area of sustainable agriculture in all cases.

Moreover, education is seen as an important alternative to regulation as a means of addressing environmental and conservation issues. Education is viewed as a less invasive and more cost-effective solution and worthy of funding. In light of a proposed reduction in commodity programs, it was suggested that some budgetary savings be used to fund research and education.

There also was endorsement for ensuring full support for those portions of the 1990 FACT Act that were passed but remained unfunded. Full implementation of existing mandates would involve certain educational provisions covered by Chapters 2 and 3 and by the CRP.

Streamlining Sustainable Agriculture Programs

In addition to supporting education and research programs, streamlining sustainable agriculture programs was emphasized. Suggested areas of emphasis were as follows:

1. improved coordination of special grants for water quality, Integrated Pest Management (IPM), and other measures, so as to facilitate creation of total sustainable agriculture resource plans;
2. coordination of regulations regarding total farm resources and their uses (stressing a voluntary approach), so as to ease compliance, avoid duplication and conflict, and diminish complexity;
3. reduction or removal of penalties and disincentives in commodity and other programs impeding the adoption of sustainable agriculture methods, e.g., crop rotation, and enhancing incentives.
4. increased cooperation and coordination among research disciplines in the implementation of sustainable agriculture research on the farm; and
5. increased funding of competitive grant programs such as the National Research Initiative, which offers a mechanism for implementing integrated systems research.

Points of Contention

Conference participants representing many points of view agreed on a number of issues but differed substantially on the general focus of sustainable agriculture programs and the specifics of farm legislation implementation.

Farm Size

Questions of focus ultimately relate to how sustainable agriculture is defined and whom programs are supposed to serve. Farm size is an issue highlighting this relation. For some individuals, farm size is

an essential component of sustainability, and the goal of sustainable agriculture programs should be to serve small or family farmers instead of large corporate farms. Others contend that farm size or corporate ownership does not determine sustainability and that sustainable agriculture programs should not consider farm size when deciding whom to support.

Sustainable Agriculture

Similar polarization occurs on the question of whether the goals of sustainable agriculture should be broad or narrow. Some individuals and groups advocate that sustainable agriculture should examine social issues and make an effort to maintain the quality of life and enhance rural development. Opponents of this position view such goals as ill-defined adjuncts to their sustainable agriculture mission, which is to increase production efficiencies by minimizing inputs and by maximizing output and profits while making market forces the primary determinants of success.

Plant and Animal Research

With respect to implementation of the sustainable agriculture provisions of the 1990 FACT Act, there also is disagreement about whether plant research is emphasized and funded at the expense of livestock research.

Session 2A Conservation Issues: Agriculture and Sustainability

Moderator: Jerald R. DeWitt, Extension Entomologist, Agronomy Extension, Iowa State University, Ames

Rapporteur: Gary D. Jolliff, Department of Crop and Soil Science, Oregon State University, Corvallis

Introduction

Agricultural commodity support programs, initiated during periods of surplus in the 1930s, represent six decades of social planning beyond the purpose of stated economic objectives, and have come to involve a delicate political balancing act. The purpose of this session was to consider the relationship between policies—aimed at stabilizing markets and enhancing producer income—and broader sustainability goals. The session was a review of commodity programs, which were not designed to meet these goals.

Several groups thought that commodity programs place too many limitations on farmers, denying them market opportunities. Others thought that the programs did too little to enhance farmers' incomes and competitive needs relative to other segments of agriculture. Some focused on the environmental effects of commodity programs. The resulting differences argue for reexamination of the commodity program policy but do not provide clear direction for policymakers. The tension in this session reflects the traditional farm policy debate. Some participants suggested that low prices caused by policy-stimulated chronic surplus production have contributed to the movement of hundreds of thousands of families from farms. Another participant described how low commodity prices benefitted specific sectors. Other participants noted that, in general, farmers assume high risks for the rate of return on their investments. All participants stated that the economic viability of farming systems is vital to achieving sustainability goals.

Recently added policy objectives regarding social and environmental sustainability are being met only partially by current programs. Policymakers may find it useful to gather information about the effects of financial pressure on farmers deciding whether to adopt technologies based on economic incentives at the expense of environmental considerations.

National sentiment for federal budget deficit reduction may indicate that the public considers commodity support program costs untenable. Revision of commodity support programs for the 1995 Farm Bill is expected and is viewed as an important opportunity for innovation. Questions about how to revise program policies are part of the larger question of who should benefit from them. The process that will produce the 1995 Farm Bill provides a unique opportunity for new, broad based coalitions to affect the nation's overall approach to agricultural policy.

Session 2A: Conservation Issues: Agriculture and Sustainability

Moderator: Jerald R. DeWitt, Iowa State University, Ames
Rapporteur: Gary D. Jolliff, Oregon State University, Corvallis

"Market Stabilization Policies and Sustainability"
Speaker: Chip Conley, Economist, House Committee on Agriculture

Panel Discussion: "Effect of Commodity Policies on the Environment, Social, and Economic Objectives of Sustainability"

Michael R. Dicks, Oklahoma State University, Stillwater
Mark R. Drabenstott, Federal Reserve Bank of Kansas City
Paul E. Faeth, World Resources Institute, Washington, D.C.
William D. Heffernan, University of Missouri-Columbia, and Henry A. Wallace Institute for Alternative Agriculture
Abner W. Womack, Food and Agricultural Policy Research Institute at University of Missouri, Columbia

Key Issues

Commodity Support Policy: Results on Sustainability Goals

The Commodity Credit Corporation, the instrument of farm policy, was created to stabilize, support, and protect farm income and prices; to maintain balanced and adequate supplies; and to facilitate order-

ly distribution of agricultural commodities. Sustainable agriculture objectives are defined in statute to satisfy human food and fiber needs, enhance environmental quality, make efficient use of nonrenewable resources, sustain the economic viability of farms, and enhance the quality of life for farmers and society. Results have been mixed: whereas they may have reduced farmer risks associated with production of certain commodities, these programs simultaneously have limited farmer options, promoted surpluses and lower prices, and forestalled development of profitable alternatives. These programs also have promoted rigid cropping patterns and maximum yield strategies, which encourage fertilizer and chemical inputs and therefore violate the principles of sustainable agriculture.

To allow increased exposure to market forces and to encourage development of profitable new products and technologies, sustainability goals have been supported in part by flex acre policies allowing rotations and alternative crops. For flex acre options and free-market exposure to be even more meaningful, producers must have access to a much broader array of profitable options.

Commodity programs, through the incentive of deficiency payments tie farmers to bulk commodities, the slowest growing segment of the world food market. Such programs, also increase input costs for value-added agricultural products, i.e., commodity prices. These same policies hinder the exportation of value-added farm products—the fastest growing segment of the world food market. Crop acreage reductions encourage foreign producers to expand production. Commodity programs encourage farmers to maximize yields and to market crops through program and market channels. Because the potential for off-farm income from first-stage commodity processing (*value adding*) is not realized, rural economic vitality may be stifled, despite government payments to farmers.

