1995

Everyone a Teacher, Everyone a Learner

Heidi Carter  
*University of Nebraska-Lincoln, csasOO7@unlvm.unl.edu*

Charles Francis  
*University of Nebraska-Lincoln, cfrancis2@unl.edu*

Follow this and additional works at: [http://digitalcommons.unl.edu/cari-sustain](http://digitalcommons.unl.edu/cari-sustain)
EXTENSION AND EDUCATION
MATERIALS FOR
SUSTAINABLE AGRICULTURE:
Volume 4

Everyone a Teacher,
Everyone a Learner

North Central Region Sustainable Agriculture Research
and Education Training Program

Michigan State University
University of Nebraska-Lincoln
The Ohio State University
Lincoln University
Midwest National Technical Center/NRCS
North Central Region Land Grant Universities
Midwest Sustainable Agriculture Working Group

Arbor Day Farm
Lied Conference Center
Nebraska City, Nebraska
March 13-15, 1995

Turkey Run State Park
Marshall, Indiana
April 3-5, 1995

Heidi Carter and Charles Francis
Editors

May 1995

This collection of materials is supported by the Extension Service, U.S. Department of Agriculture, under special project number 94-ESAG-1-0001. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

It is the policy of the University of Nebraska-Lincoln not to discriminate on the basis of gender, age, disability, race, color, religion, marital status, veteran's status, national or ethnic origin or sexual orientation.
Everyone a Teacher,  
Everyone a Learner

North Central Region Sustainable Agriculture Research  
and Education Training Program

Michigan State University  
University of Nebraska-Lincoln  
The Ohio State University  
Lincoln University  
Midwest National Technical Center/NRCS  
North Central Region Land Grant Universities  
Midwest Sustainable Agriculture Working Group

Training Workshops:  
Arbor Day Farm Lied Conference Center, Nebraska City, March 13-15, 1995  
Turkey Run State Park, Marshall, Indiana, April 3-5, 1995

Editors' Introduction

"Everyone a Teacher, Everyone a Learner" is a theme that promotes participation. The workshop and handbook title conveys the message that every person in an adult learning environment brings a special set of experiences and a certain wisdom to the activity. Our training activities under the banner and support of the Sustainable Agriculture Research and Education (SARE) program are focused on the future of agriculture and communities, incorporating the long-term economic and social dimensions of the food system with concerns about the environment and natural resources. The NRCS contributions to the workshops include a focus on watersheds and communities, and on how federal programs in the future will look at broader issues than the in-field or single farm practices that have been featured to date. This handbook brings together a unique set of educational materials that focus on preparing Extension, NRCS, and other public and private agency people for agriculture in the future.

The handbook does not tell you how to set up a training program, nor does it give a narrow recommendation about what methods to use. This is a buffet or smorgasbord of ideas and methods, of specific technical materials and handouts that could be useful in some situations. The training needed in each state and each location, and for each audience, will be unique in some ways. We look forward to learning about your experiences, and invite you to send us examples of any methods and materials that you use in this program and others. We will share these with others in the region. Thank you.

Heidi Carter & Chuck Francis, Editors

This collection of materials is supported by the Extension Service, U.S. Department of Agriculture, under special project number 94-ESAG-1-0001. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.
Volumes 1, 2, 3, and 4 are available from:

Center for Sustainable Agricultural Systems  
University of Nebraska-Lincoln  
225 Keim Hall  
Lincoln, NE 68583-0949  
Phone: 402-472-2056  
Fax: 402-472-4104  
Email: csas003@unlvm.unl.edu

Editors

Heidi Carter  
Center for Sustainable Agricultural Systems  
University of Nebraska-Lincoln  
219 Keim Hall  
Lincoln, NE 68583-0949  
Phone: 402-472-0917  
Fax: 402-472-4104  
Email: csas007@unlvm.unl.edu

Charles Francis  
Center for Sustainable Agricultural Systems  
University of Nebraska-Lincoln  
225 Keim Hall  
Lincoln, NE 68583-0949  
Phone: 402-472-1581  
Fax: 402-472-4104  
Email: csas002@unlvm.unl.edu
TABLE OF CONTENTS

Letters of Support ........................................................................................................ 1
Concerns and Comments on Chapter 3 Training ......................................................... 3
What Is Sustainable Agriculture ................................................................................... 5
Integrated Sustainable Crop and Animal Systems ..................................................... 21
Planning Learning Activities ....................................................................................... 53
Social Issues Related to Agriculture, Communities, and New Technologies ............. 63
Case Studies, Focus Groups, and Decision Cases ....................................................... 77
Environmental Impacts of Sustainable Practices and Systems ................................. 109
Economics of Sustainable Systems ............................................................................. 125
On-farm Research, Demonstrations, and Tours ......................................................... 153
Integrated Resource Management in Sustainable Agriculture ................................. 159
Cultural Resources and Sustainable Agriculture ....................................................... 183
Role of Systems Science in the Design of Pest Management Systems
    for Sustainable Agriculture ...................................................................................... 203
Resources for Sustainable Agriculture ...................................................................... 217
Focusing an Evaluation and Designing Evaluation Strategy ...................................... 241
Dear Colleagues:

_Everyone a Teacher, Everyone a Learner_ is a product of unique cooperation between the Cooperative State Research, Education, and Extension Service initiative in sustainable agriculture training and the Natural Resources Conservation Service. Joining people and ideas from the two agencies, this book of materials and learning methods developed by the North Central Region provides some highly relevant ideas about how to help agriculture move toward the future. With current challenges of energy and soil conservation, soil and water quality, and need for viable rural communities the need for further education is obvious. What is more difficult is the design of learning environments that will help our educators bring topical information to farmers and ranchers that can improve the efficiency and sustainability of production systems, as well as articulate to the general public what is happening that is positive in our food system. We need to address the economic, environmental, and social dimensions of agriculture, and to continue to reach a broader audience with positive alternatives for the future. This book is a large step in that direction.

WILLIAM D. CARLSON
Acting Administrator
A Message to Natural Resources Conservation Service Employees

The Sustainable Agriculture Research and Education Program (SARE) was created through the 1990 Farm Bill to encourage research and education that enables producers to achieve profitable agriculture while enhancing and restoring environmental resources as well as improving the quality of life in rural America. Our agency has been a key participant, along with the Cooperative State Research, Education, and Extension Service (CSREES), the Environmental Protection Agency, farmers and ranchers, Land Grant Universities, and other agencies, in administering SARE. In addition to administering research grants focused on producers and researchers, the four SARE Administrative Councils are guiding regionally tailored training programs in sustainable agriculture.

This training notebook was compiled by the North Central Region's interagency planning team in response to direction from the 1990 Farm Bill (Chapter 3 of Subtitle B). Natural Resources Conservation Service (NRCS) personnel have been a part of this interagency effort from the beginning. CSREES is committed to working with NRCS to help fulfill a joint charge in the 1990 Farm Bill to "...consult and work closely...in carrying out the information, technical assistance, and related programs..." in support of sustainable agriculture in each State.

Chapter 3 directs NRCS to help develop handbooks, technical guides, and educational materials that support the practice of sustainable agriculture. This notebook contains technical materials, materials for methods of teaching, and contacts with expertise in sustainable agriculture. The contents of this notebook will assist us in acquiring information and developing appropriate field level materials.

I strongly support the SARE Program nationally, regionally, and locally, and encourage you to give it your support as well. The partnerships that we build in carrying out our responsibilities in sustainable agriculture will also help us deliver technical assistance in a more ecological manner. I support the goal of sustainable agriculture because it is right for people and for the land.

PAUL W. JOHNSON
Chief
The Sustainable Agriculture Technology Development and Transfer Program (SATDTP) or "Chapter 3" is both a requirement and opportunity for Extension systems to provide training and education to key information providers in agriculture concerning information on sustainable agriculture. Extension must carefully consider the following as training programs are planned, developed, and delivered to the agricultural community.

1. **Maintain the Integrity of Chapter 3**
   Remember the difference between sustainable ag and more traditional programs and needs. Provide training that is not presently being offered. Do not be co-opted and dilute the Chapter 3 training with basic traditional needs.

2. **A Continuing Process**
   A strategic plan in never complete. Be prepared to provide updated training and in-service on an annual basis. Meet the needs of new staff and information providers.

3. **Listen to the Targeted Audience**
   Ask the farmers/ranchers what they want Extension/NRCS and others to know about sustainable agriculture. Ask Extension/NRCS what they feel they need to know.

4. **Build Partnerships**
   Determine appropriate partners for the planning and delivery phases. Extension cannot do it alone. Look to the private sector and non-profits for assistance. Involve state (NRCS) and federal partners, such as EPA.

5. **Direct/Indirect Input and Delivery**
   Do not rely on only traditional and formal mechanisms of planning and delivery of education. Look for existing data sources for input. Use a variety of delivery means. Not all planning and education needs to be "face to face."

6. **Make it Different**
   The state training program should not look like another Extension training or in-service event. It must be different because Chapter 3 is different! If everyone is comfortable, then maybe you have not gone far enough ......

7. **The Facts of Life**
   Not all training programs can or should be multi-state or regional. Provide future training opportunities which require less travel for staff. There is a limit to the time and travel that can be carried by the local or state partner.

8. **Farmer/Rancher Partners**
   Congress does not suggest but mandates that farmers and ranchers will be full partners in this program. Farmers must be involved in the planning, development, and delivery of Chapter 3 programming. Farmers will be some of our teachers, and we must be some of the students. We are not the only holder of the key to the gates of knowledge.

March 1995
WHAT IS SUSTAINABLE AGRICULTURE?

LEARNING METHOD: Presentation, Video and Group Discussion

PRESENTED BY: John Ikerd
University of Missouri - Columbia

One of the most frequent questions asked by farmers in the North Central Region today is, "What is sustainable agriculture?" Confused by the many definitions published over the past decade, and confounded by comparisons with organic farming and exclusively low-input approaches, many of our colleagues and clients continue to have difficulty with this term. Is this a set of practices? Is sustainable agriculture a goal or a philosophy? Because of the complications surrounding terminology, it is important to deal with definition at the outset with any group receiving training in sustainable agriculture.

The presentation deals with different definitions of sustainable agriculture, why there is confusion about the term, and how we can deal with this issue with Extension, NRCS, farmer, and other client group training. An overview of definitions has been written by John Ikerd, and several other statements of definition or reaction to the Ikerd white paper are included in this section.

KEY REFERENCES:


Ikerd, J. 1995. On defining sustainable agriculture for national training program (Chapter 3). Discussion paper.


North Dakota State Univ. 1994. Agriculture and natural resources listening sessions: comments from listening session participants. Coop. Extension (unpublished)

ON DEFINING SUSTAINABLE AGRICULTURE
FOR NATIONAL TRAINING PROGRAM (CHAPTER 3)

John Ikerd
University of Missouri

Among those working in sustainable agriculture, there seems to be a growing consensus that we need to spend less time trying to define sustainable agriculture and more time working to achieve it. In fact, the public mandate to carry out the National Training Program, commonly referred to as Chapter 3, requires that we move ahead with professional development programs addressing the sustainable agriculture issue. But, can we work toward a sustainable agriculture without defining it? We can, if we agree that the basic goal of a sustainable agriculture is agricultural sustainability, with the words agricultural and sustainability both used in the generic sense. Most of our definitional disagreements seem to stem from differing opinions concerning the "means" by which a sustainable agriculture can or should be achieved rather than the "goal" toward which those means are directed.

"Sustainability is a question rather than an answer," as the late Robert Rodale was fond of saying. Sustainability is a direction rather than a destination, like a star that guides the ships at sea but remains forever beyond the horizon. The "question of sustainability" can be asked of any ongoing activity or process. It can be asked of "conventional" agriculture and of any proposed "alternative" agriculture: Is it sustainable? Asking the question need not, and should not, presuppose the answer.

Reaching agreement on the goal of sustainability will not be simple, but it should be achievable. First, we must agree on what is to be sustained, for whom, and for how long? But, if we can agree on the answers to these questions we should be able to move forward toward the common goal of agricultural sustainability. I believe most of those who support the sustainable agriculture issue are working to sustain: what? "agriculture," for the benefit of whom? "humanity," for how long? "forever." Agriculture, by its very nature, is an effort to shift the ecological balance so as to favor humans relative to other species in production of food and physical protection. Thus, if we sustain "agriculture" we are sustaining it for the ultimate benefit of humankind. I believe there is a general consensus also that we want to sustain agriculture for the well being of people, both of this generations and for all generations to follow, forever. I have seen no definition of sustainable agriculture that places a time horizon on how long agriculture should be sustained.

We cannot prove through empirical studies that one approach to agriculture is sustainable or that another is not. It would quite literally "take forever" to collect the data for such a study. Thus, we must rely on the science of logic. What are the logical prerequisites for agricultural sustainability? The answer, I believe, is found in a growing consensus that a sustainable agriculture must be (1) ecologically sound, (2) economically viable, and (3) socially responsible. Furthermore, I contend that these three dimensions, in so far as they relate to sustainability, are inseparable. All three are essential, and thus, all are equally critical to long run sustainability.
Most who are concerned about sustainability recognize an interconnectedness of humanity with the other biophysical elements of our natural environment. Through agriculture, we may tip the ecological balance in our favor. But if we attempt to tip it too far or too fast, we will destroy the integrity of the natural ecosystem, of which both we and our agriculture are parts. If we degrade our natural resources and poison our natural environment, we will degrade the productivity of agriculture and ultimately will destroy human life on earth. Nearly everyone seems to agree that a sustainable agriculture must be ecologically sound.

There may be less agreement regarding the contentions that a sustainable agriculture must also be economically viable and socially responsible. The social sciences of economics and sociology are fundamentally different from the physical agricultural sciences and the natural science of ecology. However, agriculture, by its nature, involves self-conscious attempts by humans to change or "manage" natural ecosystems. Humans are unique among species in that we make purposeful, deliberate decision that can either enhance or degrade the health of the ecosystems of which we are a part. Thus, a question of sustainability must take into account the purposeful, self-conscious nature of individual and collective human actions which are driven by the economic and social motives of people.

Sustainable systems must be economically viable, either by nature or through human intervention. In many cases, farmers have economic incentives to adopt ecologically sound systems of farming. A healthy agroecosystem tends to be a productive and profitable agroecosystem. However, inherent conflicts exist between short run interests of individuals and long run interests of society as a whole. In such cases, society must provide economic incentives for individuals to act in ways consistent with long run societal interests.

"Human nature," fundamentally, is a part of "nature." Even when our physical survival is ensured and our basic needs are met, the nature of we humans is to act in our own economic self interest. We need not "maximize profit," but people cannot persist in actions that are inconsistent with economic survival, regardless of any personal desire to do so. Enterprises that lack economic viability will lose control over use of ecological resources to their economically viable competitors. In other words, farmers who can't survive financially ultimately will lose their farms to their economically viable "neighbors." Agriculture cannot be sustained if the only economically viable "neighbors" are those who degrade the agroecosystem in pursuit of short run profits.

A fundamental purpose of public policy is to resolve conflicts between the short run interests of individuals and the long run interest of society as a whole. Ecologically sound systems of farming can be made economically viable through the public policy making process. However, society ultimately must pay the costs of such policies, either through availability and prices of food and fiber, or through government taxing and spending. By one means no another, farming systems must be made economically viable as well as ecologically sound if they are to be sustainable. Neither is more important than the other; both are necessary and neither is sufficient.

The ultimate consensus that a sustainable agriculture must be socially responsible is still emerging. However, to argue that an economically viable and ecologically sound system of agriculture can be sustained in the absence of social justice, is to ignore the fundamental nature of humans. At their very core, such arguments beg the question of sustainability for whom, or at
least for how many at what level? No set of ecologic possibilities can sustain the maximum population that humankind might possibly choose to procreate on this earth. Nor is it ecologically possible to sustain even the current human population at any level of per capita resource consumption we might choose.

The history of human civilization provides little evidence to support a hypothesis that either regional or global population and consumption will automatically adjust to optimum sustainable levels. To the contrary, overpopulation and unrestrained greed seem more likely to result in destruction and degradation of the natural resource base. Evidence suggests that this degradation will continue to a point where only a fraction of the population can be sustained which might have been sustained if overpopulation had been avoided. No set or ecological constraints will prevent starving people from consuming the seeds that might have produced a bountiful harvest, if the harvest comes only after the people are dead.

Human societies that lack economic equity and social justice are inherently unstable, and thus, are not sustainable over time. Such system will be characterized by reoccurring social conflicts which may do irreparable damage to both the economic and ecologic systems that must support them. Nothing in history would indicate that human societies are inherently more resistant, resilient, or regenerative that are ecological communities. In an age of nuclear weapons and other forms of mass destruction, one instance of societal failure can destroy the ecosystem of an entire region. Even without war; deserts, droughts, floods, and famines are more frequently the ultimate result of failed social systems than of any naturally occurring ecosystem phenomena alone. Agriculture is a creation of human society that can be destroyed by human society. An agriculture which fails to sustain a society will not be sustained by that society.

A socially responsible agriculture -- one that equitable meets basic human food and fiber needs, provides economic opportunity, supports self-determination, and ensures social equity for both current and future generations, for example -- is no less critical to long run sustainability than is an ecologically sound and economically viable agriculture. We must have social incentives to create economic rewards for ecological protection. An important dimension of human nature is our ability to learn, discover new options, and to choose new and different responses. This ability to change our stimulus-response patterns is unique to the human species. Sustainability is not possible unless we develop our "collective" will to exercise this uniquely human social trait.

Some may question the wisdom of placing the burdens of global sustainability on American agriculture. One might logically conclude that American agriculture is but one part of global agriculture, and that agriculture is but one small part of the larger global ecosystem. If risks arising from lack of sustainability within American agriculture can be counteracted elsewhere within global agriculture, or within the rest of the global ecosystem; the system as a whole will be sustainable. This conclusion is valid, but only within limits.

As an analogy, the human body is a system. The basic function of some body organs, such as the liver and kidneys, is to handle wastes generated by other body functions. Some parts of the body, such as the heart and lungs, may adjust their activity to accommodate stresses placed on them by other parts of the body. Generation of waste is a normal function of any living organism, and some level of stress is necessary for a healthy body. However, the body as a whole is limited
in its ability to assimilate wastes and adsorb stress. When its critical limits are exceeded, the overstressed organ, a subsystem of the body, begins to die. When a critical organ or part of the body dies, the whole body dies. The system ceases to function.

When agriculture production in a particular field is not autonomously sustainable, it places stress on the farming system as a whole. When a farm is not autonomously sustainable, it places stress on the community of which it is a part. When an agricultural sector is not sustainable, it places stress on a nation; and a nation that is not sustainable places stress on the rest of the world. Some lack of autonomous sustainability at all levels, at any given time, should be considered normal, even necessary, for a healthy, interdependent global society. However, stresses placed by any one element of a system on the system as a whole should be monitored and controlled, in the same sense that stresses on the human body need to be monitored and controlled.

It is no less important to monitor and control the social stress an agricultural system places on farm families and others in rural communities than it is to monitor the economic stress agriculture puts on food consumers or the ecological stress agriculture puts on its natural environment. An agricultural system that destroys a critical element of an agroecosystem system will degrade and eventually destroy the system as a whole. We should be willing to ask of any proposed agricultural technology, enterprise, or activity: Is it socially responsible? Competent, well-informed scientists will disagree on the answer. Such is the nature of science. And, to simply ask: "Is it socially responsible?", should not presuppose either a positive or negative answer. Questions of social responsibility ultimately must be answered by society, by families, communities, and others collectively affected by agricultural decisions. However, it is logically imperative that we recognize ecological soundness, economic viability, and social responsibility all as essential and thus equally critical to the sustainability of agriculture.

Finally, how do we turn these fundamental concepts into practical approaches to agricultural sustainability? I suggest that we do so by asking of every decision we confront: Will the consequences be ecologically sound, economically viable, and socially responsible? We can then set about gathering information and assembling knowledge that will allow us to draw conclusions concerning the answers to this three-part question. We can never know for sure whether our conclusions or decisions are right or wrong. Sustainability is about "forever." However, we will at least be asking the right questions. And, by focusing our efforts on gathering the right information and pursuing the right knowledge, we should at least improve the odds of finding the right answers.

The foregoing thesis does not define the concept of "sustainable agriculture," instead it defines an "approach" to working toward "agricultural sustainability." The usefulness in defining such an approach may be made more apparent by speculating on those who are likely to reject the approach and those who are likely to embrace it.

First, those who do not accept agriculture as a legitimate human activity are likely to reject this approach, while those who question the sustainability of agriculture as it is currently practiced could easily embrace it. Those who see organic farming as the only means of achieving agricultural sustainability may reject this approach, while those who view organic farming as an approach worthy of study or active pursuit may embrace it. The proposed approach is likely to be
rejected those who refuse to consider ecological soundness, economic viability, or social responsibility as equally important dimensions of sustainability; by those who contend that if a system is ecologically sound, social values and economic incentives will adjust; by those who contend that if a system is profitable, it's sustainable, period; and by those who contend it is not necessary to provide economic incentives for farmers or other individuals to meet the long run needs of society.

This approach will not be acceptable to those who see other living species as having as much right to the earth's resources as humans, but it may be supported by those who see human survival and well being as critically interrelated with the other biological and physical elements of the global ecosystem. Thus, it will be rejected by those who feel that animals have rights in the same sense that humans have rights, but may be embraced by those who are dedicated to humane treatment of animals and animal well-being in general.

The proposed approach quite likely will be rejected by those who see agriculture as separable from the rest of the ecosystem, by those who would set aside spaces for farming separate from spaces for wildlife or from spaces for living. It will also be unacceptable to those who fail to see food production, human population, and human consumption as consequences of interdependent decisions and actions taken within the same systems context. It likely will be rejected by those with a blind faith in technological fixes, but may be embraced by those who see human intervention, through new technology and by other means, as essential elements of agriculture. It may be rejected by those who feel agriculture should produce food but need not be concerned with the productive employment of people or with other positive contributions to the quality of human life. It may be rejected also by those who fail to see the intentional self-conscious actions of people as an essential dimension of agroecosystems.

The proposed approach will be unacceptable to those who refuse to question the sustainability of conventional agriculture, but may be supported by those who feel that a conventional farming system can evolve so as to fulfill the ecologic and social prerequisites for long run sustainability. And, it will be rejected by those who have prejudged conventional agriculture as being unsustainable, but may be embraced by those who firmly believe that an alternative paradigm, or fundamentally different model of farming, offers the best hope for sustaining agriculture in the future. In general, the proposed approach will be acceptable to those who would pursue a wide range of alternative means to achieve agricultural sustainability, but will be rejected by those who see the alternative means for achieving sustainability as narrow or exclusive.

Hopefully, the general approach to agricultural sustainability suggested here can give some common direction to programs carried out under the Sustainable Agriculture National Training Program for Extension workers and those in other public and private agencies working directly with farmers. There is an apparent need to develop a consensus among these groups regarding a general approach to dealing with the sustainable agriculture issue. Hopefully, the thesis presented here can provide a foundation upon which such a consensus can be built.
What is Sustainable Agriculture?

University of California
Sustainable Agriculture Research and Education Program

Agriculture has changed dramatically, especially since the end of World War II. Food and fiber productivity soared due to new technologies, mechanization, increased chemical use, specialization and government policies that favored maximizing production. These changes allowed fewer farmers with reduced labor demands to produce the majority of the food and fiber in the U.S.

Although these changes have had many positive effects and reduced many risks in farming, there have also been significant costs. Prominent among these are topsoil depletion, groundwater contamination, the decline of family farms, continued neglect of the living and working conditions for farm laborers, increasing costs of production, and the disintegration of economic and social conditions in rural communities.

A growing movement has emerged during the past two decades to question the role of the agricultural establishment in promoting practices that contribute to these social problems. Today this movement for sustainable agriculture is garnering increasing support and acceptance within mainstream agriculture. Not only does sustainable agriculture address many environmental and social concerns, but it offers innovative and economically viable opportunities for growers, laborers, consumers, policymakers and many others in the entire food system.

This paper is an effort to identify the ideas, practices and policies that constitute our concept of sustainable agriculture. We do so for two reasons: 1) to clarify the research agenda and priorities of our program, and 2) to suggest to others practical steps that may be appropriate for them in moving toward sustainable agriculture. Because the concept of sustainable agriculture is still evolving, we intend the paper not as a definitive or final statement, but as an invitation to continue the dialogue.

**Concept Themes**

Sustainable agriculture integrates three main goals—environmental health, economic profitability, and social and economic equity. A variety of philosophies, policies and practices have contributed to these goals. People in many different capacities, from farmers to consumers, have shared this vision and contributed to it. Despite the diversity of people and perspectives, the following themes commonly weave through definitions of sustainable agriculture.

Sustainability rests on the principle that we must meet the needs of the present without compromising the ability of future generations to meet their own needs. Therefore, *stewardship of both natural and human resources* is of prime importance. Stewardship of human resources includes consideration of social responsibilities such as working and living conditions of laborers, the needs of rural communities, and consumer health and safety both in the present and the future. *Stewardship of land and natural resources* involves maintaining or enhancing this vital resource base for the long term.

A *systems perspective* is essential to understanding sustainability. The system is envisioned in its broadest sense, from the individual farm, to the local ecosystem, and to communities affected by this farming system both locally and globally. An emphasis on the system allows a larger and more thorough view of the consequences of farming practices on both human communities and the environment. A systems approach gives us the tools to explore the interconnections between farming and other aspects of our environment.

A systems approach also implies *interdisciplinary efforts in research and education*. This requires not only the input of researchers from various disciplines, but also farmers, farmworkers, consumers, policymakers and others.

*Making the transition to sustainable agriculture is a process.* For farmers, the transition to sustainable agriculture normally requires a series of small, realistic steps. Family economics and personal goals influence how fast or how far participants can go in the transition. It is important to realize that each small decision can make a difference and contribute to advancing the entire system further on the “sustainable agriculture continuum.” The key to moving forward is the will to take the next step.

Finally, it is important to point out that reaching toward the goal of sustainable agriculture is the responsibility of all participants in the system, including farmers, laborers, policymakers, researchers, retailers, and consumers. Each group
has its own part to play, its own unique contribution to make to strengthen the sustainable agriculture community.

The remainder of this document considers specific strategies for realizing these broad themes or goals. The strategies are grouped according to three separate though related areas of concern: Farming and Natural Resources, Plant and Animal Production Practices, and the Economic, Social and Political Context. They represent a range of potential ideas for individuals committed to interpreting the vision of sustainable agriculture within their own circumstances.

**Farming and Natural Resources**

**Water**. When the production of food and fiber degrades the natural resource base, the ability of future generations to produce and flourish decreases. The decline of ancient civilizations in Mesopotamia, the Mediterranean region, Pre-Columbian southwest U.S. and Central America is believed to have been strongly influenced by natural resource degradation from non-sustainable farming and forestry practices. Water is the principal resource that has helped agriculture and society to prosper, and it has been a major limiting factor when mismanaged.

**Water supply and use.** In California, an extensive water storage and transfer system has been established which has allowed crop production to expand to very arid regions. In drought years, limited surface water supplies have prompted overdraft of groundwater and consequent intrusion of salt water, or permanent collapse of aquifers. Periodic droughts, some lasting up to 50 years, have occurred in California. Several steps should be taken to develop drought-resistant farming systems even in "normal" years, including both policy and management actions: 1) improving water conservation and storage measures, 2) providing incentives for selection of drought-tolerant crop species, 3) using reduced-volume irrigation systems, 4) managing crops to reduce water loss, or 5) not planting at all.

**Water quality.** The most important issues related to water quality involve salinization and contamination of ground and surface waters by pesticides, nitrates and selenium. Salinity has become a problem wherever water of even relatively low salt content is used on shallow soils in arid regions and/or where the water table is near the root zone of crops. Tile drainage can remove the water and salts, but the disposal of the salts and other contaminants may negatively affect the environment depending upon where they are deposited. Temporary solutions include the use of salt-tolerant crops, low-volume irrigation, and various management techniques to minimize the effects of salts on crops. In the long-term, some farmland may need to be removed from production or converted to other uses. Other uses include conversion of row crop land to production of drought-tolerant forages, the restoration of wildlife habitat or the use of agroforestry to minimize the impacts of salinity and high water tables. Pesticide and nitrate contamination of water can be reduced using many of the practices discussed later in the Plant & Animal Production Practices section.

**Wildlife.** Another way in which agriculture affects water resources is through the destruction of riparian habitats within watersheds. The conversion of wild habitat to agricultural land reduces fish and wildlife through erosion and sedimentation, the effects of pesticides, removal of riparian plants, and the diversion of water. The plant diversity in and around both riparian and agricultural areas should be maintained in order to support a diversity of wildlife. This diversity will enhance natural ecosystems and could aid in agricultural pest management.

**Energy.** Modern agriculture is heavily dependent on non-renewable energy sources, especially petroleum. The continued use of these energy sources cannot be sustained indefinitely, yet to abruptly abandon our reliance on them would be economically catastrophic. However, a sudden cutoff in energy supply would be equally disruptive. In sustainable agricultural systems, there is reduced reliance on non-renewable energy sources and a substitution of renewable sources or labor to the extent that is economically feasible.

**Air.** Many agricultural activities affect air quality. These include smoke from agricultural burning; dust from tillage, traffic and harvest; pesticide drift from spraying; and nitrous oxide emissions from the use of nitrogen fertilizer. Options to improve air quality include incorporating crop residue into the soil, using appropriate levels of tillage, and planting wind breaks, cover crops or strips of native perennial grasses to reduce dust.

**Soil.** Soil erosion continues to be a serious threat to our continued ability to produce adequate food. Numerous practices have been developed to keep soil in place, which include reducing or eliminating tillage, managing irrigation to reduce runoff, and keeping the soil covered with plants or mulch. Enhancement of soil quality is discussed in the next section.

**Plant Production Practices**

Sustainable production practices involve a variety of approaches. Specific strategies must take into account topography, soil characteristics, climate, pests, local availability of inputs and the individual grower's goals. Despite the site-specific and individual nature of sustainable agriculture, several general principles can be applied to help growers select appropriate management practices:

University of California
• Selection of species and varieties that are well suited to the site and to conditions on the farm;
• Diversification of crops (including livestock) and cultural practices to enhance the biological and economic stability of the farm;
• Management of the soil to enhance and protect soil quality;
• Efficient and humane use of inputs; and
• Consideration of farmers' goals and lifestyle choices.

Selection of site, species and variety. Preventive strategies, adopted early, can reduce inputs and help establish a sustainable production system. When possible, pest-resistant crops should be selected which are tolerant of existing soil or site conditions. When site selection is an option, factors such as soil type and depth, previous crop history, and location (e.g. climate, topography) should be taken into account before planting.

Diversity. Diversified farms are usually more economically and ecologically resilient. While monoculture farming has advantages in terms of efficiency and ease of management, the loss of the crop in any one year could put a farm out of business and/or seriously disrupt the stability of a community dependent on that crop. By growing a variety of crops, farmers spread economic risk and are less susceptible to the radical price fluctuations associated with changes in supply and demand.

Properly managed, diversity can also buffer a farm in a biological sense. For example, in annual cropping systems, crop rotation can be used to suppress weeds, pathogens and insect pests. Also, cover crops can have stabilizing effects on the agroecosystem by holding soil and nutrients in place, conserving soil moisture with mowed or standing dead mulches, and by increasing the water infiltration rate and soil water holding capacity. Cover crops in orchards and vineyards can buffer the system against pest infestations by increasing beneficial arthropod populations and can therefore reduce the need for chemical inputs. Using a variety of cover crops is also important in order to protect against the failure of a particular species to grow and to attract and sustain a wide range of beneficial arthropods.

Optimum diversity may be obtained by integrating both crops and livestock in the same farming operation. This was the common practice for centuries until the mid-1900s when technology, government policy and economics compelled farms to become more specialized. Mixed crop and livestock operations have several advantages. First, growing row crops only on more level land and pasture or forages on steeper slopes will reduce soil erosion. Second, pasture and forage crops in rotation enhance soil quality and reduce erosion; livestock manure, in turn, contributes to soil fertility. Third, livestock can buffer the negative impacts of low rainfall periods by consuming crop residue that in "plant only" systems would have been considered crop failures. Finally, feeding and marketing are flexible in animal production systems. This can help cushion farmers against trade and price fluctuations and, in conjunction with cropping operations, make more efficient use of farm labor.

Soil management. A common philosophy among sustainable agriculture practitioners is that a "healthy" soil is a key component of sustainability. That is, a healthy soil will produce healthy crop plants that have optimum vigor and are less susceptible to pests. While many crops have key pests that attack even the healthiest of plants, proper soil, water and nutrient management can help prevent some pest problems brought on by crop stress or nutrient imbalance. Furthermore, crop management systems that impair soil quality often result in greater inputs of water, nutrients, pesticides, and/or energy for tillage to maintain yields.

In sustainable systems, the soil is viewed as a fragile and living medium that must be protected and nurtured to ensure its long-term productivity and stability. Methods to protect and enhance the productivity of the soil include using cover crops, compost and/or manures, reducing tillage, avoiding traffic on wet soils, and maintaining soil cover with plants and/or mulches. Conditions in most California soils (warm, irrigated, and tilled) do not favor the buildup of organic matter. Regular additions of organic matter or the use of cover crops can increase soil aggregate stability, soil tilth, and diversity of soil microbial life.

Efficient use of inputs. Many inputs and practices used by conventional farmers are also used in sustainable agriculture. Sustainable farmers, however, maximize reliance on natural, renewable, and on-farm inputs. Equally important are the environmental, social, and economic impacts of a particular strategy. Converting to sustainable practices does not mean simple input substitution. Frequently, it substitutes enhanced management and scientific knowledge for conventional inputs, especially chemical inputs that harm the environment on farms and in rural communities. The goal is to develop efficient, biological systems which do not need high levels of material inputs.

Growers frequently ask if synthetic chemicals are appropriate in a sustainable farming system. Sustainable approaches are those that are the least toxic and least energy intensive, and yet maintain productivity and profitability. Preventive strategies and other alternatives should be employed before using chemical inputs from any source. However, there may be situations where the use of synthetic chemicals would be more "sustainable" than a strictly nonchemical approach or an approach using toxic "organic" chemicals. For example, one grape grower switched from tillage to a few applications of a
broad spectrum contact herbicide in the vine row. This approach may use less energy and may compact the soil less than numerous passes with a cultivator or mower.

Consideration of farmer goals and lifestyle choices. Management decisions should reflect not only environmental and broad social considerations, but also individual goals and lifestyle choices. For example, adoption of some technologies or practices that promise profitability may also require such intensive management that one’s lifestyle actually deteriorates. Management decisions that promote sustainability, nourish the environment, the community and the individual.

Animal Production Practices

In the early part of this century, most farms integrated both crop and livestock operations. Indeed, the two were highly complementary both biologically and economically. The current picture has changed quite drastically since then. Crop and animal producers now are still dependent on one another to some degree, but the integration now most commonly takes place at a higher level — between farmers, through intermediaries, rather than within the farm itself. This is the result of a trend toward separation and specialization of crop and animal production systems. Despite this trend, there are still many farmers, particularly in the Midwest and Northeastern U.S. that integrate crop and animal systems — either on dairy farms, or with range cattle, sheep or hog operations.

Even with the growing specialization of livestock and crop producers, many of the principles outlined in the crop production section apply to both groups. The actual management practices will, of course, be quite different. Some of the specific points that livestock producers need to address are listed below.

Management Planning. Including livestock in the farming system increases the complexity of biological and economic relationships. The mobility of the stock, daily feeding, health concerns, breeding operations, seasonal feed and forage sources, and complex marketing are sources of this complexity. Therefore, a successful ranch plan should include enterprise calendars of operations, stock flows, forage flows, labor needs, herd production records and land use plans to give the manager control and a means of monitoring progress toward goals.

Animal Selection. The animal enterprise must be appropriate for the farm or ranch resources. Farm capabilities and constraints such as feed and forage sources, landscape, climate and skill of the manager must be considered in selecting which animals to produce. For example, ruminant animals can be raised on a variety of feed sources including range and pasture, cultivated forage, cover crops, shrubs, weeds, and crop residues. There is a wide range of breeds available in each of the major ruminant species, i.e., cattle, sheep and goats. Hardier breeds that, in general, have lower growth and milk production potential, are better adapted to less favorable environments with sparse or highly seasonal forage growth.

Animal nutrition. Feed costs are the largest single variable cost in any livestock operation. While most of the feed may come from other enterprises on the ranch, some purchased feed is usually imported from off the farm. Feed costs can be kept to a minimum by monitoring animal condition and performance and understanding seasonal variations in feed and forage quality on the farm. Determining the optimal use of farm-generated by-products is an important challenge of diversified farming.

Reproduction. Use of quality germplasm to improve herd performance is another key to sustainability. In combination with good genetic stock, adapting the reproduction season to fit the climate and sources of feed and forage reduce health problems and feed costs.

Herd Health. Animal health greatly influences reproductive success and weight gains, two key aspects of successful livestock production. Unhealthy stock waste feed and require additional labor. A herd health program is critical to sustainable livestock production.

Grazing Management. Most adverse environmental impacts associated with grazing can be prevented or mitigated with proper grazing management. First, the number of stock per unit area (stocking rate) must be correct for the landscape and the forage sources. There will need to be compromises between the convenience of tilling large, unfenced fields and the fencing needs of livestock operations. Use of modern, temporary fencing may provide one practical solution to this dilemma. Second, the long term carrying capacity and the stocking rate must take into account short and long-term droughts. Especially in Mediterranean climates such as in California, properly managed grazing significantly reduces fire hazards by reducing fuel build-up in grasslands and brushlands. Finally, the manager must achieve sufficient control to reduce overuse in some areas while other areas go unused. Prolonged concentration of stock that results in permanent loss of vegetative cover on uplands or in riparian zones should be avoided. However, small scale loss of vegetative cover around water or feed troughs may be tolerated if surrounding vegetative cover is adequate.

Confined Livestock Production. Animal health and waste management are key issues in confined livestock operations. The moral and ethical debate taking place today regarding animal welfare is particularly intense for confined livestock.
production systems. The issues raised in this debate need to be addressed.

Confinement livestock production is increasingly a source of surface and ground water pollutants, particularly where there are large numbers of animals per unit area. Expensive waste management facilities are now a necessary cost of confined production systems. Waste is a problem of almost all operations and must be managed with respect to both the environment and the quality of life in nearby communities. Livestock production systems that disperse stock in pastures so the wastes are not concentrated and do not overwhelm natural nutrient cycling processes have become a subject of renewed interest.

The Economic, Social & Political Context

In addition to strategies for preserving natural resources and changing production practices, sustainable agriculture requires a commitment to changing public policies, economic institutions, and social values. Strategies for change must take into account the complex, reciprocal and ever-changing relationship between agricultural production and the broader society.

The "food system" extends far beyond the farm and involves the interaction of individuals and institutions with contrasting and often competing goals including farmers, researchers, input suppliers, farmworkers, unions, farm advisors, processors, retailers, consumers, and policymakers. Relationships among these actors shift over time as new technologies spawn economic, social and political changes.

A wide diversity of strategies and approaches are necessary to create a more sustainable food system. These will range from specific and concentrated efforts to alter specific policies or practices, to the longer-term tasks of reforming key institutions, rethinking economic priorities, and challenging widely-held social values. Areas of concern where change is most needed include the following:

Food and agricultural policy. Existing federal, state and local government policies often impede the goals of sustainable agriculture. New policies are needed to simultaneously promote environmental health, economic profitability, and social and economic equity. For example, commodity and price support programs could be restructured to allow farmers to realize the full benefits of the productivity gains made possible through alternative practices. Tax and credit policies could be modified to encourage a diverse and decentralized system of family farms rather than corporate concentration and absentee ownership. Government and land grant university research policies could be modified to emphasize the development of sustainable alternatives. Marketing orders and cosmetic standards could be amended to encourage reduced pesticide use. Coalitions must be created to address these policy concerns at the local, regional, and national level.

Land use. Conversion of agricultural land to urban uses is a particular concern in California, as rapid growth and escalating land values threaten farming on prime soils. Existing farmland conversion patterns often discourage farmers from adopting sustainable practices and a long-term perspective on the value of land. At the same time, the close proximity of newly developed residential areas to farms is increasing the public demand for environmentally safe farming practices. Comprehensive new policies to protect prime soils and regulate development are needed, particularly in California's Central Valley. By helping farmers to adopt practices that reduce chemical use and conserve scarce resources, sustainable agriculture research and education can play a key role in building public support for agricultural land preservation. Educating land use planners and decision-makers about sustainable agriculture is an important priority.

Labor. In California, the conditions of agricultural labor are generally far below accepted social standards and legal protections in other forms of employment. Policies and programs are needed to address this problem, working toward socially just and safe employment that provides adequate wages, working conditions, health benefits, and chances for economic stability. The needs of migrant labor for year-around employment and adequate housing are a particularly crucial problem needing immediate attention. To be more sustainable over the long-term, labor must be acknowledged and supported by government policies, recognized as important constituents of land grant universities, and carefully considered when assessing the impacts of new technologies and practices.

Rural Community Development. Rural communities in California are currently characterized by economic and environmental deterioration. Many are among the poorest locations in the nation. The reasons for the decline are complex, but changes in farm structure have played a significant role. Sustainable agriculture presents an opportunity to rethink the importance of family farms and rural communities. Economic development policies are needed that encourage more diversified agricultural production on family farms as a foundation for healthy economies in rural communities. In combination with other strategies, sustainable agriculture practices and policies can help foster community institutions that meet employment, educational, health, cultural and spiritual needs.

Consumers and the Food System. Consumers can play a critical role in creating a sustainable food system. Through their purchases, they send...
strong messages to producers, retailers and others in the system about what they think is important. Food cost and nutritional quality have always influenced consumer choices. The challenge now is to find strategies that broaden consumer perspectives, so that environmental quality, resource use, and social equity issues are also considered in shopping decisions. At the same time, new policies and institutions must be created to enable producers using sustainable practices to market their goods to a wider public. Coalitions organized around improving the food system are one specific method of creating a dialogue among consumers, retailers, producers and others. These coalitions or other public forums can be important vehicles for clarifying issues, suggesting new policies, increasing mutual trust, and encouraging a long-term view of food production, distribution and consumption.

FOR MORE INFORMATION: contact the UC Sustainable Agriculture Research and Education Program, University of California, Davis, CA 95616, (916) 752-7556.

Written by Gail Feenstra, Writer; Chuck Ingels, Perennial Cropping Systems Analyst; and David Campbell, Economic and Public Policy Analyst with contributions from David Chaney, Melvin R. George, Eric Bradford, the staff and advisory committees of the UC Sustainable Agriculture Research and Education Program.

December 17, 1991
Sustainable Agriculture: Definitions and Terms

Special Reference Briefs: SRB 94-05

Mary V. Gold
Alternative Farming Systems Information Center
with the production assistance of Rebecca Thompson

National Agricultural Library Beltsville, Maryland 20705-2351 May 1994
Sustainable Agriculture: Definitions and Terms

Introduction

In its Congressionally mandated annual reports, the Joint Council on Food and Agricultural Sciences has consistently listed “attain sustainable production systems and ensure their compatibility with environmental and social values” as first in a set of long term objectives for food and agricultural sciences in the 1990’s (Fiscal Year 1995 Priorities for Research, Extension and Higher Education: A Report to the Secretary of Agriculture (Washington DC: USDA, Joint Council on Food and Agricultural Sciences, 1991) p. 5, NAL aS21.D26J6). The goal of sustainability requires addressing philosophical, economic and sociological issues, as well as environmental and scientific questions.

This publication strives to illustrate the commonality and some of the controversy that defining such a goal entails. Many of the authors cited are pioneers in the field of sustainable agriculture. Additional contributors to the publication include Jayne MacLean, former coordinator of the Alternative Farming Systems Information Center, and Jane Potter Gates, its present coordinator.

For additional reference sources on the many issues and techniques involved in sustainable agriculture, you may request AFSIC’s “List of Information Products”. For a copy of this list, or for answers to questions, please contact:

Alternative Farming Systems Information Center
National Agricultural Library, Room 304
10301 Baltimore Blvd.
Beltsville, MD 20705-2351

Telephone: 301 504-6559
FAX: 301 504-6409
Internet: afsic@nalusda.gov
ORIENTATION, CONCEPTS, AND TRAINING IN SUSTAINABLE AGRICULTURE

INTEGRATED SUSTAINABLE CROP AND ANIMAL SYSTEMS

LEARNING METHOD: Presentation and Discussion

PRESENTED BY: Tom Larson, Farmer and Educator (Nebraska)
St. Edward, Nebraska
Clive Edwards (Indiana)
The Ohio State University

The concept of integrated sustainable agricultural systems is approached by a focus on pragmatic goals. Tom Larson presents a biodiversified crop/animal system that balances the farmer's needs and desires with the land and other resources. Narrow crop strips, rotations, double and relay cropping, distribution of workload and integration of livestock grazing are evaluated in this hi-tech/low-impact farming method.

Another approach to understanding the integration efficiencies of systems is presented by Clive Edwards. He provides examples of how the major components of cropping and mixed systems function, and especially the major interactions that occur in the field. Nutrient, pest, and water cycles are central to the efficient functioning of sustainable systems. A number of inputs that are essential in conventional farming can be replaced by non-chemical alternatives or made unnecessary by the careful design of systems.

KEY REFERENCES:


A Teacher's Guide to Cropping System Design
by Thomas Larson

This guide has three major portions:

I. Teacher Reference Guide. Background information for various aspects of system design are listed.

II. Instructional Unit. An outline for the basic course material can be used for planning purposes.

III. Learning Activities. Suggestions for practical application and problem solving activities can be used to enhance the students understanding of the material.

I. Teacher's Reference Guide

1. Controlling Weeds With Fewer Chemicals by Craig Cramer
   A collection of cost cutting methods and ideas for weed control in various crop situations.

2. The Role of Legumes in Conservation Tillage Systems by J.F. Power
   Various aspects of legumes are covered in this resource book.

3. Agronomy Handbook by A & L Laboratories
   Soil analysis, deficiency symptoms, tissue sampling and many other topics are covered.

4. Weeds and What They Tell by Ehrenfried E. Pfeiffer
   Certain weeds flourish under specific soil and cultural conditions. This book explains some of those relationships.
5. Planting - FMO by H. Edward Breece (John Deere)
Comprehensive descriptions of planting systems and equipment operations,

6. Farmers of Forty Centuries by F. H. King
Chinese agricultural practices of the early 1900's are examined with emphasis placed on utilization of on-site resources.

7. The One-Straw Revolution by Masanobu Fukuoka
This thought provoking book examines extremely low input agricultural systems.

8. The Directory of Small Scale Agriculture U.S.D.A. May '89
This directory focuses on resource individuals who do work related to the topic of small-scale agriculture.

This book is a summary of the innovative Thompson Farm and some of the alternative farming methods they use.

II. Instructional Unit

Critical Elements of Systems Design

1. Crops to be grown in the system depends upon several factors:

   (a) Number of crops in the system.
   This may be only two or up to 5 or 6.

   (b) Personal Preference.
   The success of the system may depend upon the familiarity to the farmer of the crops to be grown. For example a corn-soybean system may be more successful than an amaranth-mung bean system.
(c) **Salable Produce.**
The Crops grown must be marketable in original form, value added or as a resource to another on-farm enterprise.

(d) **Site Suitable.**
The choice of crops to be successfully grown depends on their suitability to the existing climate, soils, slope, and water availability.

(e) **Government Programs.**
In the midwest area most crop production is directly linked to the corn base acres. Changes in cropping mix can affect base acres and therefore government program payments. Recently however the ASCS has implemented a program called the Integrated Farm Management Program (IFMP) that lets the farmer keep his corn base acre history while trying to enter a multi-crop system. See the local ASCS for more current information.

(f) **Biodiversity.**
Selecting crops from different families seems to enhance the overall performance of both. A corn- soybean (grass-legume) system seems to perform better than a soybean-pinto bean (legume-legume) system. By selecting crops from different families, populations of damaging disease organisms and pests do not have a chance to build-up. Researchers are still trying to understand various aspects of this "Rotation Effect."
2. Flow Chart of Normal Cultural Practice.
A simple calendar type of flow chart for each proposed crop in the system needs to be drawn. Below is an example of such a chart for corn.

3. Check for Cultural Practice Conflicts.
By combining the flow charts for the crops chosen, potential conflicts can be determined. For example, a corn-soybean chart may point out that a time squeeze may occur during cultivation.

4. Post Harvest Use.
A tremendous amount of crop material is left in the field after harvest. Livestock can be used to glean the fields of dropped grain and to consume some of the left over stubble or stalk material. Fields should not be overgrazed to the extent that adequate ground cover is lost. On some soils, livestock should not graze during the late spring season because of compaction problems they might create.
The following is an example of a crop-livestock farm that produces corn, dry beans, oats, and turnips in an integrated ridge--till strip crop rotation. Crops are planted in narrow strips (12 1/2 ft) on four 38" rows using the following sequence: Corn, Beans, Oats-Turnips.

