Agricultural Resources and Environmental Indicators. U.S. Department of Agriculture, Economic Research Service, Natural Resources and Environment Division. Agricultural Handbook No. 705.

Abstract

This report identifies trends in land, water, and commercial input use, reports on the condition of natural resources used in the agricultural sector, and describes and assesses public policies that affect conservation and environmental quality in agriculture. Combining data and information, this report examines the complex connections among farming practices, conservation, and the environment, which are increasingly important components in U.S. agriculture and farm policy. The report examines the economic factors that affect resource use and, when data permit, estimates the costs and benefits (to farmers, consumers, and the government) of meeting conservation and environmental goals. The report takes stock of how natural resources (land and water) and commercial inputs (energy, nutrients, pesticides, and machinery) are used in the agricultural sector; shows how they contribute to environmental quality; and links use and quality to technological change, production practices, and farm programs.

Keywords: Land, water, production inputs, cropping practices, technology, conservation and environmental programs

Contents

Production

Editor: . . . . . Margot Anderson
Managing Editor: . . . . . Richard Magleby
Copy Editor: . . . . . Dale Simms
Graphics Editor: . . . . . Susan DeGeorge
Production Assistant: . . . . . Olivia Wright
Camera copy: . . . . . Dale Simms, Susan DeGeorge, and Adrie Custer

Acknowledgments

The publication of AREI would not have been possible without the help of many ERS staff who undertook this task while the Economic Research Service was undergoing a reorganization. John Miranowski was instrumental in launching this report: he supported this project from the beginning and made sure the necessary resources were directed at accomplishing the task. Bob Robinson provided continuity and support for the project and guided the report through to final publication. Tom McDonald and Adrie Custer provided much-needed assistance in coordinating and troubleshooting the many day-to-day problems that come with a project this size. We thank Tanya Hollis, Connie Jones, Melody Mathis-Pace, Barbara Smith, and Nicole Stafford for their able assistance in preparing draft manuscripts. A special thanks to William Anderson, who provided guidance and counsel. We also thank those who took the time to review chapters and modules: their insights, edits, and suggestions unquestionably improved the quality of AREI: Bruce Baldwin (FS); Alex Barbarika (ASCS); Andy Bernat (ERS); Don Butz (SCS); Thomas Calhoun (SCS); Roger Conway (OE); Annetta Cook (ARS); Ron Davis (ARS); Suzie Diaz (FmHA); Bill Dowdy (NASS); Larry Elworth (NRE); Robert Epstein (AMS); Jack Frost (SCS); Bart Hewitt (ES); Jim Johnson (ERS); W. Doral Kemper (ARS); Gerald Larson (OBPA); Linda Lee (University of Connecticut); Gary Muckel (SCS); James Lewis (SCS); David Mackenzie (CSRS); James McMullen (ASCS); John Meisinger (ARS); Bob Milton (NASS); Richard Parry (ARS); Ed Rall (ASCS); Sam Rives (NASS); Dave Schertz (SCS); Philip Scronce (ASCS); Wayne Solly (USGS); Lawson Spivey (SCS); Homer Stroike (ASCS); Fred Swader (ES); W.H. Tallent (ARS); and Don West (ES).

Authors and Contributors

Marcel Aillery, Margot Anderson, Douglas Beach, Leonard Bull, Patrick Canning, Stephen Crutchfield, Arthur Daugherty, Kelly Day, Peter DeBraal, Herman Delvo, Keith Fuglie, Dwight Gadsby, Mohinder Gill, Noel Gollehon, Ralph Heimlich, Jim Hrubovcak, Wen-Yuan Huang, John Jones, Cassandra Klotz, Fred Kuchler, David Letson, Biing Hwan Lin, Richard Magleby, Michael Ollinger, Tim Osborn, Merritt Padgitt, Leslie Pope, William Quinby, Katherine Ralston, Mark Ribaudo, Carmen Sandretto, David Shank, Robbin Shoemaker, Harold Taylor, Marlow Vesterby, Keith Wiebe, and Gene Wunderlich.

Agricultural Resources and Environmental Indicators

Preface

It has been 8 years since the Economic Research Service (ERS) changed the content and format of its *Agricultural Resources Situation and Outlook Reports.* In the mid-1980's, ERS launched the publication of three reports: *Inputs* (twice a year); *Land Values*; and *Cropland, Water, and Conservation.* While ERS had long published reports on land values and input use, reports on resource and conservation issues were new and popular additions. We now see a need to provide a more comprehensive report that integrates the data and information previously reported in the *Resources Situation and Outlook* series and adds new data and information on broader conservation and environmental issues. This new report, *Agricultural Resources and Environmental Indicators* (AREI), identifies trends in land, water, and commercial input use, reports on the condition of natural resources used in the agricultural sector, and describes and assesses public policies that affect conservation and environmental quality in agriculture. By combining data and information into one report, we can better examine the complex connections among farming practices, conservation, and the environment, which are increasingly important components in U.S. agriculture and farm policy.

AREI examines the economic factors that affect resource use and, when data permit, estimates the costs and benefits (to farmers, consumers, and the government) of meeting conservation and environmental goals. The report takes stock of how natural resources (land and water) and commercial inputs (energy, nutrients, pesticides, and machinery) are used in the agricultural sector; shows how they contribute to environmental quality; and links use and quality to technological change, production practices, and farm programs. AREI provides basic information on resource use and quality, and constructs environmental indicators that can be used in economic assessments of farming practices, conservation policies, and environmental performance in the sector.