Commodity Support Programs and Unintended Consequences

Commodity programs have insulated participants' crop planting decisions from free-market forces. Resulting distortions permeate both private and public sectors, including farming, input supply, research, development, output processing, marketing, trading, and related infrastructure. Policy based distortions promote focus on government financed activities at the expense of ingenuity and free enterprise. The costs of these distortions are very high and are economically, environmentally, and socially far reaching.

Estimates of total program costs, including externalities, would provide policymakers with the justification needed for fundamental and long-term change in farm policy. Although effective in some instances, support policies have had unintended negative consequences such as the conflict between implicit stock and market price objectives and farm income support. Low prices caused by surplus production are believed to have contributed—in the absence of profitable alternatives—to the movement of hundreds of thousands of families from farms. Indeed, since commodity support programs began, the United States has lost 4.5 million farms; 1.7 million remain.

Because of stable, relatively low feed and raw materials prices, commodity programs may have promoted export of commodities and industrialization and vertical integration such as in the animal feeding industries.

Commodity Support Programs Targeted for Redirection of Resources

Some farmers may need to receive direct payments as profitable alternative enterprises and technologies are being developed. All facets of current commodity programs should be subject to redesign to meet economic, environmental, and social sustainability objectives. Redirected resources should focus on local needs involving many individuals with the intended outcome being fewer regulatory consequences. Adjustments and redirection should be planned to assist beneficial asset revaluation and sustainability.

Commodity programs need to be more affected by market forces; when they are, prices likely will destabilize. The General Agreement on Tariffs and Trade and the North American Free Trade Agreement promise additional exposure of farm products to global free trade (See Council for Agricultural Science and Technology, 1993). To remain economically competitive, farmers must have profitable crop alternatives to government program crops. Additionally, farmers need low-cost technologies to improve competitiveness, profitability, and sustainability. Science and technology infrastructure should be mobilized so that U.S. farmers and rural communities can have a competitive advantage in global markets, which promise to become less distorted as free trade is strengthened. If commodity programs are significantly reduced, a portion of the savings should be redirected to research, education, and conservation issues to assist farmers.

Session 2B Conservation Issues: Agriculture and Sustainability

Moderator: Vivien G. Allen, Department of Crop and Soil Environmental Sciences, Virginia Polytechnic Institute and State University, Blacksburg

Rapporteur: Marsha A. Stanton, AESOP Enterprises, Ltd., Washington, D.C.

Introduction

Conservation is one of the key elements of a sustainable agriculture. Over the years, a number of conservation programs have been implemented; the largest is the CRP initiated with the 1985 FSA. Such programs have resulted in less soil loss, cleaner water, and more wildlife habitat. Other benefits not always targeted or necessarily envisioned when programs were designed also have been derived, including recreational opportunity, aesthetic value, nutrient management, and carbon sequestering to limit carbon dioxide (CO_2) release into the atmosphere. But compared with other macroeconomic forces or government program expenditures, annual conservation spending has been small (less than 15% of commodity program expenditures and less than 20% of fertilizer and pesticide expenditures).

Conservation programs have had both positive and negative effects on local, regional, and national economies. Future programs should be designed to work with macroeconomic forces. The proper role of government and the best policy tools to accomplish objectives must be determined, and the cost-effectiveness of programs must improve. Additional benefits can be derived if planners acquire a comprehensive understanding of the multiple potential uses and impacts of programs. The cover crop established on many acres can be designed both to enhance the value of acreage for multiple benefits and to prepare it for return to production. Research is needed to clarify the integral role of conservation acreage in the total agricultural system, as well as the potential to maximize multiple values.

Session 2B: Conservation Issues: Agriculture and Sustainability

Moderator: Vivien G. Allen, Virginia Polytechnic Institute and State University, Blacksburg
Rapporteur: Marsha A. Stanton, AESOP Enterprises, Washington, D.C.

"Conservation Policies and Sustainability"

Speaker: Dana L. Hoag, Colorado State University, Fort Collins

Panel Discussion: "Future of the Conservation Reserve Program and Related Programs and the Impact on Sustainability"

Norman A. Berg, Soil and Water Conservation Society, Severna Park, Maryland
Donald F. McKenzie, Wildlife Management Institute, Washington, D.C.
Mark C. Nestlen, National Association of State Departments of Agriculture, Washington, D.C.
Timothy W. Warman, American Farmland Trust, Washington, D.C.

Key Issues

Funding

Conservation programs generally have been underfunded. When funds are insufficient, the programs must be targeted carefully to maximize benefits, but appropriate targeting has not always occurred. In future conservation programs, specific regions and sites should be identified because of their potential for beneficial results. Returns to producers for implementing a practice must be attractive, and conservation program funding often is too limited to compete with the other issues with which farmers must deal. Additionally, programs should be designed to work regardless of shifts in macroeconomic policy.

Various recommendations have centered on consolidating numerous small programs and leveraging with state and local money. A Resource Conservation Fund that would match each $1 of state programs with $3 of federal funds has been proposed. The National Association of State Departments of Agriculture recommended consolidation of USDA conserva-

tion programs to create an Environmental Enhancement Investment Program, which would be used to implement whole-farm management plans. Abrupt elimination of existing programs such as base acreage would devastate land values, however, and when considering cutbacks or other changes, policymakers also should consider unintended effects.

Benefits—Other Than Initial Targeted Objectives—Derived from Programs

The initial goals of the conservation programs may or may not have been realized. Much more than decreased soil erosion has resulted from conservation programs. Improvements have occurred in recreational opportunities, aesthetics, nutrient management, water quality, air quality, soil quality, and quality of life issues. Additionally, long-term crop retirement programs create opportunities for wildlife habitat that are not the result of annual set-asides, which provide insufficient time to develop appropriate habitat and to attract wildlife. Best management practices benefit some species but are not sufficient means of improving needed habitat for species experiencing long-term declines and historically low populations.

Planning based on experience could increase the potential for these and other benefits. For example, some acres have been planted to species combinations to provide desirable forage cover for hay or grazing after contracts have expired, but other acres have been planted to species that provide cover but have limited future value. Additionally, limited economic uses consistent with conservation goals could be developed for land in conservation programs. For instance, periodic haying, grazing, or use of biomass for fuels have been suggested. Several participants noted that management systems or alternative uses that are both suitable and profitable may require the development of knowledge, technology, and/or infrastructure.