There are 6 main features to this crop-livestock system.
1. Narrow crop strips.
2. Built in crop rotation.
3. Opportunity for double cropping.
4. Opportunity for inter-cropping.
5. Work load is spread out.

To properly assess any farming system we must first define conventional farming practices.

**Monoculture corn.**

In early spring primary tillage is preferred. This may consist of 1-3 trips over the field using a disc-harrow or field cultivator or similar tool that diminished surface residue and aerates the soil. Herbicides and or fertilizers may be incorporated at this time also.

Planting methods vary widely but the trend seems to be toward equipment that will successfully plant in high residue conditions. Factors such as soil type, slope and compatibility with existing equipment determine the planter selection.

During the planting process, insecticides, herbicides and fertilizers may be applied in the same field trip using equipment mounted on the tractor-planter unit.
Weed control may or may not involve the use of a cultivator, depending on the success of the herbicide applied. Modern cultivators are heavy, 250-500 lbs/row, and use designs that allow for effective soil profile aeration (i.e. weed kill by desiccation) or weed burial. Various electronic and/or hydraulic guidance systems are available that help guide this equipment in relation to the plant row. "Cultivator Blight" and operator fatigue are reduced.

Harvesting methods usually employ a self propelled combine using a head or table. Size of the crop gathering head or table is selected to match row width, wheel track, and capacity of the machine.

Grain carts are sometimes employed to expedite removal of grain from the combine while it is in motion. Grain in this cart is then transferred to trucks or trailers on the field perimeter.

The Larson farm tries to employ a cropping sequence that works with nature rather than trying to control it. Conventional crop producers are at the mercy of many things that they have no control over. Weather effects weed pressures, insect damage and ultimately yield. Politics (Government programs, environmental policies, international grain trade, etc.) and world calamities (Chernobyl nuclear disaster, South African drought, etc.) all affect crop prices. Any of the above factors can drive the farmer to control or eliminate as many variables in production he can. This often leads to the adoption of production practices that are preventative, whether they are needed or not. Using broad spectrum pesticides, for example, before any problem or potential problem arises. Use of excessive amount of fertilizer without regard to soil tests and realistic yield goals is another example.

In defense of the above two examples you must be aware that the cost of using the preventative practice is less than the risk of loss in crop yield.
Here is a description of the cropping sequence of one strip over its' three year cycle.

Year 1

Corn is ridge till planted one cultivation before 7-8" height. Then layby at knee high, rebuilding the ridge. Harvest, then cows graze the stubble.

Year 2

Oats are seeded in early spring by drill or broadcast, then disc lightly. Oats are harvested as grain or oat hay, depending on market conditions.

Year 3

Turnips are immediately seeded after oat harvest. By fall grazing period turnips will produce 6 T/acre dry matter at 9-22% and 70-80 %TDN. Turnips will support 300 animal units/acre/day.

protein,

Dry beans or soy beans are ridge till planted into oat-turnip strip. After harvest, cows graze on residue.
The infield sequence looks like this.

The "rotation effect" of planting different crops on different ground has been well documented for centuries. This system allows for that effect and has advantages and disadvantages as well.

Advantages of this system.

1. Elimination of primary tillage. All crops are either ridge tilled or drilled into the undisturbed seed bed.

2. Reduced need for soil insecticides. Corn is planted on the same ground every third year. This helps disrupt the life cycle of the corn rootworm.

3. Reduced need for soil applied herbicides. Weed pressures respond to the kind of crop grown and the soil type. Planting the same crop once every 3 years helps disrupt this weed cycle.
4. Reduced need for corn borer treatment for some unknown reason. Corn borer larvae infest average only 1-1 1/2 larvae/plant. Economic treatment threshold is 5-6/plant.

5. Reduced peak work-load times. The planting of annual small grains, corn, beans, and turnips naturally are suited for different times. This technique spreads out the planting workload over a much wider "window of opportunity".

6. Harvesting periods are staggered. Oats are harvested in late June, beans in early September, Corn in late September to October, and turnips are strip grazed throughout the fall and early winter.

Disadvantages

1. Participation in government commodity programs may be limited. Check with ASCS about the IFMP.

2. Social aspects. Your neighbors will be curious to say the least. Your banker may refuse to finance you.

3. Timing of the operations are critical. Don't plant more than you feel you can comfortably cultivate. Rescue herbicide-insecticide treatment strategies are becoming more effective and accepted.

4. Oat harvest-haying may interfere with irrigation requirements of corn.

5. Most effective equipment size seems to be 4 or 6 rows. Many operators would be reluctant to downsize even if it would mean an increase in overall efficiency.
III. Learning Objectives

The learner will be able to:

1. List three basic plant families.

2. Describe the cultural practices that apply to the above plants.

3. Draw a flow chart for each of the three plants described above.

4. Identify potential cultural practice conflicts for the chart produced in #3.

5. List four advantages of strip cropping.

6. List four disadvantages of strip cropping.

Define the following terms:

1. Strip cropping

2. Inter cropping

3. Relay cropping

4. Nutrient cycling

5. Soil microbes

6. Synergism

7. Aelopatby

8. Organic matter

9. Salable Product

10. Integrated Pest Management
THE IMPORTANCE OF INTEGRATION IN SUSTAINABLE AGRICULTURAL SYSTEMS

Clive A. Edwards

Crop yields in developed countries have increased dramatically since World War II. Traditionally, farming methods depended upon and maintained the soil’s inherent fertility by recycling the nutrients in organic matter. Over the last 40 years, new high-yielding crop varieties have developed. However, high yields depend upon high-energy inputs in the form of inorganic fertilizers and high inputs of synthetic pesticides to combat increased pest disease and weed problems resulting from monoculture or rotations involving only two crops.

The current use of fertilizers and pesticides (Figures 1 and 2) is predicted to continue to increase almost exponentially (Edwards, 1987) unless there are fundamental changes in the philosophy that crop yields should continue to increase, irrespective of the plight of the small farmer and environmental deterioration.

High-input practices have led to overproduction of certain crops in many developed countries in recent years. The inevitable results have been a fall in commodity prices and poorer farm incomes. Moreover, the efficiency of production has not kept pace with the increase in energy needed to produce the chemicals upon which they depend. From 1970 to 1978, U.S. farmers used 50 percent more energy to produce 30 percent more crops (Buttel et al., 1986). Moreover, high inputs are inefficient in energy terms. For every calorie of food currently produced in the United States, three calories are required in production and seven calories are needed for processing, distribution, and preparation (Papendick, 1987). These intensive cropping practices and heavy use of chemicals have created a variety of economical, environmental, and ecological problems. The most important environ-
Figure 1. World fertilizer consumption, 1955-1974 (actual) and 1975-2000 (estimated) (Edwards, 1985).

Figure 2. Predicted world pesticide use (Edwards 1986).
mental effects are (a) soil erosion, (b) pollution of groundwater and surface water with agricultural chemicals (Edwards, 1987a, 1987b, 1988), (c) destruction and disturbance of wildlife habitats (Jenkins, 1987; Papendick, et al. 1986), and (d) various adverse effects on rural landscapes (Lowrance and Groffman, 1988). The seriousness of these problems can be illustrated by data showing that one-third of the topsoil on U.S. agricultural land has been lost over the past 200 years. One-fourth of the 421 million crop acres currently suffer serious soil losses at rates well above those that permit sustainable crop production (Papendick, 1987). In addition to these serious environmental problems, frequent pesticide use has caused the development of resistant strains of pests and diseases, resulting in a need for even more pesticides and increased costs (Pimentel and Andow, 1984). Moreover, energy-based agrichemicals have become increasingly expensive, causing severe economic pressure on farmers in developed countries as a result of overproduction and falling prices. Thus, many farmers in the United States are tending to reduce their use of these inputs.

Economical and environmental problems associated with higher chemical inputs have also occurred in developing countries. In the 1960s, food production increased dramatically through the Green Revolution, which was based on high-yielding varieties of wheat and rice that responded to high inputs of nitrogenous fertilizers and irrigation. However, fertilizer efficiency is reduced in the tropics because of rapid leaching of nitrogen and a greater degree of phosphorus fixation. Many tropical soils also have poor structures and are much more susceptible to erosion when continually cropped. At the same time, a higher incidence of pests and diseases occurred, because of shorter crop rotations or monoculture. This led to much greater use of pesticides that, in turn, created new pest and disease problems because of the eradication of natural enemies and increased dependence upon chemicals. Hazards to humans are also involved because the hot, humid conditions in tropical countries discourage protective clothing, and the relatively poor education of the farmers often causes environmental hazards through poor methods of application, washing of equipment in water systems used for other purposes, and disposal of pesticide containers.

For more than a decade there has been a growing movement, which originated in developed countries, to find ways of reducing chemicals and other energy-based inputs, such as cultivations, fertilizers, and pesticides (Edens et al., 1985; Buttel et al., 1986; Wagstaff, 1987; Buckwell and Smith, 1986; Lockeretz et al., 1984; Klepper et al., 1977; Youngberg, 1984). Greater economic returns to a farmer can be attained when the use of fewer inputs is associated with little or no reductions in yields, thereby resulting in improved farm profitability. Fewer cultivations and more crop rotations, in-
increased ground cover, and innovative cultural and cropping practices can
decrease soil erosion considerably. Lower inputs of pesticides and fertilizers
result in greatly reduced contamination of surface water and groundwater
and minimization of other environmental impacts. Although developing
countries have different problems and will have to continue to depend upon
inorganic nutrient sources for some crops and soils, many of their prob­
lems are similar to those in developed countries, and solutions will differ
mainly in degree and emphasis.

Major Inputs into Farming Systems

The production of a crop involves sowing seed at an appropriate rate
and time with several key inputs. The main inputs are some degree of soil
cultivation; provision of plant nutrients by some means of fertilization;
methods of crop protection against pests, diseases, and weeds; and suitable
crop rotations to maximize productivity (Figure 3). Central to this pattern
is farm economics that encompass all other inputs, such as land, labor,
buildings, machines, chemicals, and seed, balanced against profits from
yields and other economic factors, such as market prices, exports, and sub­
sidies. A farming system is not just a simple sum of all of its components
but rather a complex system with intricate interactions. The concept of the
central position of farm economics differs markedly from the perception
of many agricultural scientists who usually assume that their own specialty,
such as pest control, nutrient supply, or cultivation, is the central and most
important component. In this context, farm economics mainly deal with
microeconomics at the farm level, but also include macroeconomics of farm
prices, subsidies, and the cost of environmental pollution.

Farmers and agricultural scientists rarely consider how the amounts of

![Figure 3. Interactions among farm inputs.](image-url)

38
fertilizer they use affect pests, diseases, or weeds. In the same way, the impact of cultivation on pest diseases and weed problems is not usually a factor in deciding the type of cultivation a farmer uses. Even in the use of pesticides where integrated pest management systems have been developed, it is rare for any account to be taken of the impact of herbicides on pests and diseases, of insecticides on diseases, or of fungicides on pests.

In conventional "higher-input" farming, large yields can often be obtained without any appreciable attention given to the interactions between various inputs. For example, if heavy fertilizer use renders a crop more susceptible to pests and diseases through production of lush, soft growth, this can be compensated for by adding more pesticides. The decline in natural pest and disease control and consequent increased pest and disease incidence caused by herbicides through loss of foliar and habitat diversity is compensated for by increased use of insecticides and fungicides. Any affect of pesticides on earthworms and other soil organisms that promote organic matter turnover, nutrient cycling, and soil fertility is covered by increased nutrients from the additional inorganic fertilizers used. When chemical inputs are lowered, it is imperative to learn what effects these inputs have on each other in much more detail. Farming systems that use fewer chemicals implicitly require a much better understanding of the interactions between and among inputs in agroecosystems.

Components of Sustainable Agricultural Systems

**Fertilizers.** At lower input levels, the increased use of inorganic fertilizers has dramatic effects on crop yields. But as the amount of fertilizer applied increases, the growth and yield response of the crop diminishes exponentially and eventually levels off (Figure 4).

At a certain point, the cost of the fertilizer equals the value of the crop yield increase. It is important to use considerably less inorganic fertilizers than this. Reductions in inorganic fertilizers can be compensated for by using crop rotations, particularly those involving legumes as a source of nitrogen and other nutrients, and using animal manures where available (Sahs and Lesoing, 1985). Other practices that can minimize fertilizer use include regular soil analyses to assess actual fertilizer needs, growing crop varieties that have lower nutrient needs, and placing inorganic fertilizers in the crop row where they have maximum benefit to the crop but do not contribute to weed growth.

There may be great potential to reduce the need for inorganic fertilizers even more as new research results are found. Research that might achieve this includes investigating the potential for increasing biological nitrogen
fixation in crops other than legumes by genetic engineering; scheduling treatment with incremental additions of nutrients through the growing season; and using alternative forms of organic matter from urban and industrial sources, which currently cause disposal problems, to supply nutrients.

Pesticides. Pesticides are often used as recommended by chemical dealers or on an insurance basis. Many of the applications used may be unnecessary and/or economically unsound (Pimentel and Andow, 1984). The amounts used could be reduced substantially and a range of alternative methods of pest control used. For instance, insecticide use can be reduced and compensated for or replaced by integrated pest management techniques in which rotations and use of resistant varieties, economic thresholds, pest forecasting, and biological and cultural pest control all play a part (Lisansky, 1981). All of these must be integrated into farming systems for pest and disease management while taking account of their side-effects on other aspects of crop production (Edwards et al., 1988).

![Figure 4. The economics of fertilizer use.](image-url)
In addition, the use of insecticides can be minimized or replaced by other techniques that involve:

- Minimal use of insecticides based on methods of forecasting pest incidence.
- Better insecticide placement and formulations, thereby using smaller amounts with improved effectiveness.
- More crop rotations to avoid carryover of pests from one season to the next and gradual build up of population.
- Appropriate cultivations that minimize pest attack. The form these cultivars should take depends upon the pest involved.
- Timing of crop sowing to avoid pest attack.
- Adoption of controlled weed growth practices as compared with total weed suppression so as to encourage natural enemies of pests.
- Use of biological insecticides based on insect pathogens that are effective without environmental impacts.
- Use of nematodes that attack insects to control them. Many nematode varieties have considerable potential but are not yet available on an extensive commercial basis.
- Release of parasites and predators of pests.
- Use of pheromones, other allelochemicals, or repellents to keep pests away from crops.
- Release of sterile male insects to abort reproduction of pests where appropriate.
- Use of crop varieties resistant to pest attack.
- Use of crop varieties with toxins implanted into their tissues by genetic engineering.
- Encouragement of natural predators by maintaining biological diversity among plants and in soil systems.
- Use of trap crops that promote pest emergence when the main crop is not available.
- Innovative cultural techniques, such as strip cropping, intercropping, etc., that increase diversity of habitat, flora, and fauna.

Fungicide use can be minimized by:

- Use of minimal amounts of fungicide based on disease forecasting methods.
- Use of crop rotations to minimize disease attack.
- Better application techniques for fungicides using small amounts and better placement.
- Timing of crop sowing to avoid the disease incidence period or climatic periods favorable to the disease.
Use of disease antagonists. A number of microorganisms inhibit the growth of plant pathogens.

Use of crop varieties that are tolerant or resistant to disease.

Herbicide applications can be replaced by:

- Use of mechanical weed control. This can be associated with row spacing to facilitate such cultivations.
- Use of rotations to avoid volunteer of seedlings from previous crops.
- Cover cropping to minimize weed seed germination.
- Use of live mulches to provide soil cover and inhibit seed germination.
- Use of mycoherbicides. These have been identified and can be produced by genetic engineering techniques.
- Release of pests of weeds. These have been used successfully against a number of weed species.

Cultivations. Traditionally, land in developed countries has been cultivated annually to a depth of 9 to 12 inches (22.5-30 cm) with the surface soil completely inverted by moldboard plows. This involves a high consumption of energy to pull the plow, particularly in difficult and compacted soils. For the last 30 years there has been a progressive trend toward fewer cultivations with corresponding reductions in energy inputs. This has culminated into a complete absence of cultivation and seeding into the previous crop using special tillage implements, usually after a herbicide application.

Techniques that reduce the number of cultivations required, compared to deep-plowing, include:

- Shallow plowing to a depth of 6 inches (15 cm) or less.
- Chisel plowing, which does not invert the soil.
- Deep subsoiling, which lifts the soil but does not invert it.
- Ridge tillage.
- Shallow-tine, soil loosening.
- Harrowing to create a seed bed.
- No-till (direct-drilling).

All of these techniques tend to create conditions that reduce soil erosion and create a more natural soil structure, which improves both drainage and water retention and favors biological and natural techniques of pest and disease control because there is less disturbance of the soil ecosystem.

Additional Components of Sustainable Agricultural Systems

In low-input systems of crop production a number of component techniques in addition to the main inputs are used. These include:
Rotations. In most developed countries there has been a trend in farming over the last 40 years toward monoculture or cropping with only two annually alternating crops. When chemical fertilizers and pesticides are reduced, it usually becomes essential to increase the use of crop rotations to provide nutrients, if possible, through legumes and to lessen pest and disease attack by minimizing infectious carryover from one season to the next.

Innovative Cultural Techniques. As chemical inputs in cropping systems are lowered, there becomes an increasing need for cultural techniques. Possible cultural techniques include:

- Systems of strip intercropping using two crops, with strips normally involving one pass of a tractor and its implements.
- Interrow crop techniques where alternate rows of two crops are sown.
- Undersowing with a legume or other crop.
- Use of varietal or species mixtures to create greater crop diversity.
- Use of trap crops, which may or may not have any commercial value but attract pests away from the main crop.
- Double-row cropping to facilitate weed control by allowing passage of cultivation implements.

Machinery Inputs. Most agricultural machinery used now is developed for farming practices that use large amounts of chemicals. As inorganic chemical inputs are reduced, new machinery is needed for better mechanical weed control. Typical machinery needs include:

- Lighter machinery that causes less soil compaction.
- Machinery for placing fertilizers in the crop row.
- Pesticide placement equipment that applies the chemical where it is required to kill the pest.
- Weed control machinery for a variety of cropping patterns.
- Subsoiling equipment to open up the soil without any inversion.

Organic Matter Inputs. Traditionally, animal manures were the main source of soil nutrients and soil fertility, making crop and animal production interdependent (Figure 5). In developed countries today, animal and crop farming occur together only on smaller farms. Diversified farming is much more common in developing countries. Thus, manurial inputs into crop production in developed countries are relatively low. The use of animals to consume crop residue is of only minor importance because these residues are not always palatable. Sustainable systems should consider increasing the association between crop and animal production. Moreover, there is
a wide range of urban and industrial waste organic materials that are used little in agriculture but hold considerable potential as sources of crop nutrients. The organic inputs that could compensate for reduced inorganic chemicals include:

- Animal manures, mainly from cattle, poultry, and hogs.
- Sewage sludge or cake that can be applied as a spray, injected liquid, or solid.
- Domestic lawn clippings and leaf material that can be composted.
- Paper pulp waste that can be sprayed or applied as a dewatered solid.
- Waste from the potato industry, either as liquid washing or solid peelings.
- Brewery wastes consisting largely of yeasts.
- Domestic vegetable and other organic wastes.

**Crop Breeding.** New crop varieties that respond to high levels of nitrogen are a major reason for the increased crop yields produced currently in developed countries. However, the crop varieties in developing countries have been designed to respond to and produce good yields with fewer inorganic fertilizers because large amounts of these chemicals are either not available or too costly. These two systems may have something to teach each other about developing sustainable agricultural systems.

Traditionally, crop breeding has involved selection of favorable plant traits, crossing to produce new varieties, and building up seed stocks. This can now be expedited by genetic engineering (Figure 6) to develop crops that respond to lower inputs of fertilizers without major decreases in yields and are highly resistant to pests and diseases (Edwards, 1988). With this new

![Figure 5. Integration of crop and animal production.](image-url)
The importance of integration has great potential for sustainable agricultural research. These potentials include:

- Breeding plant varieties that respond to fewer inputs of chemical fertilizers.
- Breeding plant varieties that are resistant to pest and disease attack.
- Implanting insect toxins into crop plants to provide pest control.
- Developing crops with disease antagonism that are less affected by pathogens.
- Breeding crops that are resistant to low levels of herbicides when they were previously susceptible.

Integration of Components

Sustainable agricultural systems depend upon suitable manipulation of the previously mentioned components and on a better awareness of how these components can reduce chemical inputs. These systems also depend upon a much better understanding of how the major and other components interact with each other. In other words, lower input agriculture is more system-oriented and, consequently, management-intensive.

Some interactions among components of agricultural systems are un-
stood, and others can be predicted from existing knowledge. But many remain poorly understood. There is a need to identify the relative importance of all of these interactions in overall crop production. Figure 7 summarizes some of these interactions in rather simplistic fashion.

These interactions and others that are more speculative include:
- Fertilizers influence the growth of weeds as well as crops (Moomaw, 1987).
- Fertilizers can increase disease incidence, for example, cereal leaf disease (Jenkyn, 1976; Jenkyn and Finney, 1981).
- Fertilizers can increase pest attack, for example, aphids on wheat (Kowalski and Visser, 1979).
- Organic matter can reduce pest and disease incidence by increasing species diversity in favor of natural enemies (Altieri, 1985; Edwards, 1988).
- Organic matter can promote populations of fungi that control nematodes (Kerry, 1988).
- Organic matter can adsorb and inactivate pesticides (Edwards, 1966).
- Organic matter can provide alternative food for marginal pests and

![Figure 7. Interactions between inputs (Edwards, 1987).](image-url)
decrease their severity (Edwards, 1979).
- Cultivations can increase or decrease the incidence of pests or diseases (Edwards, 1975).
- Cultivations affect the incidence of weeds either mechanically or by burying weed seeds (Klein et al., 1987).
- Cultivations can affect the amount of fertilizer needed (Follett et al., 1981).
- Cultivations bring pesticides into contact with the pest, thereby increasing their effectiveness (Edwards, 1966).
- Cultivations incorporate organic matter into soil where it decomposes more rapidly (Follett et al., 1987).
- Herbicides can influence the severity of pest and disease attack by removing alternative weed hosts or by reducing the availability of natural enemies (Altieri, 1987).
- Pesticides can affect soil organisms that break down organic matter and release nutrients (Edwards, 1983).
- Insecticides can reduce the incidence of viruses and diseases by killing the vectors of these organisms (Edwards and Heath, 1964).
- Insecticides can increase weed populations by killing the natural enemies of weeds (Smith, 1982).
- Insecticides kill natural enemies of pests and thereby increase pest incidence or create new pests (Edwards, 1973).
- Fungicides can kill soil fungi that exert considerable natural control over insect or nematode populations (Kerry, 1988).
- Fungicides can reduce populations of beneficial soil microorganisms (decomposers and antagonists) as well as those of pathogens (Thompson and Edwards, 1974).
- Pesticides can deplete earthworm populations and, hence, lower soil fertility (Edwards and Lofty, 1977).
- Rotations reduce the incidence of most pests and diseases dramatically by interrupting the carryover of organisms from crop to crop (Dabbert and Madden, 1986).
- Rotations provide crop nutrients, particularly when they include legumes (Follett et al., 1981).

This list of interactions is far from complete. Indeed, there is little doubt that some are still unknown, and many others have not yet been fully documented.

Clearly, as in integrated pest management, a great deal of research is necessary to identify and understand such interactions and to be able to predict how such interactions affect sustainable agriculture systems. Most of this research must be interdisciplinary. There is an urgent need for
developing well-designed, holistic agricultural systems that maximize the benefits of the more important interactions among the main components of the systems. There have been relatively few examples of such farming systems to date (El Titi, 1986; Vereijken, 1985). Computer-based, farmer-operated management systems are being developed for many farming systems and have considerable potential for sustainable agricultural systems.

There is little doubt about the ecological, environmental, and economic attraction of lower input farming systems, particularly in developed countries. Such systems would minimize soil erosion and storm runoff as well as avoid contamination of groundwater and surface water. To achieve these ends and still increase farm profitability and the sustainability of the industry, an intensive research program along the lines recommended here is certainly justified and urgently needed. The problems in developing countries are similar in principle but differ considerably in emphasis. Much more research is needed to develop sustainable systems in the tropics.

REFERENCES


THE IMPORTANCE OF INTEGRATION


Integrated Crop Management Workshop

Lincoln, Nebraska
March 16-18, 1992

Organized By:

Center for Sustainable Agricultural Systems
221 Keim Hall
University of Nebraska
Lincoln, NE 68583-0949
402-472-2056

and

USDA, Soil Conservation Service
Midwest National Technical Center
100 Centennial Mall North
Lincoln, NE 68508-3866
402-437-5315

This material is based upon work supported by the Extension Service and the ASCS-U.S. Department of Agriculture and the Cooperative Extension Service-University of Nebraska under special project number 91-EXCA-3-0149.

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Kenneth R. Bolen, Director of Cooperative Extension, University of Nebraska, Institute of Agriculture and Natural Resources.

Cooperative Extension provides information and educational programs to all people without regard to race, color, national origin, sex or handicap.
INDEX

Integrated Crop Management Workshop

Workshop Leaders:  Charles Francis, University of Nebraska-Lincoln
                 Linda Oyer, Midwest National Technical Center/Soil Conservation Service

Preface

Integrative Planning and Sustainable Agriculture

Nutrient Management

Residue Management

Cropping Systems Design

Crop Variety and Cultural Practice Strategies

Integrated Pest Management for Sustainable Systems

On-Farm and On-Ranch Research and Demonstration

Agroforestry

Communication and Information

Social Factors

Sustaining and Managing Agricultural Resources for Tomorrow
ORIENTATION, CONCEPTS, AND TRAINING IN SUSTAINABLE AGRICULTURE

PLANNING LEARNING ACTIVITIES

LEARNING METHOD: Lecture and Facilitated Discussion

PRESENTED BY: Chuck Francis & Jim King
University of Nebraska - Lincoln

Adult learning activities need to be designed and structured differently than those for younger audiences. Our clients in Extension, NRCS, and other agencies and organizations will be best served by a variety of learning methods, by hands-on activities, and by relating past life experience to what is presented in the structured educational activities. Most learners prefer a structured situation, with clear learning objectives and well-focused activities that are geared to meeting the stated objectives. Integral to the learning plan is a pre-determined method of evaluation. We use the planning of this workshop as a real world example of the planning process, including the five objectives taken directly from the Chapter 3 grant for training trainers. Five unique evaluation methods are outlined for estimating the impact of the workshops in meeting these same five stated objectives.

KEY REFERENCES:


Los Angeles County Schools. 1992. Attributes in adult learners (excerpted from "Because they want to learn," a handbook about adult learners; quoted in Adult Perspective, Southeast Community College, Lincoln, NE. 12(4).

PLANNING LEARNING ACTIVITIES

Chuck Francis & Jim King
University of Nebraska - Lincoln

Here is a practical discussion of setting learning objectives, planning and implementing a workshop or other activity, and evaluating the impact of the learning experience on participants. We use the current workshop as an example of a learning situation with objectives specified in the grant proposal and contract. Five different evaluation methods are proposed, and we will actually be using these and others over the course of the workshops.

The title of the workshops, *Everyone a Teacher, Everyone a Learner*, perhaps is unique—although it likely has been used before, we have not read about this in the literature. Even the title or theme may be a stimulus to some potential participants, and a deterrent to others. Although this participatory approach to education seems appropriate to us as workshop organizers, it may not be palatable to those teachers more accustomed to a conventional role as "expert" or to clients or students who see themselves as passive recipients of education. Many factors are confounded in the conduct and evaluation of these workshops—focus on learning rather than teaching, subject matter in sustainable agriculture, testing of multiple methods of learning and of evaluation, two sites in different states, programs that are similar in concept and organization but that differ somewhat in content and presenters. Thus, we will be doing a quantitative evaluation of learning as measured by the available tools, but will have to rely on qualitative feedback from participants and others in their organizations (universities, non-profit and farmer groups, NRCS). In the presentation of this topic, as well as in the content and conduct of the workshops, we are attempting to learn as much as possible about the learning process, especially as it relates to sustainable agriculture. This will be useful to further development of the state strategic plans and their implementation.

Wide margins on the right are provided for you to make comments and notes for your own use. We would very much appreciate your reactions and feedback on both the approach and what you consider useful or not in the method.

Steps in Organizing a Learning Activity

We’ve all put together classes and seminars, organized workshops for farmers and educators, and conducted field tours and other types of learning activities. As experienced educators, we have a good feel for "what will work and what will not!" With this experience well in mind, it’s easy to launch into specific plans for the next activity: where it will be, who we will invite, how will we organize the logistics. Based on experience, we also know that some of these activities are successful and some are not. But sometimes it’s hard to tell which ones were successful and why.
As we move into training in sustainable agriculture, it's useful to revisit ideas we've all seen before, but perhaps need refreshing in this new context. What are the steps in organizing a successful activity?

- set out clear and measurable learning objectives
- organize the topics, participants and logistics
- conduct the workshop, tour, class, or seminar
- evaluate the impact on participants and their future behavior

Since we already do a good job of organizing logistics and conducting an activity, it's more valuable to focus on learning objectives and evaluation. There are written materials in the notebook that cover these topics (for example, see evaluation section). This is only a summary, and uses the real world example of the Chapter 3 train-the-trainer workshops in which we are all involved. We discuss the learning objectives of this workshop and the evaluation procedure that will be followed.

**Clear and Measurable Learning Objectives**

It seems to simple to say that "if we don't know exactly what the objectives are, we won't know whether or not we have achieved them." But too often we take this for granted, skip over this as something that is already well known, and assume that the participants share this great information with us. "The objectives are implicit in the topic," we might say. Yet when it comes time to evaluate the impact of an activity it may become difficult because we have not made the objectives explicit in our own minds and to the audience. We need to establish:

- what are the objectives we want to accomplish?
- who is the audience, and are the methods appropriate to them?
- how will we know if these objectives have been met?
- what is the broader and longer term impact of the activity? (if this is an objective)

To illustrate this process with one example, we'll use this train the trainer workshop as a model and describe specific learning objectives and how to evaluate them.
Example: Learning Objectives for Train-the-Trainer Workshops

The objectives of these training workshops are taken directly from the grant proposal as approved by the regional technical and administrative committees for the Chapter 3 educational activities. Having completed a SARE, North Central Regional Train-the-Trainer workshop, participants will have the skills to:

1) define specific objectives and long-term strategies for training in sustainable agriculture

2) identify practical and accessible information resources and recommendations for sustainable agriculture practices

3) design and test appropriate learning activities for promoting sustainable agriculture in each state

4) organize and implement cooperative on-farm tours and workshops for varied groups in agriculture

5) evaluate the impact of training activities on an intended audience

An easy way to remember objectives is the 'ABCD Method:'

A: Audience - who receives the training? Be specific; is this farmers, beginning farmers, beginning women farmers, beginning women farmers with more than 200 acres, and so on.

B: Behavior - what will the audience do as a result of training? They will learn to design, describe, list, write, evaluate, compare, or other concrete activities. 'Understand' is too vague.

C: Conditions - what will trainees be given, or what will they know about how to accomplish or carry out the behavior? Given a case study of a dairy farm, for example, participants will identify five criteria for sustainability.

D: Degree - to what are we judging or evaluating acceptable completion of an objective? Having toured the Bender farm, participants will design an ideal farming system using two components from the tour. If they can use two components based on their description, they have completed the objective. If they don't use any or only one, the instructor should revisit the activity to determine instructional fitness of the process.
Evaluation Methods for Specific Learning Objectives

People who participated in the Cedar Rapids workshop in January (1995) of the SARE training program identified evaluation as one of the key issues that we need to explore. A short workshop session revealed that there were many techniques currently in use in states in the North Central region, but that we often use these "bean counting" methods (number of workshops held, number of people attending, miles traveled or number of presentations made) in the absence of methods or tools that can help us measure the real impact of a learning activity. What can we do differently?

Several suggestions from the Cedar Rapids workshop were useful. We need to first set clear learning objectives (see above) before we will know if we have achieved them. It's useful to go beyond "number of beans" to find out from people how their behavior will change as a result of the activity, will they adopt a new method or practice, how will this training affect profitability of environmental impact of farming? In design of the learning objectives, we need to take a serious look at how we will evaluate impact. If it seems impossible to measure, perhaps we have used the wrong method, or even chosen an objective that was too global or heroic. Again, we'll use this workshop and the above objectives to illustrate the process.

Example: Evaluation of Train-the-Trainer Workshops

The evaluation of the impact or effects of these train the trainer workshops builds from the specific learning objectives listed above. We have designed a series of different types of evaluation techniques, some well known and often used and others that may be different or less comfortable to you. These are listed in series, and each corresponds to a specific learning objective above:

1) defining objectives and strategies will be measured by asking a question about an individual's definition of sustainable agriculture on the registration sheet for the workshop, and asking again at the end of the workshop; we will evaluate if this definition has changed and how it has changed from the two responses.

2) identifying sources where information is found and how to access these resources will be measured by a question at the start of the workshop on what people consider their three best sources of information on sustainable agriculture, and asking later whether they had learned about new sources as a result of the presentation and discussion of the topic.

3) designing and testing the effectiveness of different learning activities will be measured by using an evaluation form for each of the presentations over the three days of the workshop; these will be highly structured, will identify topic, evaluator, relevance of topic, effectiveness of presenter, effectiveness of the learning method, and usefulness of the activity to future state training programs.
4) organizing and implementing on-farm tours and demonstrations will include a short written response for each of four activities, including "what did you learn from this activity," and "how would you improve this learning activity?"

5) evaluating the impact of training activities will be addressed in the last half day of the workshop, and will use a series of one-on-one interviews by the participants themselves to find out what has happened in the workshop and how it will be useful in future state programs. Participants will be asked what they learned and how they would improve the activity.

These evaluation techniques vary from one learning objective to the next. We hope they will provide us answers as to how effective the training was in each of the topic areas. This type of variety will also help us all learn about the evaluation process. Which of these methods is best? Does this vary with the type of activity and nature of the topic? Have we adequately measured the impacts of these activities on resource, economic, environmental, and social issues that are related to sustainable agriculture? Do we know ahead of time which of these is best? Absolutely not! We are trying a range of methods so that we can all learn together about how to evaluate. This is an open ended question, and we are all learners about the evaluation process.
Attributes in Adult Learners

Continual and conscious attention to improving your teaching techniques is your best insurance against losing the relevance to students and to their concerns that you have built so painstakingly. If your class enrollment begins to lessen markedly and you believe that outside factors are not the cause, it's time to ask the mirror, "What am I doing wrong?" and "What can I do to reverse this trend?"

There are several attributes that you are likely to find in adult learners — attributes which you should know about in order more effectively to tailor your efforts to your class makeup. Based on the accumulated experience of teachers of adults, it has been found that nearly every adult learner exhibits at least some of the following characteristics:

- May be less flexible in thinking and in habits of thought and action than younger students;
- May require a longer time to perform learning tasks;
- Is impatient to learn and hence less tolerant of "busywork;"
- Requires more favorable learning conditions;
- Memorizes isolated facts less efficiently;
- Needs a great deal of encouragement and the feeling of progress and achievement during the course;
- May be easily distracted from study by other adult responsibilities which compete for time;
- Reluctantly relates new information to experience;
- May be economically and culturally deprived, and home conditions and family traditions may not be conducive to study or to the diligence that leads to achievement;
- May be below average in scholastic ability;
- May need to be absent or tardy because of personal problems;
- May discourage easily, may doubt that he or she possesses the ability to learn, and may be difficult to motivate;
- May possess social values, attitudes, and goals that differ from middle class norms and interfere with doing what is required to succeed at study;
- May use and react to nonverbal forms of communication to an inordinate degree, which may even interfere with your ability to "get through" by more conventional verbal means;
- May seem to live more for today, with short term goals and gratifications, than for tomorrow, with longer range, more constructive ends and activities;
- May be seriously lacking in information about community services and even about many of the rights, opportunities, and responsibilities that many of us assume to be commonplace.
- May be a recent immigrant from a country whose culture and conventions make our approaches to study and school activity seem peculiar or improper.

While this is by no means an exhaustive list, these are some of the most commonly seen advantages, disadvantages, hangups, burdens, and other qualities that your adult students may bring with them to your first class meeting of the term. To be aware of them is to understand your students better.

Because They Want to Learn, a Handbook About Adult Learners. Los Angeles City Schools, Division of Career and Continuing Education, pp. 17-19.

Checklist on Feedback

Do you use several different methods of offering feedback to learners?

- written comment?
- general progress discussion?
- comment on each 'performance'?
- action plans?
- Does every learner receive feedback during each session?
- Do you always give feedback immediately?
- Do you always praise the good points before criticizing the bad?
- Do you criticize the performance not the person?
- Do you always give reasons for your feedback?
- Do you check that the learner has understood the feedback by asking open-ended questions?
- Do you concentrate on just a few criticisms at a time?
- Do you create an atmosphere where students can give constructive feedback to each other?

Why Adults Participate

Convenience, reputation, and self-improvement count.

Emmalou Van Tilburg Norland

Why do some adults participate in continuing education programs and other don't? What are the barriers to participation? What encourages people to attend? Why do some adults drop out and others complete a program? Are the reasons for participation and persistence different for different types of people? What can adult educators do to encourage participation and persistence in their educational programs? These questions have perplexed adult educators for many years.

Many studies on adult participation and persistence in educational programs have tried to answer these questions. A number of authors have identified factors that act as barriers or encouragers to adult participation. Johnstone and Rivera used terms such as situational barriers (time, money, child care, transportation, weather), institutional barriers (factors pertaining to the educational service provider), sociodemographic barriers (age, sex, race, income, educational level, and geographical location), and dispositional factors (self-esteem, group participation) in describing adult responses.

Burgess identified several characteristics of adults who choose to participate in the learning experience: (1) they want to know; (2) they’ve established personal, social, or religious goals; (3) they’re engaged in some activity; (4) they need to meet a formal, work-related requirement; and (5) they simply want to escape.

Boshier linked the desire to improve one’s ability to serve the community, the need to make new friends, intellectual recreation, professional advancement (either job-related or inner-directed), an abhorrence of television, the joy of learning, an introduction or supplementation of understanding, and escape to adult participation.

Other authors have identified specific factors related to participation such as involvement with a formal organization that encourages adult participation, broad and diverse leisure activities, and high levels of income.

Situational barriers to participation, such as child care, shift or overtime work, lack of transportation, poor health, and lack of time or money are more a problem for low socioeconomic adults and the elderly than the average middle-class adult. Institutional barriers (inconvenient class schedules, full-time fees for part-time study, restrictive locations) often exclude or discourage certain groups of learners such as the poor, the uneducated, and the foreign born. In addition, adults living in certain geographical areas, especially those in small towns and rural areas, are less likely to participate in educational activities.

Application to Extension Education

A 1987 study of Ohio Cooperative Extension Service clientele provided useful information for Extension educators who work with a variety of adult learners and ponder the participation/persistence phenomenon.

The study surveyed Extension clientele who had been involved in a variety of Extension programs (estimated target population n = 20,000; study cluster sample n = 599; final data sample n = 276). The relational design of the study provided results that addressed the following questions:

1. What are the encouragers and barriers to participation and persistence in Extension educational programs?
2. Are those encouragers and barriers different for the decision to participate and the decision to persist?
3. What are the anticipated outcomes of participation and persistence?
4. Can perceived barriers and encouragers to participation and persistence and outcomes be used to predict satisfaction with participation (suggested to be a best predictor of dropout)?

Data were collected using a mail questionnaire. Follow-ups with nonrespondents indicated respondent data were representative of the sample. The cluster sample was drawn to allow generalization of results to the population. Even though the findings and conclusions can be said to be true for Ohio, other Extension educators may want to note the implications this study presents.

Findings

Five factors emerged from the principal-component factor analysis of responses to items related to participation. They were: low anticipated difficulties with arrangements, high commitment to the Extension organization, anticipated positive social involvement, anticipated high quality of the information, and possession of high internal motivation to learn. With the exception of commitment to Extension, the same factors appeared to motivate persistence. Commitment to Extension was replaced with commitment to the teacher in the persistence question.

Participation outcomes fell into three broad categories: negative learning experiences, self-improvement outcomes, and positive social experiences.

Using multiple regression relating satisfaction to participation, the set of best predictors included receiving self-improvement outcomes, anticipating few arrangements, experiencing few negative learning outcomes, and having high commitment to the teacher throughout participation.

The data from this study indicated that Ohio Extension clientele participate and persist for the same reasons: they can arrange to participate, they’re internally motivated, and they enjoy social involvement.

The initial commitment to Extension as an encourager to participate transferred to the teacher as an encourager to persist (return). The reputation of Ohio Extension outweighed the quality of the teacher initially, but once individuals gained experience with the teacher, commitment to the teacher became most important.

Clientele satisfaction with participation was linked to many self-improvement outcomes, liking and respect for the teacher, and being able to take care of arrangements, such as parking, child care, fees for participation, while receiving few negative learning experiences.

Implications

This study of adult participation has implications for planning, marketing, and delivering Extension programs.

People assess whether they’ll participate initially using what they know about Extension in general as well as the specific learning opportunity. Marketing strategies should build on Extension’s reputation for quality information. The image of Extension, recently much maligned, appeared in Ohio to be a big drawing card for current clientele assessing potential future participation—as though they trust an old friend. This theme emerged in data from urban as well as rural locations, men as well as women, and agriculturally related subjects, as well as home economics, 4-H, and community development. Reaching out to new clientele or working in areas where Extension is less well-known may require marketing to establish this reputation.

The study also suggests that Extension programs should be designed to incorporate social involvement in educational experiences. Learning experiences should also be structured to stimulate self-improvement beyond learning new information and skills related to the specific topic.

When making arrangements for educational programs, convenience should be considered by and clearly marketed to potential clientele. People make choices about participation based on the information they’re given; anticipated convenience is as important as actual convenience.

Footnotes

7. Ibid.
8. Emmalou Van Tilburg, "A Comparison of Advantaged and Disadvantaged Populations of Adult Learners Using the Expectancy-Valence Paradigm of Motivation and Adult Learner Participation, Final Report" (Staff study, The Ohio State University, Columbus, Ohio Agricultural Research and Development Center, 1988).
COMMUNITY AND SOCIAL DIMENSIONS OF SUSTAINABILITY

SOCIAL ISSUES RELATED TO AGRICULTURE,
COMMUNITIES, AND NEW TECHNOLOGIES

LEARNING METHOD: Presentation and Discussion

PRESENTED BY: Cornelia B. Flora (Nebraska)
Director, North Central Regional
Center for Rural Development
Jan L. Flora (Indiana)
Department of Sociology
Iowa State University

SUMMARY:
Social capital can be envisioned as one component of our total resource base that includes human, financial, manufactured, and environmental capital as well. Social capital includes mutual trust and reciprocity. Crucial to the understanding of social capital is a definition of community; community may also refer to groups of people who interact—either around a place or common interests or both. The farming or the academic community are examples of communities of interest. Building social capital depends on the development of mutual trust among community members, emergence of networks around special issues, formation of groups, sharing of symbols and common meaning, and a collective identity. Based on research in the Midwest, diverse symbols, widespread resource mobilization and inclusive networks increase social capital. Indicators of healthy communities include diversity of ideas and people, acceptance of controversy, depersonalization of politics, focus on process rather than personality, and permeable boundaries of the community. A move toward more sustainable practices and reinvestment of some capital in the local community results in more diversified local enterprises, more options due to greater individual and collective income opportunities, and healthy local business. Local environmental conditions could improve due to communities working together to better water, air, and soil quality. With the introduction of sustainable systems and greater community involvement, there should be an increase in individual empowerment, greater participation in the community by more players, and increased opportunities for beginning farmers.

KEY REFERENCES:


COMMUNITY SUSTAINABILITY AND FORMS OF CAPITAL

Cornelia B. Flora
Jan L. Flora

COMMUNITY SUSTAINABILITY

Community sustainability can be defined as the ability of a community to utilize its resources to ensure that present and future members of that community, as well as those in adjacent communities, can attain a high degree of health and well-being, economic security, and a say in shaping their future while maintaining the integrity of the ecological systems on which all life and production depends (Kline, 1994). The definition implies a strong equity focus within the community, across generations, and across communities. This definition takes us well beyond the conventional indicators used for community development.

Community sustainability is based in part on the resiliency of that community to respond to changes in the larger environment. A community can be defined as interactions among individuals for mutual support. This definition results in two types of communities: communities of interest and communities of place. Just as the technology that made mass society possible gave us the ability to shop, worship, sleep, recreate, and work in different places, so the technology of the information age has made it possible to have our most intimate personal interactions with those a continent or more away, forming and reforming a vast number of overlapping communities of interest or affinity (Dillman). Yet the interactions based on locality are still critical for locality survival, particularly that related to ecosystem resiliency. The interactions which traditionally defined geographic communities have expanded spatially, creating the need for people to redefine community boundaries or to recognize multiple boundaries to their communities of place.

COMMUNITY RESOURCES

Resiliency depends in part on the resources available to a community. Those resources can be viewed as forms of capital, which are to be reinvested locally to produce new wealth. Capital can be thought of as any resource capable of producing new resources. Two forms of capital have conventionally been viewed as important for community development: financial and manufactured capital and human capital. When looking at community sustainability, it is also important to analyze environmental capital and social capital.

1 Much of this paper is excerpted from Cornelia B. Flora, "Sustainable Agriculture and Sustainable Communities: Social Capital in the Great Plains and Corn Belt," unpublished mss, Dept of Sociology, Iowa State University, 1994.

2 It is later argued that this collective ability to redefine and symbolically expand community boundaries is an indicator of social capital.
SUSTAINABLE COMMUNITIES: DEVELOPING SOCIAL CAPITAL

by Cornelia Butler Flora

Director, North Central Regional Center for Rural Development
317 East Hall
Iowa State University
Ames, IA 50011-1070
Phone: (515) 294-8321
Fax: (515) 294-2303
e-mail: cflora@iastate.edu

Configuration of Social Capital Within Communities

-- Horizontal Social Capital

-- Hierarchical Social Capital

Absence of Social Capital

Cornelia Butler Flora
NCRCRD
FINANCIAL AND MANUFACTURED CAPITAL

Financial and manufactured capital in a community consists of the private and public capital goods and financial assets (Flora, et al., 1992: 109). Financial and manufactured capital is what economists generally refer to as capital: human made inputs used in the production process. This includessuch financial instruments as stocks, bonds, and credit, as well as buildings, sewers, water systems, power stations, public revenues and bank deposits. There is a tendency to judge community development in terms of the increase in financial and manufactured capital, in part because it is easy to measure. Financial and manufactured capital is either already monetized or immediately convertible to monetary terms. Strategies of sustainability aim at maintaining financial and manufactured capital over time, but do not privilege maximizing financial and manufactured capital over other forms of capital investments. Financial capital is highly mobil, generally undeterred by national boundaries, while manufactured capital is also mobile, although with high transaction costs in its movement.

HUMAN CAPITAL

Human capital includes individual capacity, training, human health, values and leadership. Embodied in individual human beings, it is also mobil, but not nearly as mobil as financial capital. Economists use the term "labor", consisting of the skills abilities, education and training which workers possess and bring to their jobs. Conventionally human capital has been measured in terms of formal educational attainment (again, probably because of ease of measurement and readily available census figures on this variable). Increasingly, there has been a great concern for leadership skills as a crucial part of human capital necessary for community development to take place. Human capital also includes non-formal skills that are associated with experience carrying out a particular task and indigenous knowledge about an area. Health status is another aspect of human capital important in development and sustainability. Strategies of sustainability aim at increasing the capacity of individuals within a community and diversifying the human capital resources.

ENVIRONMENTAL CAPITAL

Environmental capital encompasses air, water, soil, biodiversity, and landscape. Economists refer more narrowly to land to summarize the environmentals used in the production process. These assets can either be consumed or invested. If they are consumed, however, they are not defined as capital because they do not generate other resources. For instance, natural beauty of an area can be environmental capital, if it is linked with other kinds of capital to encourage local tourism. The tourism "consumes" the landscape, but for those investing in tourism, the landscape is a form of capital.
<table>
<thead>
<tr>
<th>Community</th>
<th>Community Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interactions among people for mutual support</td>
<td>Communities of Interest</td>
</tr>
<tr>
<td></td>
<td>Communities of Place</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Capital</th>
<th>Financial/Manufactured Capital</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resources invested to create new resources</td>
<td>• savings &amp; money for investment</td>
</tr>
<tr>
<td></td>
<td>• stocks &amp; bonds</td>
</tr>
<tr>
<td></td>
<td>• house, farm &amp; other assets</td>
</tr>
<tr>
<td></td>
<td>• sewers, water systems, buildings</td>
</tr>
<tr>
<td></td>
<td>• timber</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Human Capital</th>
<th>Environmental Capital</th>
</tr>
</thead>
<tbody>
<tr>
<td>• education</td>
<td>• air</td>
</tr>
<tr>
<td>• skills</td>
<td>• soil</td>
</tr>
<tr>
<td>• health</td>
<td>• water</td>
</tr>
<tr>
<td>• values</td>
<td>• biodiversity</td>
</tr>
<tr>
<td>• leadership</td>
<td>• landscape</td>
</tr>
</tbody>
</table>

Cornelia Butler Flora NCRCRD

Cornelia Butler Flora NCRCRD
SOCIAL CAPITAL

Social capital in a community is the mutual reciprocity and mutual trust that exists among its citizens. Putnam describes social capital as referring "to features of social organization, such as networks, norms, and trust, that facilitate coordination and cooperation for mutual benefit. Social capital enhances the benefits of investment in financial and manufactured and human capital."