About Environmental Indicators

The public continues to be interested in monitoring the quality and quantity of the Nation's resources (such as water, land, air, plant and animal species) and in determining how human activities affect resources. Informed public policy and good resource stewardship depend on accurate assessments of environmental conditions and the economic costs and benefits of maintaining environmental quality. But environmental assessments can be hampered by: (1) too many detailed data that are difficult to interpret, (2) no baseline from which to compare change; and (3) data that are inconsistent over time or over geographic area.

Environmental indicators organize and synthesize data into measures of natural resource status and environmental performance. For example, indicators are used to measure and compare the condition of the environment over time and over geographic areas. These comparisons help formulate conservation and environmental policies and monitor progress in meeting national goals or international commitments. Indicators can be used as inputs into economic models that estimate how changes in commodity prices, input prices, public policies, and technology affect environmental performance and that assess, in turn, how environmental practices affect competitiveness and economic well-being. Environmental indicators are also closely related to environmental accounting, which adjusts farm income or GNP to account for resource depletion, degradation, or improvements.

Environmental indicators are often classified as either descriptive or performance (World Bank, 1994). Descriptive indicators illustrate the status of the environment and, for agriculture, include soil quality (such as soil erosion rates, salinization, organic matter content); water quality (such as the level of contamination in ground or surface waters); and water quantity (such as percent of land irrigated, groundwater levels, or the cost of irrigation water). Descriptive environmental indicators need to be verifiable and reproducible, comparable over time and space, scaled to an appropriate time horizon, and easily interpreted based on a clear relationship between the observed data and "indicator" phenomena (World Bank, 1994). Performance indicators are measured against some physical threshold or policy goal. In agriculture, performance indicators include tons of erosion prevented due to the Conservation Reserve Program, acres of highly erodible land under conservation compliance plans, extent of adoption of alternative tillage practices or improved nutrient and pest management techniques, and acres of wetlands restored under the Wetlands Reserve Program.

A more complex framework for developing and organizing environmental indicators is the pressure-state-response (PSR) framework used by the Organization for Economic Cooperation and Development (OECD, 1993). This framework is based on the concept of causality—human activity, such as farming, exerts *pressure* on the environment, which changes the quality or the *state* of the natural resource base. In response, society considers economic, environmental, and conservation policies. Within this context, indicators of environmental *pressure* include intensity of water resource use, land use, and input use. Indicators of *state* include erosion rates, quality of ground and surface waters, and amount of habitat protected. Societal *responses* include water pricing policies, soil erosion polices, and technological change.

The OECD lists several criteria in constructing indicators. They should: (1) provide a representative picture of environmental conditions; (2) be simple and easy to interpret; (3) provide a basis for comparison, over time or over geographic area; (4) be linkable to economic models; (5) be readily available; and (6) be regularly updated. These criteria apply to ideal indicators, which are often costly and difficult to construct. In addition, it is often difficult to make clear distinctions among pressures, states, and responses, resulting in indicators that combine all three components.

Environmental indicators, particularly indicators of performance or state, are often difficult to obtain due to their complexity and the lack of consistent time series data. Environmental monitoring programs are designed to fill the data gaps and improve existing data. For example, the EMAP (Environmental Monitoring and Assessment Program) coordinated by the U.S. Environmental Protection Agency, is a long-term program involving many Federal, regional, and State agencies (U.S. EPA, 1994). EMAP is designed to monitor the condition of the Nation's ecological resources and to establish an environmental baseline, which will be used to evaluate current policies and programs and to identify emerging problems. EMAP focuses on eight broad resource categories: landscapes, arid ecosystems, estuaries, forests, Great Lakes, surface waters, wetlands, and agroecosystems. Indicators for agroecosystems include crop productivity, soil productivity, irrigation water quality and quantity, agricultural chemical use, and land use. Many of these indicators are already collected by USDA and appear in AREI.

Just as no single economic indicator (GNP, net income, unemployment rates, interest rates, or exchange rates) can fully describe the status of the economy, multiple environmental indicators are needed to describe resource condition. Because there is no single environmental indicator or index that fully describes the agroenvironment, AREI presents multiple measures, including indicators of land use, indicators of water quality and quantity, changes in the use and price of commercial inputs (fertilizers, pesticides, energy), trends in technology, changes in farming practices, and public policy responses to conservation and environmental quality.

References

Organization for Economic Cooperation and Development (1993). *Core Set of Indicators for Environmental Performance Reviews*. Environment Monograph No. 83. Paris.

U.S. Environmental Protection Agency (1994). EMAP Monitor. Office of Research and Development. Washington, DC.

World Bank (1994). "Environmental Indicators: What Can They Tell Us?" Dissemination Notes Number 5, Environment Department, Washington, DC. Feb.

Changes in Names of USDA Agencies

Due to the Department of Agriculture Reorganization Act of 1994, names of several USDA agencies referred to in this module were changed:

Prior agency name used in this module	**New name**
Agricultural Stabilization and Conservation Service (ASCS)	Part of the new Consolidated Farm Service Agency
Cooperative State Research Service (CSRS)	Part of the new Cooperative State Research, Education, and Extension Service
Extension Service (ES)	Part of the new Cooperative State Research, Education, and Extension Service
Farmers Home Administration (FmHA)	Part of the new Consolidated Farm Service Agency
Soil Conservation Service (SCS)	Natural Resources Conservation Service