Cost-Effectiveness

The benefits of conservation programs are difficult to define and to measure. Approximately $19 billion has been spent on CRP contracts and related costs, with an estimated return on investment of between $6 billion and $23 billion. By some estimates, this program has not been cost-effective. But benefits can be difficult to measure and frequently are undervalued. Examples include benefits to wildlife, improvements in aesthetics, decreased CO_2 emissions into the atmosphere, and effects on soil quality. The wide range of benefit estimates for programs indicate that measurement methods are inexact and require further research.

Cost-effectiveness could be improved if efforts were targeted, solutions were site-specific, and policies were complementary. To optimize returns on the investment in conservation, multiple benefits should be maximized and incentives should ensure that acres in conservation practices are maintained over the long term. A number of environmental management programs exist. Their applications, practices, and plans often are too issue-specific and fail to consider a farm or ranch as a total system. The systems approach, which includes the total landscape perspective, is community based and an integral part of ecologic, economic, and production perspectives.

Government's Role in Conservation

Because groups have different stakes in policy, its development may be inconsistent. Individual goals can differ from local, state, regional, and national goals. Likewise, objectives and implementation procedures of governmental policies often are contradictory and unclear. What should be the level of involvement? When and where should governments interfere with private decisions? When interference is appropriate, which government agencies, policy mix, and involvement levels are suitable?

An ecosystem approach to research and management is needed to clarify and to incorporate the various consequences of conservation practices. Adequately funded research permits the examination of these practices and their relations to sustainable agriculture goals. Long-term costs and benefits also need examination, as does the interaction between total ecosystem and potential communitywide consequences. The whole-farm systems approach to research and management must be multidisciplinary and integrated across ecologic and geographic regions. This approach may be broad for individual universities or privately funded research and could benefit from federal support.

Needs

Benefits—Other Than Initial Targeted Objectives—Derived from Programs

The multiple benefits of current programs should be evaluated to reflect all real, direct, and long-term

benefits, both economic and environmental, including long-term costs and benefits. The new uses for conservation acres and the potential for new crops and markets need exploration. Insufficient information about new crop potentials and marketing options often limit adoption. Research and development as well as extension information and product promotion may be necessary. Additional support for the New Uses Council and the Alternative Agriculture Research and Development Council was suggested.

Funding and Cost-Effectiveness

Funding for programs should be expanded and directed more efficiently toward goals. To provide benefits with improved efficiency, future conservation programs need to target objectives precisely and numerous small programs need to be consolidated. Objectives for conservation and for sustainable agriculture programs may evolve.

Conservation programs should be consolidated and coordinated with, for instance, certain commodity programs, which may offer conflicting incentives. Future conservation programs must target environmentally sensitive acres that will provide the greatest returns on investment. Program strategies must be flexible to achieve multiple benefits but also must be compatible with program objectives. Incentives must help producers use and protect environmentally sensitive lands.

Redefining Government's Role in Sustainability

The federal role is to develop an overall strategic, long-term plan going beyond the traditional food and fiber concept and providing information, e.g., research, and tools, education, financing, and technology, to local entities able to target local priorities. Federal programs should complement state and local programs. Federal funding for research should be expanded. Support for sustainable agricultural systems requires examination of components, systems, multidisciplinary projects, communitywide consequences, and relatedness across ecologic regions.

Strategies to address new issues such as the protection of prime and unique farmland, endangered species, habitats, ground water recharge acres, and riparian—or river bank—buffers should be addressed in addition to a mix of options such as easements, limited conservation-acreage economic use, and partial field enrollment. Modifications may be necessary to target specific high-benefit acres, to increase environmental benefits, and to provide adequate economic incentives to producers.

Session 3A Environmental Issues and Sustainable Agriculture

Moderator: Dennis R. Keeney, Leopold Center for Sustainable Agriculture, Iowa State University, Ames

Rapporteur: B. L. Harris, Department of Soil and Crop Sciences, Texas A&M University, College Station

Introduction

Environmental issues are a driving force in the sustainable agriculture debate. Yet farm policy was not designed with environmental goals or sustainability in mind; these were added in the 1985 and the 1990 legislations. Even so, many of the major environmental programs were designed also to control production.

The 1995 Farm Bill offers legislators the opportunity to take a new approach by moving to environmentally based incentives and by promoting whole-farm, watershed, or ecosystem planning. There also are opportunities for new private-public partnerships, interdisciplinary research and education, and community based problem solving. This session addressed the core issues of sustainable agriculture from an environmental standpoint and suggested new partnerships and approaches to address the many public demands on agriculture.

Session 3A: Environmental Issues and Sustainable Agriculture

Moderator: Dennis R. Keeney, Leopold Center for Sustainable Agriculture, Ames, Iowa
Rapporteur: B. L. Harris, Texas A&M University, College Station

"Environmental Protection and Sustainability"

Speaker: James R. Moseley, Agricultural Commissioner of Indiana and Purdue University, West Lafayette

Panel Discussion: "Specific Goals and Objectives to Protect the Environment, Adequacy of Available Tools and Environmental Indicators"

William K. Griffith, formerly Potash & Phosphate Institute, Great Falls, Virginia
Jennifer Snoddy, Isaac Walton League, Washington, D.C.
Ann Sorenson, Agriculture and Environment Institute, Northern Illinois University, Dekalb
Robert M. Wolcott, U.S. Environmental Protection Agency, Farm Bill Working Group, Washington, D.C.

Key Issues

Adequacy of Existing Farm Bill Programs

Although the CRP program has achieved many environmental goals, it has not necessarily been targeted to achieve maximum benefits. The program thus should be reauthorized and targeted to meet sustainable agriculture goals. The 1990 FACT Act contains many desirable provisions, especially those concerning pesticide record keeping. Focus on the use of voluntary, incentive based approaches to environmental practices usually has proved successful and should be maintained.

Desirable Components of Sustainable Agriculture Policies

The 1995 Farm Bill could take a new approach to defining goals and objectives for U.S. agriculture. This approach would apply to all segments of the industry, small and large, traditional and specialized, regional and general. The general tenets would be to aim agriculture broadly at a vision of international competitiveness combined with environmental soundness and social acceptability.

New legislation should require regional and national coordination of research and extension programs in sustainable agriculture, IPM, and water quality. These programs should encourage public-private partnerships, farmer/rancher involvement, and multistate and regional projects. Local decision making should be emphasized, and planning should be done at the watershed level and be ecosystem based. Mainstream farmers and ranchers should be involved fully in programs and assist in design, plan-

ning, and implementation. Research and extension activities should be coordinated to promote the development of sustainable food and agriculture systems suitable for commercially sized farming operations. All systems and policies should be based on sound science supported by research and serve farmer and rancher interests.

Impact of Agricultural Production on the Environment

Unfortunately, there are examples of how agriculture mismanages natural resources in locations where deterioration of soil and/or water quality diminishes crop productivity. Relative to the many examples of stewardship by farmers and ranchers, however, these negative examples tend to be overemphasized in the media. Overall, agricultural producers are quite concerned about and conscious of environmental issues and make a sincere attempt to protect and to enhance their natural resources while maintaining profitability.