Social capital has a variety of configurations. Each configuration has different implications for community sustainability. Social capital can be horizontal, hierarchical, or non-existent. Horizontal social capital implies egalitarian forms of reciprocity, while vertical social capital involves a kind of patron-client relationship, as in communities stratified by race, class, or ethnicity, and non-existent social capital occurs in bedroom communities, rural communities which become a low-rent haven for jobless urbanites, and many central city neighborhoods (including those undergoing gentrification). Such communities tend to have high population turnover and many have high levels of conflict. Only horizontal capital contributes to sustainable communities.

In communities with high levels of horizontal social capital, each member of the community expected to give (and gains status and pleasure from doing so), and each is expected to receive as well. Each person in the community is seen as capable of providing something of value to any other member of the community. Further, contributions to collective projects, from parades to the volunteer fire department and Girl Scouts, is defined as a "gift" to all. Horizontal social capital tends to embed networks within the community. An example is an established farmer in southeastern Minnesota who wrote a check his neighbor, a sustainable agriculturalist who had been struggling with excessive debt load since the farm crisis. That money allowed the neighbor to get out of Chapter 11 (bankruptcy). He delivered the check with the message, "I hope you will be able to help out another young farmer some day." Social capital was being created -- for the community. Norms of reciprocity were reinforced, but payback to the donor was not required or even expected.

Hierarchical social capital is quite different. While it is also built on norms of reciprocity and mutual trust (or at least mutual obligation), those relationships are vertical rather than horizontal. Traditional patron-client relationships, typical of urban gangs (Portes & Sensenbrenner, 1993), Sicilian "families," or "boss"-run political machines are created. Those at the bottom of the hierarchy—who obviously are beholden to the few at the top—are the majority of the population in such communities. As a result, the receivers of favors owe incredible loyalty to their "patron" when time comes to vote for public office, to collect from a loser in the numbers racket, or to settle a score with a rival gang. As a result, horizontal networks, particularly outside the sphere of influence of the patron, are actively discouraged. Dependency is created and mistrust of outsiders is generated. This type of social capital is prevalent in persistent poverty communities (Duncan, 1992).

Absence of social capital is characterized by extreme isolation. In these communities, there is little trust, and, as a result, little interaction. Bedroom communities, rural communities which become a low-rent haven for jobless urbanites, and many central city
neighborhoods (including those undergoing gentrification) fit this pattern. Such communities tend to have high population turnover. Many (not the bedroom communities) have high levels of conflict. When middle and upper class residents lack social capital, they are able to substitute financial and manufactured capital for social capital: hiring private guards, fenced neighborhoods, and elaborate security systems. In poorer communities, there are often high levels of crime and delinquency. Putnam showed that areas in Italy with low levels of social capital (concentrated in southern Italy) had lower levels of government efficiency, lower levels of satisfaction with government, and slower rates of economic development than did provinces with high levels of social capital (central and northern Italy).

Interactions of Different Forms of Capital

Each form of capital can enhance the productivity of the other forms of capital. Increasing social capital greatly cuts transaction costs, making other resource use more efficient. Granovetter (1973) was one of the first among an increasing number of scholars to propose the independent effect that social capital has on the functioning of economic systems.

Overemphasizing the value of a single form of capital can reduce the levels of other forms of capital. For example, over emphasis on generating financial and manufactured capital without regard to the pollutants generated can reduce the value of human capital through negative impacts on health or on environmental capital through destruction of soil and water quality or on social capital through by-passing local networks and replacing them with impersonal bureaucratic structures with top-down mandates. Attention solely to environmental capital can lead to a wasting of human capital and a decline in financial and manufactured capital, as that form of capital preservation is pursued.

Because of its importance for community sustainability, it is important to try to measure social capital on a community level. Coleman has identified social structure that facilitates social capital on the individual level. He has identified closure of social networks (seeing the same people in more than one setting -- in the case of his study, church functions, school functions, and as parents of your children’s friends) and tried to operationalize that within the family in terms of the social capital available to the child from the family. In the case of community, Flora and Flora have identified some basic social structures within a community -- entrepreneurial social infrastructure -- which can be seen as contributing to the development of horizontal community level social capital. These are 1) diverse symbolic structures; 2) widespread resource mobilization, and 3) diversity of networks.
SOCIAL INFRASTRUCTURE

Symbolic Diversity

Symbols are the source of meaning for human beings. Symbolic interactionist theory informs us that meaning is not intrinsic in an object, but is socially determined through interaction. Different human groups have different sets of shared symbols. Indeed, the same object may have very different meanings for two different groups. The meaning given to the object in turn determines how one acts toward it (Mead). Symbolic diversity within a community means that while symbolic meanings for objects and interactions may differ, there is an appreciation among different community members of the different meaning sets. With symbolic diversity, there is a recognition of differences, but the differences are not hierarchical. "Different than" does not mean "better than".

Where there is symbolic diversity, people within the community can disagree with each other and still respect each other. There is acceptance of controversy. Because differences of opinion are accepted as valid, problems are raised early and alternative solutions discussed. Members of the community are able to separate problems ("We need better medical care") from solutions ("We need a doctor"). People feel comfortable in raising issues without being accused of causing the problem. Discussion of the pros and cons of alternative solutions can be presented and argued. At times, an individual will argue for one solution. At other times, that same individual might make a strong argument for an alternative. An individual's identity is not conflated with her or his position on a particular issue.

Because controversy is accepted and issues are raised early, communities with social infrastructure which contributes to horizontal social capital have depersonalization of politics. Community members do not avoid taking a public position. Stands on issues are not viewed as moral imperatives. Because problems can be addressed early, one's stand on an issue is not equated with one's moral worth. Risk of character assassination -- and the destruction of one's job or ruination of one's social life -- is lessened for those who take on public charges. The much discussed burnout of volunteer public officials, which is often related to the great deal of abuse they face from their constituents, is thus less.

In communities with high levels of symbolic diversity, there is attention to process, rather than ends only. These communities realize that there is no "silver bullet" solution that will solve all problems. When alternatives are laid out and discussed, decisions are made based on a high probability of taking action that will have to be modified in the near future. There is constant evaluation of impact and adjustment of action. Continuous learning occurs. Communities that focus on process tend to have lots of local celebrations.

Finally, communities with symbolic diversity have a broad definition of community and permeable boundaries. Such communities find it easy to become part of multicommunity and regional efforts, not by giving up community identity, but by expanding it.
### Social Capital
- mutual trust
- reciprocity
- groups
- shared symbols
- collective identity

### Networks
- Diversity
- Inclusive
- Horizontal
- Vertical
- Flexible

### Social Infrastructure
- Networks
- Resource mobilization
- Symbols

### Resource Mobilization
- relative equality of access
- public investment
- private investment

### Symbols
- symbolic diversity
- acceptance of controversy
- depersonalization of politics
- attention to process
- broad definition and permeable boundaries
Resource Mobilization

The ability of a community to mobilize resources is critical for social capital to develop and is a vital part of community level social infrastructure. *Resources are defined broadly*, which allows a wider range of community members to contribute. For example, certain older community members might not have large quantities of cash, but have important knowledge of community history.

There is also *equality of access* to resources within a community. For example, it is assumed that every child should have a chance at a good education. High school drops outs are viewed as a community-level problem, not the fulfilling of one’s social destiny, based on one’s parents’ social status. Equity of access often means that a wide variety of resources, from swimming pools to golf courses to schools, are financed publicly and open to all, rather than owned by private individuals or elite social groups.

In order to enhance equality of access, resource mobilization as a part of social infrastructure contributing to community social capital formation includes *collective investment*. Such communities are willing to invest in themselves, through school bonds, public recreation programs, and volunteer fire departments and emergency squads. There is the expectation that all will participate in some way, and mechanisms are in place to facilitate that participation.

Finally, there is also an ethic which encourages *individual investment* of private resources. Banks in such communities have high loan-deposit ratios, choosing to invest locally rather than in safe but distant government securities. Local entrepreneurs can find both equity capital and debt capital. And local people are willing to put individual dollars into local community development corporations and enterprises, often assuming that there will be no payback or that the payback will be in the distant future.

Networks

Networks are a crucial part of social capital (Coleman). Community social infrastructure facilitates their formation. A critical aspect of networks for social capital formation is *diversity*. While internally homogeneous groups are often the basis for diversity within the community, there must also be within the community networks that include individuals of diverse characteristics: young and old, men and women, different racial and ethnic groups, different social classes, and, often most difficult, newcomers and old timers.

Community networks must be *inclusive* to contribute to social capital. This is different from representational. There is a realization that adding more people to the table means a larger community pie, not a pie that now has to be cut into more pieces. A social infrastructure that keeps adding diverse groups to the leadership networks is more likely to develop the social capital necessary for sustainable community development.
Networks that contribute to sustainable community development link horizontally to other communities. We refer to this as *lateral learning* (Flora and Flora). Communities that develop this kind of networking often take a diverse group of people to a community which has done something they want to emulate. They visit together, ask lots of questions, and come back determined to adapt the idea -- and do it even better.

Vertical networks to regional, state or national centers are important for sustainable community development to take place and thus an important part of social infrastructure. Such networks link a large number of community individuals and groups to resources and markets beyond community limits. Wide access is a crucial aspect of social infrastructure, because where there is a single gatekeeper between the community and the outside, no matter how well connected that person is, the concentration of power in a single individual contributes to hierarchical, not horizontal, social capital.

Social capital and social infrastructure are a necessary but neglected part of sustainable communities. The elements of social infrastructure are measurable at the community level, allowing us to determine levels of and trends in social capital. We can then assess how social capital interacts with other forms of capital in real communities. The subsequent goal is to devise means to increase social capital in those communities where it is deficient.

The four forms of capital we have discussed are not an end in themselves. Rather, they should interact to bring about certain desirable outputs--outputs which can be characterized in the aggregate as sustainable communities. If sustainable communities are those which are economically viable, socially just (low in inequality), and environmentally sound, then the graph on page 16 might characterize the relationship among the different kinds of capital and community sustainability. As indicated earlier, the various kinds of capital interact with one another. Similarly, they interact to produce ends such as economic viability.

Multiple indicators of the different kinds of capital can be identified and prioritized. (Priorities may be different for different communities). Likewise, multiple measures of the ends which we are seeking could be devised for particular communities. We are working internationally to devise indicators of sustainability through the SANREM CRSP (the Sustainable Agriculture and Environmental Management Collaborative Research Support Project, a multi-university, USAID-funded effort. The same thing could be done for Iowa communities.
References


LEARNING METHODS FOR SUSTAINABLE AGRICULTURE AND ENVIRONMENTAL AND ECONOMIC DIMENSIONS OF SUSTAINABILITY

WHOLE FARM CASE STUDY

LEARNING METHOD: Participatory Learning with a Whole Farm Case Study

PRESENTED BY: Helene Murray
Minnesota Institute of Sustainable Agriculture
University of Minnesota

SUMMARY (by C.A. Francis):

Farmer knowledge and experience have long been recognized as information resources that contribute to new technologies. These sources traditionally have been difficult to access, organize, and apply. There is continuing debate about the validity and transferability of results from on-farm experience. The whole farm case study provides a method for putting information together to integrate the effects of components and their sensitivity to management in cropping and crop/animal systems. The whole farm case study is "a systematic examination over time of the biological, social, and economic factors of an entire farming system. The process is an examination of interactions among production practices, economic status, business management, and interrelations of farmers and employees. ...they are best conducted by interdisciplinary teams representing a diversity of fields within the biological and social sciences." To some degree, this method has been used when we visit farms and hear a description of goals and decision making, or when a farmer panel reports the process and results of system design and results. The method as presented formalizes this use of farmer wisdom and experience as a legitimate alternative form of systems education.

KEY REFERENCES:


Murray, H., L. M. Butler. 1994. Whole farm case studies and focus groups: participatory strategies for agricultural research and education programs. Amer. J. Altern. Agric. 9(1&2) :38-44.


Whole farm case studies and focus groups: Participatory strategies for agricultural research and education programs

Helene Murray and Lorna Michael Butler

Abstract. Research and extension personnel are beginning to look for new strategies to involve more farmers and the non-farm public in their programs. Two approaches we have used are whole farm case studies (WFCS) and focus groups. WFCS in Oregon and Washington led to several research and educational programming ideas that are currently being pursued in both states. A focus group to study water quality, nitrate leaching and farming practices in Skagit County, Washington is one outcome of the WFCS process. It is made up of 16 people, including farmers, university personnel, members of environmental groups, and government representatives.

We review these two complementary participatory strategies for systems-oriented sustainable agriculture research and education programs. Both have been very useful for building problem-solving partnerships between the land-grant universities and agricultural and environmental constituents in our area. Noteworthy outcomes include: complementary applied on-farm and experiment station research; farming systems analysis; public education; new linkages with environmental and agricultural interest groups; additional grant funds to address identified priority issues; and interdisciplinary teams that cut across the biological and social sciences and include diverse citizen representation.

Key words: whole farm case study, focus groups, participatory research, systems research, qualitative research

Introduction

Under the 1985 farm legislation, the U.S. Department of Agriculture (USDA) was directed to pursue research and educational activities in low-input sustainable agriculture (LISA). Now known as Sustainable Agriculture Research and Education (SARE), the program was designed to help agricultural producers to provide an inexpensive, plentiful and safe food supply while addressing some of agriculture’s social, environmental, and economic concerns. A major goal of the SARE program has been to examine entire farming systems, not just specific components such as weed or insect control. The justification for this approach is that problems do not manifest themselves in isolation, so that understanding the system helps put complex interactions into context. To help accomplish this goal, a major emphasis of the SARE program has been to increase farmer participation in the development and use of technology.

In the past, land-grant universities (LGUs) perceived their most important agricultural audience to be farmers and leaders of farm organizations. This is rapidly changing, since a wide range of public groups clearly are concerned about agriculture. Research and extension personnel are beginning to look for new strategies to involve more farmers and the non-farm public in their programs. Two complementary approaches we have used are whole farm case studies (WFCS) and focus groups. Both strategies can help give direction to on-farm research, experiment station research, and educational activities, and both can help build more effective partnerships between members of the public and the LGU. Rather than describing the many specific results of these two projects, our purpose in this paper is to describe our experience using these methods and to outline some strengths and difficulties of each approach.

Whole farm case studies and focus groups contribute most when they are part of a larger research and education program. Fig. 1 shows where WFCS and focus groups fit within a program in western Oregon and Washington that seeks to increase farmer participation in research and education programs.

Whole Farm Case Studies

A whole farm case study is a systematic examination over time of the biological, social, and economic factors of an entire farming system, such as production practices, economic status, business management, and relations between farmers and employees. It relies primarily on qualitative information unlikely to be derived from controlled experiments or from one-time surveys, and, therefore, is excellent as a complement to quantitative research and...
economic analysis. The case study approach has been used extensively in business, economics, and medicine. In agriculture, case studies can develop a better understanding of constraints, innovations, and human interactions in various production systems.

Because WFCS are designed to understand systems, participation of biological and social scientists and farmers in their development and implementation is crucial to their success. Among the factors to be considered when designing a WFCS are: its purposes, available time and money, expertise of team members, interdisciplinary goals and expectations, and the duration of the study.

During the design phase it is important to clarify the purpose and anticipated outcomes of the study. The design needs to be flexible enough to incorporate new information. It is important to have a plan, but it also is important to recognize that the plan will change. In our view, the process of building an interdisciplinary team is one product of the activity.

Using a collaborative team approach, Oregon and Washington State University personnel conducted WFCS of 16 small fruit and vegetable farms to provide direction for applied sustainable agriculture research and education strategies beginning in 1988. The 16 farms are located between Skagit County, Washington and Lane County, Oregon. Seven are certified organic farms, one has both certified organic and conventional production, and the remaining eight are conventional farms. In this paper we use the term "conventional" to describe those farms not meeting the requirements for organic certification. In this paper we use the term "conventional" to describe those farms not meeting the requirements for organic certification. The farms range in size from 8 to 3,000 acres, with gross sales ranging from $10,000 to $4 million annually.

Rather than comparing farms within the study group, the goal was to identify different approaches to solving similar problems and to focus on farmer-developed innovations. The study included the following steps: development of an interdisciplinary team, design of the study, collection and analysis of data, and presentation of findings.

The Implementation Team for the OSU/WSU project consisted of research and extension personnel in both states in the following fields: agricultural economics, agronomy, anthropology, ecology, entomology, family economics, farming systems research and extension, home economics, horticulture, marketing, plant pathology, soil science, and weed science. A wide range of disciplinary expertise was sought to gain a broad understanding of the complex interactions of diversified farming operations west of the Cascade Mountains. A total of 34 OSU and WSU personnel worked on the project. Because the study was conducted in two states, we chose to form a team in each state with similar areas of expertise. A single team to conduct the study might have been preferable, but travel time and expense considerations ruled out this option. Allowing two teams to evolve encouraged more people to participate and to assume ownership of the process and its outcomes.

A sondeo was used to identify farmers willing to participate. A sondeo is a rapid appraisal survey commonly used in Farming Systems Research and Extension. It employs a flexible interview process, permitting in-depth examination of issues in a whole farm context (Hildebrand, 1981; Beebe, 1985). Using a few open-ended questions, farmers were asked about cropping patterns, marketing practices, pest management strategies, and problems associated with their operations. The sondeo gave the Implementation Team members an early opportunity to work together, get to know each other, and develop a common understanding of systems problems and potential solutions. It required the social scientists to focus on the complex production issues that confront producers, and required the biological scientists to consider equally complex social and economic issues. Farmers and team members together were able to identify research and education priorities. Brophy et al. (1991) provide a summary of methods and findings.
from the sondeo interviews in Oregon and Washington.

After farms for the WFCS were identified, data were collected using several approaches: informal interviews; in-depth structured interviews; observation; forms completed by both farmers and implementation team members; soil and plant tissue testing results; photographs of production practices; and, when available, popular press articles and other printed materials about the farm, farm family, or specific production practices. Field notes were used to document interviews and observations. Use of multiple sources of information, known as triangulation of sources (Webb, 1966; Rossman and Wilson, 1985; Marshall and Rossman, 1989; Patton, 1990), contributed to the validity of the study.

At least three visits were made to each farm, besides the sondeo interview. The first visit focused on production practices, access to equipment, decision-making strategies, and sources of information. During the second trip to each farm, we talked with farmers about their production practices and decision-making strategies during the peak of the growing season. We also discussed marketing approaches and strategies during the first two visits. Data were recorded by individual team members as we toured the farm with the primary operator of the farm, or at least one member of the farm family. The first two visits lasted between two and four hours per farm. Before visiting each farm, team members listed information to examine and discuss during the visits. The flexible interview process enabled team members to explore topics and ideas in depth.

The final visit was more structured. Team members developed and used a questionnaire to gather specific information about management of each farm. Most questions asked during the third interview were open-ended, enabling respondents to elaborate on topics and allowing the interviewers to ask for clarification when necessary. We discussed household management, economic status of the farm, labor issues, and farm management during this visit. The interviews lasted an average of three hours each and were conducted by groups of two or three team members, including at least one biological and one social scientist. In this interview we also attempted to talk with each farmer's spouse or business partner to obtain their view of the farming operation.

We also requested data on farm labor use. We gave farmers a brief data form to record the monthly labor hours (both paid and unpaid) and electricity and fuel usage. All the case study farmers agreed to cooperate with this part of the study, but not all farmers supplied us with the requested information.

Data analysis was done by team members throughout the study. Implementation team members met after each series of farm visits to discuss findings, observations, and impressions, and to identify areas requiring clarification. Usually the meetings were in person, although a few were telephone conferences. Either these meetings were recorded and later transcribed, or detailed notes were taken to document the discussion.

Focus Groups

The process of conducting WFCS in western Oregon and Washington identified many research and educational needs, especially the need to include diverse stakeholders in the planning and implementation of projects. Some WFCS participants in Washington identified the focus group process as a way to involve non-university people in research and education projects.

Focus group discussions and interviews offer a way to understand and interpret how people see a particular situation or idea. The process involves collaborative learning through exchange of information and perspectives, which can generate information and insights that might not emerge from individual interviews. In a WSU project in Skagit County, 16 people representing diverse interests formed a group to study interactions among water quality, nitrate leaching, and farming practices. These topics were identified as priority issues during the WFCS study visits to Skagit Valley farms. Focus group members included row crop growers, representatives of agricultural industry, an extension agent, an extension specialist, a researcher, government agency representatives, a dairy producer, representatives of environmental groups, and a Tribal community member.

The WSU-Skagit County focus group has been giving direction to an applied research and education program focusing on nitrate leaching and water quality. Focus group members are learning from each other by sharing knowledge, experiences, opinions, and ideas, and are building a partnership of agricultural and environmental interest groups and research and extension personnel. The impetus was the growing evidence of excessive concentrations of nitrates in groundwater throughout several western Washington counties. With these findings came accusations that nitrogen from animal manures and commercial fertilizers was exceeding the needs of crops. Excess nitrogen, as nitrate, can leach into groundwater when rainfall or irrigation exceeds the waterholding capacity of the soil.

The Skagit River, the largest waterway flowing into the Puget Sound, carries substantial quantities of nitrogen. This is significant for agriculture because the lower Skagit River drains about 68,000 acres of commercial farmland.

The topic was sensitive because Northwest horticultural producers and dairy operators pride themselves on being good stewards of the land. They do not believe their production contributes to nitrate contamination of groundwater. Most believe that if there is a problem, agriculture is not its sole cause. However, most farmers in the area are interested in learning about data on nitrate leaching generated under western Washington climatic and production conditions. With this objective in mind, focus group members met every four to six weeks to analyze the nitrate issue and its implications for western Washington farming systems. Since the first meetings in February 1992, members have met 11 times, in 2-hour time blocks. Table 1 shows the different topics and activities addressed since February 1992.

Dissemination and Linkages

Outcomes of both the WFCS and the WSU-Skagit County focus group have included new partnerships and teams committed to collaborative problem solving. For example, team members have cooperated on studies with the Padilla Bay Estuarine Research program and the Minto-Brown Island Park Agricultural Task Force.
Table 1. Washington State University - Skagit County Cropping Strategies and Water Quality Project: Focus group phases and corresponding activities and topics addressed (February 1992-July 1993).

<table>
<thead>
<tr>
<th>Phases</th>
<th>Activities/Topic Addressed (in sequence)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase I: Learning Together About Nitrates</td>
<td>• Soil nitrogen cycle</td>
</tr>
<tr>
<td></td>
<td>• Human health and nitrates</td>
</tr>
<tr>
<td></td>
<td>• Cropping strategies and water quality research and education project model</td>
</tr>
<tr>
<td></td>
<td>• Introduction to station research</td>
</tr>
<tr>
<td></td>
<td>• Skagit County watershed management and planning</td>
</tr>
<tr>
<td></td>
<td>• Nitrates and forest ecosystems</td>
</tr>
<tr>
<td></td>
<td>• Baseline survey of nitrates, water quality and farming</td>
</tr>
<tr>
<td>Phase II: Defining Research and Educational Needs</td>
<td>• Clarify and document focus group ideas, issues and questions</td>
</tr>
<tr>
<td></td>
<td>• Focus group interview regarding nitrates and groundwater contamination in Skagit County</td>
</tr>
<tr>
<td></td>
<td>• Potential OFR</td>
</tr>
<tr>
<td>Phase III: Planning On-Farm Research (OFR)</td>
<td>• Implementation subteam preparation for focus group education regarding OFR</td>
</tr>
<tr>
<td></td>
<td>• Education regarding designing and implementing OFR</td>
</tr>
<tr>
<td></td>
<td>• Generate ideas for on-farm cover crop research</td>
</tr>
<tr>
<td></td>
<td>• Identify cooperators</td>
</tr>
<tr>
<td></td>
<td>- Project design</td>
</tr>
<tr>
<td></td>
<td>- Cropping strategies field day</td>
</tr>
<tr>
<td>Phase IV: Implementing On-Farm Research</td>
<td>• Cooperators lay out cover crop trials on their own farms in keeping with their own system and resources</td>
</tr>
<tr>
<td></td>
<td>• Developing an OFR evaluation tool</td>
</tr>
<tr>
<td></td>
<td>• Evaluation of OFR (team, cooperators, laboratory)</td>
</tr>
<tr>
<td>Phase V: Understanding On-Station Research Results and Implications</td>
<td>• Expanding scientific knowledge regarding effects of winter cover crops, alternative fertilizers and rations, use of lysimeters</td>
</tr>
<tr>
<td>Phase VI: Planning for Public Education</td>
<td>• Alternative audiences</td>
</tr>
<tr>
<td></td>
<td>- Environmental organizations, public</td>
</tr>
<tr>
<td></td>
<td>- Important message</td>
</tr>
<tr>
<td></td>
<td>- Alternative educational approaches</td>
</tr>
<tr>
<td></td>
<td>- Focus group involvement in team presentations</td>
</tr>
<tr>
<td>Phase VII: Acquiring Additional Grant Resources</td>
<td>• Grower information needs for use of fall-planted cover crops</td>
</tr>
<tr>
<td></td>
<td>• Need to develop best management practices (BMPs) for fall-planted cover crops</td>
</tr>
<tr>
<td></td>
<td>• Focus group application for grant funds for development and documentation of BMP information</td>
</tr>
<tr>
<td></td>
<td>• Grant funding secured (beginning 1/94)</td>
</tr>
<tr>
<td>Phase VIII: Broadening our Agenda to Include Wildlife Management</td>
<td>• Skagit Valley wildlife habitat and agricultural practices</td>
</tr>
<tr>
<td></td>
<td>• Effects of increased use of cover crops</td>
</tr>
<tr>
<td></td>
<td>• 'Poco' barley cover crop experiment launched</td>
</tr>
<tr>
<td></td>
<td>• Survey of growers regarding history/extent of winter cover crops use</td>
</tr>
</tbody>
</table>
Force. Both projects have established linkages with national environmental groups and have addressed farming, wildlife, and agricultural-urban interface issues. In both Oregon and Washington, on-farm and experiment station research has been initiated on topics such as cover cropping, crop rotation, and alternatives to commercial fertilizer. Farmer participation is a key element of these projects. Farmers, researchers and extension agents jointly identify projects, plan work, and collect and analyze data. In the Washington focus group, members of the non-farm public also are part of the research team. Information is shared by field tours and workshops as part of the ongoing Farming for Profit and Stewardship conference series. In both Washington and Oregon the SARE projects have been augmented by private and government funding that has greatly increased the scope and amount of work.

Educational materials have been created for conferences and workshops to disseminate information about participatory methods and to convey research findings. WSU and OSU researchers and extension personnel have shared information at seminars and workshops with colleagues about the lessons that have been learned from participating in the focus group and WFCS. Publications about research results and methods have been prepared (Brophy et al., 1991; DePhelps, 1992; DePhelps and Butler, 1992; Butler, 1993; Lev et al., 1993; Murray et al., 1994a; Murray et al., 1994b).

Summary and Conclusions

The strengths and difficulties of the WFCS and focus group approaches are listed in Tables 2 and 3. Both approaches are time consuming; communication takes time, but ultimately is worthwhile. Interestingly, complaints about the time that must be devoted to these approaches come mostly from academics, not farmers. However, both projects have created new linkages among diverse groups, strengthening research and educational programs in both states. Land-grant university personnel have learned a great deal from farmers and other participants. Non-university participants also have told us that they value the knowledge gained in the programs.

Despite the time commitment, team members participating in the Oregon/Washington WFCS project said that interaction with other team members provided them with new perspectives and enabled them to see how their disciplinary expertise complements analysis of whole farm systems. Working across state lines has laid the groundwork for future joint LOU efforts in our region.

The focus group approach is valuable as a mechanism to understand and interpret how different people see a particular situation or idea. Whole farm case studies, on the other hand, provide information about how systems function, and are a way to do interdisciplinary work and to increase farmers' involvement in research and education programs. Both approaches generate in-depth insights, suggest innovative solutions to problems, and build participants' ownership of outcomes.

Farmers who have participated in the case studies and focus groups have exchanged information with other farmers and have received nutrient analysis results and specific answers to questions from participating scientists. Farmers have been invited to participate as teachers and presenters at meetings and conferences and to serve on prestigious advisory boards and committees. The process also has facilitated exchange of information with other people in the United States and in several other countries. Valuable linkages have been made between environmental and other interest groups. Some of these linkages have resulted in new partnerships and grant funds.

Whole farm case studies and focus groups help to identify farmer innovations and experiences that are of value to other farmers, interest groups, and research and education programs. For university personnel, a difficulty with both approaches is gaining institutional rewards for their work. Farmer and citizen knowledge and experience are difficult to quantify and evaluate, and, therefore, the information is not widely accepted as useful when peer reviewed. Because this knowledge represents a nontraditional source of information, it is considered by some to be less valid than other forms of research-gener-

Table 2. Strengths and difficulties of the Whole Farm Case Study (WFCS) approach

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Difficulties</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Allows great flexibility in addressing the specific needs, interests and goals of all participants</td>
<td>- Need to identify farmers willing to spend time and to share specific information about their farming operations</td>
</tr>
<tr>
<td>- Team members gain better understanding of the complexity of entire farming systems, not just components of agriculture within their areas of expertise</td>
<td>- The logistics of conducting this type of research can be challenging; need to have at least one team member who is willing to coordinate the day-to-day details of the study</td>
</tr>
<tr>
<td>- Identifies farmer-developed innovations</td>
<td>- The institutional rewards for conducting this type of research may be limited</td>
</tr>
<tr>
<td>- Provides an avenue for increasing farmer involvement in research and extension activities</td>
<td>- Analysis of qualitative information can be difficult and time consuming</td>
</tr>
<tr>
<td>- Offers a means of identifying research and education needs</td>
<td>- Requires team members to spend considerable time designing, planning and conducting the study</td>
</tr>
<tr>
<td>- Improves communication among a wide group of people</td>
<td>- WFCS research is expensive, primarily because of time involved in planning, data collection, discussion of findings, analysis and reporting</td>
</tr>
</tbody>
</table>
| **Summary and Conclusions**

The strengths and difficulties of the WFCS and focus group approaches are listed in Tables 2 and 3. Both approaches are time consuming; communication takes time, but ultimately is worthwhile. Interestingly, complaints about the time that must be devoted to these approaches come mostly from academics, not farmers. However, both projects have created new linkages among diverse groups, strengthening research and educational programs in both states. Land-grant university personnel have learned a great deal from farmers and other participants. Non-university participants also have told us that they value the knowledge gained in the programs.

Despite the time commitment, team members participating in the Oregon/Washington WFCS project said that interaction with other team members provided them with new perspectives and enabled them to see how their disciplinary expertise complements analysis of whole farm systems. Working across state lines has laid the groundwork for future joint LOU efforts in our region.

The focus group approach is valuable as a mechanism to understand and interpret how different people see a particular situation or idea. Whole farm case studies, on the other hand, provide information about how systems function, and are a way to do interdisciplinary work and to increase farmers' involvement in research and education programs. Both approaches generate in-depth insights, suggest innovative solutions to problems, and build participants' ownership of outcomes.

Farmers who have participated in the case studies and focus groups have exchanged information with other farmers and have received nutrient analysis results and specific answers to questions from participating scientists. Farmers have been invited to participate as teachers and presenters at meetings and conferences and to serve on prestigious advisory boards and committees. The process also has facilitated exchange of information with other people in the United States and in several other countries. Valuable linkages have been made between environmental and other interest groups. Some of these linkages have resulted in new partnerships and grant funds.
Table 3. Washington State University — Skagit County Cropping Strategies and Water Quality Project: Strengths and difficulties of the focus group process

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Difficulties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Challenges academics to de-emphasize their &quot;expert&quot; roles and to strengthen their &quot;learner&quot; roles. The opposite is true for members of the public, who gradually assume more &quot;expert&quot; or &quot;problem solver&quot; roles</td>
<td>Identifying and involving environmental interest group representatives in the early phases of an agriculture-oriented focus group as shown by token environmental group participation</td>
</tr>
<tr>
<td>Provides an opportunity for growers, scientists and other &quot;interest&quot; groups to share knowledge, experience, expertise and opinions</td>
<td>Requires an able facilitator or organizer to nurture and support group participants; responsibilities are time consuming and not all people have the needed skills</td>
</tr>
<tr>
<td>Allows group members to develop a broader, deeper understanding of the complexity of western Washington production systems</td>
<td>Some non-grower members could not understand why they were in the focus group until considerable time had elapsed</td>
</tr>
<tr>
<td>Stimulates participants' curiosity, interest and motivation concerning agriculture, water quality and nitrate leaching</td>
<td>Subteam members need to learn to share difficulties and responsibilities, to give credit for accomplishments, etc. Requires interteam trust and communication</td>
</tr>
<tr>
<td>Provides an opportunity for coalition building by bringing diverse groups together in a neutral setting</td>
<td>Can be dominated by a few strong, vocal individuals unless there is a competent facilitator</td>
</tr>
<tr>
<td>Strengthens individuals' problem solving commitments</td>
<td>Requires considerable time commitment by all team members</td>
</tr>
<tr>
<td>With the services of a neutral facilitator, allows extension and research personnel to participate as focus group members</td>
<td>Perception on the part of the subteam that focus group members did not have the time to meet face-to-face; participants took part regularly and willingly in spite of numerous community and business responsibilities</td>
</tr>
<tr>
<td>Stimulates a proactive stance among growers concerning a problem that otherwise could have regulatory impact</td>
<td>Increases participants' interest in the subject in a nonthreatening atmosphere</td>
</tr>
<tr>
<td>Increases participants' interest in the subject in a nonthreatening atmosphere</td>
<td>Diffuses potential conflict among participants holding different beliefs and values</td>
</tr>
<tr>
<td>Diffuses potential conflict among participants holding different beliefs and values</td>
<td></td>
</tr>
</tbody>
</table>

Acknowledgments. We are grateful for the support for the research and education programs described in this paper provided by: the Western Regional Sustainable Agriculture Research and Education (SARE) Program; Washington State University; Oregon State University; Washington Department of Environmental Quality Centennial Clean Water Fund; Washington State Conservation Commission, Northwest Agricultural Research Foundation; U.S. Environmental Protection Agency; Skagit County Government; and the Northwest Area Foundation. We also thank the Implementation Team members at OSU and WSU, the 16 farm families participating in the WFCS, and the WSU-Skagit County Focus Group members.

References

Section V-C

Procedural References

Guidance for the Development and Use of Case Studies as a Source of Conservation Effects Information

Purpose: To provide guidance to SCS field office and conservation district employees in the collection and use of case study information. Case studies from representative resource problem situations may be used to complete the Conservation Treatment Information worksheet. The Conservation Treatment Information worksheet should be stored in the Tech Guide, Section V-B-1, titled "Producer Experiences" for use in future planning efforts and training activities.
# Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction: What are case studies and how can they be used</td>
<td>3</td>
</tr>
<tr>
<td>Potential Problems to be Aware of with Case Studies</td>
<td>3</td>
</tr>
<tr>
<td>Case Studies are Recommended</td>
<td>4</td>
</tr>
<tr>
<td>Case Study Development and Use</td>
<td></td>
</tr>
<tr>
<td>Selecting the farmer</td>
<td>5</td>
</tr>
<tr>
<td>What information needs to be collected?</td>
<td>5</td>
</tr>
<tr>
<td>Alternative types of case studies</td>
<td>6</td>
</tr>
<tr>
<td>Conservation effects versus impacts</td>
<td>6</td>
</tr>
<tr>
<td>How should the information be displayed?</td>
<td>7</td>
</tr>
<tr>
<td>How do I handle multi-year rotations?</td>
<td>8</td>
</tr>
<tr>
<td>Case Study Information Needs Summary</td>
<td>8</td>
</tr>
<tr>
<td>Developing Case Studies in a Group Setting</td>
<td>9</td>
</tr>
<tr>
<td>Summary and Conclusions</td>
<td>10</td>
</tr>
<tr>
<td>Exhibit 1. New York case study</td>
<td>11</td>
</tr>
<tr>
<td>Exhibit 2. Nebraska case study</td>
<td>12</td>
</tr>
<tr>
<td>Exhibit 3. Conservation Treatment Information</td>
<td>15</td>
</tr>
<tr>
<td>Exhibit 4. Conservation Effects Worksheet</td>
<td>16</td>
</tr>
<tr>
<td>Exhibit 5. A Composite Picture of Adopter Categories</td>
<td>17</td>
</tr>
<tr>
<td>Exhibit 6. Case Study Guidance Summary</td>
<td>18</td>
</tr>
</tbody>
</table>
Introduction

What are case studies and how can they be used?

A "case study" is an organized set of quantitative and qualitative information that describes before and after treatment resource conditions and the impacts from installing a conservation system.

A case study is one example of how a recommended conservation treatment, such as a change in management, practice or system installed, actually worked out to meet cooperator objectives and effectively treat resource problems.

Case studies provide field offices and districts with a distinct means to improve on-going conservation planning. Sharing case study results with potential cooperators should also promote new conservation planning opportunities and accomplish additional levels of treatment.

Case studies developed by field office and district professionals are intended to be a relatively quick and practical means of providing potential cooperators in comparable resource situations with a vision of the way their current situation might be modified to achieve a desired resource condition. They are not intended to be definitive analyses of resource treatments which scientifically determine complete cause and effect relationships.

Thus, case studies to evaluate the effects of conservation should contain neither the degree of detail nor the rigor of analysis used in university level case studies. However, they should be much more insightful than casual observation and help us gain a better understanding of the ecological implications of change from current production systems to new systems based on conservation treatments. Case study formats may vary. Exhibits 1 and 2 illustrate two formats that may be used.

"Before and after treatment" information allows for estimating change, but because exact cause and effect relationships between treatment inputs and conservation outputs (results) are difficult, and in some cases impossible to identify, the expected focus of case studies should be on the results or outcomes of treatment. Given that each cooperator's resource situation is unique, case studies should, at a minimum, describe successful treatment situations with some expectation for replicating the results. Unsuccessful treatments should also be noted so mistakes are not repeated.

Many end products can be derived from the development of case study information in addition to the case studies themselves:

- Brief information brochures containing highlights of the resource problems addressed, applied treatments, experienced effects, farmer satisfaction, etc.;
- Brief one-page information sheets, modeled after fact sheets;
- Conservation Treatment Information worksheet for Sec. V;
- Training materials for instructing field and district professionals in planning and use of technical information;
- Local news and farm magazine articles; and
- Case study farms can be the focus of Soil and Water or Resource Conservation District tours and training exercises;

All of these products and uses could be part of public information campaigns and training to illustrate effective ways to evaluate and treat resource problems.

Potential problems to be aware of with Case Studies

Attributing change to a conservation treatment is potentially the most complex and uncertain aspect of
SCS case studies. Researchers do not like to predict results based on only one example. In fact, this is a weakness of using the case study approach to predict the effects and impacts of conservation work.

However, that weakness does not destroy the usefulness of the approach. Examples of the potential problems with case studies that could complicate our understanding of the effects of conservation are:

- Variability in weather, e.g., unusually low rainfall during the growing season could cause yields to be lower than the levels expected when you planned the conservation system.

- Changes in management such as a change in varieties planted, fertilizer used or as a result of lessons learned during implementation, e.g., modifying tillage depth or timing.

- Measurement errors with respect to inputs, outputs or both;

- Some other factor might change between before and after treatment observations, e.g., biological or chemical changes in the soil which might solely be a function of time and be unrelated to the treatment, i.e., increasing salinity; and

- Significant statistical variation with respect to yields or any other measurable outcome can occur which may or may not be related to the treatment.

Paying close attention to details, objectivity in planning and collecting "after treatment" data, and experience in conducting such studies will help minimize errors.

In addition, data collected over several seasons will tend to minimize the impact of years with unexpectedly low or high responses to treatment.

Above all, you need to make it clear to subsequent farmers that "These are the results achieved on one of your neighbor's farms. We can't guarantee that you'll do the same, but we feel reasonably certain that comparable changes could be achieved. The exact magnitude of change most likely will be different, but should fall within some reasonable proximity to the case study results."

Case studies are recommended

Case studies are highly recommended as planning and public information tools.

The examples (Exhibits 1 and 2) are meant to serve as format examples that may be utilized to develop the "Conservation Treatment Information" worksheet (Exhibit 3).

Conservation treatment information can come from a variety of sources such as university research, conservation field trials, and the expert knowledge of experienced planners within and outside of our agency as well as from case studies.

Case studies are simply another planning tool - perhaps one of the most practical for improving our planning, for prioritizing assistance, and for reaching out to new farmers.

Some conservation practices and systems are so simple or easily understood that most of your farmers will not need case studies to reach a decision. Also, mandatory local ordinances regarding certain land use activities may require specific practices such as sediment basins below irrigated fields, filter strips adjacent to water bodies, or nutrient management plans. Case studies might be very desirable in these situations, but they certainly are not mandatory.

The incorporation of conservation effects information into the FOTG is a long-term, dynamic endeavor with case studies being one effective means to develop representative effects information to aid farmers and ranchers in conservation decisionmaking.
Case Study Development and Use

Most case studies should be a record of what happened under certain stated conditions when conservation treatments were applied. A case study need not be approached as a complex research effort requiring explicit hypotheses, research design, and statistical tests of significance, but each of these concepts could be considered and used.

Planners should begin by thinking about the resource base in their area (county resource and land use situations). Ask "What resource settings are dominant in this county and what are the main associated problems and opportunities?"

Answering this question will help you develop a strategic view of the area and will direct case study efforts to situations where the needs and opportunities are greatest. Some basic county level resource and land use data will facilitate the initial part of the case study development process.

Once the dominant crop/livestock and resource settings for your county are identified, predominant treatments can be identified and aligned with the land use situations. Then priorities can be established for developing case studies.

The key to success with case studies is to select resource situations with a broad applicability to many land users, i.e., the studies should be developed for major resource concerns on soil mapping units and in resource use situations that represent a significant portion of the resource users in your county.

This data and your understanding of the resource conditions, conflicts in use, current trends, and expected future changes, can be viewed along with knowledge of the socio-economic groups in your area to select case study subjects and farmer candidates.

Selecting the Farmer

A cooperative, knowledgeable farmer is one of the most important elements for a successful case study. If the cooperating farmer can be classified as an "early adopter" rather than a "late majority" or "laggard", you will have an easier job of convincing other farmers to accept the results (see Exhibit 5, "A Composite Picture of Adopter Categories" for added information). For new and untested technology, an innovator is probably the best prospect for a case study.

What information needs to be collected?

A case study can be conducted as part of your ongoing conservation planning work with little extra time needed during your review of the farm operation and while developing and evaluating alternatives (planning elements 4, 5, and 6). Additionally, follow-up (element 10) needed after the conservation plan has been implemented (element 9), will serve to verify or reject planning expectations and the results that the decision maker hoped to achieve.

This data and your understanding of the resource conditions, conflicts in use, current trends, and expected future changes, can be viewed along with knowledge of the socio-economic groups in your area to select case study subjects and farmer candidates.

1 Studies show that a farmer's most respected source of information about new crops, practices, and technologies is other farmers. If you can cite results obtained on the farm of a respected local resident, you will have satisfied one of the key concerns of most farmers.
Therefore, planning notes from an existing conservation plan might contain all or most of the information needed to produce a good case study. However, for best utility, you will need to structure the information in your case study to include data on the kinds, amounts, and timing of actions taken to implement conservation treatments.

Typically, a case study will attempt to measure quantifiably the level of inputs and outputs associated with a particular conservation practice or system (see Exhibits 1, 2, 3, and 4). You should record farming operations undertaken, type of equipment used, dates of operations, number of operations to complete work, and the kinds and amounts of inputs such as seed, fertilizer, pesticides, tractor hours, fuel consumption, and labor required.

Fertilizer and pesticide use should be based on development of a nutrient balance sheet and inventory of existing pests, respectively, in meeting the nutrient and pest management standards.

To the extent that treatment significantly affects yields, erosion rates, and other observable indicators related to the resources of concern (soil, water, air, plants, and animals) - such data should also be recorded. Any significant changes in operational and managerial conditions and decisions should also be noted.

The degree of detail and selection of input and output factors to collect data for, should be guided by common sense and professional judgement. For example, the conservationist can ask himself the question: "What should I observe in order to gauge results and judge 'success'?' Such efforts will help prioritize system variables and streamline data collection and analysis.

Alternative types of case studies

Case studies can be based on:

1. A comparison of the "before and after treatment" conditions on a single farm;

2. A comparison of two separate, but comparable resource and land use situations on different farms or even on the same farm, i.e., one site "with and one without treatment"; or

3. A simple recording of the results a farmer experiences "with treatment" on a single site regardless of the "before" treatment conditions.

The first and second alternatives mentioned above require that data be collected for both the "before treatment" or benchmark situation (without treatment) and the "after treatment" (with treatment) condition arising from the conservation option adopted.

The last alternative represents the simplest, easiest approach, but inherently has the greatest risk for misunderstanding cause and effect relationships because it focuses on "with treatment" conditions only. Interpreting specific changes attributable to conservation treatments with this method is not as valid as the other two approaches.

This may not matter, for the immediate future, if the optional situation is deemed more desirable than the new cooperator's present situation and the adoption of conservation technology is accompanied by the other innovations that were part of the case study example. However, a more precise understanding of the cause and effect relationships due to conservation is important for our work over the longer term.

Indeed, conservation effects and impacts information incorporated into Section V over time should result in improvements to Section III.

Conservation Effects vs. Impacts

The difference between "before and after treatment" or "with vs. without treatment" input/output conditions represents change. This change may be all or in part due to the conservation treatment.

Effects represent the quantitative and qualitative descriptive characteristics of the outcomes of treatment only. They are the overall results which provide a general vision of the treatment and its effectiveness. The effects show what a practice or system looks like, its characteristics and results, and represent the general expectations achievable elsewhere if the resource conditions are relatively similar.

The effects of a conservation option can be relied upon by the planner for depicting the expected response to treatment for a given conservation option and resource situation. The effects information developed with approaches 1 and 2 will influence a new cooperator's expectations for change and can be

Change attributable to SCS/District-recommended treatment is defined as the conservation impact.

Effects represent the quantitative and qualitative descriptive characteristics of the outcomes of treatment only. They are the overall results which provide a general vision of the treatment and its effectiveness. The effects show what a practice or system looks like, its characteristics and results, and represent the general expectations achievable elsewhere if the resource conditions are relatively similar.

The effects of a conservation option can be relied upon by the planner for depicting the expected response to treatment for a given conservation option and resource situation. The effects information developed with approaches 1 and 2 will influence a new cooperator's expectations for change and can be
used to focus new planning efforts in order to avoid unrealistic expectations based on a new cooperator's impressions of the case study estimated impacts (change).

The specific changes (impacts) realized in a case study can aid decision making, but are not always needed. Assuming that the new cooperator's resource and enterprise situation is comparable to the case study, then a general idea of the kinds of conditions (effects) to be created should meet his or her minimum information needs. Thus Alternative 3 is acceptable, but will not provide the new cooperator with a detailed understanding of the pretreatment case study conditions nor an estimate of the changes realized as would the first two methods.

This point is very important because the exact change or impacts achievable will vary somewhat for every farmer who applies a particular conservation option and the case study approach that you select to share with a new cooperator will be showing one of several possible comparisons:

- between the new cooperator's current condition and the case study "before and after treatment conditions" (alternative approach #1);
- between the new cooperator's current condition and the case study "with and without treatment conditions" (alternative approach #2); or
- between the new cooperator's current condition and the case study "with or after treatment conditions" (alternative approach #3).

An understanding of these analysis concepts and case study approaches is essential to avoid confusion. Apart from time requirements, the approach used does not matter as long as the expected outcomes or effects are not unique and they should not be in similar resource settings, i.e., once again, the before treatment conditions and after treatment results should be representative and therefore replicable.

The main advantage of the first two methods for conducting a case study is the identification of conservation impacts (change). They also offer another advantage over the third approach. Data from "before and after" or "with and without" treatment case studies helps to assure that all important issues and planning steps have been followed. The conservation effects and associated impacts provide an abundance of information for new clients to begin evaluating the appropriateness of the case study to their specific situation and then build their own conservation plans.