Maintaining the balance between production of food and fiber and protection of the natural resource base will be increasingly difficult as populations grow and incomes rise. A highly productive agriculture is necessary to ensure that fragile soils and areas currently preserved for wildlife and other public goods do not have to be cultivated to meet world food needs (Council for Agricultural Science and Technology, February 1994). New technologies such as precision farming, transgenic plants and animals, and crop protection chemicals must be designed not only to enhance yield and efficiency but also to meet the nation's environmental goals. Future policies regarding chemical use should emphasize efficiency and environmental protection instead of concentrating solely on limiting the amounts of chemicals used.

Common Ground Among Interest Groups

It was agreed generally that in future policy debates sustainable agriculture should be regarded not as an option but as a goal. Farm planning decisions should not be based solely on whether to use technologies, but rather on how much and which type of technology can be used to achieve economic, environmental, and social goals. The overwhelming consensus was that voluntary rather than regulatory approaches would achieve environmental goals most efficiently and effectively and at a lower cost both to the general public and to the agricultural producers; certain "bad actor" provisions would be needed, however. Polarization on the many agricultural and environmental issues will lead to neither consensus nor solutions. To avoid losses in funding and political support, the agricultural community needs to move forward with comprehensive farm planning, which will involve identification of appropriate technologies.

Adequacy of Research and Education Programs

There certainly will be budget pressures limiting expansion of all research and education programs, including the SARE program, which is currently underfunded. However, very substantial research and extension funds have been redirected both by state and federal agencies to address the sustainable agriculture agenda. Even so, there is need to meet still unfulfilled environmental and sustainable goals. These goals include the development of methodologies for implementing, measuring, and evaluating the success of IPM and sustainable agriculture research and extension activities.

Land Grant universities need to place more emphasis on educating the next generation of agricultural practitioners in total resource management. Implementation of Chapter 3 of SARE would lead to improvements in this regard, but curriculum revision to meet the need for farm advisors also would be required. Other institutions, including the 1890 institutions—whose role should be recognized in the new legislation, likely will become an integral part of sustainable agriculture programs (Council for Agricultural Science and Technology, November 1994).

Session 3B Environmental Issues and Sustainable Agriculture

Moderator: Harry S. Baumes, Chief, Resource and Environmental Policy Branch, Natural Resource and Environment Division, Economic Research Service, U.S. Department of Agriculture, Washington, D.C.

Rapporteur: Parveen Setia, Senior Economist and Coordinator, Congressional Study on the Economics of Sustainable Agriculture, Resource and Environmental Policy Branch, Natural Resource and Environment Division, Economic Research Service, U.S. Department of Agriculture, Washington, D.C.

Introduction

Although perhaps moderated by attitudes of the Congress, environmental pressures continue to mount, causing producers to be faced with an increasing number of public initiatives to alleviate these pressures. There currently is a vigorous debate over whether these environmental pressures are best achieved through regulations. Producer resistance to regulation arises when benefits and beneficiaries are not identified clearly. Hence, clear and concise objectives and guidelines should be identified, and producers should be given a great degree of flexibility in complying. Regulatory action should be founded on sound science and reviewed and revised as science and technology advance.

In addition to being flexible, regulations should be performance based. If decreased erosion is the objective, farmers should be able to decide how to decrease erosion (perhaps in concert with appropriate technical assistance or an incentive payment); otherwise, they may not be able to bear the cost of compliance. Diversity of farm structure has contributed to the strength and the resilience of U.S. agriculture. Future policy must strongly encourage innovation in maintaining and promoting this diversity.

Key Issues

Because many environmental costs are not borne by producers, investments in environmental compliance generally are not revenue enhancing in the short-term, and adjustments made by agriculture likely will have an adverse impact on farm income. Producers view many environmental regulations as lacking pragmatism and common sense, particularly in the policy implementation phase. On the other hand, clear and noncontradictory regulations, e.g., health regulations, have a relatively high probability of acceptance. Producer participation during the development phase of regulations would enhance the chances of acceptance. And effective coordination at local, state, and federal levels, in conjunction with consistent enforcement from one producer and area to the next, will minimize confusion.

Producers have come to believe that there is a role for the federal government in balancing farm and regional disparities and equity issues. There likely are a number of reasons that producers voluntarily comply with regulations, e.g., the beliefs that such regulations reassure consumers about product quality, make sense, and provide private and public benefits exceeding costs. Acceptable regulations must

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Session 3B: Environmental Issues and Sustainable Agriculture

Moderator: Harry S. Baumes, Economic Research Service, U.S. Department of Agriculture, Washington, D.C.
Rapporteur: Parveen Setia, Economic Research Service, U.S. Department of Agriculture, Washington, D.C.

"Environmental Regulations and the Structure of Agriculture"

Speaker: Amy Purvis Pagano, Texas A&M University, College Station

Panel Discussion: "The Impact of Environmental Regulations on Large and Small Producers and the Responsiveness of Producers to Voluntary versus Mandatory Programs"

Ernest W. Caldwell, Berry Holding Corporation, Winter Haven Florida
Thomas L. Dobbs, South Dakota State University, Brookings
Larry Elworth, U.S. Department of Agriculture, Washington, D.C.
Bruce Gardner, University of Maryland, College Park

take into account agronomic, economic, technical, environmental, and social factors. Policymakers must weigh trade-offs carefully when assessing policy alternatives.

The question arose as to whether regulations helped level the playing field for agriculture, either domestically or globally. In many instances, regulations may require large investments and thereby favor large, progressive producers over small ones. Indeed, regulations affect small, medium, and large producers in a variety of ways.

Increased regulations and compliance requirements also may result in cost barriers for new entrants to the sector, and disparities between small and large operators may worsen further for existing producers. Hence, over time, increased regulation could alter the structure of U.S. agriculture. Regulators must recognize that conflicts or tensions between producers and between producers and communities likely will arise if producer concentration in the sector increases. The political process, however, tends to weaken such regulations and requirements by exempting small or limited-resource producers. If regulations are to be accepted widely, they should be characterized by reasonableness and not by exemptions.

Proposed regulations must make common sense; that is, economic analysis of intended regulations must demonstrate that public and private benefits exceed costs, and public benefits must be funded by public funds. Provision of compliance incentives certainly can send a positive signal to producers regarding proposed regulations. Regulations also must send clear signals about what may happen if concentration in a sector exceeds certain levels. Implementation of regulations should aim at cutting disincentives for pending and future regulations. Enforcement should be less stringent during the transition period, when producers are trying to adapt, than in other stages. Compliance may require technical and financial assistance.