In summary, the results of any case study must be described within a context which identifies the resource situation and the actions and timing of those actions taken to achieve expected treatment outcomes.

Several methods for organization and development may be used and a minimum of data requirements must be met to help other farmers understand the consequences of their choice.

The data collected in a case study at a minimum must:

1. be specific for a conservation practice or system;
2. attempt to hold all variables not related to the conservation treatment constant (this requires careful farmer selection and consultation during implementation to avoid changes in varieties, fertilizer, etc.);
3. include the kinds, amounts and timing of treatment actions; and
4. identify the physical and biological effects associated with those actions.

Item number 2 above is impossible to completely control because every year's weather, crop sequence, and methodology of operations will vary. Under certain circumstances, a case study effort could even be rendered useless because of weather, farmer finance, or other induced changes unrelated to the conservation treatment.

**How should the information be displayed?**

Exhibit 4 illustrates one way case study information could be displayed for use with a new cooperator.

The left-hand column shows the kinds, amount and timing of actions undertaken by the case study farmer in the "before treatment" or benchmark condition.
The second column from the left shows the effects of those actions. This data is recorded during elements 4 and 5 of the planning process.

The third column from the left shows the impacts (changes) of adopting the option displayed in Exhibit 3. Again, the impacts are the differences between the effects observed in the "before treatment" benchmark condition and those effects realized in the option or "after treatment" condition. The evaluation of impacts essentially constitutes element 10 of the planning process.

Finally, the last or right-hand column shows the farmer's perception of the value of those impacts. Such a display of the case study information can be especially helpful to assist a new farmer to decide whether or not to develop a conservation plan.

Care and good judgement must be used in deciding whether to use the participating farmer's name when presenting results to others. Ideally, the case study farmer would consent to the public use of the results and also be an esteemed local resident. However, if confidentiality is a concern, case study information can be presented carefully without reference to the particular cooperating farmer.

How do I handle multi-year rotations?

Information from each of the years of a multi-year rotation must be collected and kept separate. If a multi-year rotation is the conservation option you are evaluating, and you want to compare it with a continuous crop benchmark condition, then you will need to do some summarizing and averaging over those years to make comparisons.

Some planning assistance from the area or state office may be needed for your first case study efforts, but you will soon develop a good idea for handling multi-year rotations and other complications. The point to remember is that you must collect the information regarding the kinds, amounts and timing of actions and the resulting effects for each year of the treatment rotation that is different from the benchmark or "before treatment" condition. Exhibit 4 displays an example of a two-year rotation.

Case Study Information Needs Summary

The following is a comprehensive list for conducting case studies that evaluate change. Some case studies (see page 6 "Alternative types...") would not need "before treatment" data.

(See Exhibit 6 "Case Study Guidance Summary," for an outline of the steps to conduct a case study.)

1. Benchmark or "before treatment" resource and landuse situation (soil mapping unit, slope range, crop rotation, etc.), problems and opportunities;

2. The Farmer's objectives, concerns and understanding of his resource condition and trends;

3. Treatment response to problem: Kinds, amounts and timing of actions whether practice or system specific;

4. Conservation effects by relevant resources: land, air, water, plants, animals and as they relate to on-farm operations. The effects measured could be, e.g., soil pH, nutrient or pesticide loadings, or management related, etc., but will invariably include the physical and biological effects. Profitability might also be included;

5. Conservation impacts (optional for use with alternative methods 1 and 2 covered previously): The changes that occur as a result of treatments applied (the difference between "before treatment" or the Benchmark conditions and the Option or "after treatment" conditions); change in profitability might also be included;

6. Other impacts, such as changes that occur which we cannot attribute to the conservation treatment: these include changes that we are unable to explain or quantify, but which are observable;

---

2 Information on the costs and returns associated with a case study can be developed to help market conservation. Consult your state economist for assistance.

---
7. Did the "after treatment" condition fulfill SCS/District goals as well as the farmer's needs and objectives?

8. Other observations? Lessons learned? Information gaps and research needs?

Remember that the purpose is to develop meaningful effects information that can help explain the features and benefits of conservation treatments.

Developing Case Studies in a Group Setting

One of the most interesting and productive ways to develop case studies is through the simultaneous conduction of numerous studies by a group of employees working within a specified geographic area.

Group interaction could greatly facilitate development of case studies and training in their development and use. For example, suppose that each conservation planner within a given area develops one complete case study during the fiscal year.

Assuming that they could be completed within one year, such an effort could be part of a regional staff meeting, e.g., an Area/Field Office meeting. The initial meeting could be used to explain the case study process, set objectives, develop farmer selection criteria, identify and assign study priorities, and establish target dates for review and completion.

In order to gain the most from group interaction, case studies could either be assigned so that all participants work on the same resource/landuse situation or on completely different situations.

Working in one group would concentrate attention on a common theme and enrich the depth of mutual understanding of both the case study process and the technical aspects of treatments. Working individually or in small groups would facilitate a broader understanding of multiple situations and avoid duplication of efforts.

At subsequent staff meetings, planners could make a brief report on their case study progress. The conservation plan itself, as well as the case study, will likely be improved by the observations, questions, and suggestions of your colleagues. Omissions or needs for additional effort might be identified with everyone benefiting from the experience of others. Such efforts would have a positive influence on the participant's interest in case studies and the quality of the work performed.

Once the first follow-up session has been completed, studies, reports, or display sheets could be shared among the participants to maximize the transfer of information. Examples of particularly effective write-ups and data displays will be helpful to everyone involved even if the data itself is not pertinent for use in other areas.

In subsequent years, effort should be directed towards filling the gaps in our understanding of existing case studies and determining other potential case study topics that could be developed in the future. Improvements could be achieved through additional data on already completed case studies and additional efforts with new farmers.

In most cases, planners should be encouraged to undertake at least one case study per year to maintain their skills of observation, analysis, and reporting.
Conducting case studies should not require significant efforts beyond normal conservation planning activities. Properly structured, they will provide more insights on actual results from conservation treatments experienced by producers in your area.

These insights will improve your knowledge of the outcomes experienced by farmers. Therefore, you will be able to express your recommendations for treatment in a more credible manner because of greater "product" knowledge and understanding. Farmers will recognize this expertise and your effectiveness will increase accordingly.

You will also be better able to apply "Professional Selling Skills" and other conservation marketing concepts to identify and target priority resource problems and potential cooperators.

Case studies will also help build a permanent record of treatment results that are very useful for selling conservation and that won’t disappear as employee retirements and transfers occur. They should also serve technology transfer purposes when shared between field offices and with other interested parties. The information contained in a case study enables planners with various levels of experience to have access to the knowledge of the best.

Finally, going through the process of developing and evaluating a case study could be an excellent training exercise for new employees to refine their knowledge of planning and to enhance measurement skills and use of the predictive models.
Whole Farm Case Studies: A How-To Guide

H. Murray, D. Green-McGrath, L.S. Lev, and A.M. Morrow

Agricultural scientists recognize farmer knowledge and experience can provide important contributions to the development of new agricultural technologies. However, insufficient use has been made of this valuable resource because farmer knowledge and experience are difficult to collect, quantify, and evaluate. Some agricultural scientists argue that farmers’ experiences and observations are unique to a specific site or situation, and information learned is not transferable to others. Scientists rely on research-based information derived from replicated experiments that are, for the most part, reductive in nature. Farmers, on the other hand, often question the relevance of small, controlled, and replicated plot research conducted on research stations rather than farms under normal farm constraints. The discussion about the relevance and value of scientific agricultural research and farmer knowledge quickly becomes complex.

How can scientists and farmers work together to incorporate their collective knowledge to make agricultural research more efficient and effective? One approach we have used is whole farm case studies (WFCS). Case studies offer a systematic means of compiling information in complicated areas of human endeavor, providing useful observations that go beyond the range of controlled experiments. Whole farm case studies can be used as a complement to, but not a replacement for, other methods of research. Whole farm case studies contribute the most when they are part of a larger research and extension program.

Helene Murray, former Sustainable Agriculture Project associate, Department of Soil and Crop Science; Daniel Green-McGrath, Extension agent, Marion County; Larry S. Lev, Extension economist; and Alice Mills Morrow, Extension family economics specialist, Oregon State University.
other forms of scientific research. When used as a single tool in a project, their value diminishes because much of the information learned will not be put to use. They can, however, provide insights into how systems work, and can help identify what is important to clientele. Most importantly, case study research provides an avenue for increasing farmer involvement in research and extension activities.

For More Information


Ordering Instructions
EM 8558, Whole Farm Case Studies: A How-To Guide, is available at no charge from Oregon State University Agricultural Communications. Also available at no charge is EM 8554, Farmer-Scientist Focus Sessions: A How-To Guide.

You may order up to six no-charge publications without charge. If you request seven or more no-charge publications, include 25 cents for each publication beyond six. Send order and payment to:

Publications Orders
Agricultural Communications
Oregon State University
Administrative Services A422
Corvallis, OR 97331-2119

We offer discounts on orders of 100 or more copies of a single title. For price quotes, please call (503) 737-2513.

This originally was issued as a Working Paper in Economics, No. 93-103, funded by two USDA grants: “Information Delivery System for Use in Implementation of LISA Research and Technology” and “Evaluation and Design of Low-Input Sustainable Vegetable/Small Grain and Small Fruit Systems of Western Oregon and Washington.”
Whole Farm Case Studies of Horticultural Crop Producers in the Maritime Pacific Northwest

Helene Murray, OSU/WSU Sustainable Agriculture Project Associate
Richard Dick, OSU Soil Scientist
Daniel Green-McGrath, OSU Extension Horticulturist, Vegetable Crops
Lorna Michael Butler, WSU Extension Anthropologist
Larry S. Lev, OSU Extension Agricultural Economist, Marketing
Richard Carkner, WSU Extension Agricultural Economist

ORDERING INFORMATION

If you would like additional copies of this publication, please order by title and series number: SB 678 Whole Farm Case Studies of Horticultural Crop Producers in the Maritime Pacific Northwest. If ordering more than six copies, enclose 25¢ for each copy for shipping and handling costs.

Publications Orders
Agricultural Communications
Oregon State University
Administrative Services A422
Corvallis, OR 97331-2119
(503)737-2513.
# CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Executive Summary</td>
<td>5</td>
</tr>
<tr>
<td>Introduction</td>
<td>7</td>
</tr>
<tr>
<td>Methodology</td>
<td>8</td>
</tr>
<tr>
<td>Identification of Participants</td>
<td>9</td>
</tr>
<tr>
<td>Data Collection and Analysis</td>
<td>12</td>
</tr>
<tr>
<td>Findings</td>
<td>14</td>
</tr>
<tr>
<td>Descriptions of Farms and Farm Families</td>
<td>14</td>
</tr>
<tr>
<td>Soil and Soil Fertility Management</td>
<td>18</td>
</tr>
<tr>
<td>Plant Protection</td>
<td>19</td>
</tr>
<tr>
<td>Vegetation Management</td>
<td>19</td>
</tr>
<tr>
<td>Insect Management</td>
<td>21</td>
</tr>
<tr>
<td>Plant Disease Management</td>
<td>22</td>
</tr>
<tr>
<td>Business Management</td>
<td>24</td>
</tr>
<tr>
<td>Family Participation</td>
<td>24</td>
</tr>
<tr>
<td>Sources of Farming Information</td>
<td>25</td>
</tr>
<tr>
<td>Labor</td>
<td>26</td>
</tr>
<tr>
<td>Marketing</td>
<td>27</td>
</tr>
<tr>
<td>Record-keeping Systems</td>
<td>29</td>
</tr>
<tr>
<td>Insurance Coverage</td>
<td>29</td>
</tr>
<tr>
<td>Land, Capital, and Equipment</td>
<td>29</td>
</tr>
<tr>
<td>Problems and Challenges</td>
<td>31</td>
</tr>
<tr>
<td>Summary</td>
<td>32</td>
</tr>
<tr>
<td>Implementation Team Interaction</td>
<td>32</td>
</tr>
<tr>
<td>Research and Educational Needs</td>
<td>35</td>
</tr>
<tr>
<td>Implications and Conclusions</td>
<td>38</td>
</tr>
<tr>
<td>Bibliography</td>
<td>39</td>
</tr>
</tbody>
</table>
Farmer/Scientist Focus Sessions: A How-To Guide

D. Green-McGrath, L.S. Lev, H. Murray, and R.D. William

What Are Farmer/Scientist Focus Sessions?

Farmer/Scientist focus sessions are collaborative learning experiences in which farmers and scientists work together as peers to solve a problem. These focus sessions are an effective approach to dealing with especially complex or urgent questions facing the agricultural community.

Traditionally, scientists have communicated with farmers in two principal ways (see Figure 1). When scientists seek to transmit information to farmers, they depend on lectures, publications, and demonstrations. The information provided is intended to increase farmers' knowledge and potentially influence their actions.

When scientists seek to gather information from farmers, they use methods such as surveys and focus groups. Scientists gather information either to answer a current question or to direct future research.

Farmer/Scientist focus sessions, along with other activities such as jointly managed on-farm experiments, are a third and different style of communication between farmers and scientists.

Focus sessions take advantage of the creativity and synergism that occur when farmers and scientists listen carefully to each other and learn as a team. Because the focus session is a collaborative process of problem solving, it gives all participants the chance to influence the thinking and action of others and to discover promising new approaches for themselves.

The philosophy and techniques for collaborative problem solving described in

Figure 1.—Types of farmer/scientist communication.
most complete picture of a given problem and the most comprehensive list of alternative strategies for solving that problem that are available at the time. Individuals can use this document in developing their own courses of action.

- Identification of important questions that need more research, and a framework for the research that considers the whole picture.
- An enhanced sense of teamwork between farmers and scientists.

For More Information


LEARNING METHODS FOR SUSTAINABLE AGRICULTURE AND ENVIRONMENTAL AND ECONOMIC DIMENSIONS OF SUSTAINABILITY

DECISION CASE STUDY

LEARNING METHOD: Participatory Learning with a Decision Case Study

PRESENTED BY: Tammy Dunrud (Nebraska)
Steve Simmons (Indiana)
Program for Decision Cases
University of Minnesota

SUMMARY (by C.A. Francis):

Decision cases were pioneered in business colleges and are widely used in such programs around the world. The method recently has been adapted to create participatory learning environments for agriculture, natural resources and the environment. A decision case is focused around a clearly-defined decision maker, who is struggling with a dilemma to which there is no obvious solution. This learning method provides a way to approach complex systems or situations that cannot be reduced to limited variables. Often there are resource, environmental, or ethical dimensions to the questions or cases presented. Decision cases bring a real world relevance and non-academic dimensions to the complex issues that face society. This learning paradigm may incorporate the importance of experience, the power of social values, and the growing awareness of environmental impact of human society in decision making within agriculture, natural resources and food systems. This method is a useful compliment to conventional teaching methods.

KEY REFERENCES:


A Case for Case Study

Steve R. Simmons,* R. Kent Crookston, and Melvin J. Stanford

In 1908, Edwin Gay, the first dean of the newly instituted Harvard Business School, predicted that use of case studies would become widespread in courses of the college (Copeland, 1955). That visionary, and at the time controversial, prediction provided the beginning for what has become one of the most advanced and successful case educational programs in the world. Decision cases developed by the Harvard Business School now number in the thousands and are used in business and management programs at hundreds of colleges and universities around the world.

The recent decision by the Editorial Board of the Journal of Natural Resources and Life Sciences Education to publish decision cases could prove to be as important for stimulating case use in agriculture, natural resources, and the life sciences as Dean Gay's advocacy was for Harvard.

Although agriculture, natural resource and life science educators have long used problems, simulations, and descriptive case situations in their class and extension education efforts, the use of decision cases is relatively new to these fields. Since 1987, the College of Agriculture at the University of Minnesota has been promoting the development and use of decision cases in courses within the college. We have been participants in this effort and, as case teachers, we have found great satisfaction in using decision cases to enrich our programs.

What are Decision Cases? Decision cases have been described as "a documentation of reality." Specifically, a decision case describes an actual (not simulated or contrived) situation or dilemma requiring that a decision be made. Within this issue of the Journal are three decision cases that we hope will be the first of many to be published in future issues. The protocol and format for decision case development and publication are well established within the business and management professions. However, there have been interesting challenges in adapting the concept of decision cases to agricultural or scientific contexts. But our experience at Minnesota, where more than 25 decision cases have been developed to date, has convinced us that case studies are very well suited to our professions.

What is Unique about Decision Cases? The difference between a decision case and other case-like educational experiences that we and others have used is subtle, but profound. The atmosphere of interest, curiosity, and informed debate created by a well-developed decision case serves as a powerful catalyst for student learning and participation. Decision case teaching can be intense. Some cases precipitate arguments and some students are frustrated when the instructor insists that "There is no one right answer." Good cases usually lead to several plausible or compelling decision possibilities, each standing the test of sound reasoning and technical validity. Most importantly, students learn that although more data would be desirable and that no perfect solution seems to exist, a decision still must be made. Such is the stuff of decision making in the "real world." The more that we can prepare students to function in such situations, the better professionals they will be.

A former Harvard case teacher, Charles Gragg, wrote a classic article entitled "Because Wisdom Can't be Told" (Gragg, 1940). In it, Gragg maintained that the mere act of listening to wise statements and sound advice does little for anyone. In the process of learning, the learner's dynamic cooperation is required... students are provided with [case] materials which make it possible for them to think purposefully. They are not given general theories or hypotheses to criticize. Rather, they are given the specific facts, the raw materials, out of which decisions have to be reached in life and from which they can realistically and usefully draw conclusions [italics added for emphasis].

Gragg proceeded to make a convincing argument that decision case educational experiences lead to the development of professional "wisdom."

Why Publish Decision Cases? Although agricultural and other scientific educators might conceivably publish cases in business-oriented journals, it is unlikely that they would have the readership of those published in a forum devoted to these fields. Since 1987, the College of Agriculture at the University of Minnesota has been promoting the development and use of decision cases in courses within the college. We have been participants in this effort and, as case teachers, we have found great satisfaction in using decision cases to enrich our programs.


Journal Requires Format for Decision Cases

Contemporary interest in providing problem-solving and decision-making experiences in education has prompted the adaptation of decision cases to agricultural, natural resource, and life science situations. At the 1990 annual meeting of the American Society of Agronomy, the Journal of Natural Resources and Life Sciences Education Editorial Board approved the publication of decision cases suitable for use in classroom or extension education situations. The following guidelines describe the format for publication of decision cases. Prospective authors will find it helpful to consult these guidelines in manuscript preparation to ensure minimal editorial delay.

Decision Case Guidelines in the Journal of Natural Resources and Life Sciences Education

I. Criteria for Evaluation

Primary consideration is given to original cases that describe actual situations (not simulations) requiring a decision. Decision cases should foster integration of concepts, use of problem-solving skills, application of technical information, and/or consideration of human, societal, and ethical factors. Appropriate decision-maker roles for published cases include producers, scientists, or other professionals, educators, and policymakers. Criteria for acceptance of decision cases are:

1. Cases must describe an actual (not simulated) situation that advances understanding or teaching of decision making
2. Cases must be thorough and well-documented (e.g., adequate exhibit support)
such as the Journal of Natural Resources and Life Sciences Education. Most importantly, it is imperative that a large number of high-quality decision cases in a number of disciplinary contexts be developed and shared if the use of decision cases is to proliferate in agriculture, natural resources, and the life sciences.

Case development and writing is hard work; it requires considerable time and effort to identify a suitable decision maker and decision focus, to research the case background and supporting data, and to elucidate the decision issues and alternatives. Such scholarship must have a ready outlet for publication if professionals are to be expected to commit the effort needed to develop cases. Although some modifications are usually necessary to convert a class or extension-tested decision case into a refereed manuscript, it is one of the best options available for informing other professionals about the case, its attributes, and its potential utility for their educational activities. Peer review also helps to assure high and consistent quality for cases that are shared among institutions.

Summary. There has been considerable emphasis of late on the importance of higher-order outcomes in education. Such outcomes include developing students' critical thinking and problem-solving abilities, helping them deal with ambiguity and the assessment of risks, and enhancing their decision-making skills. We have found that decision cases directly and successfully address such outcomes. Decision cases are not equally suited for every educational purpose (Dooley and Skinner, 1977), but they are a powerful part of the educator's "tool box." The inclusion of decision cases as a regular feature in the Journal of Natural Resources and Life Sciences Education is a positive step and should help stimulate the development and publication of good cases. We applaud the Journal's action and encourage readers to consider whether they might develop, publish, and use decision cases in their educational and professional activities.

REFERENCES


Your comments concerning the content of this editorial or other published material in this journal are welcome at any time. Please send your letter to the Editor to: David A. Munn, NLE Editor, The Ohio State Univ., Agricultural Technical Institute, 1328 Dover Road, Wooster, OH 44691.

(continued from p. 2)

3. Cases must address topics and issues of interest to a broad educational audience
4. Cases must be clearly and concisely written

II. Format Specifications

Abstract. A clearly worded abstract of the case situation including description of the decision maker, decision focus, key issues, and case objectives/use. The abstract should contain a maximum of 250 words.

The Case. The case text should be interesting and easy to read. An introductory paragraph preceding the case should set forth the context of the case, including citation of other published cases of relevance to the case being presented. The case description should permit the reader to fully understand the background and specific considerations of the case. The text should allow the reader to readily identify with the decision maker(s) and the decision. The objectives of the decision maker should be evident in the case, either by explicit mention or by inference from other case information. The alternatives or options of the decision maker in dealing with the issues should also be clear to the reader. The concluding paragraph of the case should refocus on the major issue(s). It is convention to write cases in past tense.

Exhibits. Effective cases are usually supported by relevant exhibits. Examples of exhibits include data bearing on the decision, illustrations, background documents, correspondence, etc. Exhibits should be drawn from actual, unaltered sources (exceptions may be made when confidentiality must be protected) and should be referenced in the appropriate places within the case text. Case exhibits should be well-organized and concise and should not contain information that is irrelevant to the case. Exhibit information taken directly from citable publications should be referenced. Exhibits should be numbered in the same order as they are referenced in the case.

Teaching Note. The teaching note describes the objectives of the case and the principal issues considered. This section of the manuscript should provide the reader a concise interpretation of the significance and educational value of the case. The section should also describe how the case has or might be used in a classroom or extension education context. If the case has been used, the teaching note may provide a summary of student evaluations of the case. The teaching note may also include the author's analysis of the case, although the detail provided in this analysis may be limited to protect the potential use of the case by readers. Educators interested in teaching the case can usually obtain a full copy of the author's analysis by corresponding directly with the author. The teaching note is particularly important for assisting readers in deciding whether or how to use the case.

References. Citable references in the case text, teaching note, or exhibits should be listed. Use the author/year system for citing references.

Abridged Case Format. Some cases cannot be published as complete cases due to their length or complexity. Such cases may be published in an abridged case format. All abridged cases submitted for publication, regardless of length or complexity, must be reviewed in their entirety prior to acceptance. No case will be accepted unless both the complete case and abridged version has been favorably reviewed by the reviewers and editors. Text of abridged cases should be identified as "Case (Abridged)." The text of an abridged case, as well as the teaching note, should be of sufficient length and detail to permit readers to understand the nature of the decision, the identity of the decision maker(s), the principal issues of the case, and the educational value of the case. The abridged text and teaching note should contain sufficient information to allow readers to assess the potential for use of the case. Important exhibits should also be presented whenever possible. As a minimum, abridged cases should contain a complete list and brief description of all exhibits referenced in the complete case. If readers are interested in teaching a case published in abridged format, they should request a copy of the complete case directly from the corresponding author.

Examples of complete and abridged cases are published in the Journal of Natural Resources and Life Sciences Education (see pages 9–26). Prospective authors may reference these for guidance on format and style. See a recent issue of the Journal for the "Suggestions for Contributors" page for contribution guidelines and style information (see p. viii).
This case catalog has been developed by the Program for Decision Cases to facilitate dissemination of cases developed by faculty and students within the College of Agriculture, University of Minnesota. Their goal, which is also that of the Program for Decision Cases, is to make education both relevant and applicable to real-world experiences. Teachers who use cases know the power they have to instill professional qualities like: critical thinking, problem-solving and the capacity to make sound decisions using an interdisciplinary approach. These are the qualities and characteristics that the workforce is looking for in graduates. We trust that users of these cases will find them to be powerful tools for providing more effective educational experiences for their students.

The Program for Decision Cases was established in 1991 by the College of Agriculture, University of Minnesota to serve as a catalyst for stimulating case education in agriculture, natural resources and environmental education. This is done through:
- Serving as an information resource to case developers including students, researchers and educators.
- Acting as a support network to case developers and users.
- Extending case education to new disciplines and audiences.
- Promoting an approach to decision-making that encourages more reflective and analytical practice.
- Disseminating high-quality cases to educators, students and researchers.

Use of this catalog
Included in this catalog are twenty-six cases specifically written for higher education and seven that are written for secondary education. All of them focus on one of three areas: agriculture, natural resources and environmental studies. Several of the cases are also suitable for extension education settings. All of the cases have a teaching note available which is written for the case teacher only. It includes objectives for the case, possible discussion questions and additional background information from the case developer. The case teacher can adapt information from the teaching note to meet diverse audience needs.

To aid in your choice of which decision cases to order, a short abstract is given for each case. The cases are also listed by a topic index so you can readily find cases for specific areas of interest. We invite you to browse through the catalog and request examination copies of those cases that might be appropriate for your course or extension settings. To order those cases, fill out the order form at the back of the catalog. The ordering information and cost is included on the order form. If you have questions, please contact the Program for Decision Cases and we will be happy to assist you.

DECISION CASE CATALOG
FIRST EDITION, FALL 1994

CASE TOPIC INDEX

AGRI-INDUSTRY: Agriserve Crop Insurance (001), Agricultural Manager’s Dilemma at St. Croix Foods (008), Lindenman Vegetable and Herb Farm (016), Grain Deterioration in Green Grain Bin No. 3 (020)

AGRICULTURE-SOCIETY RELATIONS: Carpenter Orchard (003), The Worth of a Sparrow (018), Minto Brown Island Park (019)

AGROECOLOGY: Gustavson Farm (014), Minto Brown Island Park (019), Trees of Sogolonbougou (022), Seeds of Discord (026)

DIVERSIFICATION: Mueller Farm (017), Beach Dairy Farm (024)

CROP MANAGEMENT: Red River Valley Crop Consultant (004), Red River Crop Consultant II (005), Goss Farm (006), Peterson Farms (009), Manomen Development Corporation (011)

ENVIRONMENT: Carpenter Orchard (003), Goss Farm (006), Kalmes Farms (010), In the Eye of the Beholder (021), Dandelion Dilemma (025), Seeds of Discord (026)

ECONOMICS: Metz Farm (002), Goss Farm (006)

EXTENSION: Kalmes Farms (010), Minnesota Sunflower (023), Dandelion Dilemma (025)

INTERNATIONAL: Trees of Sogolonbougou (022), Seeds of Discord (026)

NATURAL RESOURCE CONSERVATION: Minto Brown Island Park (019), Trees of Sogolonbougou (022)

PESTICIDES & PEST MANAGEMENT: Goss Farm (006), The Containment of P. Sorghl (013), Gustavson Farm (014), Minnesota Sunflower (023)

SUSTAINABLE AGRICULTURE: Goss Farm (006), Dick and Sharon Thompson’s Problem Child (012), The Sustainable Farm (015), Trees of Sogolonbougou (022), Beach Dairy Farm (024)

TECHNOLOGY ADOPTION: Metz Farm (002), Mueller Farm (017), Beach Dairy Farm (024)

WATER QUALITY: Goss Farm (006), Kalmes Farms (010)
**ORDER FORM**

(Please fill in billing and shipping information on back).

<table>
<thead>
<tr>
<th>Case #</th>
<th>Case Title</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Number of case copies x $2.00 per copy * ______

Total of merchandise ______

Add 10% for shipping and handling ($20 maximum) ______

TOTAL ______

This catalog is available in alternative formats upon request. Please contact:

Program for Decision Cases
411 Borlaug Hall
University of Minnesota
St. Paul, MN 55108
Tel. 612-624-1211
Concern in this society about water and air quality has resulted in a number of

government regulations on agriculture and other sectors. Participation in government

support programs is contingent on using soil conserving and non-polluting practices on

the farm. Since agriculture has been identified as a major non-point source of some

pollutants, attention of environmental and other public interest groups has focused on

reducing these unintended impacts of food production. One major advantage of

sustainable practices and systems is the potential for reduction of pesticide, fertilizer,

and soil loss from production fields. The reduction in input purchase and substitution

of internal, renewable, non-purchased resources from the farm can result in

considerable cost savings for the producer as well as water quality and other benefits

for the broader environment.

Soil and water quality receive major attention today in the rural areas of the United

States. People who live in smaller communities are concerned about their domestic

water supply as well as that needed for livestock. Costs of soil erosion are paid in the

short term by society, as we pay for extra water treatment, cleaning of harbors,
culverts and road ditches, and shorten the useful lives of dams and other water control
structures. In the long term, the costs of productive topsoil loss are even greater as we
defer these costs to future generations. A thoughtful discussion on environmental
impacts of sustainable practices and systems includes the viewpoints of producers,
federal agency specialists, downstream users and representatives of environmental and
other non-profit organizations.
Agroforestry involves planting conservation trees to work for your farm, family and future. The objectives of this paper are to describe the common agroforestry practices and the benefits they provide. Agroforestry may be defined as:

An intensive land-management system that optimizes the benefits from the biological interactions created when trees and/or shrubs are deliberately combined with crops and/or livestock (Garrett et al., 1994).

Agroforestry systems can provide many benefits. Depending on the agroforestry practice established including windbreaks, alleycropping, riparian buffers, etc. the following benefits (Garrett et al., 1994) can result:

- Increased productivity during successional changes
- Improved economic efficiency
- Increased biodiversity in agricultural landscapes
- Decreased wind and water erosion
- Enhanced biological regulation of major insect problems
- Increased efficiency in use of solar radiation
- Increased soil organic matter
- Decreased agricultural derived contaminants in riparian zones
- Increased uptake and fixation of atmospheric carbon dioxide
- Increased nutrient retention via greater exploitation of soil profiles
- Decreased weed competition

Each of the different agroforestry practices provide different benefits. The following agroforestry practices are usually oriented in rows:

- Farmstead windbreaks
- Field borders
- Field windbreaks
- Alley cropping
- Livestock windbreaks
- Living snow fences

When windbreaks are discussed with most landowners, the value of farmstead windbreaks is generally recognized. In fact, that is usually the first windbreak planting opportunity for most farmers. A farmstead windbreak provides a number of benefits to the owner (Wight, 1988). Some of these benefits can be easily translated into dollars but others are intangible. These benefits include:
The energy savings of 10 to 40% for the home and other buildings results primarily from reduced heat losses from air infiltration (DeWalle and Heisler, 1988). Windbreaks in northern climates will provide larger savings. The better built the home resulting in lower air infiltration, the lower the savings will be.

Farmstead windbreaks can also prevent problem snow drifts around buildings. The cost savings from less snow removal will vary from year to year but can be substantial. Additional protection is also provided to buildings and equipment from wind damage and to humans who have to work outside throughout the year.

A well established windbreak will increase property values. A rural subdivision in North Dakota established windbreaks prior to selling the lots for homes. The lots were sold for several thousand dollars more than similar lots without trees (Wight, 1987).

Noise from adjoining highways or other noise sources like grain drying equipment can be reduced with a properly placed farmstead windbreak. A 10 to 20 percent reduction in noise can be achieved with well designed plantings. The most reduction results when trees and shrubs are combined with landforms like earth berms.

A second type of row planting is a field border. These are plantings of trees and/or shrubs adjacent to fields which can provide wind protection and other microclimatic changes to adjacent fields similar to field windbreaks. In addition to this, they serve as buffer strips to help enhance water quality and add wildlife habitat.

Field windbreaks are the third row type agroforestry practice. Field windbreaks provide a variety of benefits to adjoining fields and crops including the following (Brandle and Hintz, 1987):

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Percent +/- Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crop Production</td>
<td>+6 to +44</td>
</tr>
<tr>
<td>Wind Erosion</td>
<td>-50 to -100</td>
</tr>
<tr>
<td>Snow Distribution</td>
<td>&gt; +50</td>
</tr>
<tr>
<td>Irrigation</td>
<td>-3 to -22</td>
</tr>
</tbody>
</table>

The energy savings of 10 to 40% for the home and other buildings results primarily from reduced heat losses from air infiltration (DeWalle and Heisler, 1988). Windbreaks in northern climates will provide larger savings. The better built the home resulting in lower air infiltration, the lower the savings will be.

Farmstead windbreaks can also prevent problem snow drifts around buildings. The cost savings from less snow removal will vary from year to year but can be substantial. Additional protection is also provided to buildings and equipment from wind damage and to humans who have to work outside throughout the year.

A well established windbreak will increase property values. A rural subdivision in North Dakota established windbreaks prior to selling the lots for homes. The lots were sold for several thousand dollars more than similar lots without trees (Wight, 1987).

Noise from adjoining highways or other noise sources like grain drying equipment can be reduced with a properly placed farmstead windbreak. A 10 to 20 percent reduction in noise can be achieved with well designed plantings. The most reduction results when trees and shrubs are combined with landforms like earth berms.

A second type of row planting is a field border. These are plantings of trees and/or shrubs adjacent to fields which can provide wind protection and other microclimatic changes to adjacent fields similar to field windbreaks. In addition to this, they serve as buffer strips to help enhance water quality and add wildlife habitat.

Field windbreaks are the third row type agroforestry practice. Field windbreaks provide a variety of benefits to adjoining fields and crops including the following (Brandle and Hintz, 1987):

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Percent +/- Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crop Production</td>
<td>+6 to +44</td>
</tr>
<tr>
<td>Wind Erosion</td>
<td>-50 to -100</td>
</tr>
<tr>
<td>Snow Distribution</td>
<td>&gt; +50</td>
</tr>
<tr>
<td>Irrigation</td>
<td>-3 to -22</td>
</tr>
</tbody>
</table>
Ask most farmers to describe a field windbreak and they will often describe a large, multiple-row windbreak planted in the 1940's. Today's field windbreaks are narrower windbreaks. These are often single-row and certainly no more than two-row windbreaks in most cases.

Most of the benefits are a direct result of the changes in the microclimate on the leeward side of the windbreak. Studies have been done with a number of crops and in many areas to determine the influence on crop production. In fact, a summary of yield studies for major crops from around the world indicates a significant increase in the major crops that are of concern to us in the Midwest. The following table was developed after reviewing current literature from around the world (Kort, 1988):

<table>
<thead>
<tr>
<th>Crop</th>
<th>No. of field-years</th>
<th>Weighted mean yield increase (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring wheat</td>
<td>190</td>
<td>8</td>
</tr>
<tr>
<td>Winter wheat</td>
<td>131</td>
<td>23</td>
</tr>
<tr>
<td>Barley</td>
<td>30</td>
<td>25</td>
</tr>
<tr>
<td>Oats</td>
<td>48</td>
<td>6</td>
</tr>
<tr>
<td>Rye</td>
<td>39</td>
<td>19</td>
</tr>
<tr>
<td>Millet</td>
<td>18</td>
<td>44</td>
</tr>
<tr>
<td>Corn</td>
<td>209</td>
<td>12</td>
</tr>
<tr>
<td>Alfalfa (mixed grasses and legumes)</td>
<td>3</td>
<td>99</td>
</tr>
<tr>
<td>Hay</td>
<td>14</td>
<td>20</td>
</tr>
</tbody>
</table>

Yields are also improved in horticultural crops like fruit orchards (Norton, 1988) and a variety of vegetable crops (Baldwin, 1988) like onions. Honey production is improved with windbreaks by providing a calm area for the bees. Generally, the yield benefits extend from 10 to 15 H (H is the height of the windbreak) to the leeward of a field windbreak and 2 to 5 H to the windward. This yield benefit results in positive economic returns from the windbreak investment (Brandle et al., 1992).

Field windbreaks are considered most often for their reduction of wind erosion. When they are combined with other conservation practices such as conservation tillage and annual crop barriers, an effective wind erosion system can be achieved (Ticknor, 1988). By reducing soil erosion, the potential damage to young crop seedlings from soil abrasion is also reduced.

Managing snow to provide additional moisture for crops is another effective use of field windbreak systems (Scholten, 1988). This is especially important in areas where snow provides a significant proportion of the available moisture. Care must be taken in the design of snow management windbreaks since the size and location of the snow drift is a function of windbreak density.

Snow can be spread evenly across the field with not only tree and/or shrub windbreaks but also herbaceous barriers. A tree and shrub windbreak system supplemented with herbaceous barriers like tall wheat grass or switchgrass is a very effective snow harvesting technique. Systems composed entirely of grass barriers are also very effective in harvesting snow.
Moisture management on irrigated fields is enhanced with field windbreaks. By reducing wind velocity, a windbreak will improve the efficiency of irrigation (Dickey, 1988; Davis, 1988). Windbreaks around and through sprinkler irrigated fields reduce the evaporation losses.

The fourth type of agroforestry practice in rows is alley cropping. Alley cropping is similar to field windbreak layouts with single rows of trees or shrubs planted at varying widths with crops grown in the "alleys" between the tree rows. The major difference with field windbreaks is that the rows of trees or shrubs are planted with the intention of obtaining a product in the future such as wood or nuts instead of just protecting the crop. Some of the benefits of alley cropping include:

- Reduce water and wind erosion.
- Improve crop production.
- Supplement income.
- Provide wildlife habitat and travel corridors.
- Improve aesthetic diversity.

Windbreaks also have a significant role to play in protection of livestock. They improve animal health, increase feed efficiency, and improve survivability during stress periods such as winter and spring storms. The benefits of livestock windbreaks include:

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Percent</th>
<th>+/-</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feed</td>
<td>-10 to -30</td>
<td>Variable</td>
<td></td>
</tr>
<tr>
<td>Livestock</td>
<td>-10 to -30</td>
<td>Variable</td>
<td></td>
</tr>
</tbody>
</table>

All animals increase food intake and energy expenditure when subjected to temperatures below their comfort zone. For example, the estimated lower critical temperatures for beef cattle are:

- Summer coat or wet: 59°F
- Fall coat: 45°F
- Winter coat: 32°F
- Heavy winter coat: 18°F

Each degree below this critical temperature is considered a degree of cold. Increased maintenance energy costs occurs for varying sizes and coats of beef cattle. For example, a 660 pound beef animal with a winter coat will need approximately 1.1 percent more feed for each degree of cold below 32°F (Hintz, 1983).

Wind chills contribute to this impact on livestock energy needs. Windbreaks can reduce this impact by lowering wind velocities by as much as 70 percent. Let's look at an example of the amount of energy demand on a 660 pound beef animal with a winter coat. The air temperature is 20°F and the critical temperature is 32°F. For a 20 mph wind the wind chill on this animal will be 0°F in the open and 13°F behind a windbreak. When these two wind chills are subtracted from the 32°F critical temperature, the degrees cold can be determined:

\[32°F - 0°F = 32 \text{ degrees cold in the open}\]
\[32°F - 13°F = 19 \text{ degrees cold behind a windbreak}\]
The degrees cold are then multiplied times the percent increase in energy cost for each degree cold. In this case it is 1.1 percent:

32 deg. cold (in open)  \( \times 1.1\% = 35\% \) increased energy need
19 deg. cold (with windbreak) \( \times 1.1\% = 21\% \) increased energy need

In this situation the windbreak provides a 14% savings in energy needs of the beef animal. This translates into less feed demands or less weight loss. Thus a livestock windbreak can mean added profits not only from feed savings but may also mean the difference between life and death for animals caught in a storm.

Snow and cold is not only dangerous to livestock but humans as well. Living snow fences are designed to keep snow off transportation corridors. The savings for snow removal, use of slatted snow fence, and traffic flow will vary from year to year but can be significant. Plowing through drifts versus a well designed living snow fence results in major energy and time savings for individuals and taxpayers.

In addition to row type agroforestry plantings, block type tree and shrub plantings can also add economic and ecological diversity to a farm. For example, Christmas trees can provide a favorable economic return if adequate markets exist.

Many of the agroforestry practices provide wildlife habitat as a secondary benefit. However, some landowners may want to focus on encouraging wildlife by planting specific areas with clumps of trees and shrubs. These special plantings can key into specific wildlife needs such as food, cover or living space. Locating these plantings near water sources will enhance their wildlife value. Wildlife plantings are often made for the pure enjoyment of the landowner or can result in economic returns with fee hunting or nature observation.

Other block agroforestry practices include nut and/or fruit orchards which add economic diversity to a farm operation. In certain parts of the country, primarily in the South, investigations are being made to combine livestock grazing of forage under pine plantations as a means of obtaining both short and long range economic returns from a field.

Riparian vegetation not only provides many aesthetic qualities to the landscape but plays a major role in water quality. Some of the benefits of riparian trees include:

- Reduce floods & erosion
- Trap nutrients
- Home for wildlife
- Store water
- A place for people to enjoy

Another economic opportunity may involve producing trees for landscape uses. Again the market needs to be analyzed first before jumping into production. The final block type agroforestry practice involves planting fast growing trees in a plantation for fiber production or for fuelwood either as chips or cordwood.

In conclusion, agroforestry can be the answer to:

- Biodiverse habitats for humans and wildlife.
- Enhancement of local ecosystems.
- Reduction of resource problems and costs.
With your interest and help, landscapes with few trees and diversity can be transformed into multiple species and practices that can enhance the farm, family and future.

REFERENCES


The Economics of Sustainable Agriculture: Adding a Downstream Perspective

Fred J. Hitzhusen

INTRODUCTION

The objectives of this downstream perspective and assessment of the economics of sustainable agriculture are: (1) to explain to a general audience (broader than economists) that sustainability from an economic perspective as a minimum requires accounting for both on and off-site effects of economic activity, (2) to focus on soil erosion and related water quality impacts (including changing property rights) as the major sub-set of downstream economics of alternative farming systems, and (3) to present some empirical results and policy implications of Ohio downstream impacts which would seem to be generalizable to many other settings.

There are many points of view on the concept of sustainability as it relates to natural systems including agriculture. Dixon and Fallon suggest that these viewpoints can be grouped into three distinct categories including: (1) a purely physical concept for a single resource such as a fishery where the rule is to use no more than the annual increase in the resource, i.e., maximum sustainable yield, (2) a physical concept for a group of resources or an ecosystem where a variety of system outputs involve trade-offs, i.e., individual resources may be enhanced, maintained or degraded to maintain system integrity, and (3) a social, physical, economic concept with emphasis on economic rationality and efficiency.

Although the words 'economics' and 'ecology' share the same root (oikos or house), the meaning of sustainability is not the same or singular from an economic perspective. A farmer's view of economic sustainability is primarily the long term profitability, liquidity or solvency of the farm business. A laissez-faire economic approach would suggest that sustainability is a non-issue in the sense that technology and relative prices of capital, labor and natural resources such as land and water determine the efficient/profitable levels or combinations of their use. As long as one can substitute capital or labor for natural resources there is no problem.

Problems may arise when some economic impacts are external to the seller and buyer and property rights are not clearly defined, or when tenure or lease agreements are short term and not conducive to soil conserving investments. Examples of external impacts include chemical contaminants in an underground water aquifer or externalities such as soil sediment impacting harbors and lakes, and sediment, nitrate and pesticide impacts on surface water treatment plants. These situations require some notion of "shadow pricing" that is, valuing natural resource non-market services or alternatively stated, valuing the external impacts on the natural environment. Cases involving critical threshold resources may require a safe minimum standard approach (e.g., maximum safe levels of nitrates in well water) to assure sustainability or deal with uncertainty about future repercussions. In either case, poorly defined property rights on lake and harbor sedimentation or water quality impacts makes it difficult to establish proper tax, compensation, or other schemes to internalize or correct the problems.

Another way of viewing the notion of a shadow price for soil erosion related to off-site damage is to argue for a broader accounting stance such as a watershed to evaluate these important economic impacts. This may result in the transfer of some property rights from the farmers (or taxing of farmers) to those impacted downstream, particularly if on-farm practices are contributing excessive soil loss and if the off-site economic impacts are large. The social profitability of a given farming enterprise in this context becomes the economic gains and losses to not only the farmer, but to any...
downstream residents who may stand to lose (e.g., higher water treatment costs) or gain (e.g., new deposits of nutrient rich sediment) from the enterprise.

SOIL EROSION CONTROL

Historically, soil erosion control programs have focused on preventing damage to on-farm productivity and resultant losses in land values. Much debate exists regarding on-site productivity losses, particularly the value of nutrients carried away with eroded soil. The best historical evidence is provided by Crosson and Stout. They analyzed U.S. county level soil loss data for 1950 to 1980 and concluded that the resulting yield loss was 2 to 3 percent over this 30-year period. In contrast, recent estimates of off-site damage costs of soil erosion indicate that these may often exceed the cost of on-site damage. Strohbehn concluded that "off-site benefits may account for two-thirds of total erosion control benefits." Gutermann et al. found off-site economic costs several times larger than on-site productivity losses in five representative Illinois watersheds.

National aggregate off-site cost estimates for soil erosion establish the magnitude of the problem; Clarke, Havercamp, and Chapman estimated total annual off-farm costs for all agricultural erosion sources to range from $3-$13 billion with a point estimate of $6.1 billion of which $2.2 billion was attributed to cropland erosion (in 1980 dollars). Damage to recreational uses accounted for the largest share of costs—comprising nearly 33 percent of total costs, and boating was the largest recreation sub-group. Other high impact receptors or users and their percent of total costs included municipal and industrial (14.8), water storage facilities (11.3), dredging (8.5), and preservation values (8.2). Cropland erosion was the largest source at 38 percent of total erosion. A re-analysis of these results suggested a $7.1 billion point estimate (Ribaudo, 1986a).

More recent analysis of the Conservation Reserve Program (CRP) by Ribaudo et al. (1989) found that water quality benefits from the first 23 million acres enrolled in the CRP totalled $2.05 billion or an average of $89 per acre. This suggests that Ribaudo's 1986 point estimate should be adjusted downward by about $2 billion. However, both the Clark and Ribaudo analyses omit several categories of downstream impacts (e.g., dredge spoil disposal, delays to commercial shipping, biological impacts, etc.) which may make their estimates very conservative.

Spurred by this accumulating evidence, the conservation provisions of the Food Security Act of 1985 provided for a number of programs to retire or alter tillage practices on certain highly erodible acres that "pose an off-farm environmental threat." Although this represents a shift in federal erosion control policy, the actual targeting of program acreages continues to be made primarily on the basis of technical measures of soil erosion at the farm level, such as "T values" (Strohbehn). While these technical measures provide a convenient tool for addressing on-site erosion control policy, they may be unreliable indicators of off-site damage (Erwin and Blase; Runge, Larson and Roloff; Ribaudo, 1986).

In their simplest form, soil erosion off-site impacts can be conceptualized as an externality of farm production where the marginal private costs of the farmer diverge from the marginal social cost of all watershed residents. As a result, the joint production of crops and soil loss is higher than socially desirable. Alternatively stated, the assimilative capacity of downstream receptors (e.g., harbors, lakes, water treatment plants) for sediment deposition is exceeded. Internalizing this externality results in net gains to economic welfare. This analysis is static, so one must recognize the possibilities for market, technological and property rights adjustments and changes over time.

CHANGING PROPERTY RIGHTS

Most economists have tended to take property rights or entitlements as one of the "givens" in their analysis. Bromley and Hodge (1990) argue that historically property rights in land and in associated agricultural production have been strongly upheld in order to meet the economic pressures for greater quantities of food and fiber. However, these authors argue that income elasticities of demand in the industrialized countries (such as the U.S.) for rural amenities such as improved environmental quality (including pleasing landscapes) and viable rural communities are now higher than they are for increased food and fiber production. This has resulted
in increasing conflict between the presumed "right" of a landowner to do as he or she wishes and the right of other residents of a watershed or members of a society to be free from the unwanted effects of agricultural land use.

This conflict has been evolving in the U.S. over a relatively long period of time. According to Braden (1982), the model state soil conservation district law issued by the USDA in 1936 included provisions for districts to administer land use regulations for controlling soil erosion. By the early 1980s, most states either did not extend this authority to districts or required such regulations to pass stiff referenda. Where the authority has been available, few districts have employed it. Although participation in farm programs is voluntary, swamplubber, sodbuster, cross compliance and conservation plan requirements of the 1985 Farm Bill and pesticide record keeping requirements and graduated fines for sodbuster or swamplubber violations in the 1990 Farm Bill are all examples of changing entitlements in the use of agricultural land.

Reichelderfer (1991) of Resources for the Future confirms that since 1985 penalties have been added to the incentives offered to farmers for resource conservation. She cites federal examples such as the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) which has reduced the number and variety of substances available to farmers for pest control. At the state level, taxes in Iowa on fertilizers and pesticides and liability laws in Connecticut imposed on individuals (including farmers) for groundwater contamination are also cited as examples. Furthermore, this author suggests that future environmental-related reductions in property rights (e.g., increases in taxes and penalties) on farm producers will be associated with the following factors: continued economic growth and thus demand for environmental services relative to food and fiber; rise in relative farm income; growth in size and influence of environmental and public interest groups; rising cost of farm subsidies; and legislative reapportionment in favor of rapidly growing urban areas.

The actual externality relationships between alternative farming systems, gross erosion and water quality and the variations in types and intensities of downstream uses is complex and implies a need for site-specific analysis. Thus, the economic efficiency of soil erosion programs will likely be improved if economic measures of at least watershed level off-site damages are incorporated into the allocation decision process. This occurs since the benefits derived from these programs ultimately depend on the presence of or potential for riparian and in-water uses in a watershed or river basin.

**SOME OHIO EVIDENCE**

In Ohio, the large portion of sediment comes from row crop acreage which is 77 percent of the 15.4 million acres of cropland. Beyond farms, such sediment imposes costs on a wide variety of receptors such as Lake Erie harbors, state park lakes, water treatment plants, and the Ohio River. An unpublished survey in 1983 by the Soil and Water Division of the Ohio Department of Natural Resources estimated annual off-site sediment costs of soil erosion in Ohio at $160 million. In 1988, The Ohio Alliance for the Environment estimated the annual cost of removing sediment from Ohio's lakes, streams, waterways, harbors and water treatment plants at $162 million/year.

One can also estimate annual agriculturally related off-site soil erosion costs in Ohio from the estimates for three regions with common characteristics to Ohio. Ribaudo (1986b) found average annual downstream costs per ton of gross erosion of $9.96 for the Cornbelt, $2.86 for the Great Lakes States and $5.57 for the Northeast. The average of these values (e.g., $ = $3.13) times a 1985 estimate of agricultural erosion in Ohio (68.7 million tons/yr.) gives an annual estimate of over $215 million. As an alternative approach, resource economists at The Ohio State University have analyzed the downstream economic impacts of soil erosion in Ohio on several receptors representative of the major impact categories identified by Clark et al. The purpose of this effort is to develop a policy relevant and cost-effective method for internalizing downstream costs.

Macgregor (1988) used the Ohio Department of Natural Resources State Park Lakes data on lake characteristics, visitations and dredging to estimate the boater value losses and dredging costs due to sedimentation in 46 state park lakes. Macgregor et al. report that sediment deposition was significantly and negatively related to boater visitor days and this coefficient was multiplied by a mean value ($23.92) for a motorized boating recreational day to get
boater value loss. These findings indicate an average boater value loss in the 46 lakes of $0.49 per ton of sediment, but the values ranged from $0.08 to $1.19 per ton of sediment. This emphasizes the need for targeting of soil conservation funds based on off-site economic impacts. The average cost was $1.29 to dredge one ton of sediment in 11 state park lakes where dredging was being done in 1987 and costs ranged from $1.20 to $1.46 per ton. This dredging is funded by boater license fees and a portion of the gasoline tax. Ironically, farmers are exempt from this tax on fuels used in the farm operation.

An analysis by Kabongo and Hitzhusen (September 1989) of Army Corps of Engineers data for 1985-87 on quantities of sediment dredged and contractual costs for 10 Lake Erie harbors shows an average cost of $2.90 per ton of sediment dredged. The costs ranged from a low of $2.26 to a high of $5.14 per ton. A similar analysis shows an average dredging cost in the Ohio River of $2.52 per ton of sediment. The major limitation of the Lake Erie and Ohio River dredging cost analyses is that they do not account for the cost of soil storage or removal which may actually exceed dredging costs in many situations. Figures from Forster and Abrahim for the dredging of drainage ditches in six Northwest Ohio counties indicate an average cost of $1.87 per ton of sediment removed.

Forster et al. estimated the relationship between water treatment costs and soil erosion in 12 public water treatment plants in western Ohio. Independent variables other than soil erosion used in the regression analysis included treatment plant size, storage time of untreated water and turbidity improvement due to water treatment. Results indicate that a 10 percent reduction in annual gross soil erosion results in a four percent reduction in annual water treatment costs. The average increase in water treatment costs per ton of sediment delivered was $0.32 at the 12 treatment plants. For all Ohio communities, it is estimated that annual water treatment costs would decline by $2.7 million with a 25 percent reduction in soil erosion.

The farm level implications of the foregoing downstream research results are summarized for a hypothetical 500 acre farm in Table 1 utilizing observed low (L), mean (M), and high (H) downstream impacts and comparing 15 and 5 ton on-site soil losses/A/
him concluded that socially optimal soil loss is considerably below the on-site productivity related "T" value.

Reduced tillage generally results in less soil erosion than conventional tillage and may show equal to or greater net returns to the farmer. However, reduced tillage, particularly no-till, usually results in the use of more chemicals, particularly pesticides (herbicides and insecticides) which may impact surface and groundwater quality. Research by Barker in 1984 surveyed 139 Ohio farmers in 12 counties to determine the relationship between tillage systems and pesticide use. He found the average pounds of active ingredients of pesticides by tillage systems for corn and soybeans as follows:

<table>
<thead>
<tr>
<th></th>
<th>Corn</th>
<th>Soybeans</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional tillage</td>
<td>3.81</td>
<td>2.63</td>
</tr>
<tr>
<td>Conservation tillage</td>
<td>4.73</td>
<td>2.85</td>
</tr>
<tr>
<td>No till</td>
<td>4.74</td>
<td>3.70</td>
</tr>
</tbody>
</table>

Any water quality related economic impacts of pesticides and fertilizers as well as soil erosion need to be estimated before attempting to optimize on-site production systems based on social or watershed level costs and returns. Unfortunately, estimates of downstream economic impacts of fertilizers and pesticides are very difficult to make and almost non-existent. A first step is to determine if surface or groundwaters have been contaminated. For example, a USEPA (Fall 1990) survey of pesticides in drinking water wells found nitrates, OCPA acid metabolites and atrazine to be the most common contaminants. Testing of 16,166 rural Ohio wells by the Water Quality Lab at Heidelberg College found 2.8 percent of the wells contaminated by nitrates based on the USEPA drinking water standards of 10 mg/L or greater. Atrazine was found in excess of 1.0 g/L (USEPA Health Advisory lower level) in 0.4 percent of the wells tested.

The next step is to estimate clean-up or treatment as well as monitoring and testing costs as one (a conservative) way of monetizing these impacts. In this context, the cost of annually testing just 10 percent of the rural wells for nitrates and selected pesticides in the

<table>
<thead>
<tr>
<th></th>
<th>Corn</th>
<th>Soybeans</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional tillage</td>
<td>3.81</td>
<td>2.63</td>
</tr>
<tr>
<td>Conservation tillage</td>
<td>4.73</td>
<td>2.85</td>
</tr>
<tr>
<td>No till</td>
<td>4.74</td>
<td>3.70</td>
</tr>
</tbody>
</table>
60 Ohio counties most likely to have contaminated groundwater is estimated by Neilson and Lee to be $11.2 million.

Alternatively, it may be necessary to use a constrained optimum or safe minimum standard approach if there is empirical evidence of safe threshold levels of pesticide and fertilizer use and some irreversible human health or other consequences above those levels. Operationalizing these standards is more complicated and some pragmatic compromises may be necessary. For example, in analysis by Repetto and Faeth (1989), an indifference point between the best low-input and best conventional rotations was found at a tax rate of 32 percent on all pesticides and fertilizers. This kind of evidence could be used to formulate a tax strategy to increase low-input (reduced chemical) practices, provide funds for water quality research and reduce off-site chemical impacts to acceptable levels without banning certain chemicals or unduly restricting farmers' choices.

SOME TENTATIVE CONCLUSIONS

It is clear that more empirical evidence is needed regarding on-site and downstream costs (particularly groundwater contamination) and returns of alternative tillage and rotation systems if socially optimal systems are to be identified. However, the evidence to date suggests that on average downstream costs of soil erosion are not trivial and that they exceed the average on-site costs of soil erosion. This implies that some form of tax, subsidy, technical assistance or regulatory intervention may be appropriate and necessary. The evidence also suggests that downstream costs per unit of soil loss can vary dramatically from site to site. This points to the extreme importance of targeting control measures (even if chemical input taxes or penalties are based on average downstream impacts) and to the need for revision of property rights or institutions to assure both efficiency and fairness in remediation.

Neither of these notions, intervention or targeting, is new. In fact, soil conservation policy in the U.S. has a relatively long history of intervening with subsidies and technical assistance. Targeting is a more recent concern with the implementation of the Conservation Reserve Program (CRP) in the 1985 and 1990 Farm Bills to pay farmers to take the most erosive croplands out of production.

What is new or changing is the accumulating evidence on the extent and variability of downstream economic costs of soil erosion and some evidence that public attitudes regarding the right of farmers to impose these costs are currently shifting and will likely continue to do so in the future.

A political consensus on policies for downstream impacts of alternative farming systems is not yet fully evident, but the empirical evidence on the economics of soil erosion to date suggests the following for consideration:

1. Further research and extension of information to farmers on sustainable reduced tillage and expanded rotation systems which reduce downstream costs without reducing profitability to the farmer.
2. More comprehensive research on downstream costs of soil erosion and related chemical contamination of water and identification of any strong correlates or proxies, e.g., population, existence of harbors, density of private wells, etc. for these impacts.
3. Better targeting of the CRP acres based more on downstream economic impacts rather than gross erosion.
4. Further expansion in flexibility and reduced incentives in agricultural commodity programs for more chemically intensive and erosive systems.
5. Penalties based on downstream damage of soil erosion above the "T" level (and subsidies if it is socially desirable to reduce erosion below "T") for those producers not participating in CRP or other government commodity programs.
6. Taxes on the inputs, such as nitrogen (e.g., N without inhibitors) and selected pesticides (e.g., Atrazine and DCPA metabolites) which have been most problematic in surface and groundwater contamination to at least provide revenues for further research.

In sum, more comprehensive economic assessment, particularly of the downstream costs and benefits of alternative farming systems, is likely to favor those systems that are less erosive and chemically intensive. This in turn leads to the need to reassess the entitle-
ments and property rights related to alternative farming systems and their downstream impacts. Evidence to date suggests shifts in favor of the impacted downstream users and these trends will probably continue. Thus, sustainable agriculture is an idea that is currently ecologically, and in many cases, economically attractive. In addition, its future economic attractiveness is likely to increase.

REFERENCES


30. Ribaudo, M.O. September 1986. "Reducing Soil Erosion: Off-site Bene-

RECEIVED: 3/4/91
REVISED: 6/27/91
ACCEPTED: 7/11/91
LEARNING METHODS FOR SUSTAINABLE AGRICULTURE AND ENVIRONMENTAL AND ECONOMIC DIMENSIONS OF SUSTAINABILITY

ECONOMICS OF SUSTAINABLE SYSTEMS

LEARNING METHOD: Presentation, Discussion, Group Activity

PRESENTED BY: John Ikerd
University of Missouri - Columbia

SUMMARY (by C.A. Francis):
One of the most frequent questions asked by farmers today is, "sustainable agriculture may be all right, but is it profitable?" For the individual farmer, if a system is not profitable in both the short and the long term, it is obviously not sustainable. Over the past century, the share of the food dollar that goes to processing and marketing has risen steadily from less than 40% to more than 67%, while the portion paid for purchased inputs has risen from about 12% to near 24%. The average farmer share of about 9% today is steadily shrinking, and farm size has rapidly increased to compensate for low profit margins. Unintended impacts of this change have included the concentration of wealth in fewer hands and the decline of many rural communities.

It is important to evaluate the long-term impacts of introduction of new technologies, on quality of life for farmers and for communities. The careful choice of practices and reduction of purchased, fossil-fuel-based inputs and substitution of management can help the producer reduce costs and capture more of the sale value of farm products. Likewise, adding value on the farm or in the community, or marketing directly to the consumer can also accrue more of the total sale price of food to the primary producer. But even more important to the success of both farmers and rural communities is the careful evaluation of the impact of concentration of land in larger farms, the vertical integration of production with processing that moves decisions and control away from the community, and the individual and community decisions that result in loss of family farms and opportunities for young farmers. The average age of farmers in the Midwest is over 52 years, while the modal age is about 58 years. To establish a viable agriculture we can build on local natural resources and social capital, and search for equitable opportunities for all rural residents. It is especially important to examine the long-term impacts of our decisions on quality of life for farmers and other rural residents.

KEY REFERENCES:
Ikerd, J. E. 1993. Economic and quality of life issues in sustainable agriculture. Significant portions of the manuscript were taken from a report, Sustainable agriculture and quality of life, developed by a special Sustainable Agriculture Research and Education task force.
ECONOMIC AND QUALITY OF LIFE ISSUES IN SUSTAINABLE AGRICULTURE

John Ikerd
Sustainable Agriculture Systems Program
University of Missouri

Quality of life is a product of the terms by which people relate to each other, socially, politically, and economically; and the terms by which people relate to other elements of their physical and biological environment (QOL task force).

The intrinsic importance of both economic and quality of life issues for sustainable agriculture were codified by the U.S. Congress in the 1990 FACT act. In setting forth purposes for research and extension related to sustainable agriculture, the Congress defined sustainable agriculture as "integrated systems of plant and animal production practices having site specific application that will over the long term:

- satisfy human food and fiber needs,
- enhance environmental quality and the natural resource base upon which the agricultural economy depends,
- make the most efficient use of nonrenewable resources and on-farm resources and integrate, where appropriate, natural biological cycles and controls,
- sustain the economic viability of farm operations, and
- enhance the quality of life for farmers and society as a whole."

The intent of Congress regarding quality of life issues was further clarified in a House Agricultural Research subcommittee discussion which confirmed that quality of life research includes research to "increase income and employment -- especially self-employment -- opportunities in agricultural and rural communities and strengthen the family farm system of agriculture, a system characterized by small and moderate sized farms which are principally owner operated" (Congressional Record 10/22/90:H11128).

A universally acceptable definition of sustainable agriculture is yet to be found. However, there seems to be a growing consensus that a sustainable agriculture must be ecologically sound, economically viable, and socially acceptable. The criteria for sustainability identified in the FACT Act fit easily within these ecologic, economic, and social dimensions. The ecological questions of resource conservation and environmental protection have received most of the public attention directed to the sustainable agriculture issue to date. The remainder of this paper represents an attempt to shed some added light on the economic and social dimensions of sustainability.

Economics of Sustainable Agriculture. Is it possible to sustain economically viable farming operations while addressing the ecological issues of sustainability? Some will answer, "Yes, many of the changes in farming systems needed to conserve resources and protect the environment can also reduce production costs and increase profits." Others will answer, "No,
if farmers change their operations to address conservation and environmental issues, productivity will drop, costs will rise, and farmers’ profits will fall." Who’s right and who’s wrong? Is there any right or wrong answer?

It may be decades before we have sufficient evidence to make general statements about relationships between farm ecology and farm economics. In the meantime, farmers, policy makers, and people in general will continue to make decisions that affect the future of American agriculture. They will base their decisions on whatever information is available at the time. So the more relevant question might be; what do we know about the tradeoffs between ecology and economics in farming?

**National Economic Impact Studies.** Several national studies have attempted to address the economic implications of reduced chemical use in agriculture. David Pimentel and his colleagues at Cornell University estimated the national environmental and economic impacts of reducing agricultural pesticide use to one-half of current use levels. Knutson and Associates evaluated the potential impacts of a total ban on commercial pesticides and nitrogen fertilizers. Other studies have attempted to evaluate the profitability of alternative farming systems by evaluating alternative crop rotations identified as "conventional" and "alternative" or "sustainable." The World Resources Institute, for example, compared several conventional and organic cropping systems in two different regions of the country. They estimated off-site environmental costs and long run depreciation of soil productivity and included these costs in their economic comparisons. A University of Missouri study was based on "conventional" and "alternative" farming system scenarios. Each scenario reflected differences in crop rotations, tillage methods, and input strategies. A recent article in the American Journal of Alternative Agriculture by Linda Lee provides a review of several studies comparing "organic, low input, and conventional" systems of farming. Not surprising, each of the above studies reached different, but not necessarily inconsistent, conclusions.

An individual farmer’s problems and opportunities are unique and may be significantly different from those assumed in national studies. Thus, farmers must rely on their own judgment concerning whether or not research results are relevant to their particular farming situation. Policy makers are concerned about profits of individual farmers, but they must also be concerned with regional and national impacts. Policy makers need information from national studies, such as those mentioned above, as a basis for policy decisions. But, each of these studies is based on a unique set of assumptions and research procedures; none of which can precisely reflect reality. Assumptions and procedures inevitably affect the conclusion of any study. Thus, policy makers and the public in general must make judgments concerning the relevance of various studies to their decisions in much the same way as farmers must make judgments concerning the relevance of research and demonstration projects to their farming operation.

The Cornell study mentioned previously was based on an extensive review of previously published research relating primarily to integrated pest management systems. The researchers estimated costs of alternative pest control methods for all major U.S. crops. They estimated a "social" or environmental cost of pesticide use of $2.2 billion in addition to the $4.1 billion that farmers spend annually on pesticides. They concluded that "it might be possible to reduce
pesticide use by one-half," while maintaining crop yields at current levels, "at a cost of approximately $1.0 billion," a 25% increase in cost of pest control.

The Knutson study relied primarily on a national panel of Land Grant University scientists to estimate yield impacts of eliminating pesticides and fertilizers. They used economic models to estimate the resulting impacts on farmers' costs and profits and consumers' expenditures on food. They concluded that a total ban on commercial pesticides and nitrogen fertilizer would result in yield reductions ranging from 37% for soybeans to 78% for peanuts. Yield reductions would more than offset reductions in costs per acre resulting in higher costs per unit of production. Smaller supplies would result in higher prices and an increase in profits for crop producers. However, an offsetting decline in the profitability of livestock production would leave overall farm profits about the same as before.

The World Resources Institute study was based on yields, production costs, chemical use, and changes in soil conditions recorded over nine years at two case study sites. In Pennsylvania, where on-farm and off-farm environmental costs were relatively high, organic rotations were clearly superior to conventional, chemical-intensive systems; agronomically, environmentally, and economically. Their resource-conserving practices cut production costs by 25% and reduced soil erosion by 50%. In addition, WRI estimated off-site damages to the environment at $30 per acre of cropland and the present value of maintaining long run soil productivity at $124 per acre. The addition of these values resulted in an estimated two-to-one economic advantage for the resource-conserving system over conventional systems. In Nebraska, where on-farm and off-farm environmental costs were relatively low, conventional systems outperformed the alternative systems in terms of market profitability by enough to just about offset the lower resource and environmental costs of alternative systems.

In the Missouri study, a conventional farming scenario was based on cropping practices in use during 1984-1987, as reported in the 1987 National Resource Inventory. Crop rotations were matched with soil erodibility characteristics for nine major land resource areas which include a large proportion of total U.S. field crop production. Resource management strategies; including tillage, inputs, costs, and production levels were based on budget data supplied by extension specialists from 13 different states. The lower-input scenario utilized alternative sets of resource management strategies for each crop rotation and soil category in each region. The alternative scenario utilized alternative crop rotations, tillage practices, and input strategies to address soil erosion and environmental risks identified in the conventional farming scenario. Total acreage and production levels for each crop in each region were the same for conventional and alternative scenarios although the crops were shifted among soil types and rotations within regions.

The basic conclusions of the Missouri study were that adoption of logical alternatives to conventional cropping systems could simultaneously reduce soil loss by 70% from 1987 levels, reduce fossil fuel use by 21%, reduce use of commercial herbicides by 40%, reduce nitrogen fertilizer use by 30%, and reduce total direct production costs by 17%. Lower-input systems would require more management, but crop production labor was estimated to be only 7% greater for the alternative scenario. No attempt was made to estimate differences in management or overhead between the two scenarios. However, the study indicated an economic advantage for
the alternative scenario in terms of returns of internal resources, including land and management, if not in overall profitability.

Costs of Transition. None of the studies mentioned above dealt explicitly with sacrifices in profits associated with a widespread transition from conventional to alternative or sustainable systems of farming. The most obvious cost would be those associated with changes in machinery and equipment, such as those required for conservation tillage and reduced input application methods. Costs associated with changes in nutrient and pest management systems are equally obvious, but they are more difficult to quantify. For example, the reestablishment of efficient organic nutrient cycling in regenerative production systems may require several years. Likewise, re-establishment of beneficial species, an integral part of many integrated pest management systems, may require several years of limited reliance on chemical pest control methods. Yields and profits may fall during such transition periods before recovering to long run sustainable levels.

The most important transition costs may be those associated with changes in management resources, the farmer’s management ability. Sustainable farming operations may be characterized as highly-integrated, dynamic, site-specific, individualistic, systems of production. Much of the technology developed and implemented on U.S. farms over the past several decades has supported specialized, capital-intensive, mechanized, systems of mass production. Management of lower input farming systems may require a different type of management ability that could take many years of study and observation for a farmer to acquire.

Iowa’s Experience with Economics and the Environment. The best evidence to date of farmers’ ability to profitably reduce use of agricultural chemicals is reflected in fertilizer use statistics from Iowa (Hallberg, et. al). Since 1982, a consortium of state and federal organizations has implemented an array of programs to improve the environmental performance of agriculture in Iowa. The Iowa legislature passed a Groundwater Protection Act in the mid 1980s that raises some $4 million per year for various water quality programs including research and education for farmers. Coincidentally, Iowa farmers "reduced" nitrogen use per acre of corn by 12 percent from 145 lbs. per acre in 1985 to 127 lbs. per acre in 1990. Illinois has had no comparable groundwater program, and Illinois farmers "increased" nitrogen use by 5% during the 1985 to 1990 period. Equally important, corn yields of Iowa and Illinois were virtually identical during this entire period. In 1990, Iowa farmers, on the average, applied nearly 40 lbs. less nitrogen per acre of corn than Illinois farmers with no difference in average yields. Iowa farmers saved an estimated $80-89 million during 1989-90 by practicing better fertilizer management. By 1992, Iowa corn growers had cut nitrogen use even further to only 118 lbs. per acre. That same year, Iowa recorded an all time record corn yield of 145 bu. per acre.

Iowa farmers did not achieve these results simply by cutting nitrogen use per acre without changing their nutrient management programs. They have increased their reliance on soil tests in determining whether they really need the fertilizers they are applying. Many farmers make split applications of nitrogen and use a late spring soil test to determine the amount for their last application. They have begun to take credit for the application of livestock manure in calculating commercial nutrient requirements. More farmers have begun to apply nitrogen in
bands in the root zones of their crops rather than broadcasting. In general, they achieve higher yields and reduced nitrogen use through better nutrient management.

**Food Cost Considerations.** The general public may be more concerned with tradeoffs between environmental quality and food costs than in profitability of individual farms or agriculture in aggregate. All of the studies cited above provide some general indications of such tradeoffs. The Cornell study indicates that environmental risks associated with pesticide use could be cut essentially in half with a resulting price increase in purchased food of only 0.6%. The Knutson study estimated that food prices would average about 6.5% higher with a total pesticide ban and 12% higher if both pesticides and commercial nitrogen were banned.

The WRI report focuses on reducing government farm program costs to tax payers and off-site environmental and resource depletion costs to society in general. It concludes that such costs can be reduced with no sacrifice in farm income, in some cases, and that reductions in social costs will offset lower profits in others. The report suggests changes in current government programs that could benefit farmers and the general public. The Missouri report concludes that significant improvements could be made in resource conservation, environmental protection, and economic performance through wider adoption of farming methods already in use on many farms. Government programs could be redirected to facilitate the transition from conventional to alternative systems with no increase in total program costs. Alternative, lower-input systems could maintain current production levels and, thus, would have no measurable impact on consumer food prices.

Contrary to popular opinion, changes in farm level productivity and costs have relatively little impact on consumers. USDA estimates that consumers on the average spent 11.5% of their income on food in 1991. Lower income consumers may spend up to 40% of their income on food, but the basic problem of the poor is low income rather than high food prices. Put another way, we can't expect to solve the problem of poverty with cheap food. Food costs are now such a small percentage of total expenditures for most people in the U.S. that changes in food prices have relatively little impact on their economic well being.

Farmers received only 22% of the amount that consumers spent on food. If seafood and imports are subtracted out of the farm share, it drops from 22% to 17%. Farm production expenses account for more than half of this total farm value. These expenses exclude feed, livestock, and other inputs of farm origin but include interest on borrowed money, land rent, and hired labor in addition to fertilizers, pesticides, and other purchased inputs. The bottom line is that less than half of the amount that consumers spend on food goes to farmers' gross margin to cover costs and profits associated with value added on farms. Thus, less than 10% of the amount consumers spend on food is affected by productivity of farmers. This means that it takes a 10% increase or decrease in farm level productivity or costs to account for a 1% change in food costs to consumers. Thus, a 50% change in farm-level gross margins would result in only a 5% change in food prices if farm input and marketing costs remain unchanged.

In summary, the potential for major changes in food prices through either positive or negative changes in farm level productivity is relatively small. Thus, changes in costs and
profits associated with environmental concerns are matters of economic significance primarily to farmers rather than consumers.

Quality of Life and Sustainable Agriculture. Quality of life is related to both economics and ecology but is determined by neither. Food, clothing, shelter are critical to quality of life until basic human needs or the economic necessities of life are fulfilled. When survival is the primary concern, people think mainly about self preservation. As personal survival becomes less threatened, people begin to assign greater importance to their relationships with other people. Most people recognize that their well being is interrelated with the other biological and physical elements of their environment. However, their social bonds with other people tend to be stronger than their bonds with the non-human elements of the ecosystem. Quality of life is the product of the terms by which people relate to each other; socially, politically, economically; in the present, and the terms by which people of this generation relate to future generations through stewardship of the natural resource base and protection of the natural environment. Quality of life is the social dimension of agricultural sustainability.

The Industrialization of U.S. Agriculture. Most would agree that American agriculture has made tremendous gains in productivity during this century, at least when measured in terms of output per hour of labor on per acre of land. These advances were achieved primarily through specialization and mechanization which allowed farmers to realize economies of large scale production. Commercial fertilizers and pesticides allowed farmers to break away from crop rotations and diversified crop and livestock farms. They could now specialize in crops, or livestock, or even in single crops, or single phases of the livestock business. By doing fewer things better, each farmer could do more. Mechanization and inexpensive fossil fuels allowed farmers to farm more acres or produce more livestock and thus, achieve greater economies of scale. Not only were input-intensive, industrial farming systems economically viable in the U.S., they were considered to be the model of efficient food production for the World. Farms became factories without roofs.

Industrial systems of farming, however, have begun to raise significant economic and environmental concerns. First, there are growing indications of declining effectiveness of the inputs and technologies which support specialized systems. Increased concentration of a single crop within a geographic region increases pest pressures for that crop. In addition, insects and weeds are becoming resistant to pesticides and require higher rates of application or new, more costly pesticides for control. Previously fertile soils in some areas have lost organic matter and natural fertility through monocropping, conventional tillage, and removal of crop aftermath year after year. Lower organic matter has meant less microbial activity, less ability to hold water, and less availability of nutrients in root zones, meaning lower yields from a given level of water and fertilization or higher fertilizer and irrigation costs to maintain yields.

Water tables in some of the major irrigated areas are declining as rates of irrigation surpass rates of natural regeneration of aquifers. Irrigation supports some of the largest of the large farming operations. Salinization of soils is occurring in some of these areas as a consequence of continuous irrigation. Soil conservation rose to the top of the political agenda in 1985 primarily because of rising soil erosion rates. Soil losses went up as farmers abandoned
forage grass and legume based crop rotations in the 1960s and rose still further as farmers intensified row crop production for growing export markets during the 1970s.

Other costs of increasing specialization are showing up in the form of health risks related to pesticide residues in foods and to farmers' handling of pesticides. Chemical contamination of farm wells and of rural and urban water supplies are additional concerns. Nitrate leaching into groundwater may be attributed as much or more to organic sources, such as livestock waste and crop residues, as to the use of commercial fertilizer. However, the nitrogen leaching issue, as much as any other, has increased awareness in rural areas of the potential environmental hazards of chemically dependent farming.

The industrialization of agriculture has also changed rural landscapes. Farmers planted "fence row to fence row" during the 1970s and many tore down the fences and plowed out the fence rows. Farming areas were no longer patchworks of fields, meadows, grassy hills, and valleys separated by rows of trees. The previously diverse rural vistas were pleasing to the human eye and were hospitable for wildlife. Rural landscapes, however, have become field after field of corn, soybeans, wheat, and cotton across the hills and valleys. Even the wooded hills were cleared to make way for cow herds. Livestock feeding and poultry operations became large concentrated feed lots, animal producing factories.

Impacts of Industrialization on Farmers. Larger, more specialized farming operations have meant fewer farming families. There are less than one-third as many farmers today as there were in the 1930's, prior to the boom in agricultural mechanization and widespread use of agricultural chemicals. The only notable exception to the downward trend in farm numbers was during the export boom years of the 1970s. Fewer people are needed on farms with industrial farming technologies. Not only have machines been substituted for labor, but purchased inputs have been substituted for human knowledge, and technology in general has been substituted for people.

The unneeded human resources have been squeezed out of agriculture as a natural economic consequence of substitution of technology-based inputs for people. Technological advances reduced costs of production and provided incentives for expanded production which, in turn, reduced market prices and ultimately reduced farm incomes. Only those farmers who adopted new technologies first made profits. Those who lagged behind were forced to adopt in order to survive. Those who couldn't adopt or adapt quickly enough were forced to sell out to their more progressing or lucky neighbors.

The continual repetition of this process over time has ensured that the economic returns to those remaining in agriculture were kept well below that of growing economic sectors. This process was an economic necessity to move unwilling people and resources out of agriculture and into other uses within the economy. But, there were costs associated with this migration out of agriculture. These costs have included "social disorganization, shrinking rural economic bases, declining rural communities and institutions, and the specter of a permanent underclass in the cities" (Glover).
New Economic Realities. If industrial trends of the past were to continue, the quality of life objectives of sustainable agriculture would be very difficult if not impossible to achieve. There would be little hope of increasing income and self-employment opportunities in agricultural and rural communities or of strengthening the family farm system of agriculture through profitable, owner-operated, small and moderate sized farms. But, the World is continually changing.

Alvin Toffler, in his book Powershift, points out that many forecasters simply present unrelated trends, as if they would continue indefinitely, without providing any insight regarding how the trends are interconnected or the forces likely to reverse them. He contends that the forces of industrialization have run their course and are now reversing. The Industrial models of economic progress are becoming increasingly obsolete. Old notions of efficiency and productivity are no longer valid. Mass production is no longer a symbol of "modern" business operation. The new "modern" model is to produce customized goods and services aimed at niche markets, to constantly innovate, to focus on value-added products, and specialized production. Toffler contends that these are the trends of the future.

He goes on to state that "the most important economic development of our lifetime has been the rise of a new system of creating wealth, based no longer on muscle but on the mind" (Toffler, p. 9). He contends that "the conventional factors of production -- land, labor, raw materials, and capital -- become less important as knowledge is substituted for them" (Toffler, p. 238). "Because it reduces the need for raw material, labor, time, space, and capital, knowledge becomes the central resource of the advanced economy (Toffler, p. 91). Toffler also provides some insights into the nature of knowledge-based production. He states that separate and sequential systems of production are being replaced with synthesis and simultaneous systems of production. Synergism is replacing specialization as a source of production efficiency. Tailoring products to desires of specific customers is replacing low price as source of value. Simultaneity, synthesis, synergism, tailored production; this is the "mind work" of the future.

Peter Drucker, a noted business consultant, talks of the "Post Business Society," in his book, The New Realities. He states "the biggest shift -- bigger by far than the changes in politics, government or economics -- is the shift to the knowledge society. The social center of gravity has shifted to the knowledge worker. All developed countries are becoming post-business, knowledge societies. Looked at one way, this is the logical result of a long evolution in which we moved from working by the sweat of our brow and by muscle to industrial work and finally to knowledge work" (Drucker, p. 173).

Drucker contends that there is an important, fundamental difference between knowledge work and industrial work. Industrial work is fundamentally a mechanical process whereas the basic principle of knowledge work is biological. He relates this difference to determining the "right size" of organization required to perform a given task. "Greater performance in a mechanical system is obtained by scaling up. Greater power means greater output: bigger is better. But this does not hold for biological systems. Their size follows function. It would surely be counterproductive for a cockroach to be big, and equally counterproductive for the elephant to be small. As biologists are fond of saying, 'The rat knows everything it needs to know to be a successful rat.' Whether the rat is more intelligent that the human being is a
Differences in organizing principles may be critically important in determining the future size and ownership structure of economic enterprises, including farms. Other things equal, the smallest effective size is best for enterprises based on information and knowledge work. "Bigger' will be 'better' only if the task cannot be done otherwise" (Drucker, p. 260).

As American business has struggled to maintain its competitiveness in global markets, management strategies have begun to reflect these new economic realities. The old model of large scale, centralized production characterized by high volume production, standardized units, and little flexibility has fallen out of favor. In the past 10 years, about two-thirds of all new non-farm jobs were created by small business. A recent National Science Foundation study showed that small businesses produce 24 times as many innovations per research dollar as do large businesses. Large companies often employ small business management strategies, with more employee involvement and attention to improving quality through quality circles, zero defect quality standards, and just-in-time inventory management. Many large, industrial organizations such as Sears, IBM, GM, and AT&T are facing stiff competition from much smaller competitors. IBM is in the process of breaking up into a series of smaller independent businesses that will be more flexible and quicker to respond to changing economic conditions (Stein, 1991). GM created a new, much smaller automobile company to produce the Saturn.

In "The Real Economy," an article by Robert Reich, he writes: "Worldwide competition continues to compress profits on anything that is uniform, routine, and standard -- that is, on anything that can be made, reproduced, or extracted in volume almost anywhere on the globe." Higher earnings are concentrated in businesses that are knowledge-intensive, that solve problems for customers, and meet social needs. Large corporations are downsizing and decentralizing to smaller, more flexible, problem solving units.

Clearly, big business is moving away from many of the principles that conventional agriculture continues to embrace. Conventional agriculture is behind the learning curve in aggressively investing in people, management skills and education, and away from low skill labor and large scale capital intensive approaches.

Enhancing Quality of Life for Farm Families. Sustainable agriculture, with attention to equity, empowerment, and high levels of management skills is consistent with trends in the business world. The increased knowledge needed to manage resources sustainable suggests a trend toward smaller family farms that allows farm families to remain personally connected to the land. Sustainable agriculture strategies provide more opportunities for local ownership, hands-on management, and long term commitment to the local community. A high level of farming skill increases returns to management and leads to greater profitability for small farms. Farming becomes profitable for farmers and for rural communities as more dollars remain in the community.

The essential linkages among quality of life, conservation of our natural resource base, and sustainable agriculture are becoming recognized by many leaders in the environmental and
conservation communities. It is now generally recognized that the best way to protect the environment is to have people living in local communities who understand and care for the environment. In the long run, we probably will not be able to achieve environmental quality without this essential ingredient. Similarly, soil conservation, without which we will not be able to maintain agricultural productivity, cannot be achieved without people on the land who are willing and able to care for the land.

Agricultural sustainability requires a systems approach to decision making which treats farms, families, and communities as parts of shared ecological systems. Such systems embody enormous complexity in simultaneous and dynamic linkages among a multitude of interrelated factors. Cognitive scientists have shown that humans can deal consciously with only a very small number of separate variables simultaneously. Yet humans can perform enormously complex tasks; such as driving a car in heavy traffic, playing a tennis match, or carrying on a conversation that baffles the most sophisticated computers. People are capable of performing such tasks routinely by using their well developed subconscious minds.

The subconscious human mind appears to be virtually unlimited in its capacity to cope with complexity. As organizational theorist Charles Keifer puts it, "When the switch is thrown subconsciously, you become a systems thinker thereafter. Reality is automatically seen systemically as well as linearly. Alternatives that are impossible to see linearly are surfaced by the subconscious as proposed solutions. Solutions that were outside of our 'feasible set' become part of our feasible set. 'Systemic' becomes a way of thinking and not just a problem solving methodology" (as quoted in Senge, The Fifth Discipline, p. 366). The subconscious mind is capable of assimilating hundreds of feedback relationships simultaneously as it integrates detail and dynamic complexities together (Senge, The Fifth Discipline p. 367). The human mind may be the only mechanism capable of dealing effectively with the systems complexities embodied in the concept of sustainable agriculture.

Wendell Berry, a Kentucky farmer, has clearly articulated the connections among people, quality of life, and a sustainable agriculture. "...if agriculture is to remain productive, it must preserve the land and the fertility and ecological health of the land; the land, that is, must be used well. A further requirement, therefore, is that if the land is to be used well, the people who use it must know it well, must be highly motivated to use it well, must know how to use it well, must have time to use it well, and must be able to afford to use it well" (What are People For? p. 147).

Without knowledgeable people living on the land who have some sense of ownership, empowerment, and independence, we are not likely to see the land managed in responsible ways. The opportunity for people to live a quality life on the land is therefore indispensable to a sustainable agriculture.

Enhancing Quality of Life in Rural Communities. Community economic development strategies are also undergoing a significant change consistent with sustainable agriculture incorporating critically important quality of life issues. The old strategies of industrial recruitment through building industrial parks by offering tax breaks has given way to growth-from-within policies. This strategy, in line with the business theories of Reich and others,
invests in entrepreneurs within the community to build small businesses and strengthen the local economy. Local buyer-supplier projects plug the loss in dollars leaving the community by replacing imports with locally produced goods and services.

As large companies and branch plants move overseas for cheap labor, efforts to attract these low quality, low paying jobs are increasingly regarded as an expensive and ineffective strategy for economic development. Attracting large companies, although they may provide a large number of jobs, often pay poorly and may be unstable since there is no local commitment; they are expensive to attract and maintain, and are slow to respond to new economic conditions. Economic development professionals are beginning to concentrate on improving the quality of jobs rather than quantity, as the number of working poor -- workers with full time jobs who live below the poverty line -- continues to increase.

Sustainable agriculture is a growth-from-within approach to rural economic development. It is an asset-based rather than deficiency-based strategy where human capital is more highly valued than financial capital. Intellectual capital, as it is employed, is enhanced in value rather than depleted as are other resources. It is the "virtuous cycle" of education, increased innovation, increased investment, increased value, and higher wages. Sustainable development offers an alternative to the vicious cycle of industrial recruitment, low wages, declining emphasis on education, declining communities, and resulting downward spiral (Reich, 1991).

The well-being of rural communities is essential to the future well-being of the nation. A viable rural economy can use existing resources of land and experienced farmers to provide a strong agricultural component to the rural community, supplying food and creating jobs. Urban citizens benefit as well from a healthy, sustainable, rural economy. They benefit not only through better quality water, green space, and a higher quality food supply, but also through the support of strong rural partners to relieve urban pressures on in-migration of unemployed or underemployed workers.

It is well known that different farming systems have different implications for the community and its quality of life. Sustainable agriculture relies on a knowledge of the land and the ecology that supports the production of food and fiber. The strength of this approach lies in human intellectual capacity to work with nature and maintain productivity. It empowers the farmer and the local community through its dependence upon people rather than money and strengthens local economies.

The management of resources to enhance the dignity of work and quality of life for farm families is powerfully connected to the resulting knowledge and productivity that is needed to keep agriculture productive and profitable and to protect the environment, preserve the natural resource base, and enhance the quality of life of society as a whole for the present and for future generations.
REFERENCES


Ikerd, John E., Sandra J. Monson and Donald L. Van Dyne, "Financial Incentives Needed to Encourage Adoption of Sustainable Agriculture," Special project report, Department of Agricultural Economics, University of Missouri, Columbia, MO, 1992.


Agriculture’s search for sustainability and profitability

Tradeoffs between resource conservation and environmental soundness and productivity and competitiveness are the key in the search for sustainable agricultural systems

By John E. Ikard

Are sustainable systems necessarily profitable? Are profitable systems necessarily sustainable? The answers to these questions depend on whether one talks about the long or short run or about an individual farm or society in general.

Sustainability, by definition, is a long-term concept. The term sustainability, as used here, refers to farming systems that are capable of maintaining their productivity and utility indefinitely. Sustainable systems must be resource-conserving, environmentally compatible, socially supportive, and commercially competitive.

Systems that fail to conserve the resource base eventually lose their ability to produce. Systems that fail to protect the environment eventually destroy their reason for existence. Farming systems that fail to provide an adequate food supply at reasonable costs lose their utility to society. And finally, systems that are not commercially competitive will not generate the profits that are necessary for economic survival.

A system must be profitable in the long run or it cannot be sustained. A system must be sustainable or it cannot be profitable in the long run. Some may quarrel about the philosophical concept of long run and at what point in time sustainability and profitability converge. But most would agree that in the long run there is no conflict between sustainability and profitability.

Even in the short run, there is no conflict between sustainability and profitability from the standpoint of society as a whole. Societies that exploit resources and degrade the environment for unsustainable, short-run benefits are not profitable from the standpoint of society as a whole. They create an illusion of productivity and profitability by failing to consider all social costs. One segment of society bears the costs that another segment ignores, or one generation bears the costs that a previous generation failed to consider. Social benefits exceed costs only for those systems that also are sustainable.

The conflict between sustainability and profitability arises for individual producers in the short run. Profitable individual farming systems may or may not be sustainable in the long run. Also, sustainable, individual farming systems may or may not be profitable in the short run. Thus, a conflict may arise that forces farmers to choose between short-run profit maximization and low-run sustainability. This potential conflict is the root of most economic issues related to low-input, sustainable agricultural systems.

A sustainable, individual farming system must be able to survive short-run losses due to periodic crop failures or depressed markets that characterize the agricultural sectors of most economies. Thus, sustainable farming systems are unprofitable, at least at times. In fact, sustainable farming systems may be less profitable than unsustainable alternatives, even for extended periods of time.

Farmers may generate short-run profits by mining or wasting the resource base, degrading the environment, or exploiting the consuming public. Such systems are not sustainable in the long run, but they may well be profitable, even most profitable, for extended periods of time.

This potential conflict between long-run sustainability and short-run profitability is perhaps the most significant question confronting U.S. farmers today.

Are low-input systems sustainable?

Low-input, sustainable agriculture is a relatively new term and, thus, has no universally accepted definition. The term actually embodies two separate concepts: low-input and sustainable agriculture. These two terms do not mean the same thing.

The term “low input,” as used here, means systems that rely less on external, purchased inputs and more on internal resources (10). Some people add other qualifications to purchased inputs, such as nonrenewable energy, inorganic, or synthetic inputs (3). These qualifications add clarity in some contexts but add confusion in others. The broader concept of inputs, which includes all external or purchased inputs, is used here unless otherwise specified.

There is no clear division or point of separation between low-input and high-input farming systems. Thus, lower input rather than low input might be a more appropriate...
Lower input systems may or may not be more sustainable than higher input, conventional farming systems. Lower input systems tend to be more resource-conserving and environmentally compatible than conventional systems that rely more on external purchased inputs. Thus, if the socioeconomic dimensions of sustainability are ignored, low-input may appear to be synonymous with sustainability.

However, the socioeconomic issues of sustainability cannot be ignored. Questions regarding sustainability of lower input systems tend to focus on their productivity or ability to support growing populations and on their commercially competitiveness with higher input systems. Continuing profitability tends to reflect both productive efficiency and commercial competitiveness.

Systems that are both lower input and sustainable must measure up to socioeconomic standards of productivity and competitiveness, in addition to resource conservation and environmental soundness. Neither lower inputs nor higher profits alone are adequate short-run measures of sustainability.

In some cases, lower input systems may also be higher profit systems, even in the short run (2). In many cases, however, farmers may be forced to choose between systems that are more resource-conserving and environmentally sound and alternative systems that are more productive and commercially competitive.

The search for sustainability in agriculture, in a practical sense, is the search for an acceptable balance between lower external inputs and greater profitability.

Are we going backward?

Critics of low-input, sustainable agricultural systems point out similarities between lower input systems and earlier conventional agricultural systems. They have observed the positive correlation between greater reliance on purchased inputs and greater agricultural output at lower costs. Does lower input mean lower output? Aren’t low-input, sustainable agricultural systems really farming systems of the past rather than farming systems of the future?

U.S. farmers have persistently increased their reliance on purchased inputs over the past several decades because of the need to reduce costs, remain competitive, and pursue greater profitability in their farming operations. Conventional, higher input farming systems have become conventional, that is, widely adopted, in large part because farmers were motivated by the promise of greater profitability.

Efficiency gains from specialization generally have been recognized and widely accepted for centuries as an economic fact of life. Profitability from higher input farming systems has come in no small part from realization of gains from specialization. Commercial fertilizers and synthetic pesticides allowed farmers to abandon crop rotations and mixed livestock, cropping systems in favor of more specialized cropping and specialized livestock systems. Low energy prices also allowed economic use of larger, more specialized equipment and production facilities that encouraged greater specialization.

The trend toward greater reliance on external inputs has not been limited to commercial fertilizers and pesticides or nonrenewable, energy-based inputs. Specialization also has facilitated greater use of specialized, hired labor. And it has allowed farmers to acquire more specialized knowledge bases and management skills, sometimes taking the form of paid consultants. The shift toward greater reliance on these particular external inputs has important but often ignored implications for socioeconomic sustainability.

Farming seemed to be following the specialization trends of other sectors of the economy. Farms were becoming factories without roofs; specially trained people performing specific tasks at specific times; assembly lines dictated by weather; farmers following recipes that specify varieties, tillage practices, fertilizers, irrigation schedules, pesticides, and harvest times required to produce a quality-controlled product.

Why consider changing that trend? Low-input, sustainable agriculture assumes diversification rather than specialization. Such systems require broad knowledge rather than
specialized information or training. They require judgment and flexibility rather than assembly-line repetition. There are no recipes for successful low-input, sustainable agricultural systems.

Old concepts with new technologies. A return to more diversified, less specialized farming systems does not necessarily mean a return to farming systems of the past. A wide range of technology is available today that was not available to farmers 40 or 50 years ago. Farmers who use low-input, sustainable agricultural systems now may be able to use many of those technologies to enhance the productivity of internal resources, thus reducing dependence on external inputs.

First, low-input, sustainable agriculture does not imply total elimination of external inputs, only lower use of external inputs. Thus, low-input, sustainable agricultural systems that use environmentally compatible level of fertilizers and pesticides and nonrenewable energy conservatively may be far more productive and profitable than similar systems of 40 years ago.

Microcomputers represent a new technology that holds great promise for old farming systems. Computer setups costing less than $3,000, for example, give farmers access to more computing power than that available to most large corporations less than three decades ago. Microcomputers can complement and enhance the farmer's management abilities, allowing him or her to effectively substitute information and knowledge for purchased inputs.

A farmer with a computer can plan, organize, direct, and control the most complex of farming systems. Today's farmers can apply logic and scientific knowledge to systems that farmers of the past managed mostly by intuition and guesswork.

Modern mechanization likewise opens new opportunities for farmers to apply old, tried, and proven principles. No-till and low-till farming equipment not only conserve and enhance the soil resource but make intercropping systems more feasible and potentially profitable. Deep-tillage systems can improve drainage and inherent productivity of soils and reduce water quality risks. Modern electric fencing makes intensive grazing systems economically practical, enabling possibly greater returns from forages used in crop rotation systems.

These are just a few of the technologies that until recently were viewed largely as ways of enhancing specialized farming operations. But they may have equal or even greater impacts on enhancing the potential productivity and profitability of low-input, diversified farming systems. All that is required is a change in the farming paradigm, a new model or way of thinking. With a new paradigm, diversified farming may be viewed as the system of the future rather than the system of the past.

Not only may existing technology be applied in new ways, but new technology may be forthcoming that will make possible even more sustainable and profitable farming systems in the future. Systems technology may follow once there has been a change in the farming paradigm.

Rising costs of specialized systems. There are several other logical reasons why farmers should question the advisability of continuing the trend toward greater reliance on external, purchased inputs, even if they view a return to diversified systems as going backward. First, there are growing indications of declining effectiveness of the technologies that allowed greater specialization. Insects are becoming resistant to insecticides, necessitating higher rates of application or new insecticides. New insects sometimes replace the old. Beneficial insects often are destroyed along with the pests, requiring even greater reliance on insecticides, at higher costs. The same types of problems are appearing for herbicides as new weeds appear after others are brought under control. In addition, herbicide build-up in some soils seems to be causing problems.

Some previously fertile soils have lost organic matter and natural fertility through monocropping or removal of aftermath year after year. Lower organic matter levels have meant less ability to hold water and nutrients in root zones, meaning lower yields from a given level of water and fertilization or higher fertilizer costs to maintain yields.