Pesticide laws, e.g., the Federal Insecticide, Fungicide and Rodenticide Act, are not environmental but pesticide registration laws that determine which pesticides will be made available, on what crops they can be applied, and how they will be used. These laws indirectly determine which agricultural practices can continue and have a variety of effects on limited resources and large producers. On the other hand, environmental laws such as the Clean Water Act and the Clean Air Act look at the broader issue of environmental degradation, to which pesticides are a contributing factor. Although fully enforceable, such laws so far have been applied according to a voluntary compliance approach. Conference participants noted that environmental laws may generate regional inequalities, depending on how site specificity is determined.

The need to comply may impose on agricultural producers additional costs with implications for the structure of agriculture. If a policy's intent is on-farm resource protection and conservation, then producers comply willingly if a policy is cost-effective. When cost-sharing is available, environmental compliance is less problematic. But if a policy's primary intent is off-farm resource amenities, then some think the cost of compliance should be borne proportionately by those who benefit. Restricting management options on privately owned land is construed by some as tantamount to "taking"; fair compensation therefore is required—a property rights versus states rights issue.

Added costs affect producer profits or ability to make them. For example, if regulations prohibit the use of a particular pesticide and an alternative must be used, then the cost to achieve the same degree of efficacy or the cost in terms of lost production (value) may exceed the cost of the restricted pesticide, and producer profit is decreased.

Although "one size fits all" seems a simple and fair approach, in practice it is difficult to apply, because of the site-specific nature of environmental concerns. Differences in farm/ranch resources likely will cause the impact of regulations on profitability, capital intensity, complexity, and risk to differ across operations. But there is a dilemma regarding increased flexibility. On the one hand, sound arguments exist in favor of specifying clear technical guidelines for environmental compliance so that farmers can implement appropriate technologies and/or modify management so as to make enforcement simpler and less problematic. On the other hand, precise and narrow guidelines for environmental compliance can dampen incentives and options for technological innovation.

Once an approved management plan is implemented, there should be long-term permits and/or term permits to minimize costs and risks. Though a management plan is approved for the long-term, e.g., 20 to 25 years, it should be reviewed at regular intervals, approximately every 4 to 5 years, with no cost penalties if a track record of compliance is demonstrable. Additionally, allowances should be made for unintentional violations of regulatory guidelines. Ways should be found to compensate agricultural producers for generating environmental public goods such

as improved wildlife habitat or panoramic country vistas.

The science of the day in which rules are created tends to ossify regulations, which need to be adaptable. Regulation by demonstration instead of by practice may be a viable alternative. For example, a producer might be asked to demonstrate how his or her choice of practice can achieve environmental goals while maintaining a sustainable farming operation. This approach may be preferable to forcing producers to choose from an approved set of practices. Generally, regulations can be effective if they lead to whole-farm/watershed management planning in the spirit of ecosystem management.

On the whole, producers see themselves and their neighbors as good stewards because stewardship is good business and/or because the land is their endowment to their children. Farm and ranch families have a direct stake in environmental protection because it affects their quality of life and health. Hence, when other segments of society challenge their commitment to sustainability, friction can arise. But other land management options such as centralized control or managing resources as a public trust go against the grain of fundamental American values and property rights.

Session 4 Rural Development and Sustainable Agriculture

Moderator: Deon D. Stuthman, Department of Agronomy and Plant Genetics, University of Minnesota, St. Paul

Rapporteur: James R. Allen, Director of Experiment Station, University of the District of Columbia, Washington, D.C.

Introduction

Historically, national efforts aimed at sustaining rural community development have been limited by several factors. Since the New Deal, much of what has been considered rural policy really has been only farm policy. However, the great transfer of rural jobs away from extractive industries has rendered farm policy a very poor surrogate for rural development policy. Federal rural development policy is widely regarded as minimalist, with a heavy emphasis on physical infrastructure issues (sewer, water, roads, electricity, etc.). Concern for economic infrastructure has been present but weak, and social infrastructure has been left primarily to local and state governments.

Session 4: Rural Development and Sustainable Agriculture

Moderator: Deon D. Stuthman, University of Minnesota, St. Paul
Rapporteur: James R. Allen, Director of Experiment Station, University of the District of Columbia, Washington, D.C.

"Going Beyond Buildings and Processing Plants: Addressing Community and Human Resource Needs in Rural America"

Speaker: Louis E. Swanson, University of Kentucky, Lexington

Panel Discussion: "Identifying and Meeting the Real Needs of Rural Communities"

Elizabeth Ann R. Bird, Center for Rural Affairs, Madison, Wisconsin
Kelly Eversol, Eversol Associates, Harwood, Maryland
Cornelia B. Flora, North Central Regional Center for Rural Development, Ames, Iowa
Marvin Konen, U.S. Department of Agriculture, CREES
Sandra E. Miller, Arkansas Rural Development Enterprise Center, Morrilton

In fact, all three types of community infrastructure are needed for communities to adapt to rapid changes in the global and national economies and their associated requirements for education, health care, and entrepreneurship.

The general lack of attention to the needs of rural economic and social restructuring reflects a lack of vision among rural policymakers. This may be changing, but until farm policy is considered only one of the several dimensions of rural policy, it is doubtful that a workable vision will emerge. Moreover, the general "muddling-through" character of farm bills has deemphasized nonfarm rural issues. Such an environment has not engendered a policy dialogue about how sustainable agriculture and sustainable rural community issues might be related.

Consequently, most policies have been considered in the time frame of "till the next farm bill"—or usually a maximum of five years and sometimes even less. Moreover, most efforts of the traditional agricultural-community have been reactive, i.e., preventive of specific items unfavorable to this or that special interest, instead of spacially and temporally comprehensive. Both approaches greatly handicap development programs, from design stage onward.

The current administration, including the USDA, has emphasized the development and the infrastructure needs of rural communities. Yet there also is a move to decentralize rural development efforts in the reorganized USDA, and ever more units within the organization are redefining their roles so as to emphasize the achievement of a variety of goals in light of sustainable rural community vitality, instead of simply maximizing a single end. Healthy rural communities are critical to the long-term productivity and profitability of U.S. agriculture, and nonfarm rural population needs should be considered when rural community development is pursued, especially given that more than 80% of U.S. farms are dependent on about 90% of their income from off-farm employment.

Key Issues

Human, Physical, and Environmental Capital

There are numerous examples of rural community development efforts that are most effective when human and social capital have had coequal status with physical and environmental capital. Although it is logical that a balance between emphasis on technology and on the social organization needed to make it productive will maximize the wealth generated in local communities, disagreement arises concerning proper balance. Most participants agree that sustainable development requires continual infrastructure development within the community even after initial successes in development have been achieved.

Local Empowerment and Decision Making

Community development efforts are most effective when initiated in response to locally well-defined problems and opportunities. Local capacity for problem solving is, however, often problematic. Community development studies suggest that community capacity for problem solving can be enhanced by the collective skills of individuals in both private and public institutions. It is important that community efforts be inclusive and representative of the diversity of the community.

Much of the recent political change stems from the belief that micromanagement, especially from Washington, is unnecessarily intrusive and often ineffective. Presumably, there is a greater interest in how local society can initiate or implement policy.

The Relation Between Sustainable Agricultural and Viable Rural Communities

In one sense, sustainable agriculture may be viewed as a subset of sustainable rural communities. Some agricultural operators, however, mistakenly view rural development efforts as detrimental instead of key to the long-term viability of their communities. Current efforts to establish enterprise empowerment zones have helped some communities work together for mutual benefit and have shown the complementarity of sustainable agriculture and rural development. Similarly, the establishment of locally owned value-added enterprises would enhance rural community development greatly.

Need for a Proactive, Visionary Agricultural Policy

As Congress, state, and even local officials, as well as representatives from other social institutions, e.g., higher education and health care professions, become stronger partners in achieving national goals emanating from such a vision, initial efforts are likely to be determined and negotiated locally and the likelihood that rural development policies and efforts will stay focused and limiting unnecessary duplication will increase. National goals defined by such a policy would promote a rural development approach more comprehensive than the reactive and piecemeal approaches of many previous farm bills.

Needs

If there is to be a shift to greater local partnership with federal programs, the definition of a community needs to be clarified. And, at a national level, criteria need to be developed with which to measure sustainability so that local communities can integrate economic and social development more effectively with concerns for a sustainable agriculture.

What other roles, if any, should the federal government play in rural community development? One role might be that of providing appropriate mechanisms with which to ensure that local solutions do not serve simply to solidify existing power structures unsustainable over the long term. Perhaps a competitive rural development block grant program might initiate greater local concern for federal rural development. Another issue is the impact of telecommunications and the information superhighway on rural communities. The issues is *not* whether telecommunications is important or whether it will become a reality, but rather if rural communities will be able to participate and how.

Finally, support is needed for value-added product research and for technology development and transfer to help local communities develop the capacity for initial processing of commodities.

Session 5 The Agricultural Research and Education Agenda

Moderator: Victor L. Lechtenberg, Dean of Agriculture, Purdue University, West Lafayette, Indiana

Rapporteur: Andrew Weber, Natural Resources and Environment; Cooperative State Research, Education, and Extension Service; U.S. Department of Agriculture, Washington, D.C.

Session 5: The Future Agricultural Research and Education Agenda

Moderator: Victor L. Lechtenberg, Purdue University, West Lafayette, Indiana
Rapporteur: Andrew J. Weber, U.S. Department of Agriculture

"Summary of Research, Education and Extension Issues Identified in Previous Sessions"

Speaker: Charles Scifres, University of Arkansas, Fayetteville

"Presentation of American Institute of Biological Sciences Workshop on Sustainable Agriculture Research Priorities"

Speaker: O. W. Barnett, North Carolina State University, Raleigh

"Research Planning Processes at the Land Grant Universities"

Speaker: Neville P. Clarke, Southern Association of Agricultural Experiment Station Directors

"Extension Planning Processes at the Land Grant Universities"

Speaker: Robert C. Wells, North Carolina State University, Raleigh

"President's Council on Sustainable Development"

Speaker: Paul Johnson, U.S. Department of Agriculture, Natural Resource Conservation Service, Washington, D.C.

Panel Discussion: "Addressing Priority and Integration Issues"

Dean Fairchild, Soil Teq, Inc., Minnetonka, Minnesota
David R. Swaim, Swaim and Associates, Crawfordsville, Indiana
John H. Thorne, Capitolink Public Affairs and Legislative Services, Washington, D.C.
Harry Wells, U.S. Environmental Protection Agency, Washington, D.C.
I. Garth Youngberg, Henry A. Wallace Institute for Alternative Agriculture, Greenbelt, Maryland

Introduction

The State Agricultural Experiment Stations, in cooperation with their USDA partners in the CSREES, engage in ongoing strategic planning that seeks broad input from users and conductors of research and from other stakeholders. The product is a forward rolling document that is revised annually and every four years substantively. The document, which is divided into six major areas identified in the 1990 FACT Act, was reviewed at the conference and is the primary basis on which this summary is organized. Under each major area, three or four initiatives are described in terms of general scope and intent. Details may be found in the full document. (Experiment Station Committee on Organization and Policy and the U.S. Department of Agriculture, 1994). The issues and goals carry a corresponding education component and implication.

Opportunities to Meet Changing Needs

The Environment and Natural Resources

Conserving and Enhancing Air, Soil, and Water Resources

The quality of air, soil, and water resources is critical not only to the continued production of food, fiber, and forest products but also to the well-being of the biosphere. Accordingly, research is needed to ensure that vital resources are conserved and enhanced in the use of natural and managed ecosystems. The societal value of protecting natural resources must be expressed in terms much broader than economics. Accepted methods of establishing a value system for this purpose only now are emerging.

Results of such research will provide the knowledge and the technology needed to diminish contamination of ground and surface waters, to address the problem of bay and estuary contamination with chemicals of agricultural origin, to decrease soil erosion, and to ensure that agricultural and forestry opera-

tions are not associated with unacceptable air quality degradation. As the demand for and the cost of water continue to grow, further development of methods to conserve and to use this resource wisely is necessary, as are methods to restore and to enhance fundamental natural resources and to use new systems to limit industrial and urban effects on the environment.

Managing Ecosystems to Conserve and to Enhance Biodiversity

Because of society's diverse economic and environmental goals, pressure for more efficient and wiser management of natural resources is increasing. By integrating knowledge of the individual components of natural and managed systems into an ecosystem approach, management strategies to meet these goals will be facilitated. Ecosystem research is needed to foster agricultural and forestry production that is environmentally sound, economically viable, and socially acceptable; to benefit natural resource management by promoting health and productivity of forests, rangeland, and aquatic systems; and to meet the needs of urban communities for an aesthetic, wholesome, healthy environment with improved recreational opportunities. Such knowledge also will assist in predicting, mitigating, and adapting to global climate change and will increase society's ability to meet changing or conflicting demands for resources.

Maintaining the biological diversity and the biotic integrity of natural and managed ecosystems is of utmost importance to ecosystem health and productivity. Currently, knowledge of how ecosystems respond to environmental change and to management is extensive but focused narrowly; this knowledge must be broadened.

The natural sources of antibiotics, germplasms for food and fiber crops, natural pesticides, raw materials for industry and medicine, fuels, ornamentals, and recreation all are part of biodiversity, which makes possible indispensable ecological services such as the recycling of wastes, the maintaining of the atmosphere's chemical composition, and the shaping of global climate.