Other costs of increasing specialization are beginning to show up in the environment. Farm families and workers. Health risks in handling pesticides have become a major issue in farm safety. These risks eventually translate into less effective pest control, higher labor costs, or greater health risks for family members.

Chemical contamination of farm water supplies is another emerging concern of farm families. This issue, as much as any other, has increased the awareness of farmers to the potential environmental hazards of chemically dependent farming. Until recently, the environmental costs of increased use of chemical fertilizers and pesticides were external to the farm or imposed on society in general. The health risks to farm families and workers are internal costs and thus command the immediate attention of farmers.

In short, current trends in fertilizer and pesticide use seem to point to an increasing cost of supporting specialized farming systems. Research currently is underway to validate or refute this hypothesis and, if valid, to evaluate its significance.

However, some farmers already have seen costs increase and productivity fall to the point where gains from specialization no longer offset increased costs. For them, lower input systems are also the most profitable systems.

Gains from integration: Synergism. Gains from specialization are undeniable, but specialization is not the only route to greater efficiency. There are potential gains also from integration. The productivity of an integrated system can be greater than the sum of the products of the individual system components. This phenomenon is called synergism. Specialized systems sacrifice the potential gains from synergistic interaction among the various components of diversified systems.

An obvious example of synergism is the interaction between livestock and crop rotations that include high quality legume forage crops. Livestock add value to the forage and recycle nutrients back to the soil in the form or manure. Legumes add nitrogen to the soil, break row-crop pest cycles, and provide feed for the livestock. Livestock without high-quality legume pastures may not be profitable. Legume rotations without livestock may not be profitable. Integrated livestock, legume rotation systems may add profitability to the toal farming operation. This is but one example of the potential synergistic gains from integrated farming systems.

Risk is another important but often overlooked consideration in diversification. Risks are far greater in a specialized farming operation than in a diversified farming system with the same basic level of uncertainty in each system component.

For example, assume that one farmer has four enterprises and that each has an equal chance of returning a positive $6,000 or negative $2,000 net return in any given year. Thus, if they all are positive, the farmer will make $24,000, and if they all are negative, he or she will lose $8,000. But let's assume that the enterprises are totally uncorrelated. Net returns from each enterprise move up or down independently of each other.

Now assume that another farmer specializes in one of the four enterprises but produces four times as much of it as the first farmer. The second farmer has the chance of making $24,000 or losing $8,000 in any given year as the first has of making $6,000 or losing $2,000 on that one particular enterprise.

Both farmers have the same long-run average or expected net return, about $8,000. However, the diversified farmer is far more certain of a positive return than is the
Sustainable farming means to internalize costs that otherwise would be external and thus of no economic consequence to individual farmers. Costs of technologies that have allowed specialization may outweigh gains from specialization when all costs, private and social, are accounted for.

In fact, regulations may impose costs in excess of total social costs. This potential for overregulation provides an additional incentive for farmers to address environmental concerns voluntarily. The threat of regulation provides a primary motive for farmers to ask whether or not they should reexamine the feasibility of low-input systems.

**Sustainable profits, not profit maximization.** Many farmers feel special responsibilities to society that go beyond those spelled out in government regulations. Farmers occupy most of the geographic area of the United States. They own most of the country, so to speak. Farmers also are responsible for providing food, clothing, and shelter for the people. People depend upon farmers for their very existence.

Society has given special consideration and concessions to farmers reflecting these critical relationships. Many farmers, in return, feel a moral obligation to fulfill their responsibilities and live up to this trust. This gives such farmers a set of values that cannot be captured in the dollar-and-cent language of most economic analyses.

Many farm families also place a high value on farming as a way of life. They may be willing to work harder for less money because they feel that the farm is a good place to live and to raise their children. They may value enterprises and activities that provide opportunities for family interactions and learning experiences in terms other than net returns.

But farmers cannot live on appreciation from society. And a desirable quality of life requires an acceptable level of income. A farming operation must be profitable or it cannot fulfill its social responsibility or be a good way of life for farm families.

Profitability is a necessary and, thus, important objective of any farming operation. However, profitability does not imply the same thing as profit maximization. Many farmers appear to be at least as concerned with other objectives as with profits. Such farmers, in growing numbers, support the alternative agricultural movement in U.S. agriculture.

Alternative agriculture includes farmers who identify with a wide range of concepts, including low-input, sustainable, regenerative, organic, holistic, agroecology, and others (7). All of these alternative agricultural concepts have one thing in common. They challenge the concept of profit maximization as the dominant factor in farm decision-making. Many farmers are challenging the wisdom of conventional farming systems because they challenge the motive of profit maximization, which has driven farmers to greater specialization.

**Economic Implications**

Economists seem well prepared to deal with the macroeconomics of the social costs and social benefits associated with sustainable agricultural systems. However, they seem less prepared to deal with the microeconomic, farm-level choices among conventional enterprises and sustainable farming systems. The microeconomics of sustainable agriculture call for a change of economic paradigms, but not a change in the basic principles of economics. We need new economic mind-sets or models but not new

---

**Sustainable Must Be Profitable**

As a nation, we are now centering much debate and rhetoric around "sustainable agriculture." As a society, we have been able to achieve a real mind set as to what sustainable agriculture is. Unfortunately, in my opinion, we immediately identify it as some sort of new and oftentimes exotic approach to the business of farming, such as growing Belgian endive, or other new and (to us) strange crops, often along the way ignoring markets, adaptability to our climate, and similar concerns.

While such factors as government farm programs, conservation concerns, and water quality are factors in sustainable agriculture, I feel we tend to miss the most important factor, namely, that sustainable agriculture, to be sustainable, must first and foremost be profitable.

Ultimately, profitable agriculture must remain the cornerstone of what we view as sustainable. Without profit, producers cannot continue in the business of agriculture. When we recognize this, we can then direct our efforts to deal with concerns about water quality and quantity, conservation, and appropriate use of chemicals in agriculture—issues that concern farmers as well as the public in general.

Farmers themselves are as important to the concept of sustainable agriculture as soil and water. The business of farming must be profitable for it to be sustainable.—Bryce P. Neldig, Nebraska Farm Bureau Federation, Lincoln.

---

**Notes:**

economic principles to address the issue of sustainability.

Economics is the social science that deals with allocation of scarce resources among competing ends. Economics provides the principles for making choices that enable society and individuals to realize as much satisfaction as possible from limited resources. The basic assumptions of economics are that wants and needs are unlimited and that resources are scarce. We do not have sufficient resources to provide everyone with everything. We must make difficult choices.

The fundamental principles of economics are derived from the law of diminishing returns. As more and more of any good or service is consumed, at some point that good or service diminishes in its ability to provide added satisfaction. As more and more of any input is applied to a given, fixed resource base to produce something useful, at some point the input will diminish in its ability to add productivity.

Decisions based on sustainability are in no way inconsistent with these basic economic principles or with the fundamental laws on which economic principles are based. In fact, the issue of sustainability seems to be a perfect illustration of the relevance of economics to real world problems. How are scarce resources best used for the greatest benefit for individuals and society?

Tradeoffs in productivity between external and internal inputs are critical in achieving a balance between profitability and sustainability.

This is the fundamental question of economics.

However, many conventional economic paradigms or models are based on economic assumptions that are not valid when dealing with issues of sustainability. Economists simply need to rethink their paradigms, not their fundamental laws. They need to go back to the basics.

**Profit maximization.** The assumption of profit maximization allows economists to develop models for optimum resource allocation. Profit maximization assumes that money can be converted into any good or service. Higher levels of net income or profit allow farmers to have more of everything or at least to have more of some things without giving up anything else. Thus, more profit will make farmers better off.

However, profits reflect only those costs and returns that are internal to the farm and thus are translated into dollars and cents. Social costs and benefits are not reflected in profits unless they are internalized through public policy.

External costs and returns, when included in economic analyses, are considered through a process of constrained maximization. Constrained maximization assumes that farmers maximize profits subject to individual constraints that might include maximum levels of soil loss, nonrenewable energy use, or environmental degradation. However, this paradigm implies that profit maximization is the dominant consideration.

Economists could just as easily assume that farmers minimize environmental degradation or maximize resource conservation subject to a profit constraint. Such a paradigm would seem more consistent with objectives of most farmers currently interested in alternative farming systems. Sustainable levels of profit may be viewed as a constraint to achieving environmental and social objectives. Considering profit as a constraint rather than the objective of decision making is completely consistent with fundamental economic principles, but would be a paradigm for most economists.

Managing for multiple objectives would seem to be a better model for those families who view farming as a way of life as well as a business and for those who choose to consider social costs and benefits in their private decisions. Managing for multiple objectives rather than maximizing profits is good economics and good common sense.

**External inputs versus internal resources.** Economists typically separate costs of production into fixed and variable categories. Fixed costs are associated with any resource or input that already is committed to the production process. Fixed costs will be the same regardless of how much, or even if nothing, is produced.

Variable costs are associated with those inputs not yet committed to production. Different quantities of variable inputs can be used, and the level chosen will affect costs of production and expected levels and production or output.

Economic analysis typically begins by assuming a given level of fixed costs associated with committed resources. The objective then becomes to choose the level of variable input that will maximize profits or net returns.

This paradigm has been used by economists to show that any deviation from profit-maximizing levels of purchased inputs, nitrogen fertilizer, for example, will represent a reduction in farm profits. This traditional paradigm ignores the possibility of generating productivity and profitability from internal resources as well as from external inputs.

Assume, for example, that 200 pounds of nitrogen is the profit-maximizing level of total nitrogen for a corn crop on a given field in a given year. This might indicate an addition of 180 pounds of nitrogen, assuming that 20 pounds of nitrogen are available from the soil. Traditional economic analysis would imply that any deviation from the 180 pounds of purchased nitrogen input would reduce profits.

This paradigm ignores the possibility of generating nitrogen through management of the soil resource rather than purchasing.
profits might instead be maximum with 150 pounds of purchased nitrogen per acre if 50 pounds of nitrogen could be generated at a lower cost internally, through the use of legumes, for example, than the cost of 50 pounds of nitrogen purchased in commercial fertilizer. The paradigm of fixed and variable resources is not an inherent limitation of economic analysis. Economics provides the concepts and tools for dealing with changes in productivity of resources as well as inputs. The limitations are not in the economic principles but rather in the way those principles have been applied.

Resource risks—the cost of dependence. The concept of comparative advantage commonly is used by economists to illustrate potential gains from specialization and trade (6). The principles of comparative advantage show that maximum output can be achieved at minimum cost if all producers specialize in producing things they can produce most efficiently relative to other producers. Specialized producers can trade their surplus production to others who have specialized in producing other things. Each producer trades with others to acquire the things they need and want but did not produce for themselves. By realizing comparative advantages, everybody could be better off without making anybody worse off.

Comparative advantage is a valid, useful concept. However, it ignores risks that are associated with real world economic decisions. In a perfect world, everyone would depend upon each other. In a perfect world, we would have perfect information about the present and the future. In the real world, however, we have learned that we cannot always depend upon others for our own well being, and we face uncertainty concerning both the present and the future.

Few countries are willing to depend totally on any other country for its survival. Countries sacrifice potential gains from specialization and free trade to maintain some minimum level of economic security. Few regions, states, or communities within countries seem comfortable with employment bases that rely on markets or input suppliers in places beyond their economic control or influence.

Countries, regions, and communities recognize the necessity to specialize as a means of realizing their comparative advantages. The costs of self-sufficiency are too high. However, they also are willing to sacrifice some level of economic gain from specialization to maintain a degree of economic or social independence.

Farmers who rely on external inputs and specialized farming systems for their economic well-being are similar in many respects to countries, regions, and communities that rely on specialization and trade for their economic well-being. They gain from greater economic efficiency by realizing their competitive advantages relative to other economic entities.

However, reliance on external markets and inputs embodies risks—risk that currently profitable markets will be lost and risk that inputs will no longer be available at reasonable costs from external sources.

Perhaps the most graphic, recent example of such risks was the reliance of U.S. crop producers on export markets for wheat, corn, and soybeans during the 1970s. Many farmers borrowed large sums of money to buy additional land and buy specialized equipment to supply these potentially profitable markets.

Specialized farmers producing export commodities were hardest hit by the financial crisis of American agriculture in the early 1980s. They had taken the risks associated with dependence on external inputs, including capital and labor-saving equipment in addition to chemical fertilizers and synthetic pesticides, to produce for markets that were vulnerable to an unpredictable world economy.

Farmers today who rely heavily on synthetic pesticide and fertilizers must consider the risk of future restrictions on use of those inputs. Such restrictions may make some inputs unavailable and others more costly. Economists have developed well-defined concepts and tools for evaluating financial risks associated with reliance on borrowed capital. Financial risks are a specialized case of the more general concept of resource risks.

The economic principles of decision-making under uncertainty and risk are adequate to address the issue of resource risks associated with various levels of reliance on purchased inputs versus internal resources. However, those principles are yet to be applied to the question of low-input, sustainable agricultural systems.

The key: Tradeoffs

Tradeoffs are the key to decision-making, the key to evaluating the sustainability of farming systems. Systems must be chosen that consider tradeoffs between resource conservation and environmental soundness on the one hand and productivity and competitiveness on the other. In many cases, this will mean considering tradeoffs between long-run sustainability on the one hand and greater short-run profitability on the other.

Tradeoffs between productivity from external inputs and productivity from internal resources are critical in achieving an acceptable balance between short-run profitability and sustainability. Productivity from internal resources is the result of synergism achieved through integrated farming systems. Productivity from external inputs often reflects gains from specialization. Tradeoffs between gains from specialization and gains from integration are critical in developing systems that are both profitable and sustainable.

Tradeoffs between comparative advantage and resource risks are another critical consideration in balancing short-run profitability with long-run survival. Systems that are most profitable in the short run may be most vulnerable in the long run.

Economics is the science of tradeoffs. Economics is sometimes called the dismal science because it points to the tradeoffs of potential cost and potential benefit associated with each decision alternative. However, economics is reality. There are potential costs associated with each potential benefit in all cases of significant choice. There are potential losses in short-run profitability that must be weighed against the benefits of long-run sustainability.

Better decisions rarely result from systematically ignoring reality. Economists have a vital contribution of make to low-input, sustainable agriculture. Economists must be willing to change their paradigms to address the relevant issues. Low-input, sustainable agriculture advocates must be willing to accept economic reality.

REFERENCES CITED

EXECUTIVE SUMMARY

A Better Row to Hoe

The Economic, Environmental, and Social Impact of Sustainable Agriculture

Northwest Area Foundation  December 1994

There is a contradiction in American agriculture. A succession of mechanical, biological, and chemical innovations has transformed agriculture into a powerful industrial machine that produces food abundantly. But these innovations have also had serious environmental impacts, including increased soil erosion, water pollution and depletion, disappearing wildlife, elevated environmental health risks for farmers, and food safety concerns for consumers. At the same time, these technological changes have fueled farm consolidation, depopulating rural communities and shrinking rural business opportunities.

Concern about these adverse effects increasingly influences national farm policy debates, as society searches for a way to resolve the contradiction between abundant food and deteriorating rural resources and communities.

Many farmers share the growing public concern about the future of our food system. Some are deliberately searching for ways to farm that are not only profitable, but durable. They aspire to a more “sustainable” agriculture.

Sustainable agriculture usually involves substituting renewable resources generated on the farm for nonrenewable, purchased resources. It also makes use of ecological practices such as crop rotations, landscape management, and livestock waste management. Most important, sustainable farming involves a commitment to such practices as a means of achieving permanence. In this sense, sustainable agriculture has real and measurable environmental benefits, including reduced toxins in soil and water, less erosion, enhanced wildlife habitat, and lower energy use.

CONTINUED ON PAGE 2
agriculture is a reflection of the values of the farmer, and not merely a prescription for good farming.

To inform the growing debate over sustainable agriculture, the Northwest Area Foundation launched a research initiative to evaluate the impact of a shift toward sustainable agriculture on the economy, environment, and rural communities in the eight-state region the Foundation serves (Minnesota, Iowa, North Dakota, South Dakota, Montana, Idaho, Washington, and Oregon). In all, the initiative totaled an investment of over $4.5 million over six years. *A Better Row to Hoe* presents the Foundation's interpretation of this entire body of research.

**Sustainable Agriculture: A Modern, Evolving Technology**

Sustainable agriculture is a management goal that relies on a modern, evolving, and highly adaptable management technology. It has real and measurable environmental benefits and will become more popular as environmental constraints grow. It can also provide new farming and business opportunities for people in rural communities. A rural development policy that identifies and supports entrepreneurs willing to accept the challenge of defining and exploiting these markets is needed.

While it is already clear that the best sustainable farmers can be economically competitive with conventional agriculture, more research and education efforts need to be directed toward it and policy changes must be made to level the playing field with conventional agriculture. Agricultural science will have to adapt itself to long-term, whole-farm methods of analysis to support the development and adoption of sustainable agriculture.

**Farm Practices and Yields**

Sustainable farms are more diversified in both crops and livestock than are conventional farms and have less land planted to the major commodities that, within current systems of production, deplete the soil most. Sustainable farmers use less commercial fertilizer, pesticides, and energy. Instead of these purchased inputs, they rotate crops, recycle plant nutrients and manure, and plant more soil-building crops than do conventional farmers. They also use more cover crops, strip crops, contour grass waterways, and field windbreaks to conserve moisture for crop production and reduce soil erosion.

These practices can cause some, although in most cases not large, losses of yield of some crops. But they have positive environmental impacts. And importantly, the best sustainable farmers have yields comparable with conventional farming despite lower resource use.

**Farm Finance and Economic Performance**

The economic performance of sustainable agriculture is difficult to compare with conventional agriculture on a year-to-year basis because the economic strategy involved in sustainable agriculture is long term.

On average, sustainable farms have fewer farm assets than conventional farms, but are proportionately no more heavily in debt.
Sustainable farmers spend less on some items, but average total production expenditures reported by conventional and sustainable farmers are not consistently or significantly different.

Conventional farms generally report higher gross income, and in 1991 performed better overall than sustainable farms, except in Iowa, where sustainable farmers produced twice as much net farm income per acre as conventional farmers. In general, factors other than the practice of sustainable agriculture contributed as much or more to the comparatively poorer performance of sustainable agriculture in other states, according to statistical analysis. Moreover, the top one-third of the sustainable farmers performed very competitively with conventional farmers, even after principal and interest payments, family labor costs, and adjustments in value of livestock were taken into account.

Some sustainable farmers did extremely well. These top-performing sustainable farms were often smaller than other sustainable farms. Management skill appears to be the crucial factor in their success.

**Labor and Management**

Sustainable farmers (operator and spouse combined) spend over one-fourth more time on farm work than do conventional farmers. However, the sustainable farmers' work is more centered on livestock and is therefore spread out more evenly over the year, while labor demands on conventional farms are more concentrated during crop-growing seasons.

Sustainable farmers are more likely than conventional farmers to share management decisions with other family members. The toughest management issues for sustainable farmers involve crop production and soil management, while for conventional farmers, the biggest problem is how to market the large volume of commodities they produce.

These relationships suggest that sustainable agriculture is even more of a partnership between spouses than is conventional agriculture, and that the demands on this partnership are substantial.

**Community Interactions**

Sustainable farmers buy less fertilizer and pesticide than conventional farmers and less of some related services, like custom crop spraying. They travel farther to buy livestock and livestock products, but not as far to take out operating loans. They are also more likely to purchase locally produced products and services, both from other farmers and from nonfarm businesses. And although they generally spend less per farm on these locally produced inputs, sustainable farmers spend more per acre because their farms are smaller.

These differences may, in part, reflect differences in the availability of goods and services needed most by the two groups.

Both groups market their crops and livestock within their home state, but sustainable farmers are more likely to sell out-of-state because of the lack of available markets for the products they produce. To realize the business development potential of new markets for products from sustainable farms, the business infrastructure of rural communities will

---

To order these publications, please complete and return this form to the address below:

- Please send me ______ copy/copies of the full report of *A Better Row to Hoe.* (If you are ordering multiple copies, how do you plan to use them?)

- I would like to purchase a copy of *Planting the Future,* a book reporting on this research to be published by Iowa State University Press. Please send me an order form.
have to be diversified to reflect the greater diversity of crops produced on sustainable farms.

Sustainable farmers also participate in the social and civic life of the community. They are as likely as conventional farmers to participate in and provide leadership to farm, church, and civic groups, despite working more hours on the farm.

**Adopting Sustainable Agriculture**

Sustainable farmers are innovators whose farms are likely to be smaller, but who are likely to own a greater portion of the land they farm. They are slightly younger than conventional farmers and adopted sustainable practices early in their farming careers. They are likely to cite environmental and health concerns as the basis for adopting those practices.

When first adopting sustainable practices, sustainable farmers were most concerned about how it would affect crop yields, weeds, profitability, and workload. Many of these concerns have lessened, while others have not. Sustainable farmers get help on these issues from research they do themselves on their own farm, from other sustainable farmers, sustainable farm organizations, and farm magazines. Most do not rely much on extension personnel, university scientists, or government agency staff.

Conventional farmers are discouraged from adopting sustainable agriculture primarily from fear of reduced crop yields, more labor, and lower income. But those who convert report that many of these concerns have been reduced as their experience with sustainable agriculture grows.

Both sustainable and conventional farmers report stress related to their farming operations, but are satisfied with farming as a way of life.

**A Matter of Choice**

Sustainable agriculture is a matter of choice, both for farmers and for society.

For farmers, the choice is made more inviting by the clear success that some sustainable farmers have achieved. But it is made more difficult by public policies that discourage sustainable practices.

Federal farm commodity programs reward top-yield production of grain crops and provide smaller benefits to those who minimize inputs and plant soil-conserving crops and forages. The commodity programs should be reformed to reward environmental performance, remove penalties from farmers making a shift to sustainable agriculture, and extend benefits to those who have been penalized in the past for using sustainable practices.

Greater emphasis should be placed on sustainable agriculture in research and education programs to develop, refine, and teach the management systems sustainable agriculture requires. Progress has been made in establishing policy goals in legislation, but these goals have been poorly supported by weak funding.

More also needs to be done to support beginning farmers who use sustainable practices. Many sustainable farmers adopt their practices when they are young. It may be even easier to start farming with sustainable practices than it is to convert after years of experience and substantial investments have been made in conventional practices. At the same time, low-cost sustainable strategies may present an ideal way for beginning farmers to break the financial barriers to entry into agriculture.

Sustainable agriculture and rural development need each other, and our nation needs a policy that advances both. A comprehensive rural development policy ought to support development of the local rural business infrastructure needed by sustainable agriculture, and farm policy that nourishes sustainable agriculture ought to foster new business opportunities in rural communities.

Like many new technologies, sustainable agriculture faces an uncertain future. Clearly, interest in the principles that underlie it is now widespread, and the public benefits of its practice are becoming more apparent. Fears and apprehension, especially among farmers, remain significant, but no longer seem daunting. Because sustainable agriculture requires a new management technology, the need to refine and teach the principles that guide decision-making is especially important.

Choices should be made deliberately, whether they are the personal choices of farmers or the policy choices of society. *A Better Row to Hoe* distills over $4.5 million worth of research into sustainable agriculture and tries to make the choices both clearer and better informed. We cannot say that sustainable agriculture will prevail. But we can share the vision it offers of a farming system that rewards land stewardship, yields food abundantly, provides economic opportunity for farmers, and supports healthy rural communities.
About the Research
Over the last six years, Northwest Area Foundation has provided over $4.5 million to support research on the economic, environmental, and social impacts of sustainable agriculture in seven states: Iowa, Minnesota, North Dakota, South Dakota, Montana, Oregon, and Washington. A Better Row to Hoe summarizes the Foundation’s interpretation of the results of this research.

Research participants include: Iowa State University, Practical Farmers of Iowa, University of Minnesota, Land Stewardship Project, North Dakota State University, Northern Plains Sustainable Agriculture Society, Montana State University, University of Montana, Alternative Energy Resources Organization, Oregon State University, Oregon Tilth, Washington State University, South Dakota State University, Tufts University, Virginia Polytechnic Institute and State University, and Center for Rural Affairs.

About the Report
A Better Row to Hoe is a publication of the Northwest Area Foundation. It was prepared with the assistance of Marty Strange and Cheryl Miller, consultants to the Foundation. Readers who would like to request the full report, additional copies of this executive summary, or Planting the Future, a book reporting on the research to be published by Iowa State University Press, may use the order form on page 3.

About the Foundation
Northwest Area Foundation is a private regional foundation established in 1934. Its mission is to contribute to the vitality of its eight-state region—Minnesota, Iowa, North Dakota, South Dakota, Montana, Idaho, Washington, and Oregon—by promoting economic revitalization and improving the standard of living for the region’s most vulnerable citizens.
THE PROFITABILITY OF FOUR SUSTAINABLE FARMS IN MINNESOTA

Charlene Chan-Muehlbauer, MDA
Doug Gunnick, MDA
Jodi Dansingberg, LSP
The Profitability of Four Sustainable Farms in Minnesota

Table of Contents

Acknowledgements ................................................................. 1

Introduction ................................................................. 2

Beach Farm
A 334 acre dairy farm in Southeastern Minnesota utilizing a controlled
grazing system for its herd of 67 dairy cows .......................... 3

Mason Farm
A 248 acre dairy farm with 73 registered holstein cows in South Central
Minnesota which raises corn, oats and hay with little or no pesticides or
soluble fertilizers .............................................................. 9

Webster Farm
A diversified crop and livestock farm which uses no chemical fertilizers,
pesticides or sub-therapeutic antibiotics in its alfalfa, corn, small grain and
peas, soybean, triticale, dairy cow, dairy steer or hog enterprises, which are
managed on 305 acres of rolling South Central Minnesota farm land .... 15

Elwood Farm
A 305 acre crop and dairy farm in South Central Minnesota which markets
organic yellow corn, blue corn, soybeans and small grains .......... 25

Charlene Chan-Muehlbauer, Minnesota Department of Agriculture
lead author on the Beach, Mason and Webster case studies and introduction

Jodi Dansingburg, Land Stewardship Project
lead author on the Elwood case study and introduction

Douglas Gunnink, Minnesota Department of Agriculture
provided the financial analysis and interpretation of the four case study farms
LEARNING METHODS, ENVIRONMENTAL, AND ECONOMIC DIMENSIONS

ON-FARM RESEARCH, DEMONSTRATIONS, AND TOURS

SUMMARY (by C. A. Francis): On-farm research activities provide a valuable resource both for demonstration and for generating location- and management-specific information for the producer. Much of the research conducted “on farm” in the past has actually been planned and managed by researchers. This may be valuable for collecting additional information on specific components of technology under a new set of conditions, but in most cases should not be considered “participatory on-farm research.” In contrast, much of the methodology that comes from the Farming Systems Research/Extension experience in the U.S. and in the international community is highly relevant to the study of cropping and crop/animal systems under conditions of the farm. It involves the farm owner or operator as a full member of the research and education team. A list of key references to the methods used in on-farm research and demonstration has been assembled by Hildebrand, King, and Francis. More detailed information on recent innovations in this area has been assembled and published by the Center for Sustainable Agricultural systems with partial support from a SARE grant:

“Alternative Approaches to On-Farm Research and Technology Exchange,” Charles Francis, Rhonda Janke, Victoria Mundy, and James King, editors. Center for Sustainable Agricultural Systems, Coop. Extension Division, University of Nebraska, Lincoln, NE 68583-0949. 174p.

Alternative practices and crop/livestock systems that depend on fewer purchased inputs are receiving increased attention due to the success of progressive farmers who substitute management and biological structure for conventional use of chemical pesticides and fertilizers. Organic farming provides a sharp contrast to conventional use of chemical inputs. This option offers an opportunity to explore new markets in a society that is concerned about both food quality and the impacts of conventional agriculture on the environment. A farm tour that includes a presentation of the philosophy and goals that drive decisions by an organic farmer can be valuable as a point of contrast to conventional operations. An on-site visit to a farm that integrates crops and animals without chemical inputs can provide first hand evidence to participants of the integration efficiencies and biological structuring of alternative systems. A field tour should have clear learning objectives and a structured approach that will help reach them, and a way to evaluate impact.

Learning objectives for a farm demonstration visit or tour should be carefully planned, and the activities on farm designed to meet those objectives. Examples of these objectives (modified from a list developed by Dr. Helene Murray, Coordinator, MISA, U. Minnesota) include:

• explore the guiding philosophy and long-term goals of the farmer in order to better understand decision making and how goals will be attained

• identify what factors are influencing management decisions among farmers in the region, and document farmer perceptions of problems, needs, immediate concerns
• examine how farmers with different farm size or resource base choose different production methods and respond to changes in the market place or environmental rules

• identify farmers' visions for the future, such as threats to the current agricultural system, opportunities for long-term investment, and multi-generational concerns

• identify potential collaborating farmers for longer-term projects, such as educational tours or participatory research projects

Before leaving for a farm tour, it is useful to have an overview document or handout that profiles the farm and its resources, philosophy of the owner and/or manager, general approach and acres in each crop or dedicated to each enterprise. This facilitates discussion after arrival and makes the transfer of information more efficient. It also allows visitors to formulate questions and be ready to initiation discussion of key issues with the farmer host. Drawn from this document and the learning objectives of the tour, it is useful to design an evaluation instrument to get feedback from the participants. They should be asked about content of the tour as well as the method of communication. What lesson was most important from this visit? What information will be most useful in their own future activities? How would they suggest that the tour could be improved? The evaluation should be related specifically to the learning objectives, in order to determine if they have been achieved. Farmers who host tours are usually very interested in getting copies of the evaluations of the tour.

Additional comments on farm tours were submitted by Dr. Mary Hanks, Program Supervisor, Energy and Sustainable Agriculture Program, Minnesota Department of Agriculture: “In our farm tours, we try to avoid having an Extension educator in front of the audience with a flip chart. We put the farmer in charge of the tour and provide help with the plan. The farmer is the main speaker. He or she identifies other presenters from a pool of specialists and decides when they speak on the program. We have a “run through” the day before to work out any glitches.

Another approach we have used is to tour two, contrasting farms, such as a confinement dairy and one that practices rotational grazing. At the end of the day, we compare and contrast both operations. We discuss the benefits and disadvantages of each one regarding economic, environmental, and social parameters. The comparison/contrast farm tour has worked especially well with graduate students. We will be trying it next with Extension educators.”

We welcome any comments or suggestions you have about on-farm research and on-farm demonstrations and tours. The SARE project will continue to collect relevant information on these topics and make it available to researchers, farmers, non-profit groups, Extension specialists and educators, and state and federal agency people in the region. Please send these comments to Charles Francis at the Center for Sustainable Agricultural Systems, University of Nebraska, Lincoln, NE 68583-0949.
EXTENSION AND EDUCATION
MATERIALS FOR
SUSTAINABLE AGRICULTURE:
Volume 3

Alternative Approaches
to On-Farm Research
and Technology Exchange

A Project of the North Central Region
Sustainable Agriculture Research and Education and
Agriculture in Concert with the Environment

Charles Francis, Rhonda Janke, Victoria Mundy, James King
Editors

University of Nebraska - Lincoln
Lincoln, Nebraska

Center for Sustainable Agricultural Systems
University of Nebraska-Lincoln
Lincoln, NE 68583-0949
April 1995

It is the policy of the University of Nebraska-Lincoln not to discriminate on the basis of gender, age, disability, race, color, religion, marital status, veteran's status, national or ethnic origin or sexual orientation.
INTRODUCTION

What is the latest thinking about on-farm research and education opportunities and challenges in the U.S.? A symposium on "Alternative Approaches to On-Farm Research and Technology Exchange" was convened in Seattle on November 1995, sponsored by the Division A-8 (Integrated Agricultural Systems) of the American Society of Agronomy. The symposium was chaired by Wanda Collins and Steve Oberle (Chair of Division A-8) and attended by more than 100 people. Following the symposium, a number of attendees requested that we bring the papers together for distribution to a wider audience and make them available as a publication. Gary Peterson, Editor-in-Chief for ASA publications, gave us permission to print the papers presented in the symposium, and editors of several journals likewise agreed that key papers could be reproduced here for easy reference.

There is growing interest in the concept and practice of "participatory on-farm research" since the highly successful conference at University of Illinois in 1992 (Clement, 1992). Although many key research activities continue to be planted on farmers' fields under the accepted definition of "researcher-designed, researcher-managed" experiments, there is growing acceptance of the concept of farmer-designed or team-designed participatory activities. As we become more convinced of the site-specificity of results and recommendations, it becomes obvious that there is a vital role for individual farmers to conduct some of their own testing of new components and systems. We have heard farmers say, "Research does not cost, it actually pays!" The cooperative spirit is further reflected in a current series of Extension and NRCS training sessions with the theme, "Everyone a Teacher, Everyone a Learner" (Carter and Francis, 1995).

Seven papers from the symposium represent current ideas and practices of participatory on-farm research and education. Fourteen other recent papers or discussion summaries include items that have received major attention in the last several years, or represent ideas that have not had broad distribution. A report on "Participatory Research and Other Sharing of Experience" came from an "open space" discussion at the recent Santa Cruz cluster workshop of the Integrated Farming Systems initiative sponsored by W.K. Kellogg Foundation. Others are from University of Illinois and Kansas State University. We realize there are many more people working in this area, and sincerely invite you to send current reports of experiences and programs to our Center. If there is a critical mass of additional materials, we will put them together in a similar summary document for distribution.

Charles Francis, Rhonda Janke (Kansas State U.), Victoria Mundy, James King
Editors
TABLE OF CONTENTS

Papers Presented in Symposium

Decision Case Studies are Ideal for On-Farm Research
R. Kent Crookston, University of Minnesota ........................................... 1

Use of On-Farm Research by Farmers for Technology Development and Transfer
Stewart Wuest, Baird Miller, Stephen Guy, Russ Karow, Rojer Veseth,

Best Information for Choosing Crop Varieties
Dale Hicks and Robert Stucker, University of Minnesota ........................... 13

Adaptability Analysis for Diverse Environments
Peter Hildebrand and John Russell, University of Florida ......................... 19

Use of the Focus Group in Designing, Implementing, and Evaluating Cover Crop
Trials in Western Washington
Dyvon Havens, N. L. Liggett, Lorna Butler, and W. C. Anderson,
Washington State University, .............................................................. 29

Complementary Abilities and Objectives in On-Farm Research
Derrick Exner, Iowa State University .................................................... 33

Credibility of On-Farm Research in Future Information Networks
Charles Francis, University of Nebraska-Lincoln ..................................... 37

Recent Papers Related to On-Farm Research

Participatory Research and Other Sharing of Experience
Committee Report Summarized by Charles Francis, U. Nebraska - Lincoln; from
W.K. Kellogg Foundation Cluster Workshop, Integrated Farming Systems,
Santa Cruz, California; February 23, 1995 ............................................. 51

On-Farm Research
Emerson Nafziger, University of Illinois (Chapter 19 from 1994 book from
Department of Agronomy, U. Illinois .................................................. 55

Responsive Constructivist Requirements Engineering: a Paradigm
Michael Mayhew and Samuel Alessi, Iowa State Univ. and USDA/ARS, Morris,
Minnesota (In Systems Engineering: A Competitive Edge in a Changing World,

On-Farm Research in Kansas, 1993: Summarized Results of a Farmer Opinion Survey
Stay Freyenberger, Kansas State University (unpublished) ....................... 69
On-Farm Experiment Designs and Implications for Locating Research Sites
Phil Rzewnicki, Richard Thompson, Gary Lesoing, Roger Elmore, Charles Francis, Anne Parkhurst, and Russell Moomaw, U. Nebraska and Practical Farmers of Iowa
(Amer. J. Altern. Agric. 3:168-173. 1988) ........................................... 81

Establishing the Proper Role for On-Farm Research
William Lockeretz, Tufts University (Amer. J. Altern. Agric. 2:132-136. 1987) ... 87

Farmer Participation in Research and Extension: N Fertilizer Response in Crop Rotation
Alan Franzleubbers and Charles Francis, University of Nebraska
(J. Sustain. Agric. 2:9-30. 1991) ......................................................... 93

Modified Stability Analysis of Farmer Managed, On-Farm Trials
Peter Hildebrand, Univ. of Florida (Agron. J. 76:271-274. 1984) ................. 105

Farmer Initiated On-Farm Research

Participatory Strategies for Information Exchange
Charles Francis, James King, Jerry DeWitt, James Bushnell, and Leo Lucas, Univ. of Nebraska and Iowa State Univ. (Amer. J. Altern. Agric. 5:153-160. 1990) .... 113

Farmer Participation in Research: A Model for Adaptive Research and Education
John Gerber, Univ. of Massachusetts (Amer. J. Altern. Agric. 7:118-121. 1992) ... 121

Communicating between Farmers and Scientists: A Story about Stories
Connie and Doc Hatfield, Preston and Wanda Boop, and Ray William, Oregon and Pennsylvania Farmers, and Oregon State Univ.

On-Farm Sustainable Agriculture Research: Lessons from the Past, Directions for the Future
Donald Taylor, South Dakota State Univ. (J. Sustain. Agric. 1:43-86. 1990) .... 127

Farmers' Use of Validity Cues to Evaluate Reports of Field-Scale Agricultural Research
Gerry Walter, Univ. of Illinois (Amer. J. Altern. Agric. 8:107-117. 1993) ....... 151

Key Recent References ................................................................. 163

Introduction and Tables of Contents, Volumes 1 and 2, January 1994 ............... 167

Subscription Information for the
Amer. J. Alternative Agric. and J. Sustainable Agric. ................................ 173
INTEGRATIVE SYSTEMS AND RESOURCES FOR SUSTAINABLE AGRICULTURE

INTEGRATED RESOURCE MANAGEMENT
IN SUSTAINABLE AGRICULTURE

LEARNING METHOD: Talk Show, Group Exercises, Jeopardy

PRESENTED BY: Barbara Maureen Vining, CCA
Midwest National Technical Center
USDA Natural Resources Conservation Service
Lincoln, NE

Talk shows have become popular with the American public, emphasizing that people have something to say and want a chance to say it. What appeals to loyal listeners is the ability of the talk show host (or hostess?) to state what the listener has on his/her mind. This approach will be tried to generate ideas from the group before beginning exercises. This is brainstorming with a new face. We will investigate the question "How do we interlink various management systems or enterprises to address environmental, economic, and ethos concerns of the farmer, the community and the federal government?" Group exercises focusing on a proposed planning process will involve the audience and challenge each individual to be attentive. An adaptation of the gameshow "Jeopardy" will be used to evaluate student's retention of material presented during the session.

KEY REFERENCES:


Resource Planning Process: Steps 1 through 4
(Conservation Plan)

Client's Goals, Objectives, Resource Concerns, Problems, etc.

Conservation District's Long-Range Plan

Soil Survey

Resource Concerns - CPPE

Legislated Programs and Criteria

FOTG

State Quality Criteria

Local Quality Criteria

Discipline Manuals and Handbooks

Project Plan (Report)

FOCS

Steps 5 and 6

Planner's Assistance

Ecosystem Components
- Natural and Introduced
- Human Activities
- Interactions and Effects

Effects from Off-Site Systems or Activities

Inventory Resources

Identify Problems

Analyze Resource Data

Determine Objectives

Problems Defined and Quantified; Objectives Established
Resource Planning Process: Steps 5 through 8 (Conservation Plan)

Established Objectives and Defined and Quantified Problems and Resource Concerns

Client(s)

CPPE and CMS Process

Legislated Programs and Criteria

State Quality Criteria

Local Quality Criteria

FOTG

CED

Formulate Alternatives

Evaluate Alternatives

Discipline Manuals and Handbooks

Planner's Assistance

Project Area
- Ecosystem Components
- Resource Concerns
- Cause and Source of Impairment

Client Selects Alternatives

Step 8: Implement Plan

Planning Unit
- Ecosystem Components
- Natural and Introduced
- Human Activities
- Interactions and Effects

Effects
CHAPTER IV • CONSERVATION EFFECTS FOR DECISION-MAKING: A FRAMEWORK FOR ECONOMIC EVALUATION

INTRODUCTION

Conservation Effects for Decision-Making (CED) is a process that was developed to enable SCS planners to display and evaluate positive and negative effects of various conservation options available to the land user.

The CED process can be used to assist land users with their conservation decisions by:
1. Providing a framework in which to organize and present information in a form that facilitates comparison of the positive (gains) and negative (losses) effects of a conservation option.
2. Permitting consideration of all physical, sociological, and economic values pertinent to the evaluation.
3. Encouraging the employment of analytical tools at appropriate levels of sophistication, as needed, to enable land users to make informed decisions.
4. Capitalizing on the knowledge and experience of our agency professionals and clients to foster interaction throughout the decision-making process.

COLLECTING AND RECORDING INFORMATION

The collecting and recording of effects information for the Conservation Effects for Decision-Making (CED) process is not a new approach; it has been the major thrust of conservation management systems (CMS) and planning in general. The CED idea emerged from a national economic applications work group as a conceptual framework linking the planning process with economic input and emphasizing the end objective, i.e. the identification of the expected effects from applied conservation which allows decisions and actions to be taken. The CED framework is conceptually applicable to all SCS programs and planning situations. Consequently, it is also the theme and organizational tool for this handbook. What follows is an explanation of the steps in the process of evaluation, a diagram of the decision making process, and presentation of examples of evaluation approaches. Case studies have been included as examples from each of the four Technical Center Regions. Subsequent chapters in this handbook explain the various economic principles, tools, and techniques available for use if one wishes to carry evaluations to a more detailed level of analysis.
THE FRAMEWORK

The CED framework enables the combination of information from many different disciplines so that a comprehensive and effective evaluation can be made. For more guidance on how to carry out a CED analysis consult with your state office about CED training, the CED Training Manual and the Conservation Effects for Decision Making Workbook. The CED Workbook contains step-by-step instructions on how to carry out a CED analysis and explains each step of the process. Lessons and questions are provided for self study. One should always keep in mind that economics is just one of the many tools available to help SCS do a better job and help the land user make more informed decisions.

STEPS IN THE CED PROCESS

THE FIRST STEP

Field office level planning efforts should always first identify the benchmark condition. The planner and land user work together to develop a picture of existing conditions, trends, problems, opportunities, and objectives. The assistance provided is based on soil, water, and other natural and cultural resource information. The description of benchmark conditions could also include other inventories and evaluations as needed. These may include a description of current crops, farming practices, livestock type and condition, and available equipment. It could also include consideration of sociological and economic characteristics. Planning objectives and problem complexity for each specific situation determine the detail of inventories and evaluations needed.

OBJECTIVES

The objectives of the land user will usually affect the kinds and amounts of information gathered and evaluated. However, it is important to point out that the formulation of planning objectives requires that both the objectives of society as well as those of the land user be considered as problems and concerns are identified. The planning process should also identify opportunities. This assists in creating a broader view that spans beyond the search for resource problems to recognize those situations where resource enhancements may be achieved. For example, if a given situation is evaluated to not have a significant soil resource problem onsite, opportunities may still exist to make on-farm improvements which could increase farm efficiency and profitability while at the same time reducing negative offsite water or air quality effects.
OPTIONS

Those options appropriate to meet the individual and societal objectives need to be considered after a picture of the benchmark situation and expected future trends is developed. An option is a desired view of the future.

Proposed options enable planners to develop a new picture of the conditions that could exist on the farm or ranch. With treatment conditions are referred to, in the CED framework, as options. Options represent the world of possibilities, a vision of what could be, based on predictive models, professional judgement, and experience regarding the expected effects of each action or set of actions considered. Options are the alternatives to the existing situation that are proposed to deal with current and future problems or issues.

Options are generally components of a Resource Management System (RMS), but could also be an Alternative Management System (AMS), Acceptable Conservation System (ACS) for plans developed for the 1985 Food Security Act, be a single practice or simply an adjustment to present farming operations. Proposed options must be consistent with Sections III and IV of the Field Office Technical Guide (FOTG). They must also be within the approval authority of the planner. Apart from the FOTG, the experience and knowledge of the planner and decision maker are the main sources of information used for selecting proposed options.

ACTIONS

To achieve a specific option, steps or actions need to be taken to achieve that option. Examples of actions could include a change in cropping sequence, land use, time of seeding, tillage or timing of cultivation, structural improvements to the farm or simply a lowering of the speed of a single tillage operation.

Each individual has a different experience base which can be increased by on-the-job training, specialized training courses, field trials, or the use of models. One of the most useful learning experiences for planners is to visit land users with successful conservation treatments already applied. Technology transfer through exposure in this manner rapidly broadens an employee's perspective and improves their expertise and confidence. If successful on-farm experiences are documented and shared as case studies, the knowledge base of others within and outside of the Agency could also be easily enhanced. Such experiences should be recorded first in physical and biological terms rather than monetary terms because monetary values are simply a translation of the former and can be expressed in current dollars at any time.
IMPACTS

The completed option is compared with the benchmark condition to estimate the impacts of the actions. The impacts of applied conservation options are the difference between the conservation effects of the benchmark or current condition and trends, and the effects of the options situation. Quantification of the impacts is dependent upon the degree of detail used to describe or measure the benchmark and expected option conditions. The impacts should be described in narrative form at a minimum, and in quantitative terms to the extent possible. They should also be recorded in an easy to understand manner for consideration by the decision maker. One way to do this is on Conservation Effects or Impacts Worksheets. Differences in erosion rates, habitat values, water quality, acres farmed, bushels harvested, labor and fuel requirements, pesticides used, etc. should all be documented to the extent that such information serves the agency. The time frame when the impacts occur might also be identified because certain actions such as pasture improvements can result in immediate costs, but the resulting yield increases may be delayed and then occur for an extended period of time.

VALUES

Each individual's values will affect the relative merits of an impact. Ten additional quail may be a positive impact to one person and a negative impact to another. An individual's set of values may be in harmony with "society's best interest" or it may be in direct conflict. Once the land user's set of values has been applied to the impacts, the positive and negative effects may be listed. This listing can go through many iterations of detail, starting rather general and working to more and more detailed levels. The iteration process may involve travelling completely back through the decision making process, or it may involve increasingly more sophisticated levels of detail on the same impacts. The process is continued until the land user has sufficient detail to make an informed decision. In most cases the planner will identify the costs and describe necessary maintenance for each of the options. Often this low amount of detailed information will be sufficient for the land user to make a decision. However, occasionally a more complex analysis will be necessary, which will require higher levels of detail. This is where the concepts presented in this handbook may help.

THE PLANNING PROCESS

The CED process is completely consistent with the National Planning Manual. It is not a new system, but rather a method of thought organization. The CED process provides a method to evaluate the continuum of all options available to the land user. It is intended that the process will make conservation planning and application easier and more efficient. The following diagram is presented to graphically explain the CED decision making process.
Subject: TCH - TECHNOLOGY

Series No.: 450-LI-2

Reference: A Strategy to Promote Residue Management

Date: June 1992

DIST:
S-MIDWEST
T
N (ESS)

SOIL CONSERVATION SERVICE
U.S. DEPARTMENT OF AGRICULTURE
On August 14, 1991, the Chief of the Soil Conservation Service released the "Three-Year Action Plan to Accelerate Adoption of Residue Management." This plan is designed to facilitate the near doubling of current residue management acreages needed for conservation compliance by 1995. An initial step in the plan was to formulate focus groups comprising of agents (SCS, ASCS, SWCD), producers, and farm managers from around the country. As part of their objectives, the focus groups developed some preliminary findings regarding residue management.

- Increase farmer knowledge of residue, residue levels
- Economics - biggest hurdle
- Fear of unknown, change
- Farmer needs to take ownership of plan
- Farmer needs to be aware of SCS flexibility
- Demonstration, farmer to farmer best sales tool
- Equipment availability could be a problem
- Accessibility of data
- Localize, localize, localize

Purpose

The purpose of this technical note is to address as many of the focus groups' findings as possible using simple, available tools and approaches. The information contained in this document is most important at the field level, and should be shared at that level in some form. Specifically, the strategy and information that follows is meant to:

1. allow SCS and our clients to lay out the economics of residue management alternatives,
2. help our clients overcome the fear of the unknown involved in changing the way that they operate,
3. help our clients understand the physical effects they may achieve on resource problems and concerns with proper residue management,

4. facilitate the clients feeling of ownership of the plan,

5. encourage farmer to farmer demonstrations,

6. make residue management data more available to the client who is contemplating a change of operation, and

7. allow for localized aspects of decisionmaking.

Strategy

There are two main ingredients needed to meet the objectives outlined above. They are: 1) localized data on residue management, and 2) a tool to use that data in a customized analysis.

Case Studies* - One of the most effective and cost-efficient methods of collecting localized data on residue management is through the use of case studies. A case study is an organized set of quantitative and qualitative information that describes benchmark and planned condition of the resource and the impacts from installing that treatment. It basically documents how residue management meets cooperator objectives and effectively treats resource problems. (This documentation should be stored in Section V-B-1 (Producer Experiences) of the Field Office Technical Guide.)