Recovering and Using Waste Resources

Research is needed to develop more economically and ecologically viable methods of converting and using water—a resource that can be recycled productively through agricultural and forestry systems. Animal, food, and forest processing and human wastes become pollutants when out of place in the environment. Many byproducts, however, have substantial nutritive or other biological/physical potentials to be recycled during food and fiber production. The cost for disposing of animal, plant, and human waste increases each year, and when not handled appropriately, waste products often constitute a continuing environmental problem. Methods of recycling waste materials in food and fiber production systems not only mitigate the disposal problem but enhance the effective use of natural resources.

Developing Resource Management Decision Systems

Through the development and the use of research products, significant progress has been made in the efficient and cost-effective production of food, fiber, and forest products. But the impact of current and emerging practices on the protection and conservation of natural resources must be given increased attention if society's expectations and needs are to be met.

There is a growing need to clarify the social and environmental consequences of resource management decisions. Multiple uses of both public and private lands complicate the equation. Research and education in this area is needed (1) to provide database information about missing fundamental information about the use of natural resources and (2) to develop multifaceted management system models allowing users of natural resources and policy/decision makers to make science based judgments about the relative merits of alternative practices. Research and education in this area will result in enlightened policy and natural resource usage, and in improved efficiency of food, fiber, and forest production and management systems compatible with social and environmental values.

Nutrition, Food Safety, and Health

Enhancing Food Safety

The safety of the food supply is paramount to consumers, policymakers, distributors, processors, producers, and input suppliers. The U.S. Centers for Disease Control and Prevention estimates that more than 6 million cases of foodborne illness resulting in 8,000 deaths occur annually, at a total cost of about $5 billion. The role of foodborne microorganisms and of natural and synthetic chemicals in chronic disease such as arthritis, diarrhea, and cancer remains undetermined. Research is needed to identify the causes and the costs of foodborne diseases better and to improve methods for their detection, assessment, and control. The goals of food safety research and educa-

tion are to prevent foodborne diseases and to control associated costs.

Targeting Optimal Nutrition for Individual Health

Optimal nutrition enables people to achieve their genetic potential, to feel their best, and to decrease their susceptibility to disease. Better health through improved nutrition can improve quality of life, productivity, and learning potential and can decrease health care costs. Costs associated with the four major chronic diseases linked to inappropriate diet now approach $145 billion annually.

Research is needed to determine the optimal nutrient intakes for people from all subpopulations, as well as the role of dietary factors in the development and the prevention of obesity and chronic diseases. Research determining the relationships of diet to genetic regulation and of diet and fitness to health is needed to establish the nutrient needs of individuals.

Underlying the research objectives are continuing needs to clarify the function of individual nutrients and their interactions and to develop reliable indicators of nutritional status, health, and performance. New methodologies, including those in molecular and cellular biology, have the potential to create new and more reliable indicators of nutrient status and predictors of nutrient needs. This research can be used by agricultural producers, food processors, and manufacturers to enhance the value of foods; by policymakers to establish nutrition guidelines; and by educators to initiate efforts to improve nutritional status.

Designing Foods for Healthy Diets

Manipulation of existing foods and design of new ones can improve the growth and productivity of Americans and can decrease their susceptibility to disease. Design and use of foods to modify intake and proportion of nutrients that people consume can influence cell growth, metabolism, and/or immune system function. Improved understanding of essential and nonessential compounds within food, including their contents in the food supply, bioavailability, and roles and interactions in nutrition, will provide a basis on which to develop foods tailored to individual needs. The creation of novel foods using modified constituents such as fat substitutes offers additional means of developing and using agricultural products. Research is needed, however, to determine the maximum quantity of modified dietary constituents that safely can be eaten and to evaluate the processes used to develop novel foods. New technologies applied to agricultural products offer unprecedented opportunities to respond to consumer demands for healthy diets.

Promoting Healthy Food Choices

Changing consumer demographics, family structures, and lifestyles, coupled with an expanding array of available products, have had dramatic effects on food choices. Improving understanding of the roles both of consumer food choices and of demand is a necessary step in promoting optimal health through improved nutrition. The economic and the behavioral obstacles to adopting healthy food habits consistent with U.S. dietary guidelines and with the food guide pyramid must be identified. Complete and current information with which to monitor food composition and food intake is needed as a basis for effective nutrition policies and food assistance programs.

Processes and Products

Converting Processing By-Products to Beneficial Uses

The processing and manufacturing of products derived from agriculture and forestry generate large volumes of by-products and residuals capable of conversion into useful products by means of advanced technologies. The alternative is to continue sending waste products into sewers and landfills or to dispose of them by incineration or other environmentally harmful methods. New and improved food and nonfood uses for waste products will contribute to economic development and will benefit the environment. Processing technologies also can decrease the amount of by-products and residuals or can create safe and cost-effective new uses.

Enhancing Food Quality and Value

Through research, consumers will be provided with a broad selection of high-quality, low-cost, safe, and nutritious food. Production and processing to meet their needs will enhance citizen well-being and will improve U.S. domestic economy and global competitiveness. Understanding the structural and functional relationships among various components of foods will facilitate control and enhance food quality during processing, storage, distribution, and preparation for consumption.

Developing New or Improved Nonfood Products

Clarification of the chemical composition of agricultural and forestry products can provide the basis for innovative or improved industrial processes and

products. Agricultural nonfood industries have the potential to breathe new life into rural communities; to provide existing industries with alternative oils, fuels, and base materials; and to produce new consumer products. These new processes and products will be environmentally compatible, will stimulate the economy through job creation, and will increase income from domestic and export markets.

Economic and Social Issues

Enhancing Agricultural Markets and Competitiveness

Research providing alternative policies for coping with a changing marketplace supports policy decisions enhancing the well-being of consumers, families, and the economy. Analysis of domestic and international markets is essential for increased trade and sustained farm incomes in an environment of decreased federal spending for agriculture. Improved understanding of the linkages among general, regional, state, local, and farm economies provides the foundation for formulating policies with which to enhance economic growth and to stimulate rural community development. As new technologies emerge, research will develop and employ new methods of assessing their economic, social, and environmental costs and benefits, including their effects on national and international production patterns.

Enhancing Rural Economic Development

More than one-fourth of Americans live in rural communities, and this proportion is increasing. The definition of *rural America* is diverse and changing. Towns of 50,000 inhabitants or fewer and that surround metropolitan areas often are preferred residences as a result of their community atmosphere, and the economies of these communities often are service based. Many other rural communities once sustained by production agriculture and related main street service industries now are at risk economically. If rural America is to remain a productive contributor to the U.S. economy, as well as a preferred home to many citizens, the factors constituting a viable community must be understood.

Empowering People for Economic and Social Viability

The effective functioning of a people is a primary factor in the efficiency of markets and the general condition of society. Americans therefore must confront increased economic and social uncertainties as they strive to enhance their productivity, well-being, and contributions to society. They also must interact daily with increasingly complex products, services, and market practices. The ability to function effectively within this environment will determine the extent to which individuals attain economic independence and satisfactory quality of life. Those unable to cope due to educational deficiencies and poverty create a drain on revenues and rob the nation of productive capacity. Research will generate the information needed for decision making and bring about more effective economic and social policies to resolve societal problems, especially those attending rural families and communities.

Animal Systems

Developing Integrated and Sustainable Animal Production Systems

Industry interest is broad based in the development of methods for linking knowledge that exists and that is being developed in regard to the individual components of production, marketing, and processing of animals and their products. Research is needed to identify these interrelationships in quantitative models that will translate into management models increasing efficiency, sustainability, and profitability. Socioeconomic and environmental considerations will be components of the system. General knowledge will provide a framework for more site-specific management paradigms for farm, range, and forestry operations on public and on private lands.

Enhancing Animal Genetic Diversity and Biological Performance

Use of molecular genetics, improved understanding of the physiological and metabolic functions under genetic control, and a combination of molecular and quantitative genetic techniques offer unparalleled opportunities to improve animal systems. Improvements are forthcoming in the nutritional quality of animal products, the limiting of antibiotics and other chemicals (and their residues) in meat, the sustainable use of natural resources, and the efficiency and profitability of production system. Research also will provide methods of better understanding, using, and preserving genetic diversity in the world's animal populations.

Enhancing the Well-Being of Food Animals

Food animal disease results in $18 billion in lost revenues annually, and in the current era of modern transportation and high mobility the possibility of importing exotic animal diseases poses an economic

threat of even greater proportions. Recently, societal concerns about the well-being of animals have increased greatly. Healthy animals provide safer, higher-quality foods and better-quality by-products. Healthy animals also have a decreased need for antibiotics and pesticides—thereby decreasing production costs—and decrease the risk of chemical residues in food.

Research will use the exciting new tools of modern biology to explore new methods of detecting and preventing animal disease. This research will contribute directly to the development of health management in integrated animal production systems. It will develop methods by which to measure animal well-being objectively and to evaluate the factors contributing to it. Controlling disease and modifying current animal management practices to limit stress will improve performance and profitability and will assure the public of the well-being of food animals.

Plant Systems

Protecting Plants for Sustained Productivity

Protecting useful and life-sustaining plants from insects, diseases, nematodes, and weeds is critical to maintaining food and fiber quality and to enhancing U.S. farm productivity and international competitiveness. Increasingly, both domestic and international consumers are concerned not only about the safety and quality of the food that they eat but also about the environmental and social consequences of production.

For more than 20 years, the methods of integrated pest management (IPM), and—more recently—integrated crop management (ICM), have been used to strike a compromise minimizing the use of chemical pesticides and making use of biological control methods where possible. There is both need and opportunity to build on these earlier methodologies and to take advantage of newer research techniques with which to provide the next generation of plant protection for sustainable systems. Decreasing the use of pesticides will directly and effectively limit contamination of the U.S. food and water supply. Research efforts will increase to protect plants and plant products against pests throughout the production, storage, processing, and marketing components of the food chain.

Research should be accelerated in the use of predators, parasites, competitors, pathogens, attractants, repellents, insect sterility, pest resistance, culture, improved pesticides, application technology, and areawide management strategies. Studies should be targeted at both established and emerging pests. Meanwhile, synthetic pesticides remain the primary means of controlling pests, and more research is needed to perfect these methods so that they are more effective and environmentally benign. The overall impact of such research will be to provide environmentally friendly, economically viable, and publicly acceptable plant protection strategies resulting in a safe, dependable, and wholesome food and fiber supply. Plant protection strategies are a critical component of total plant systems management methods.

Developing Alternative Plant Management Systems

Crop, forestry, and rangeland management systems have become more demanding due to the need for improved management of inputs, production practices, harvesting, and marketing to maintain competitiveness in the marketplace. This situation is complicated by the need for food safety and environmental protection, coupled with concerns about the social consequences of food and fiber production.

The knowledge base from which new technology can be drawn also is growing much more complex and interactive. Thus, the need to provide technology allowing farmers, ranchers, and foresters to "put the pieces together" in interactive management systems making the best use of existing and emerging knowledge and optimizing output in terms of multiple goals and objectives also is growing. Plant management systems are one subset of broader systems dealing with the consequences of using natural resources at basin and landscape levels.

Research is needed to improve production stability and to optimize profits, to decrease erosion and to restore soil quality, to protect threatened and endangered species including wildlife, and to protect fragile ecosystems such as wetlands; in short, to provide the fundamental knowledge needed to develop site-specific adaptive applications of new knowledge in a total system context. Research also is needed in a systems approach that examines the management of organic resources, manure, sludge, and crop rotation. Data needs include the assimilative capacity of farms and watersheds, and the evaluation of livestock and cropping enterprise costs.

Understanding Fundamental Plant Processes

The major breakthroughs providing quantum increases in quality, efficiency, and sustainability of plant systems most likely will come from fundamental new knowledge. New discoveries built on the foundations of current knowledge also offer the opportu-

nity to make major contributions to societal and economic goals for safer and more effective food and fiber production systems. Under this plant system initiative, targeted research will range from molecular to population levels and will involve population biology, microbial ecology, genetics, and physiology. Research will emphasize interactions at the root-soil interface of nutrients, microbes (soil biota), and water and will provide the "next generation" of building blocks needed for information and management systems to sustain essential plant production more effectively.

Using Genetics to Improve Plants for the Twenty-First Century

An ambitious effort to map the genome of economically important plants has been initiated jointly by the State Agricultural Experiment Stations and the USDA Agricultural Research Service. Industry is making a major contribution to science and application in this area. Plants are approaching the marketplace that were developed using recombinant DNA methods coupled with quantitative plant genetic development. Such research has just begun to scratch the surface of opportunity.

To take full advantage of this technology and to maintain the internationally competitive position of the United States, research should be expanded and accelerated in the development of genome mapping, gene transfer, gene expression control, and the application of these technologies to conventional plant-breeding programs. Concerns for biological safety and for the social consequences of such developments as well as for methods of ensuring appropriate regulatory oversight without unnecessary impairment of progress will continue.

Promising applications of the new technologies seem unlimited. They include improved nutritional quality and performance traits, more stable and sustainable production systems, natural resistance to plant pests (with resulting decreases in chemical residues in food), diversification and expansion of markets, specifically tailored urban decorator landscape plants, and the ability to recognize the value of and to protect biodiveristy. In the aggregate, research will provide new and improved plant products produced in an environmentally sound way for consumers who will be increasingly satisfied with their quality, safety, and convenience.

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