A case study can be conducted as part of your ongoing conservation planning work during review of the farm operation and while developing and evaluating alternatives. Additionally, follow-up after the conservation plan has been implemented will serve to verify or reject planning expectations. Planning notes from an existing plan might contain all or most of the information needed to produce a good case study. One purpose of this technical note is to give information on structuring that data to include kinds, amounts, and timing of actions taken to implement residue management.

Typically, actions to implement residue management include changes in inputs and outputs. Therefore, the case studies should attempt to measure or quantify those changes. They should reflect farming operations undertaken, type of equipment used, dates of operations, number of operations to complete work, and the kinds and amounts of inputs such as seed, fertilizer, pesticides, tractor hours, fuel consumption, and labor required.

They should reflect yields, erosion rates, and other observable indicators related to the resources of concern (soil, water, air, plants, and animals).

They should reflect any significant changes in operational and managerial conditions and decisions.

* More information on case studies can be found in the National Technical Center Technical Note entitled "Guidance for the Development and Use of Case Studies as a Source of Conservation Effects Information."
All available data on changes in the five resources should be recorded as that
deals directly with our SCS mission. The degree of detail and selection of input
and output factors to collect data for, however, should be guided by common
sense and professional judgement. For example, the conservationist can ask the
question: "What should I observe in order to gauge results and judge
'success'?" Such efforts will help prioritize and streamline data collection and
analysis.

Case studies of residue management can be of three types:

1. a comparison of the "before and after treatment" conditions on a single
   site,

2. a comparison of two separate, but comparable resources and landuse
   situations (sites) on different farms or even on the same farm, i.e., one
   site "with and one without treatment"; or

3. a simple recording of the results a farmer experiences "with treatment"
   on a single site regardless of the "before" treatment conditions.

The first and second types mentioned above require that data be collected for
both the "before treatment" or benchmark situation (without treatment) and the
"after treatment" (with treatment) condition arising from the adoption of residue
management.

The last alternative represents the simplest, easiest approach, but inherently has
the greatest risk for misunderstanding cause and effect relationships because it
focuses on "with treatment" conditions only. This may not matter, for the
immediate future, as the optional situation with residue management is deemed
more desirable than the new cooperator's present situation. However, a more
precise understanding of the cause and effect relationships due to conservation
is important for our work over the longer term. Indeed, conservation effects
information incorporated into Section V over time should result in improvements
to Section III.

Exhibits 1* and 2* illustrate one way case study information could be displayed.
To start the process, a "Type 3" case study could be completed by recording
the results of Farmer A's experiences with residue management, as part of a
successfully applied conservation plan, Exhibit 1. This format allows for the
recording of actions and effects from Farmer A's successful application of a
conservation treatment which includes residue management. (The collection of
this type of information was suggested at the FOTG training sessions in 1990
and 1991. Some states are well on the way to obtaining many useful sets.)

Exhibit 2 illustrates how the case study from Farmer A can be used to promote
residue management as a viable option for Farmer B.

* Exhibits 1 and 2 were derived from actual case studies developed for use by
a Midwest State.
### Exhibit 1

**Conservation Treatment Information**

<table>
<thead>
<tr>
<th>Field Office:</th>
<th>Resource Setting:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmer A. Somewhere, USA</td>
<td>Blair Silt Loam - 8% Slope.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Conservation Treatment:</th>
<th>Resource Problems Before Treatment:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residue Management - No-Till Corn and Soybeans</td>
<td>Excessive soil erosion - nutrient and pesticide runoff.</td>
</tr>
<tr>
<td>Nutrient Management</td>
<td></td>
</tr>
<tr>
<td>Pesticide Management</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Actions</th>
<th>Effects</th>
</tr>
</thead>
</table>

**No-Till Corn in Soybean Residue**
- Surface applied herbicides 22 of March, 28% liquid nitrogen 100 lbs. of Actual N.
- Bicep (Dual & Atrazine) (2 quart rate)
- Spray broad leaf weeds with Bladex and 2,4-D amine

**No-Till Beans in Corn Stalks**
- Spray preplant herbicides
- Gramoxone Prowl/Surfact X-77 residual 2,4-DB
- Apply lime in Spring

- **Soil loss 3T/Ac**
- P<sub>2</sub>O<sub>5</sub> runoff diminished
- N runoff decreased
- Nutrient pollution reduced
- Machinery
  - 75 HP Tractor
  - No-Till Planter
  - Chopper
  - Stalk buster bush hog
  - Sprayer
  - Planter
- Chemicals: Corn Bladex .3 Gal./Ac
- Beans Gramoxone 1 pt./Ac
- Fertilizer: Corn - N 40# Starter 8-100#
  - P<sub>2</sub>O<sub>5</sub> 60 lb/Ac
  - K<sub>2</sub>O 90 lb/Ac
- Soybeans - Lime 2 Tons/Ac
- Fuel: Corn - 6.5 Gal/Ac
  - Soybeans 5.0 Gal/Ac
- Labor: Corn - 7.4 Hr/Ac
  - Soybeans - 6.0 Hr/Ac
- Yields - Corn - 105 Bu/Ac
  - Soybeans - 28 Bu/Ac

**Comments:**

The use of brand names does not constitute an endorsement by the Soil Conservation Service.

SCS-Any State December 1991
### Exhibit 2

#### Conservation Effects Worksheet

<table>
<thead>
<tr>
<th>Name: Farmer B</th>
<th>Address: Somewhere, USA</th>
<th>OPID No.: 1234</th>
<th>Field or Track No.: 1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Resource Setting:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hoylton Silt Loam, 5%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Resource Problems Before Treatment</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excessive soil erosion, nutrient and pesticide runoff</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Description of Treatment Option:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residue Management, Nutrient Management, Pesticide Management</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Benchmark (Present management system):</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conventional Tillage</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Actions</strong></th>
<th><strong>Effects</strong></th>
<th><strong>Comparison of Effects of Benchmark and Treatment Option</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Soybeans:</strong> Apply lime in the spring. Disk twice in the spring. Apply herbicides (Sencore &amp; Lasso) at planting. Cultivate once.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Comments:**
The left-hand column of Exhibit 2 shows the kinds, amount and timing of actions undertaken by Farmer B in the "before treatment" or benchmark condition. The second column from the left shows the effects of those actions. This data is recorded during elements 4 and 5 of the nine step planning process.

The third column from the left in Exhibit 2 shows the impacts (changes) of adopting the option displayed in Exhibit 1. The impacts are the differences between the effects observed in the "before treatment" benchmark condition of Farmer B and those effects realized by Farmer A in the option of "after treatment" condition. The evaluation of impacts essentially constitutes element 9 of the nine step planning process.

Finally, the last or right-hand column of Exhibit 2 shows Farmer B's perception of the value of those impacts. Such a display of the case study information can be especially helpful to assist client in deciding whether or not to develop a conservation plan.

Care and good judgement must be used in deciding whether to use the participating farmer's name when presenting results to others. Ideally, the case study farmer would consent to the public use of the results and also be an esteemed local resident. However, if confidentiality is a concern, case study information can be presented carefully without reference to the particular cooperating farmer.

If this physical information in Exhibit 2 is enough to allow Farmer B to make a decision on applying residue management, then the strategy has succeeded. If, however, Farmer B wants to see how this option will effect his/her bottom line economically, then the strategy must continue.

**Quick Budget** - The second part of the strategy to promote residue management is to develop a tool that is capable of turning case study data into a customized analysis for the farmer. Fortunately, this tool has been developed by SCS and resides currently in CAMPS 1.6 and a future issue of FOCS. Quick Budget, the field office option of the Cost and Return Estimator (CARE), was developed specifically to analyze conservation options such as residue management.

Quick Budget uses "base crop budgets" developed at the state office as a starting point. Then, information from the farmer is easily incorporated to customize a budget reflecting the current condition for that individual. Now the fun begins as data from appropriate case studies are interjected to answer any "what if" questions the farmer might have about residue management for his own farm.

Data requirements beyond the case studies are not excessive. Over ninety percent of the data comes from base budgets which are developed at the state office. The remaining ten percent or less comes from asking the farmer enough questions to customize a base budget to reflect his or her situation. Quick Budget was designed to make this customization process extremely easy. Also extremely easy is the way it can be used with case studies to analyze residue management options using a "what if" approach.

What makes these processes in Quick Budget so easy? The best way to answer this question is to walk through a demonstration using a state's base budget and the case study described previously in Exhibits 1 and 2.
The MAKE sub-option of Quick Budget pulls a selected base budget to the screen for editing. Exhibit 3 shows how a base budget would appear on the screen in its Quick Budget form. The Quick Budget data screen consists of seven parts entitled:

I. Parameters. - Budget Title, ID, associated field, land and management charges, and number of acres.

II. Revenue. - Total income from the crop (Yield x Price).

III. Machinery Operations. - A base set of machinery operations can be loaded into the Quick Budget form by selecting an appropriate budget to MAKE. Machinery operations can be added with a machinery worksheet or deleted with a few keystrokes.

IV. Materials and Services. - A base set of materials and services can be loaded into the Quick Budget form by selecting an appropriate budget to MAKE. Materials and Services can be added or deleted with a few keystrokes.

V. Other Charges. - Other charges include interest on operating capital, crop drying costs and parameters, settlement month, etc.

VI. Total Costs. - Sum of all costs to produce the crop.

VII. Net Returns. - Revenue minus total costs.

Exhibits 4 and 5 illustrate the editing features available. These features aid in customizing the base budget to match the particular farmer's situation (Farmer B). Overall, Quick Budget functions as a full screen editor, allowing for easy on screen changes. In addition, unique "auto-select" windows can be invoked giving the user a list of selections from which to choose. This feature eliminates the need for typing and greatly speeds up the editing process. Auto-select windows are available for all noncalculated sections of Quick Budget and the data sets for these functions are developed as part of the base budgets by the state office. Many states have completed this task. Exhibit 4 illustrates how this process works for Part IV, Materials and Services. Not only are inputs added, deleted, or replaced; but the costs associated with those inputs are also carried along with the input.

Exhibit 5 illustrates the auto-select windowing available for the Machinery Operations Section. The first window is a machinery calculator which aids in the addition of a new operation, while the second level window gives a list of machines to select for that operation. All operations are sorted chronologically and costs are automatically brought in when a new machinery combination is selected. Again, the data needs for this function are supplied in the program by the state office.

An "auto-recalculation" feature of Quick Budget is extremely useful for the "what if" type analyses.
### Parameters

<table>
<thead>
<tr>
<th>Title</th>
<th>Farmer A Corn Gr Residue</th>
<th>Budget ID</th>
<th>US-021-0021</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field Name</td>
<td>Somewhere, USA</td>
<td>Acres</td>
<td>1</td>
</tr>
<tr>
<td>Land Charge Type</td>
<td>No Charge</td>
<td>Land Charge</td>
<td>0.00</td>
</tr>
<tr>
<td>Mgmt Charge Type</td>
<td>None</td>
<td>Mgmt Charge</td>
<td>0.00</td>
</tr>
</tbody>
</table>

### Revenue

<table>
<thead>
<tr>
<th>Crop Name</th>
<th>Quantity</th>
<th>Price</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn Grain</td>
<td>105.00</td>
<td>2.00</td>
<td>210.00</td>
</tr>
</tbody>
</table>

### Machinery Operations

#### Pre-Harvest Activities

<table>
<thead>
<tr>
<th>Date</th>
<th>Operation</th>
<th>Acres</th>
<th>Times</th>
<th>Cost</th>
<th>Cost</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mar</td>
<td>Sprayer Pull Type</td>
<td>15.36</td>
<td>1.00</td>
<td>0.01</td>
<td>1.42</td>
<td>1.42</td>
</tr>
<tr>
<td>Apr</td>
<td>Custom Fertilize</td>
<td>24.24</td>
<td>1.00</td>
<td>0.03</td>
<td>0.23</td>
<td>0.23</td>
</tr>
<tr>
<td>May</td>
<td>Planter No-Till 6R</td>
<td>5.48</td>
<td>1.00</td>
<td>0.08</td>
<td>8.26</td>
<td>8.26</td>
</tr>
</tbody>
</table>

#### Harvest Activities

<table>
<thead>
<tr>
<th>Date</th>
<th>Operation</th>
<th>Acres</th>
<th>Times</th>
<th>Cost</th>
<th>Cost</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oct</td>
<td>Combine Head Corn 6R</td>
<td>4.58</td>
<td>1.00</td>
<td>0.29</td>
<td>30.36</td>
<td>30.36</td>
</tr>
</tbody>
</table>

### Materials and Services

<table>
<thead>
<tr>
<th>Date</th>
<th>Material / Service</th>
<th>Quantity</th>
<th>Price</th>
<th>Cost</th>
<th>Cost</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mar</td>
<td>Herbicide Bladex</td>
<td>0.50</td>
<td>21.60</td>
<td>10.80</td>
<td>10.80</td>
<td></td>
</tr>
<tr>
<td>Apr</td>
<td>Nitrogen 28% Liquid</td>
<td>40.00</td>
<td>0.17</td>
<td>6.80</td>
<td>6.80</td>
<td></td>
</tr>
<tr>
<td>Apr</td>
<td>Phosphorous</td>
<td>60.00</td>
<td>0.11</td>
<td>6.60</td>
<td>6.60</td>
<td></td>
</tr>
<tr>
<td>Apr</td>
<td>Potassium</td>
<td>90.00</td>
<td>0.12</td>
<td>10.80</td>
<td>10.80</td>
<td></td>
</tr>
<tr>
<td>May</td>
<td>Nitrogen</td>
<td>100.00</td>
<td>0.17</td>
<td>17.00</td>
<td>17.00</td>
<td></td>
</tr>
<tr>
<td>May</td>
<td>Corn Seed</td>
<td>0.25</td>
<td>64.90</td>
<td>16.23</td>
<td>16.23</td>
<td></td>
</tr>
<tr>
<td>Jun</td>
<td>Herbicide Bladex</td>
<td>0.30</td>
<td>17.50</td>
<td>5.25</td>
<td>5.25</td>
<td></td>
</tr>
<tr>
<td>Jun</td>
<td>Herbicide 2,4D amine</td>
<td>0.13</td>
<td>8.00</td>
<td>1.04</td>
<td>1.04</td>
<td></td>
</tr>
</tbody>
</table>

### Other Charges

<table>
<thead>
<tr>
<th>Charge</th>
<th>Cost</th>
<th>Cost</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interest On Operating Capital</td>
<td>0.04</td>
<td>4.14</td>
<td>4.14</td>
</tr>
<tr>
<td>Crop Drying Costs</td>
<td>0.04</td>
<td>3.75</td>
<td>3.75</td>
</tr>
<tr>
<td>Land Charges</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Management Charges</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

### Total Costs

<table>
<thead>
<tr>
<th></th>
<th>Cost</th>
<th>Cost</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>VI. Total Costs</td>
<td>1.18</td>
<td>124.10</td>
<td>124.10</td>
</tr>
<tr>
<td>VII. Net Returns</td>
<td>0.82</td>
<td>85.90</td>
<td>85.90</td>
</tr>
</tbody>
</table>

---

**Exhibit 3. Quick Budget Report**
Exhibit 4. Quick Budget Materials and Services Selection

<table>
<thead>
<tr>
<th>Date</th>
<th>Material / Service</th>
<th>Units</th>
<th>Quantity</th>
<th>Cost /Unit</th>
<th>Cost /Acre</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mar</td>
<td>Nitrogen</td>
<td>Pounds</td>
<td>40.00</td>
<td>0.17</td>
<td>6.80</td>
<td>1496.00</td>
</tr>
<tr>
<td>Mar</td>
<td>Phosphorous</td>
<td>Pounds</td>
<td>150.00</td>
<td>0.11</td>
<td>16.50</td>
<td>3630.00</td>
</tr>
<tr>
<td>Apr</td>
<td>Potassium</td>
<td>Pounds</td>
<td>200.00</td>
<td>0.12</td>
<td>24.00</td>
<td>5280.00</td>
</tr>
<tr>
<td>May</td>
<td>Herbicide Lariat</td>
<td>Gallons</td>
<td>0.88</td>
<td>15.00</td>
<td>13.20</td>
<td>2904.00</td>
</tr>
<tr>
<td>May</td>
<td>Corn Seed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3570.60</td>
</tr>
<tr>
<td>Jun</td>
<td>Herbicide Banve</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>334.40</td>
</tr>
<tr>
<td>Jun</td>
<td>Nitrogen</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3740.00</td>
</tr>
</tbody>
</table>

Materials/Services Summary
- Corn Grain: 20955.00
- Corn Seed: 3740.00
- Other Charges: 1373.10

Total Revenue = 46200.00  Total Cost = 40696.58  Net Profit = 5503.42

Exhibit 5. Quick Budget Machinery Cost Calculator Selection

<table>
<thead>
<tr>
<th>Machinery Used</th>
<th>Misc. Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Tractor 130 hp</td>
<td>Operation Month: Apr</td>
</tr>
<tr>
<td>2. Disk - Tandem 21'</td>
<td>Times Over: 1.00</td>
</tr>
<tr>
<td>3.</td>
<td>Select a Machine</td>
</tr>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Disk - Tandem 14'</td>
</tr>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Disk - Tandem 21'</td>
</tr>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Fert Anhydrous App 15 WithTank</td>
</tr>
<tr>
<td>Fert Anhydrous App 21 No Tank</td>
<td>20.00</td>
</tr>
<tr>
<td>Harrow Springtooth Drag 10'</td>
<td>9.16</td>
</tr>
<tr>
<td>Hay Baler Large Round 900 lb</td>
<td>24.01</td>
</tr>
<tr>
<td>Hay Baler Large Round 1500 lb</td>
<td>15.37</td>
</tr>
<tr>
<td>Hay Hauler Large Round Bales</td>
<td>10 - Save</td>
</tr>
<tr>
<td></td>
<td>Press Escape to Cancel or ENTER to Select</td>
</tr>
</tbody>
</table>

Total Revenue = 46200.00  Total Cost = 40696.58  Net Profit = 5503.42
Whenever any number is added, deleted, changed, or replaced, based on
information from a case study, the total budget recalculates and results are
instantaneously seen. A stationary bar at the bottom of the screen gives Total
Revenue, Total Costs, and Net Returns. Thus, wherever the user is at in the
budget, a change will be reflected on the bar and a new "bottom line" will
appear without scrolling. Instant simulations can be produced employing various
levels of residue management, customized for Farmer B, based on Farmer A's
experiences.

Currently, an option has been added to Quick Budget to specifically address
without and with treatment comparisons. This option, called COMPARE, is an
additional report available to users. This report (Exhibit 6), allows a user to
select two budgets (current condition and with residue management) and have
them compared to each other in one report.

This report is a useful study tool for the farmer as he or she makes conservation
compliance decisions because the predicted economic effects from moving to
residue management are clearly laid out.

In this example, Exhibit 6, Farmer B's current condition for corn (customized by
Quick Budget using a state supplied base budget as a starting point) is
compared to a residue management alternative (using Farmer A's case study
and Quick Budget). The resulting comparison shows that a move to residue
management could change Farmer B's corn operation in the following
economic ways:

a) Machinery operation costs decreased by $38.04 per acre.

b) Material usage costs (including fertilizer and pesticides) decreased by
   $24.06 per acre.

c) Fuel and labor costs decreased by $10.39 per acre.

d) Net returns increased by $64.57 per acre.

In Exhibit 7, the economic effects of Farmer B's move to residue management
on the soybean enterprise is examined. This COMPARE report illustrates that a
move to residue management could change Farmer B's soybean operation in the
following economic ways:

a) Machinery operation costs decreased by $10.86 per acre.

b) Material usage costs (including fertilizer and pesticides) decreased by $4.53
   per acre.

c) Fuel and labor costs decreased by $2.71 per acre.

d) Net returns increased by $15.84 per acre.

* Remember that Farmer A's case study supplies the non-economic (5
   resources) changes that Farmer B might expect. The changes in Exhibit 6,
deal specifically with economic changes as computed by CARE.
### I. Budget Information

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Budget 1</th>
<th>Budget 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source</td>
<td>Somewhere, USA</td>
<td>Somewhere, USA</td>
</tr>
<tr>
<td>Number of Acres</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Land Charge Type</td>
<td>No Charge</td>
<td>No Charge</td>
</tr>
<tr>
<td>Management Type</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Management Charge Amount</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

### II. Crop Production

<table>
<thead>
<tr>
<th>Crop Name</th>
<th>Units</th>
<th>Yield / Acre</th>
<th>Price / Unit</th>
<th>Total Revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn Grain</td>
<td>Bushels</td>
<td>105.00</td>
<td>2.00</td>
<td>210.00</td>
</tr>
</tbody>
</table>

Total Revenue: 210.00

### III. Machinery Operations

<table>
<thead>
<tr>
<th>Date</th>
<th>Pre-Harvest Operations</th>
<th>Cost / Acre</th>
<th>Cost / Unit</th>
<th>Total Cost</th>
<th>Cost / Acre</th>
<th>Cost / Unit</th>
<th>Total Cost</th>
<th>Difference / Acre</th>
<th>Difference / Unit</th>
<th>Difference Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mar</td>
<td>Custom Fertilizer</td>
<td>0.23</td>
<td>0.00</td>
<td>0.23</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apr</td>
<td>Plow Moldboard 5-16</td>
<td>16.71</td>
<td>0.14</td>
<td>16.71</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apr</td>
<td>Disk - Tandem 21</td>
<td>5.07</td>
<td>0.05</td>
<td>5.07</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apr</td>
<td>Disk - Tandem 21</td>
<td>4.56</td>
<td>0.04</td>
<td>4.56</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apr</td>
<td>Planter 6-30</td>
<td>9.64</td>
<td>0.00</td>
<td>9.64</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jun</td>
<td>Sprayer Full Type</td>
<td>2.05</td>
<td>0.02</td>
<td>2.05</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jun</td>
<td>Fert Anhydrous App 1</td>
<td>7.28</td>
<td>0.07</td>
<td>7.28</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jun</td>
<td>Cultivator - Row 6R</td>
<td>5.83</td>
<td>0.06</td>
<td>5.83</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mar</td>
<td>Sprayer Full Type</td>
<td>1.42</td>
<td>0.01</td>
<td>1.42</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apr</td>
<td>Custom Fertilizer</td>
<td>0.23</td>
<td>0.00</td>
<td>0.23</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>May</td>
<td>Planter No-Till 6R</td>
<td>8.26</td>
<td>0.08</td>
<td>8.26</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jun</td>
<td>Sprayer Full Type</td>
<td>1.42</td>
<td>0.01</td>
<td>1.42</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total Pre-Harvest Operations Costs: 49.37  0.47  49.37  11.33  0.11  11.33

<table>
<thead>
<tr>
<th>Date</th>
<th>Harvest Operations</th>
<th>Cost / Acre</th>
<th>Cost / Unit</th>
<th>Total Cost</th>
<th>Cost / Acre</th>
<th>Cost / Unit</th>
<th>Total Cost</th>
<th>Difference / Acre</th>
<th>Difference / Unit</th>
<th>Difference Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oct</td>
<td>Combine Read Corn 6R</td>
<td>30.36</td>
<td>0.29</td>
<td>30.36</td>
<td>30.36</td>
<td>0.29</td>
<td>30.36</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oct</td>
<td>Combine Read Corn 6R</td>
<td>30.36</td>
<td>0.29</td>
<td>30.36</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total Harvest Operations Costs: 79.73  0.76  79.73  41.69  0.40  41.69

Total Operations Costs: 129.09  1.43  129.09  51.02  0.41  51.02

### V. Material Usage

<table>
<thead>
<tr>
<th>Material Name</th>
<th>Units</th>
<th>Quant / Acre</th>
<th>Cost / Unit</th>
<th>Total Cost</th>
<th>Quant / Acre</th>
<th>Cost / Unit</th>
<th>Total Cost</th>
<th>Difference / Acre</th>
<th>Difference / Unit</th>
<th>Difference Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn Seed</td>
<td>Bushels</td>
<td>0.25</td>
<td>64.90</td>
<td>16.23</td>
<td>0.25</td>
<td>64.90</td>
<td>16.23</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Herbicide 2,4-D</td>
<td>Gallons</td>
<td>0.06</td>
<td>50.80</td>
<td>3.05</td>
<td>0.06</td>
<td>50.80</td>
<td>3.05</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Herbicide Banvel</td>
<td>Gallons</td>
<td>0.06</td>
<td>11.50</td>
<td>0.07</td>
<td>0.06</td>
<td>11.50</td>
<td>0.07</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Herbicide Bilee</td>
<td>Gallons</td>
<td>0.06</td>
<td>11.50</td>
<td>0.07</td>
<td>0.06</td>
<td>11.50</td>
<td>0.07</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Herbicide Basil</td>
<td>Gallons</td>
<td>0.06</td>
<td>11.50</td>
<td>0.07</td>
<td>0.06</td>
<td>11.50</td>
<td>0.07</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Herbicide Lariat</td>
<td>Gallons</td>
<td>0.06</td>
<td>11.50</td>
<td>0.07</td>
<td>0.06</td>
<td>11.50</td>
<td>0.07</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitrogen</td>
<td>Pounds</td>
<td>100.00</td>
<td>0.17</td>
<td>17.00</td>
<td>100.00</td>
<td>0.17</td>
<td>17.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitrogen 2% Liquid</td>
<td>Pounds</td>
<td>40.00</td>
<td>0.17</td>
<td>6.80</td>
<td>40.00</td>
<td>0.17</td>
<td>6.80</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitrogen side</td>
<td>Pounds</td>
<td>100.00</td>
<td>0.17</td>
<td>17.00</td>
<td>100.00</td>
<td>0.17</td>
<td>17.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phosphorous</td>
<td>Pounds</td>
<td>150.00</td>
<td>0.11</td>
<td>16.50</td>
<td>150.00</td>
<td>0.11</td>
<td>16.50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potassium</td>
<td>Pounds</td>
<td>200.00</td>
<td>0.12</td>
<td>24.00</td>
<td>200.00</td>
<td>0.12</td>
<td>24.00</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total Material Cost: 98.57  74.51

### VI. Other Charges

<table>
<thead>
<tr>
<th>Other Charges</th>
<th>Budget 1</th>
<th>Budget 2</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost / Acre</td>
<td>Cost / Unit</td>
<td>Total Cost</td>
<td>Cost / Acre</td>
</tr>
<tr>
<td>Other Charges</td>
<td>10.36</td>
<td>0.10</td>
<td>10.36</td>
</tr>
<tr>
<td>Total Costs</td>
<td>188.67</td>
<td>1.80</td>
<td>188.67</td>
</tr>
<tr>
<td>Net Returns</td>
<td>21.33</td>
<td>0.20</td>
<td>21.33</td>
</tr>
<tr>
<td>Total Fuel Cost</td>
<td>14.46</td>
<td>8.97</td>
<td>14.46</td>
</tr>
<tr>
<td>Total Labor Cost</td>
<td>9.70</td>
<td>4.80</td>
<td>9.70</td>
</tr>
</tbody>
</table>

Net Returns: 21.33  0.20  21.33  85.90  0.82  85.90  64.57  0.62  64.57

Total Fuel Cost: 14.46  8.97  14.46  8.97  5.49

Total Labor Cost: 9.70  4.80  9.70  4.80  4.90

Net Returns: 21.33  0.20  21.33  85.90  0.82  85.90  64.57  0.62  64.57

Total Fuel Cost: 14.46  8.97  14.46  8.97  5.49

Total Labor Cost: 9.70  4.80  9.70  4.80  4.90

### Exhibit 6. Quick Budget Comparison Report, Corn Grain
## I. Budget Information

<table>
<thead>
<tr>
<th></th>
<th>Budget 1</th>
<th>Budget 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field Name</td>
<td>Somewhere, USA</td>
<td>Somewhere, USA</td>
</tr>
<tr>
<td>Number of Acres</td>
<td>1 Acres</td>
<td>1 Acres</td>
</tr>
<tr>
<td>Land Charge Type</td>
<td>No Charge</td>
<td>No Charge</td>
</tr>
<tr>
<td>Management Type</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Management Charge Amount</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

## II. Crop Production

<table>
<thead>
<tr>
<th>Crop Name</th>
<th>Units</th>
<th>Yield / Acre</th>
<th>Price / Unit</th>
<th>Total Revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soybeans</td>
<td>Bushels</td>
<td>28.00</td>
<td>5.10</td>
<td>142.80</td>
</tr>
</tbody>
</table>

## III. Machinery Operations

### Pre-Harvest Operations

<table>
<thead>
<tr>
<th>Date</th>
<th>Pre-Harvest Operations</th>
<th>Cost / Acre</th>
<th>Cost / Unit</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mar</td>
<td>Custom Fertilize</td>
<td>0.23</td>
<td>0.01</td>
<td>0.23</td>
</tr>
<tr>
<td>Apr</td>
<td>Disk - Tandem 21'</td>
<td>5.07</td>
<td>0.18</td>
<td>5.07</td>
</tr>
<tr>
<td>Apr</td>
<td>Disk - Tandem 21'</td>
<td>5.07</td>
<td>0.18</td>
<td>5.07</td>
</tr>
<tr>
<td>May</td>
<td>Planter 6-30</td>
<td>9.64</td>
<td>0.34</td>
<td>9.64</td>
</tr>
<tr>
<td>Jun</td>
<td>Cultivator - Row 6R</td>
<td>5.63</td>
<td>0.21</td>
<td>5.63</td>
</tr>
<tr>
<td>Mar</td>
<td>Stalk Chopper, 12'</td>
<td>5.07</td>
<td>0.18</td>
<td>5.07</td>
</tr>
<tr>
<td>Mar</td>
<td>Custom Fertilize</td>
<td>0.23</td>
<td>0.01</td>
<td>0.23</td>
</tr>
<tr>
<td>Apr</td>
<td>Sprayer Pull Type</td>
<td>1.62</td>
<td>0.05</td>
<td>1.62</td>
</tr>
<tr>
<td>May</td>
<td>Planter No-Till 6R</td>
<td>6.26</td>
<td>0.30</td>
<td>6.26</td>
</tr>
</tbody>
</table>

### Harvest Operations

<table>
<thead>
<tr>
<th>Date</th>
<th>Harvest Operations</th>
<th>Cost / Acre</th>
<th>Cost / Unit</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sep</td>
<td>Combine Platform w/p</td>
<td>28.44</td>
<td>1.02</td>
<td>28.44</td>
</tr>
<tr>
<td>Oct</td>
<td>Combine Platform w/p</td>
<td>28.44</td>
<td>1.02</td>
<td>28.44</td>
</tr>
</tbody>
</table>

## V. Material Usage

<table>
<thead>
<tr>
<th>Material Name</th>
<th>Units</th>
<th>Quantity / Acre</th>
<th>Cost / Unit</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Herbicide 2,4-DB Res</td>
<td>Gallons</td>
<td>0.13</td>
<td>10.00</td>
<td>1.30</td>
</tr>
<tr>
<td>Herbicide Gramoxone</td>
<td>Gallons</td>
<td>0.13</td>
<td>40.00</td>
<td>5.20</td>
</tr>
<tr>
<td>Herbicide Lasso</td>
<td>Gallons</td>
<td>0.13</td>
<td>24.00</td>
<td>3.12</td>
</tr>
<tr>
<td>Herbicide Prowl/surf</td>
<td>Gallons</td>
<td>0.13</td>
<td>24.00</td>
<td>3.12</td>
</tr>
<tr>
<td>Herbicide Sencore</td>
<td>Gallons</td>
<td>0.13</td>
<td>95.00</td>
<td>12.35</td>
</tr>
<tr>
<td>Lime Application</td>
<td>Tons</td>
<td>2.00</td>
<td>22.00</td>
<td>44.00</td>
</tr>
<tr>
<td>Soybean Seed</td>
<td>Bushels</td>
<td>1.00</td>
<td>13.00</td>
<td>13.00</td>
</tr>
</tbody>
</table>

## VI. Other Charges

<table>
<thead>
<tr>
<th>Other Charges</th>
<th>Cost / Acre</th>
<th>Cost / Unit</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other Charges SubTotal</td>
<td>4.92</td>
<td>0.18</td>
<td>4.92</td>
</tr>
<tr>
<td>Total Costs</td>
<td>130.35</td>
<td>4.66</td>
<td>130.35</td>
</tr>
<tr>
<td>Wet Returns</td>
<td>12.45</td>
<td>0.44</td>
<td>12.45</td>
</tr>
<tr>
<td>Total Fuel Cost</td>
<td></td>
<td></td>
<td>7.45</td>
</tr>
<tr>
<td>Total Labor Cost</td>
<td></td>
<td></td>
<td>6.30</td>
</tr>
</tbody>
</table>

Exhibit 7. Quick Budget Comparison Report, Soybeans
Summary

As SCS continues its promotion of residue management to aid farmers in meeting conservation compliance goals, we must continue to be responsive to the needs of those farmers. Farmers tell us that one of the most needed types of information is economics. They want the residue management alternatives laid out in a logical manner using data from their neighbors who are using residue management. They also want to feel an ownership in the conservation plan and have localized emphasis placed on that plan.

To meet these needs, the use of localized case studies in conjunction with Quick Budget (if needed by the decisionmaker) is recommended. Case studies provide insights on actual localized results experienced by neighbors. They allow SCS to express residue management recommendations in a more credible manner which will be recognized by our clients. Case studies will also help build a permanent record of treatment results that would not disappear as employee retirements and transfers occur. The process of developing a case study is excellent training for our employees to refine their planning skills.

The use of Quick Budget to compare a farmer's actual current operation to an alternative including residue management (with effects obtained from a innovative neighbor) can effectively customize a conservation plan for that particular farmer. His or her ownership of that plan is greatly enhanced when it is customized in such a manner. The customizing process for Farmer B can be summarized in 4 steps:

1. Select a base budget in CARE (supplied to the field by the state office) that most closely approximates Farmer B's current operation.

2. Use the editing features of Quick Budget and input from Farmer B to quickly customize the base budget for Farmer B's current operation.

3. Develop an alternative budget for Farmer B including residue management options based on a case study developed for Farmer A.

4. Produce a "COMPARE" report (using Quick Budget) as a decision tool for Farmer B.

After Farmer B decides to apply residue management, you may want to develop a case study of his or her situation for inclusion in Section V-B-1 of the FOTG.

Remember, part of the benefit of this strategy is the documentation of results for future use. This type of documentation process will greatly enhance our future effectiveness. Think of the possibilities if we in SCS had begun developing case studies of this type 50 years ago.
CULTURAL RESOURCES
AND SUSTAINABLE AGRICULTURE

LEARNING METHOD: Video Module and Workbook, Brief Lecture, Small Group Discussion, Audience Feedback; Display of Selected Information Sources

PRESENTED BY: Stan Riggle
Midwest National Technical Center
USDA Natural Resources Conservation Service
Lincoln, NE

Cultural resources are nonrenewable pieces of our past that have scientific, cultural and historical value for families, communities and the Nation. These archeological and historical sites are part of our social fabric and literally are part of the soil. One half of the known archeological sites in the United States are in private ownership, mostly in rural settings. With care these resources are sustainable to the degree that agriculture is sustainable. Existing sources of technical and financial assistance help conserve these technical and financial assistance help conserve these dwindling resources that, once gone, can never be replaced. Partnerships between local governments and the private sector enhance such efforts. A revolution is needed, and it should focus on treating cultural resources as a component of the soil and agricultural "eco"- system of which it is already an inextricable part and on which such energy is focused in an effort to sustain. The land owner is in the key position for, as with virtually all resources on private land, it will be through that owner's personal commitment to stewardship and sustainability that conservation of significant cultural resources will best be carried out.

KEY REFERENCES:


# SUMMARY OF MODULES

<table>
<thead>
<tr>
<th>Module 1</th>
<th>Cultural Resources—Why Are They Important?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>This module defines cultural resources, discusses why they are important, and explains the reasons why SCS protects them.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 2</th>
<th>Cultural Resources in the Planning Process.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>This module explains the importance of planning for the presence of cultural resources in conservation activities and outlines the planning process.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 3</th>
<th>Using Existing Information to Identify Cultural Resources.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>This module shows how to conduct a cultural resource review by examining current sources of information.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 4</th>
<th>Identifying Cultural Resources in the Field.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>This module explains how to identify and document the presence of cultural resources on the ground as part of an environmental evaluation during planning.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 5</th>
<th>Evaluating Cultural Resources.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>This module explains how a cultural resource is determined to be significant and eligible for the National Register of Historic Places.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 6</th>
<th>Considering Cultural Resources During Implementation.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>This module discusses different types of mitigation plans, tells how such plans are carried out, and explains how to handle cultural resources discovered during construction.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 7</th>
<th>The Early Americans—Regional History and Prehistory.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>This module treats the history and prehistory of North America in general. Understanding and identifying cultural resources that are unique to a region is also covered. The separate regional modules are: California, Northeast, Southeast, the Plains, Midwest, Southwest/Great Basin, Pacific Northwest, Arctic, and Hawaii/Pacific Islands.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 8</th>
<th>Cultural Resources Field Workshop.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>This module is an in-the-field session to learn how to identify artifacts and other cultural resources while laying out practices or projects. The 1- to 2-day workshop is scheduled upon satisfactory completion of Modules 1 through 7.</td>
</tr>
</tbody>
</table>
MODULE 1
CULTURAL RESOURCES—WHY ARE THEY IMPORTANT?
This module defines cultural resources and explains why SCS considers them in agency activities. You will need General Manual 420, Part 401 close at hand for reference.

OBJECTIVES
When you have completed this module, you will be able to:

1. Define cultural resources.
2. Explain why SCS considers cultural resources in agency activities.
3. State SCS policy and identify the procedures SCS uses.
4. List public benefits gained from protecting cultural resources.

Start your audiovisual equipment for Module 1.

INTRODUCTION
Do you enjoy looking at your family’s photograph albums and souvenirs? Do you like hearing stories about your parents and their parents? Are family traditions important to you? Most of us are interested in our personal histories. We want to know about the past because it helps us recognize who we are, how we became what we are, and how we are similar as well as different from others.

In a broader sense, it is important to all of us to preserve the past—our North American cultural heritage—a legacy of over 10,000 years. To learn about these deepest roots of human development is to learn something of what humanity is, what shapes it, and of what it is capable.

It may be easy for you to dig into old trunks and talk with relatives to learn your personal heritage, but it is sometimes difficult to piece together the story of humankind. These stories await discovery in the fragile traces of the past. Some traces are easy to see and identify, while others are harder to detect. By carefully studying and recording these clues, we can learn how people lived, where they lived, what their homes were like, and if they were friendly with neighboring groups of people. We can begin to outline human history down through the ages and learn from the successes and failures of those before us.

WHAT ARE CULTURAL RESOURCES?
We call these traces of the past cultural resources. Simply stated, cultural resources are all the past activities and accomplishments of people. They are of many types. They include buildings, objects, locations, and structures that have scientific, historic, and cultural value. You may be surprised that folkways, dance forms, and other less tangible resources are also considered cultural resources.
The cultural resources that SCS deals with most often are known as historic properties. These may be prehistoric or historic districts, sites, buildings, structures, features, or objects. The type of historic property encountered most by SCS field personnel is a non-structural archeological site. It often extends below the soil surface and must be protected during SCS conservation practices because it is part of the overall resource base. Artifacts, records, and other scientific remains related to the historic property must also be conserved. Even a few flakes of chert deserve attention and should be recorded. Such a find, which initially might seem unimportant, could contribute to a larger pattern of knowledge about the past.

**YOUR TURN**

Which of the following cultural resources may be encountered during SCS activities?

1. Town festival.
2. Remnants of an old road.
3. Trailer park.
4. Arrowheads (projectile points).

**FEEDBACK**

If you checked numbers 2 and 4, you are right.

**WHY DOES SCS CONSIDER CULTURAL RESOURCES?**

There are many reasons why SCS considers and protects cultural resources. Major reasons are that they are non-renewable, they provide information about the past, and they help solve modern-day problems. There is no way to “grow” a new archeological site or historic house once it has been destroyed. Even the act of excavating an archeological site and recording its information is ultimately destructive. That is why detailed record keeping is such an important part of archeological excavations.

The information recovered from studying cultural resources can be applied to present day activities. Archeological sites are important because they are the only way to learn about people who kept no written records. Information from archeological sites can also be used to confirm or correct the written records left by our ancestors.
Because of the unique value of these resources, Congress passed many laws protecting cultural resources from unnecessary destruction. One of the most important of these laws is the National Historic Preservation Act of 1966 (NHPA) and its amendments that established a national policy for protecting our important cultural resources. It also established the Advisory Council on Historic Preservation (ACHP), a body of the Executive Branch that serves as an overseer for historic preservation.

Section 106 of the NHPA requires Federal agencies to provide the Advisory Council on Historic Preservation an opportunity to comment on any Federal undertaking that may affect a cultural resource that meets specific criteria making it important enough to list in a register of historic places. A diagram of the section 106 process is included for reference at the end of this module.

The Advisory Council on Historic Preservation has procedures for implementing this section and other historic preservation requirements. All Federal agencies are required to follow these procedures, which are entitled “Protection of Historic Properties.”

Under an agreement with the Advisory Council on Historic Preservation, SCS is allowed to follow its own procedures and to consider cultural resources as another resource concern in environmental evaluations. Failure to follow those procedures could result in lawsuits. Noncompliance with Section 106 of NHPA and/or other laws would result in the termination of the program agreement with the Advisory Council on
Historic Preservation. Lack of an agreement would then require renegotiation with each State Historic Preservation Office (SHPO) and result in innumerable conservation planning delays while this process was taking place. SCS procedures are shown in General Manual (GM) 420, Part 401. A full list of preservation laws and their summaries can be found in the GM 420, Part 401.1. A selected list of preservation law summaries can also be found at the end of this module.

YOUR TURN

Turn to GM 401.1 to familiarize yourself with the complete list.

Which of the following appear in the list of preservation laws in GM 401.1?

<table>
<thead>
<tr>
<th></th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>❑</td>
<td>❑</td>
</tr>
<tr>
<td>2.</td>
<td>❑</td>
<td>❑</td>
</tr>
<tr>
<td>3.</td>
<td>❑</td>
<td>❑</td>
</tr>
</tbody>
</table>

FEEDBACK

The Department of Agriculture has the distinction of being one of the first Federal agencies to be involved in protecting cultural resources. The Antiquities Act of 1906 gave this mandate to the Secretaries of Agriculture, Interior, and War, thus initiating a proud commitment on behalf of the Department.

Nice-to-Know

Various implementing regulations.

Rule of Thumb

IF CULTURAL RESOURCES ARE LOCATED ON FEDERAL LAND, or if
FEDERAL ASSISTANCE IS PROVIDED, or if
FEDERAL PERMITS ARE NEEDED, or if
IN ANY WAY THE FEDERAL GOVERNMENT IS INVOLVED IN ANY ACTIVITY WHICH MAY AFFECT A CULTURAL RESOURCE,
then
CULTURAL RESOURCES PROTECTION PROCEDURES MUST BE FOLLOWED.
WHAT IS SCS POLICY REGARDING CULTURAL RESOURCES?

SCS recognizes that cultural resources are an important part of our national heritage. It is SCS policy to protect and consider cultural resources in all its conservation programs. The protection and consideration of cultural resources is to be accomplished by:

a. identifying and making plans to protect resources early in the planning and environmental evaluation phases of all assistance activities.

b. preserving resources in the original place to the fullest extent possible and developing feasible alternatives to lessen unavoidable impacts that may be harmful.

c. informing participants about the importance of the cultural environment and providing training to all field personnel.

d. working with state and local authorities, other federal agencies, SCS participants, and the public to ensure the best way for conserving our Nation's heritage.

More detailed information on SCS policy can be found in GM 420, Part 401.2. Procedures for implementing this policy in conservation operations, projects, and discoveries during construction are covered in GM 420, Parts 401.6-8.

YOUR TURN

Which of these two statements is true?

<table>
<thead>
<tr>
<th>Statement</th>
<th>TRUE</th>
<th>FALSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. It is the policy of SCS to wait until construction begins to think about cultural resources.</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>2. SCS will provide training for field personnel to ensure consideration of historic properties.</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

FEEDBACK

1. This is a true statement.

2. This is a false statement.
WHAT PUBLIC BENEFITS CAN BE GAINED BY PROTECTING CULTURAL RESOURCES?

There are many informational, educational, and economical benefits to be gained from studying cultural resources. For example, they can give us information on conservation problems. By studying resource use in the past, we can learn which practices were destructive and resulted in the depletion of resources and which practices were successful. Using this information, we can develop better conservation practices today.

Because the age of archeological sites often can be determined, they can provide us with information on environmental fluctuations. Archeological sites provide a much longer record of past climatic variation than do historic records. Many historic records only contain consistent information of the last 50 years. Information on rainfall and waterflow fluctuations from pollen, plant, and sediment studies can assist planners in designing water control structures that will adequately retain floodwater.

Prehistoric (before written history) archeological sites also provide the only record of the relationships between people and their environments in the remote past. By understanding how changing environments affected people in the past, we can better understand our own relationship with the natural environment. For example, we can take a lesson from the Mesopotamian civilization of 5000 years ago. The people who gave us writing, the wheel, and irrigation were overpowered by problems with their natural environment. This complex civilization wrestled with the problems of salinity and lost. We are faced with similar problems today.

The recent droughts of 1980 and 1988 have had major impacts on agriculture and our economy. The need to predict these climatic events is clearly the best way of planning for and coping with them when they occur. It is important to know how often these events are likely to happen. The National Oceanic and Atmospheric Administration has proposed a study of archeological sites for this kind of information. Our future may, indeed, be tied to the past more than we realize at this moment!

Rural development programs can also benefit from the management of cultural resources. Restoring historic building is not only economical; it also conserves energy, produces less air pollution, and creates more jobs than constructing new buildings. Rehabilitation is more labor intensive.

An Advisory Council on Historic Preservation study found, for example, that restoring the Grand Central Arcade, an old hotel in Seattle, Washington, saved 90 billion BTUs (British thermal units) of energy. The energy saved was enough to operate the building for the next 200 years. Rehabilitation also encourages the use of already existing but unused buildings within a community rather than encouraging growth and development into surrounding farmland areas.

For more information on public benefits, see the extra pages at the end of this module for an interesting account of prehistoric Hohokam Indians of Arizona and what we are learning from their way of life.
The audiovisual presentation and this study guide gave numerous examples of benefits derived from preservation of cultural resources.

List five examples of scientific or public benefits gained from the study of cultural resources.

a. __________________________

b. __________________________

c. __________________________

d. __________________________

e. __________________________

If your answers included any of the following, you have been paying attention.

1. Public benefits
   a. Plant information
   b. Soil and water conservation engineering designs
   c. Animal species diversity
   d. Soil development information
   e. Recreation of parks
   f. Creation of recreation areas

2. Scientific benefits
   __________________________

The Federal Government protects cultural resources because they are our heritage and identity. They give us all a sense of direction and belonging. Cultural resources are the tangible symbols of our beginnings as well as the reminders of our growth and maturity.

Will future generations forgive us if we allow our roots to be neglected or destroyed?

You deserve a break before continuing with Module 2—Cultural Resources in the Planning Process.
CAN THE CENTURIES-LONG EXPERIENCE OF THE HOHOKAM, WHOSE PAST LIES BURIED BENEATH MODERN PHOENIX, BE IGNORED?

By Fred Plog, Professor in the Anthropology/Sociology Department at New Mexico State University, Las Cruces.

(This article is reprinted by permission of Fred Plog)

Phoenix and its suburban area encompassing Tempe, Scottsdale and Mesa, with a population of more than one-and-one half million, comprises one of the most rapidly growing metropolises in the country. Sustained only by transportation ties that bring food, dams and canals that bring water, and power that is produced on the plateaus hundreds of miles away, this urban complex covering 9,253 square miles may be described as a modern miracle arising in the southern Arizona desert.

Can such an enterprise be sustained? Better yet: What do we need to know to sustain it?

The history of our own society, barely 100 years old in the southwestern deserts, does not provide answers. In lesser time than this, desert cities all over the planet have failed. Those that have lasted for centuries are relatively few. One group of desert people with more success were the Hohokam, whose archeological remains lie buried beneath the Phoenix metropolis, and who mastered the difficult environment of the southern Arizona desert for at least ten centuries, and perhaps much longer—from 300 B.C. to A.D. 1450.

Surely, such a record of success—but of ultimate failure—can provide important clues to the problems that modern inhabitants of the area are facing now and must confront in the future.

Differences in technology between modern society and the ancient Hohokam are not so great as one might think. A simple example: The thick, adobe-walled buildings of the Hohokam are increasingly being copied as a means of maintaining even temperatures—“passive heating/cooling”—in the sometimes torrid, sometimes frigid desert.

Even more notable: The very water supply on which the modern metropolis depends is fundamentally the one that served the Hohokam. Omar Turney, an amateur archeologist who made major contributions to our understanding of Hohokam life, was the first Phoenix city engineer. He was hired to build a water supply system, and recognizing the importance of the centuries-old remnants of Hohokam canals, he modelled his system on the pattern of ancient channels.

What else can be learned from these resourceful people of the past? Water, salt, and people are pivotal concerns.

Floods: Even a desert, the variation in water flowing through the rivers is enormous, and in the last decade, Phoenix has experienced several “hundred year floods”. With only a hundred years of stream flow records
for the area, however, the extent of a genuine hundred year flood is unlikely to have been recorded. In fact, farther from the present-day river channel than any modern flood has reached are Hokokam sites containing dense silt layers left by flooding. It is quite likely that these prehistoric sites contain the very record of flooding that modern residents should be aware of to prepare for a truly major flood.

Drought: The Central Arizona Project is a canal system being built to bring Colorado River water to Phoenix and Tucson. Tunnels have been drilled through mountains and concrete-lined channels excavated across the desert. But will there be enough water? Extending back into Hohokam times, records compiled in the Southwest of tree-rings, which are formed annually and vary in thickness proportionate to yearly precipitation, suggest a problem. If these records are correct, Arizona and the other western states drew up their plans to divide the waters of the Colorado River on the basis of the two wettest decades in centuries.

Salt: Desert rivers are often saline—the Salt River of the Phoenix area is not casually named. In desert environments, soils are also fragile. When large volumes of water are dumped on them, these soils trap the salt. In large quantities, salt poisons plants. Today, residents of the area routinely purchase chemicals to offset the ubiquitous yellowing of lawns and shrubs caused by chlorosis or salt poisoning. The government spends millions of dollars each year to remove salt from downstream canals whose waters are poisoning field along the Mexican border.

One early theory is the Hohokam demise focused on salt. Maps of their canals correspond closely with charts of the Phoenix area today showing where soils are strongly alkaline—heavily saturated with soil salts. Studies of prehistoric pollens suggest that Hohokam peoples during the later periods may have grown salt-loving plants in their agricultural fields to avert impending catastrophe.

Salt may not have been the only cause of the Hohokam demise, but it almost certainly contributed to this society’s collapse. Which Hohokam groups overcame the salt problem? And How?

The answers to these questions could provide the solutions to a major problem in the Southwest.
THE SECTION 106 PROCESS DIAGRAMMED

BASIC STEPS OF THE SECTION 106 REVIEW PROCESS

This flowchart plots the major steps of Section 106 review.
For complete details, refer to the regulations at 36 CFR Part 800.
CULTURAL RESOURCE LEGISLATION

Executive Order No. 11593


This directs Federal agencies to take a leadership role in preserving, restoring, and maintaining the historic and cultural environment of the Nation. Agencies must locate, inventory, and nominate to the National Register all historic resources under their jurisdiction or control. Until this process is completed, agencies must ensure that potentially qualified properties are not transferred, sold, demolished, or substantially altered. When planning projects, agencies request the opinion of the Secretary of the Interior as to the eligibility for National Register listing of properties whose resource value is unknown. Agencies are directed to institute procedures, in consultation with the Advisory Council on Historic Preservation, to ensure that Federal plans and programs contribute to the preservation and enhancement of non-federally owned historic resources.

For information and procedures on requesting determinations of eligibility, consult the Keeper of the National Register of Historic Places, National Park Service, Department of the Interior, P.O. Box 37127, Washington, DC 20013-7127.

Antiquities Act of 1906

16 U.S.C. §§431-433

This authorizes the President to designate as National Monuments historic and natural resources of national significance located on federally owned or controlled lands. The act further provides for the protection of all historic and prehistoric ruins and objects of antiquity located on Federal lands by providing criminal sanctions against excavation, injury, or destruction of such antiquities without the permission of the Federal department. The Secretaries of the Interior, Agriculture, and Defense are further authorized to issue permits for archeological investigations on lands under their control to recognized educational and scientific institutions for the purpose of systematically and professionally gathering data of scientific value.

For further information consult the Departmental Consulting Archeologist, National Park Service, Department of the Interior, P.O. Box 37127, Washington, DC 20013-7127.

National Environmental Policy Act of 1969

42 U.S.C. §§4321-4347

This directs Federal agencies to administer Federal programs and resources to foster environmental quality and preservation. For major Federal actions significantly affecting the quality of the human environment, Federal agencies must prepare and make available for public comment an environmental impact statement.

Compliance with the National Environmental Policy Act may be done in coordination with compliance with the National Preservation Act (NPHA) under the regulations of the Advisory Council on Historic Preservation, 36 CFR Part 800.
Archeological Resources Protection Act of 1979

16 U.S.C. §§470aa–470ll

This requires a permit for any excavation or removal of archeological resources from public lands or Indian lands. Excavations must be undertaken for the purpose of furthering archeological knowledge in the public interest, and resources removed remain the property of the United States. The act provides both civil and criminal penalties for violation of the permit requirements. Consent must be obtained from the Indian tribe owning or having jurisdiction over lands on which a resource is located prior to issuance of a permit, and the permit must contain any terms or conditions requested by the tribe.

National Historic Preservation Act of 1966 (NPHA)

16 U.S.C. §§470–470w-6

This expresses a general policy of supporting and encouraging the preservation of prehistoric and historic resources for present and future generations by directing Federal agencies to assume responsibility for considering historic resources in their activities.

First, the act authorizes the Secretary of the Interior to maintain a National Register of Historic Places and establishes procedures for nomination of properties to the Register.

Second, the act directs State preservation programs that provide for the designation of a State Historic Preservation Officer (SHPO) to administer preservation efforts, a State Historic preservation review board, and public participation in the State program.

Third, the act authorizes a grant program that provides funds to the States for historic preservation projects and to individuals for the preservation of properties listed in the National Register.

Fourth, the statute established the Advisory Council on Historic Preservation as an independent Federal agency. The act directs the Council to advise the President, Congress, and other Federal agencies on historic preservation matters, conduct training and other educational programs, and encourage public interest in preservation.

The Council is also responsible for implementation of Section 106 of NHPA. Section 106 requires Federal agencies to take into account the effect of their undertakings on historic properties and afford the Council an opportunity to comment on the undertakings. To administer these requests, the Council has issued regulations to govern agencies in their compliance with Section 106.

Fifth, the act established procedures that Federal agencies must follow in managing federally owned or controlled property and requires that, prior to the approval of any Federal undertaking, agencies must undertake such planning to minimize harm to the landmark.

Procedures for the nomination of properties to the National Register under NHPA have been established by the National Park Service at 36 CFR Part 60. Procedures for the Section 106 are at 36 CFR Part 800.

For further information on the nomination procedures, consult the Keeper of the National Register of Historic Places, National Park Service, Department of the Interior, P.O. Box 37127, Washington, DC 20013-7127. For further information on the Council’s procedures, consult the Advisory Council on Historic Preservation, 1100 Pennsylvania Avenue, NW., Room 809, Washington, DC 20004.
1972 amendment to the Federal Property and Administrative Services Act of 1949

40 U.S.C. §484(k)(3)

This authorizes the General Services Administration to convey approved surplus Federal property to any State agency or municipality free of charge, provided that the property is used as a historic monument for the benefit of the public. The act includes recapture provisions under which the property would revert to the Federal Government should it be used for purposes incompatible with the objective of preserving historic monuments.

Address inquiries to the Federal Property Resources Service, Office of Real Property, General Services Administration, 18th and F Streets, NW, Room 4236, Washington, DC 20405.

The Historic and Archaeological Data Preservation Act of 1974

16 U.S.C. §§469-469c

This is directed to the preservation of historic and archeological data that would otherwise be lost as a result of Federal construction or other federally licensed or assisted activities. When Federal agencies find that their undertakings may cause damage to archeological resources, the agencies must notify the Secretary of the Interior, in writing, of the situation. The agencies involved may undertake recovery, protection, and preservation of data with their own project funds, or they may request the Secretary of the Interior to undertake preservation measures.

For further information consult the Associate Director, Cultural Resources, National Park Service, Department of the Interior, P.O. Box 37127, Washington, DC 20013-7127.

Historic Sites Act of 1935

16 U.S.C. §§461-467

This establishes as national policy the preservation for public use of historic resources by giving the Secretary of the Interior the power to make historic surveys and to document, evaluate, acquire, and preserve archeological and historic sites across the country. The act led to the eventual establishment within the National Park Service of the Historic Sites Survey, the Historic American Buildings Survey, and the Historic American Engineering Record.

For further information consult the Associate Director, Cultural Resources, National Park Service, Department of the Interior, P.O. Box 37127, Washington, DC 20013-7127.
Appendix G  Sources of Additional Information

ARCHEOLOGICAL SITE STABILIZATION TECHNIQUES
National Clearinghouse for Archaeological Site Stabilization
Center for Archaeological Research
University of Mississippi
University, Mississippi 38677
(601) 232-7129

U.S. Army Corps of Engineers
Waterways Experiment Station
3909 Halls Ferry Road
Vicksburg, Mississippi 391-6199
(601) 634-3111

ARCHEOLOGICAL SOCIETIES
Society for American Archaeology
900 2nd Street, NE. Suite 12
Washington, D.C. 20002
(202) 543-7164

Society for Professional Archaeologists
Larry D. Banks, President
4909 Weyland Drive
Hurst, Texas 76053

For information on professional and avocational societies in your state, contact your State Historic Preservation Office.

CERTIFIED LOCAL GOVERNMENTS
Contact your State Historic Preservation Office.

COMMUNITY ARCHEOLOGY PROGRAMS
Contact your State Historic Preservation Office.
CONSERVATION ORGANIZATIONS

The Archeological Conservancy has three offices across the country:

National Office:
5301 Central Ave., NE, Suite 1218
Albuquerque, New Mexico 87108
(505) 266-1540

Midwestern Regional Office:
91 Fletcher Court
Groveport, Ohio 43125
(614) 836-3603

Western Regional Office:
1217 23rd Street
Sacramento, California 95816
(916) 448-1892

Southeastern Regional Office:
5435 Royce Drive
Duluth, Georgia 30136
(404) 664-0507

The Conservation Foundation
1250 24th Street, N.W.
Washington, D.C. 20036
(202) 293-4800

Land Trust Alliance
900 17th Street, N.W., Suite 410
Washington, D.C. 20006
(202) 785-1410

The Nature Conservancy
1815 North Lynn Street
Arlington, Virginia 22209
(703) 841-5300

The Trust for Public Land
116 New Montgomery Street
San Francisco, California 94105

Other organizations are listed in The Conservation Directory from

National Wildlife Federation
1412 16th Street, N.W.
Washington, D.C. 20036

FINANCIAL ASSISTANCE

Contact your State Historic Preservation Office.

National Endowment for the Humanities
1100 Pennsylvania Avenue. N.W., Suite 318
Washington, D.C. 20506
(202) 606-8310

National Science Foundation
1800 G Street, N.W.
Washington, D.C. 20550
(202) 357-7804

National Endowment for the Arts
1100 Pennsylvania Avenue, N.W.
Washington, D.C. 20506
(202) 682-5437

The Foundation Center
1001 Connecticut Avenue, N.W.
Washington, D.C. 20036
800-424-9836 toll-free
HISTORIC PRESERVATION ORGANIZATIONS

Contact your State Historic Preservation Office for information on state and local organizations.

The National Trust for Historic Preservation
1785 Massachusetts Avenue, N.W.
Washington, D.C. 20036
(202) 673-4100

INVENTORIES OF ARCHEOLOGICAL SITES

Contact your State Historic Preservation Office.

LAW

Your local library should have copies of your state laws and local ordinances.

The National Center for Preservation Law
1333 Connecticut Avenue, N.W.
Washington, D.C.
(202) 338-0392

The Environmental Law Institute
1616 P Street, N.W.
Washington, D.C.
(202) 939-3810

LOCAL PRESERVATION COMMISSIONS

Contact your State Historic Preservation Office.

National Alliance of Preservation Commissions
Hall of the States, Suite 332
444 North Capitol Street, N.W.
Washington, D.C. 20001

NATIONAL REGISTER OF HISTORIC PLACES

Contact your State Historic Preservation Office.

National Register of Historic Places
Interagency Resources Division (413)
National Park Service
P.O. Box 37127
Washington, D.C. 20013-7127

PLANNING

Contact your local government planning office.

American Planning Association (has chapters in each state)
1313 E. 60th Street
Chicago, Illinois 60637
(312) 955-9100
PUBLICATIONS FROM THE NATIONAL PARK SERVICE

For publications about the National Register and other publications issued by the Interagency Resources Division, contact:

Publications Coordinator
Interagency Resources Division (413)
National Park Service
P.O. Box 37127
Washington, D.C. 20013-7127

For publications issued by the Archeological Assistance Division, contact:

Publications Coordinator
Archeological Assistance Division (436)
National Park Service
P.O. Box 37127
Washington, D.C. 20013-7127

For information on CRM, a periodical providing cultural resource management information for parks, federal agencies, Indian tribes, states, local governments, and the private sector, contact:

Editor, CRM (400)
Cultural Resources
National Park Service
P.O. Box 37127
Washington, D.C. 20013-7127

SECTION 106 PROCESS

Contact your State Historic Preservation Office.

Advisory Council on Historic Preservation
1100 Pennsylvania Avenue, N.W., Suite 803
Washington, D.C. 20004
(202) 606-8672
ORIENTATION, CONCEPTS AND TRAINING IN SUSTAINABLE AGRICULTURE

ROLE OF SYSTEMS SCIENCE IN THE DESIGN OF PEST MANAGEMENT SYSTEMS FOR SUSTAINABLE AGRICULTURE

LEARNING: Team Approach to the Development of a Systems Model for IPM

PRESENTED BY: G. W. Bird
Michigan State University

SUMMARY:

The objective of this training experience is to have participants develop a comprehensive IPM model for a specific farming system. Participants are divided into teams. The nature of the farming system is described and the goals of the IPM system presented. The training should be undertaken in 10, two-hour sessions over a period of about 10 weeks. It is also possible to use a concentrated workshop format of about two days. At the Train-the-Trainer Workshop in Marshall, Indiana, the objective was to provide a brief overview of the training procedure.

Workshop participants must be provided with a review of the concept, strategies and tactics of IPM, and given an introduction to the procedure of Systems Science. At Marshall, the participants were requested to use the procedures of Systems Science for development of a seven-year pest management plan designed to facilitate the transition of a 1,920 acre conventional corn-soybean enterprise operated under the structure of a current Industrial Model Farm to a 640-acre 21st Century Diversified Farm. The nine steps used in this analysis included: 1. Dichotomization of the universe of concern into the object of control and the external environment; 2. Identification of the desired system responses; 3. Dichotomization of the external environment into controllable and non-controllable factors; 4. Identification of the external system inputs; 5. Identification of the non-controlled factors; 6. Identification of the monitored components of the external environment; 7. Identification of appropriate enterprise controllers; 8. Identification of all subsystems, components, and their known linkages; and 9. Development of a seven-year enterprise transition plan based on the desired system response identified in Step No. 2.

KEY REFERENCES:


ROLE OF SYSTEMS SCIENCE IN THE DESIGN OF PEST MANAGEMENT SYSTEMS FOR SUSTAINABLE AGRICULTURE

G. W. BIRD

Session Objectives

- Provide workshop participants with a review of the concept of IPM
- Introduce workshop participants to the procedures of Systems Science
- Have workshop participants use the procedures of Systems Science in the development of a seven-year pest management plan designed to facilitate the transition a 1,920 acre conventional corn-soybean enterprise operated under the structure of the 15-85 Industrial Model Farm to a 640 acre 21st Century Diversified Farm.
- Provide workshop participants with an opportunity to evaluate this Teacher-Learner interactive session in relation to its value as an adult education tool.

History of IPM

Developed between 1959 and 1975 because of the unexpected consequences associated with the Chemotechnology Era that evolved following World War II.

- Human health risks.
- Environmental risks.
- Development of pest resistance to pesticides.
- Detriment impacts on non-target organisms.
- Pest population density resurgence.
- Evolution of new pest problems.

Interactive Teacher-Learner Session presented at the North Central Sustainable Agriculture Train the Trainer Workshop on April 4, 1995, in Marshall, Indiana.

Professor of Nematology, Department of Entomology, Michigan State University. East Lansing, MI 48824
Definitions of IPM

"Development, use and evaluation of pest control procedures that result in favorable socio-economic and environmental consequences" (Bird, 1976)

"A systems approach to reduce pest damage to tolerable levels through a variety of techniques, including predators and parasites, genetically resistant hosts, natural environmental modifications and, when necessary and appropriate, chemical pesticides" (President Carter, 1979)

IPM Strategies

- Avoidance - Exclusion - Containment - Eradication
- Control - Do nothing

Control Tactics

- Physical - Biological
- Chemical - System Design
- Genetic - Regulatory

Process of IPM
Concept of Thresholds (Bird, 1990)

Pest Management Goal for a 21st Century Diversified Farm (Bird, 1990)
Structural Attributes of the 15-85 Industrial Model Farm (Bird and Ikerd, 1993)

- Centralized management.
- Emphasis on specialization.
- Hired worker days exceed owner on-farm workdays.
- Separation of management and labor.
- Technology used to minimize labor inputs; limited education required for labor component.
- Heavy reliance on purchased inputs.
- Technology designed to minimize real-time infield decision-making.
- Emphasis on standardized farming practices.

Structural Attributes of the 21st Century Diversified Farm (Bird and Ikerd, 1993)

- Owner-operated farm.
- Hired worker days usually do not exceed farm family worker days.
- Usually maximum of a three family partnership.
- Joint management-labor relationship.
- Farm families usually live on the farm.
- Diversified farm; special reference to biodiversity.
- Emphasis on use of on-farm resources; a knowledge intensive process.
- Common use of site-specific and real-time decision-making, requiring extensive education and experience.
- Diverse set of enterprise statements, including type of enterprise goals, economic goals, environmental goals, natural resource conservation goals, and quality of life goals.
Introduction to Systems Science

"Systems science is the study of interactions among related entities. It is an engineering philosophy with its foundations in constructing models (both conceptual and mathematical) or real world systems to aid in evaluation and optimization of existing systems and design of new systems" (Bird, 1990)

Ten Steps of Systems Analysis for Sustainable Farm Enterprises (Bird, Tummala and Gage, 1985)

1. Dichotomization of the universe of concern into the system of concern (object of control) and the external environment. This includes identification of the system boundaries and some initial thinking about subsystems and components.

2. Identification of the desired system responses. It may now be necessary to revise the system boundaries.

3. Dichotomization of the external environment into controllable and non-controllable factors.

4. Identification of the controllable parameters that you want to control.

5. Add the controllable parameters that you decided not to control to the non-controllable parameter list, and rename it non-controlled factors.

6. Decide which of the non-controlled factors need to be monitored. Label this list as monitored parameters and discard the remaining non-controlled factors.

7. Identify appropriate enterprise controllers.

8. Identify all subsystems and components, and describe their known linkages.

9. Develop the seven-year enterprise transition plan based on the desired system responses identified in Step No. 2.

10. Begin to implement the transition plan. It is essential to remember that a 21st Century Diversity Farm is a highly knowledge intensive and dynamic enterprise. All aspects of the transition plan must be evaluated at appropriate intervals. Some factors may only require assessment on an annual basis; whereas, others may require daily monitoring.

1A sustainable farm enterprise should not use renewable resources at a rate greater than the regenerative capacity of the system, it should not use non-renewable resources at a rate greater than the development of substitutes, the farm should not create system residuals that exceed the assimilation capacity of the system, and the enterprise should provide for intergenerational equity (Meadows, Meadows and Randers, 1992). It may not be realistic or desirable for an individual 21st Century Diversified Farm to include all these components of sustainable development in the initial seven-year enterprise transition plan (Bender, 1995).
Seven Year Transition Plan

Current 15-85 Industrial Model Farm

- 1,920 usable acres (all currently owned)
- Corn and soybean (usually 1,200 acres of corn and 720 acres of beans)
- Grown on 10 parcels of land distributed throughout 3 original farm sites

Desired 21st Century Diversified Farm (based on the Bender Farm; Bender, 1995)

- 640 acres of usable land
- Possible produce
  - Livestock
  - Sweet Clover
  - Corn
  - Soybeans
  - Oats
  - Milo
  - Alfalfa
  - Red Clover
  - Grain Sorghum
  - Turnips
  - Wheat
  - Prairie Hay
  - Forage Sorghum

Pest groups to be considered in the Seven Year Transition Plant

- Weeds
- Nematodes
- Bacteria
- Insects
- Fungi
- Viruses
- Vertebrates

Essential Components of the Transition Plan

- Do you want the farm to be a pesticide-free enterprise?
- All aspects of the system model.
- First year experimentation plan (experimentation on a limited basis in one or two fields, and comprehensive monitoring of all sites).
- First field to be managed using the 21st Century Diversified Farm Pest Management Plan. It is highly probable that this will not be possible until about the third year of the transition.
- Enterprise Controller procedure for plan evaluation, plan implementation evaluation, biological monitoring (pests, produce and beneficial organisms), environmental monitoring, economic monitoring.
- What happens to be remaining 1,280 acres? This question allows for many additional options for the overall facilitation of sustainable development and the enhancement of U.S. agriculture for the 21st Century!!
Integrated pest management (IPM) and sustainable agriculture are essential for developing and maintaining an appropriate high quality of life for both current society and future generations. IPM and sustainable agriculture have similarities and important differences. The purpose of this contribution is to provide an overview of these similarities and differences, for use by the IPM and sustainable agriculture communities as they begin dialogue in search of common ground for development and implementation of joint initiatives designed to benefit both agriculture and all of society in a future era of sustainable development. Although both IPM and sustainable agriculture have lengthy histories, they are perceived as emerging concepts to be implemented through practices resulting in economically viable, environmentally sound and sociologically acceptable consequences.

The first 9000 years after the beginning of the Agriculture Revolution provided the foundation necessary for the Industrial Revolution, and its impacts on civilization and our biosphere. By early in the Twentieth Century, both agriculturalists and pest management specialists had understandings of the complexity of nature, and the benefits and risks associated with biological diversity. The mandates of the subsequent Industrial Growth Era, impacted by two World Wars, caused major changes in U.S. agriculture and pest management. These changes resulted in amazing advances in comfort and materialistic aspects of quality of life, and allowed for continuing increases in human population growth. They also catalyzed unexpected consequences that have the potential for long-term detrimental impacts to the environment and society.

In U.S. agriculture, the unexpected changes included a decrease in the number of farms, increase in farm size, high dependency on off-farm purchased inputs, increase in risk of farm failure, increase in specialization, decrease in biological diversity, decrease in reliance on rural communities, and decrease in direct contact between the farm sector and urban-suburban communities. In pest management, the unexpected consequences included, increases in environmental and human health risks, development of pest resistance to pesticides, destruction of beneficial organisms, pest population density resurgence, and evolution of new pest problems. The current visions of IPM and sustainable agriculture evolved from the fundamental need to identify solutions to the above issues.
IPM. - The concepts of pest management outlined by Bessey (1915) and Lord (1947) are very similar to the current concept of IPM. The research of Stern, Smith, van den Bosch and Hagen (1959), however, serves as the basis of modern IPM. IPM was an important initiative in the Nixon Administration, and matured to became a focal point for President Carter's 1979 Environmental Message to Congress: in which he defined IPM as "a systems approach to reduce pest damage to tolerable levels through a variety of techniques, including predators and parasites, genetically resistant hosts, natural environmental modifications and, when necessary and appropriate, chemical pesticides."

In 1982, Edens and Haynes went beyond the usual boundaries of IPM and presented a comprehensive discussion of sustainable agriculture in the Annual Review of Phytopathology. In 1985, Frisbie and Adkission provided a comprehensive summary of CIPM (Consortium for Integrated Pest Management), and in 1989 the author of this comparative assessment wrote an analysis of IPM for the U.S. Senate Planning Document for the 1990 Farm Bill (Bird, 1989) and co-authored a book chapter entitled, Design of Pest Management Systems for Sustainable Agriculture (Bird, Edens, Drummond and Groden, 1989). In 1993, the Clinton Administration announced a pesticide use reduction goal based on IPM and sustainable agriculture.

Sustainable Agriculture. - In 1984, the late Robert Rodale authored a book entitled, "Our Next Frontier". He indicated that the first phase of development of our country involved the discovery of its natural resources, the second phase included learning how to use the resources for enhancing quality of life, and the third phase is the challenge of sustainability. During the subsequent decade, sustainable development emerged as a major imperative, both for our nation and global society.

In 1987, the World Commission on Environment and Development defined sustainable development as "development that meets the needs of the present, without compromising the ability of future generations to meet their own needs". In 1990, the Food, Agriculture, Conservation and Trade Act defined sustainable agriculture as "an integrated system of plant and animal production practices having a site specific application that will, over the long-term: satisfy human food and fiber needs; enhance environmental quality and the natural resource base upon which the agriculture economy depends; make the most efficient use of non-renewable resources and integrate where appropriate, natural biological cycles and control; sustain the economic viability of arm operations; and enhance the quality of life for farmers and society as a whole". The current model of sustainable agriculture includes a focus on both sustainable development and alternative systems of agriculture.

In 1992, Meadows, Meadows and Randers published a vision of sustainable development and its relation to renewable resources,
non-renewable resources, system residuals, societal goals and intergenerational equity. It also included a description of the difference between growth and development, and recognized the concept of limits.

**Similarities and Differences.** IPM and sustainable agriculture have similarities and important differences. It is imperative that these be identified and used as a foundation for dialogue between the IPM and sustainable agriculture communities as they search for common ground for future joint initiatives. The following descriptions of 19 similarities and 10 differences are intended to be examples and not an inclusive listings:

**SIMILARITIES**

- Both existed in principle early in the Twentieth Century,
- Both are based on a philosophy,
- Both are based on a systems approach,
- Both are implemented through systems and practices,
- Both recognize the concepts of limits and equilibria,
- Both place emphasis on the public good,
- Both have a temporal nature and long-term goals,
- Both are based on the principles of ecology,
- Both involve site-specific practices,
- Both differ from our current dominant world view,
- Both have economic viability as one of a number of goals,
- Both require biological diversity,
- Both are based, in-part, on real-time in-field decision making and rely on systems of biological and environmental monitoring,
- Both are perceived differently from within their respective communities than by individuals outside the IPM and sustainable agriculture communities,
- Both evolved under skepticism and controversy,
- Both go beyond the production system unit,
- Both have had difficulty in attracting interest from various elements of the scientific community,
- Both are advocates of appropriate reduction in external system inputs, and
- Both have potential for increases in local added-value activities.

**DIFFERENCES**

- IPM was developed for use in conventional agriculture; whereas, sustainable agriculture focuses on alternatives agriculture systems.
- Components of IPM are outside the boundaries of sustainable agriculture (e.g., public school, restaurant and medical facility IPM), and parts of sustainable agriculture are outside the established boundaries of IPM (e.g., rural community development and farm family quality of life).
- Sustainable agriculture focuses on farming systems; whereas, IPM frequently places emphasis on a commodity.
- IPM has a goal of social acceptability within the boundaries of conventional agriculture; whereas, sustainable agriculture includes the social acceptability of alternative agriculture.
- IPM is based on a threshold concept; whereas, system design is the fundamental management variable for sustainable agriculture. Although system design is highly compatible with IPM and has been proposed as an IPM strategy, it has not been extensively adopted throughout IPM.
- The origins of IPM reside in the pest management community of academia; whereas, the origins of sustainable agriculture come from coalitions among farmers and ranchers, non-profit private organizations, and the science of ecology. IPM evolved through the research and education initiatives of U.S. scientists; whereas, sustainable agriculture is based, in part, on the works of international philosophers.
- Fundamental aspects of sustainable agriculture include major emphasis on on-farm research and farmer to farmer education; whereas, IPM research is usually conducted by pest management specialists and disseminated through Land Grant and government institution resources.
- Agriculture currently has a reasonable degree of comfort with modification of the practices of IPM for use in conventional agriculture (e.g., application timing and efficient use of pesticides). Conventional agriculture is currently less comfortable with the methodologies of sustainable agriculture. This is due, in part, to the short period of time that information on sustainable agriculture has been readily available to conventional farmers, and some
previous perceptions of sustainable agriculture.

-Although both IPM and sustainable agriculture have had difficulty in interesting other members of the overall science community in their respective initiatives, the two communities have attempted to resolve this issue in different ways. IPM has based its initiatives on interdisciplinary programs in government and academia; with support from private consultants, commodity organizations, coalitions among academic institutions and various political action initiatives. Today this includes agribusiness, although agribusiness was originally an opponent of IPM. Sustainable agriculture, however, has chosen to develop new ways to conduct their own research and education programs, organize local support groups, and design procedures for state, regional and national campaigns.

-Emphasis on local added-value initiatives and quality of life for farm families and local communities is an integral component of the sustainable agriculture. IPM has historically assumed that decreases in human health risks would result in increases in quality of life.

Prognosis and Recommendations.- IPM and sustainable agriculture have many similarities and important differences. In U.S. agriculture, both IPM and sustainable agriculture are relatively young concepts. It is imperative that both retain their uniqueness and identity as they mature and have highly significant positive impacts at the local community, global society and biosphere levels. It is equally important for IPM and sustainable agriculture, however, to maintain extensive and meaningful dialogue in a search for common ground for the development of joint initiatives designed to facilitate the evolution of agriculture into an age of sustainable development. For this to happen, it will be necessary for the primary stakeholders of agriculture, producers (farmers and ranchers) and consumers to play leadership roles in this transformation. Other stakeholders (eg. input suppliers, market sector, research and education community, and government) have extremely important roles to play in facilitating change; however, it is imperative that they be accountable to the primary stakeholders.

It is evident that IPM and sustainable agriculture have played major roles as pioneers and catalysts for the emerging concept of sustainable development. Both have the potential to continue to play both individual and joint leadership roles as the societal values associated with natural resources, human resources, fiscal resources and civicness evolve in a progressive and positive manner.

January 15, 1995 (revised, February 9, 1995), gwb
RESOURCES FOR SUSTAINABLE AGRICULTURE

LEARNING METHOD: Presentation and Discussion

PRESENTED BY: Gabriel Hegyes
National Agricultural Library and
Kansas State University

SUMMARY:

"Where do we find information about alternative practices and cropping systems?"

"I'd like to change to a lower input system if I can maintain profitability, but I don't know where to learn more about sustainable systems."

These are frequent comments we hear from farmers in the Midwest. We are also asked by Extension Educators and Specialists where to go for up-to-date ideas and recommendations on alternative and organic practices.

Over the past decade, a wide range of resources have become available. The Sustainable Agriculture Network (SAN) is a SARE-funded cooperative effort of university, government, and non-profit organizations dedicated to the exchange of scientific and practical information on sustainable agricultural systems.

SAN has organized its information around the WHO, WHAT, WHERE and HOW of sustainable agriculture. Its products are available as publications, over Internet and through easy-to-use, full-text searching software. For more details, call the SAN Coordinator, (301) 504-6425.

A wealth of information is also available from the Alternative Farming Systems Information Center (AFSIC), at the National Agricultural Library, in Beltsville, Maryland. Available to everyone at no charge are numerous lists on specific topics from Aquaculture to Biological Control to Organic Farming. The staff at AFSIC also offer frequently updated catalogs of current books, periodicals and videos available in sustainable agriculture. Contact Mary Gold, (301) 504-6559 for a List of Publications.

Another valuable resource include the Appropriate Technology Transfer for Rural Areas (ATTRA), in Fayetteville, Arkansas. A national resource center, it can be called toll-free during working hours, Central Time, (1-800-346-9140). Numerous popular journals are now including information about alternative systems, and there are newsletters and technical journals published by many groups (e.g. American Journal of Alternative Agriculture and Journal of Sustainable Agriculture). A number of states have centers or programs dedicated to alternative or sustainable agriculture, including the University of Maine, University of Wisconsin, Pennsylvania State University, University of Minnesota, Iowa State University, University of Nebraska, Washington State University, and University of California Davis, among others. Most of these centers publish a newsletter and other topical items, often through the Cooperative Extension Network.
The Sustainable Agriculture Network (SAN) is a cooperative effort of university, government, business and non-profit organizations dedicated to the exchange of scientific and practical information on sustainable agricultural systems. Publishing is a vital tool for networking.

SAN has organized its publications around the WHO, WHAT, WHERE and HOW of sustainable agriculture.

WHO
The "Sustainable Agriculture Directory of Expertise -- 1993" lists hundreds of people and groups you can contact for advice on building soil health, broadening your arsenal of pest-control tools, diversifying cash flow and much more. It is produced by ATTRA in cooperation with SAN.

WHAT
SAN sponsors the "Showcase of Educational Materials", a compilation of publications, videos, and other materials, as a way to identify both exemplary educational materials and knowledge "gaps" to fill.

WHEN AND WHERE
There is a 12 page "Calendar of Sustainable Agriculture" meetings and events updated bi-monthly. Also attached is a current schedule of the regional SARE/ACE granting cycles. Contact Gabriel Hegyes to join the mailing list.

HOW
"Managing Cover Crops Profitably" is the first in a series of SAN Handbooks. It was prepared because more and more farmers want reliable, easy-to-scan information on cover crops. "Managing Cover Crops Profitably" is a practical, introductory guide to help remove some of the guesswork.
A SAN factsheet, "Sustainable Agriculture vs. Weeds," highlights some of the Sustainable Agriculture Research and Education (SARE) and Agriculture in Concert with the Environment (ACE) projects aimed at controlling weeds with fewer herbicides.

A new handbook on sustainable agriculture tillage tools and techniques is currently in production.

**TO ORDER**
Please send your check, or purchase order to:
Sustainable Agriculture Publications, Hills Building, Room 12, University of Vermont, Burlington, VT 05405-0082

*Managing Cover Crops Profitably*  $9.95

*The Sustainable Agriculture Directory of Expertise*  $14.95

*The Showcase of Sustainable Agriculture Information and Education Materials*  $4.95

*Tillage Tools and Techniques*  (To be announced)

*SARE/ACE Research Summaries*  (Folio™ only. See ELECTRONIC RESOURCES above.)

---

**ELECTRONIC RESOURCES**

You may also order SAN Publications as "electronic books." Whether from a computer disk or over a computer network their information can be searched more quickly than it takes to scan a paper index.
The program runs on MS-DOS-compatible machines only, for the time being.

**SUPPORT**

SAN is supported by the USDA's Sustainable Agriculture Research and Education program. The Coordinating Committee includes:

- Gabriel Hegyes, SAN Coordinator, Ch 3. (ghegyes@oz.oznet.ksu.edu)
- Jayne MacLean, SAN Coordinator, NAL (san@nalusa.gov)
- Jill Auburn, University of California (jsauburn@ucdavis.edu)
- Kevin Gamble, North Carolina State University (kgamble@twosocks.ces.ncsu.edu)
- Beth Holtzman, Northeast SARE Program, University of Vermont (bholtzma@moose.uvm.edu)
- Lisa Jasa, North Central SARE Program, University of Nebraska (agcm005@unlvm.unl.edu)
- Kristen Kelleher, Western SARE Program, University of CA. (kkelleher@ucdavis.edu)
- Hans Kok, Kansas State University (kok@ksuvm.ksu.edu)
- Jim Lukens, ATTRA (jiml@ncatfyv.uark.edu)
- Charles Panton, North Carolina A & T (forbesb@athena.ncat.edu)
- Ed Rajotte, Pennsylvania State University (egrjottee@al.psupen.psu.edu)
- Gwen Roland, Southern SARE Program
- Tory Shade, University Extension, Wayne County, Missouri (wayneco@ext.missouri.edu)
The Sustainable Agriculture Network (SAN) is a cooperative effort of university, government, business and non-profit organizations dedicated to the exchange of scientific and practical information on sustainable agricultural systems. It is a network in the broadest sense of the word, supporting the exchange of information with a variety of users. The networking takes many forms: print, meetings, as well as electronic networks. This document explains how to use the Internet portion of SAN.

SAN is encouraging the distribution of information via the existing network of computer networks commonly called "the Internet". Originally developed in the United States to rapidly share research results the Internet currently connects over 10,000,000 computers throughout the world with "gateways" that exchange messages. Because it is a decentralized system of existing networks, instructions for using the Internet vary from site to site. The intention of this overview is to help you access agricultural information once you get connected to and familiar with your system.

GATEWAYS VS. FULL INTERNET SERVICE

If you are at a university or government facility, your computer may be fully connected to the Internet. Alternatively, you may have an account on a system with a "gateway" to the Internet, such as FTS2000, CompuServe, America On-Line, or many others. A full Internet connection includes three functions: electronic mail, FTP, gopher and Telnet. Your local system operator should be able to give you as much detail as you request.

Once you are familiar with your system, join the SAN discussion group and explore the SAN databases or calendar.

20 January 1995

GETTING STARTED ELECTRONICALLY WITH THE SUSTAINABLE AGRICULTURE NETWORK

SAN Databases:

SARE/ACE Research Reports, summaries of the projects funded by the USDA/CSRS Sustainable Agriculture Research and Education program and the EPA/USDA Agriculture in Concert with the Environment program;

The Directory, a listing of detailed characteristics by individuals and organizations that are willing to share their expertise in sustainable agriculture;

Showcase, annotated bibliography of educational and informational materials, emphasizing information readily useful to farmers;

Managing Cover Crops Profitably, a guide for farmers looking for alternatives to chemical fertility and weed control.

To search them interactively, through gopher, point to: gopher.ces.ncsu.edu. At the opening menu select the menu item, NATIONAL CES INFORMATION, to access SAN publications.

Discussion Group:

SAN has an email group "sanet-mg" with over 700 individuals interested in, and knowledgeable about, sustainable agriculture. Members of the group share sources of information and help answer each others' questions. To join "sanet-mg" send the following line: subscribe sanet-mg in the body of an email address to: almanac@ces.ncsu.edu

After you have subscribed, anything that anyone sends to sanet-mg@ces.ncsu.edu will automatically be sent to you and everyone else on the list.
Notice that the address that handles subscribe/unsubscribe requests is different from the address that handles mail to the group. When you send mail to sanet-mg@ces.ncsu.edu you will probably get a few "bounced-back" messages; don't be concerned, your posting was delivered to all valid and active addresses on the list.

MORE INTERNET RESOURCES

In addition to these specialized information sources, the Internet has quite a few other databases and mail lists on agriculture and other topics relevant to sustainable agriculture. Deborah Shaffer's publication, "Exploring Internet: An Introduction to Networking..." provides more detailed explanations of Almanac, Listserv, Gopher and WAIS. She also lists dozens of Internet locations where different topics of interest are addressed. "Exploring Internet" is available by sending the email message:

send internet exploring-internet
to the address: almanac@esusda.gov

From Utah State University, SAN hypertext databases are available for downloading from their Gopher site, extsparc.agsci.usu.edu. Once you acquire them, their information can be browsed, printed, cut or pasted from your computer. Among these databases is the 1990 Farm Bill. (See SAN Overview for details)

An excellent general guide to the Internet (more than agriculture) is Brendan Kehoe's "Zen and the Art of the Internet." The first edition is available via FTP from many sites, including ftp.cs.widener.edu. (If you are not familiar with how to use FTP, ask your computer support personnel).

FOR MORE INFORMATION

For more information or help accessing SAN, contact:
SAN Coordinator
c/o AFSIC, Room 304
NAL/ARS
10301 Baltimore Boulevard
Beltsville, MD 20705-2351
Internet: san@nalusda.gov
Telephone: 301/504-6425
FAX: 301/504-6409

SAN is a national initiative of the USDA's Sustainable Agriculture Research and Education (SARE) Program
As we promised in September, Carol Briggs-Erickson and I have completed our "Guide to Environmental Resources on the Internet." It is available via anonymous ftp at:

host: una.hh.lib.umich.edu
path: /inetdirsstacks
file: environment: murphybriggs

or
gopher: North America
USA
Michigan
Clearinghouse of Subject-Oriented Internet Resource Guides
All Guides
Environment

URL for World Wide Web
gopher://una.hh.lib.umich.edu/00/inetdirsstacks/environment: murphybriggs

We hope it will be of use to you, and we would like to thank all of the people who helped us to find resources for this guide. If you have any questions or information for future updates, we can be reached at:

murphyt@sils.umich.edu and
cbriggs@sils.umich.edu

Thanks again for all your help,
Toni Murphy
ANNOUNCING:  A Gateway to the NewCROP Information System

We are pleased to announce NewCROP = NewCrops Resource Online Program, an electronic information system that will provide a window to new and specialty crops, literature, newletters, a directory of new crop researchers, announcements and upcoming events, and coverage of the Indiana Center for New Crops & Plant Products, Purdue University, West Lafayette, IN 47907-1165, USA, which has sponsored this project.

NewCROPS World Wide Web (WWW) can be reached by WWW browsers (mosaic, netscape, www, lynx), by accessing your local WWW link via internet and connecting to:

http://newcrop.hort.purdue.edu

We have developed NewCROP as a gateway into the world of new crop information. This server will provide access to detailed information about research, presentations, and papers by the New Crop Center Staff and other new crop groups, an electronic version of New Crops News, plus our main feature attraction: CropSEARCH—a database of crop plants. With CropSEARCH, you can access basic information on hundreds of new crops by common name (and eventually by species).

A search mechanism will soon be installed to provide rapid keyword search capability. The system is built with links to a more detailed NewCROP FactSHEET which, when available, provides greater in-depth coverage. The NewCROP FactSHEETS include a list of germplasm, in addition to a wealth of information on botany, crop culture and the natural product(s) of commerce or interest. At present, only the basil FactSHEET is ready and on-line but about 50 are currently in preparation by various New Crops experts.

NewCROPS is still under construction. We welcome your comments, constructive suggestions, and hope that you will find NewCROPS exciting, challenging, and a rewarding experience.

We invite you to contribute—please send us announcements, and other new crop information. Text contributions can be sent by electronic mail or as a WORD document on diskette (Mac or PC). We lack photographs for most crops cited in CropSEARCH. Contributions are welcome either as GIF files, original photographs or slides. Be sure to clearly label the pictures.

We will acknowledge all sources of information. Please send contributions to: Jim Simon. All materials will be returned upon request.

Jim Simon and Jules Janick Center for New Crops & Plant Products Purdue University West Lafayette, IN 47907 USA Tel: 317-494-1328 Fax: 317-494-0391 E-mail: jim_simon@hort.purdue.edu and: jjanick@hort.purdue.edu

-- Jim Simon
Folio InfoBases Available Regarding Sustainable Agriculture
Prepared by the National Sustainable Agriculture Network
of the USDA - SARE/ACE Program

1. The Electronic InfoBase of the Showcase of Sustainable Agriculture Education Materials
   1 Disk, IBM Format, 720k, 3 1/2" size, (2nd Revision) Released in January 1995

   This InfoBase is a major revision of a previous release and was compiled from a publication of the Sustainable Agriculture Network by Dr. Jill Shore-Auburn of the University of California-Davis. It contains information on an extremely wide range of education and information materials related to sustainable agriculture. Slide-tape sets, videos, computer simulations and databases, pamphlets, books, popular publications, anthologies, bibliographies, journals, newsletters, audio recordings, video histories, brochures, policy papers, and other media are listed with short abstracts or descriptions. All information is searchable by keyword on this InfoBase.

2. The Revised Electronic InfoBase of Sustainable Agriculture Experts and Expertise
   1 Disk, IBM Format, 1.44mb, 3 1/2" size, (2nd Revision) released December 1994

   This InfoBase is a major revision of a previous release and contains a directory of available experts and expertise that was originally compiled in book form for the Sustainable Agriculture Network by ATTRA (The Center for Appropriate Technology Transfer for Rural Areas). It has been updated in 1994 with new listings that are only available on this InfoBase. As with all InfoBase disks, EVERY WORD is completely indexed and searchable by the user.

3. The October 1993 Revised Project Summaries from USDA Sustainable Agriculture Research and Education Program and EPA-USDA ACE Program Projects
   1 Disk, IBM Format, 1.44mb, 3 1/2" size, (3rd Revision) Released October 1993

   This InfoBase is the latest and most comprehensive listing of research-based information on sustainable agriculture systems. It contains summaries of the research reports of all projects funded by the USDA-SARE (formerly LISA) program through 1993. All projects texts are available on the InfoBase and are searchable by any single word.
4. The Computerized Cover Crops Handbook
   1 Disk, IBM Format, 720k, 3 1/2" size, Released August 1993

   This InfoBase contains the complete text of the Sustainable Agriculture Network book "Managing Cover Crops Profitably". It is a common-sense guide for the farmer or rancher who desires to utilize cover crops in their cropping system. All of the text is available on the InfoBase and is searchable by any desired word or group of words.

5. The Pasture and Intensive Grazing Bibliography InfoBase
   1 Disk, IBM Format, 1.44mb, 3 1/2" size, Released March 1994

   This InfoBase contains the complete text of a comprehensive bibliography of intensive grazing and pasture establishment literature compiled by the Intermountain (Western) Interagency (NRCS, ARS, Ext., etc.) Pasture and Intensive Grazing Committee. It was prepared for use in the West, but contains citations from throughout the United States, New Zealand, and other areas. Those involved with intensive rotational grazing systems would find this resource valuable. Because of the immense (2.2 megabyte) size of this InfoBase, it has been "compressed" onto a 1.44mb 3 1/2" disk and requires some knowledge of IBM-DOS commands to decompress it. All of the text is available on the InfoBase and is searchable by any desired word or group of words.

6. The Conference Proceedings from the "Participatory On-Farm Research and Education for Agricultural Sustainability" Conference sponsored by the University of Illinois
   1 Disk, IBM Format, 1.44mb, 3 1/2" size, Released January 1993

   This InfoBase contains the complete text of the published proceedings of the "1992 Conference on Participatory On-Farm Research and Education for Agricultural Sustainability," held at Champaign, Illinois. The conference was organized by Dr. John Gerber and the proceedings were edited by Dennis L. Clement. All of the text is available on the InfoBase and is searchable by any desired word or group of words.

7. The InfoBase of the 1990 "FACTA" Farm Bill
   1 Disk, IBM Format, 1.44mb, 3 1/2" size, Released February 1994

   This InfoBase contains the text of the 1990 "FACTA (Farm Bill) -- Food, Agriculture, Conservation and Trace Act." It was scanned (by electronic scanner and word recognition software) into the InfoBase and contains some errors due to the scanning process. However, each word of the complete text is available on the InfoBase and can be searched by any word or topic desired. It is extremely useful to those concerned quickly identifying individual topics within the Farm Bill.
8. The Computerized Agronomy Handbook with Hypertext Graphics Links

1 Disk, IBM Format, 1.44mb, 3 1/2" size, Released January 1993

This InfoBase contains the complete text of a conventional agriculture agronomy handbook. It does not address many sustainable agriculture issues. However, may be useful to the use because of the breadth and depth of the research-based information contained within the handbook. Subjects such as soil pH, soil testing, soil organic matter, soil water holding capacity, and soil salinity are defined and discussed. All of the text is available on the InfoBase and is searchable by any desired word or group of words.

9. The Annotated Bibliography of the Pinion-Juniper Ecosystems in the Intermountain West

1 Disk, IBM Format, 1.44mb, 3 1/2" size, Released February 1993

This is the complete text of a bibliography of Pinion-Juniper (tree) Ecosystems that are prominent in the Western United States. It was compiled by a coalition of conservation agencies and groups, led by western Soil and Water Conservation Societies. The InfoBase can be searched by author, keyword, journal, or any other desired word or word group. The long-term sustainability of these systems and their impact on water quality and soil erosion is of prime concern in the Southwestern United States. This will be of limited value to users in the North Central, Northeast, and Southern regions of the United States.

10. The 1994 Directory of State Alternative Agriculture Laws

1 Disk, IBM Format, 720k, 3 1/2" size, Released July 1994

This disk contains information compiled by the Center for Policy Alternatives, 1875 Connecticut Ave., N.W., Suite 710, Washington, DC 20009-5728. The Center spent over 12 months researching state laws from across the United States pertaining to alternative agriculture. The result was a database encompassing a wide range of legislative issues in all 50 states. These include laws relating to: soil conservation, water quality, public health, energy conservation, farmland preservation, technical and financial assistance, pesticide reduction, market assistance, organic food production, environmental protection, and farm safety. These laws are completely searchable in this InfoBase.

**All of the above programs have been successfully run on an Apple Macintosh with Insignia Corporation's "Soft-PC" and "Soft-Windows" programs installed.**

***A Beta-version (for evaluation only) of an IBM-compatible Recordable CD-ROM (CD-R) containing all of the above InfoBases that also contains two sustainable agriculture videos (in MS-Windows multimedia format) is available for evaluation for $45.00. Please contact Phil Rasmussen, Utah State University, soilcomp.cc.usu.edu, 801/797-2230 or 3394; 801/797-4002 (FAX).
**WHO TO CALL?**

Mary Gold, Alternative Farming Systems Information Center, National Agricultural Library, Beltsville, MD  
Phone: 301.504.6559  
FAX: 301.504.6409  
Internet: mgold@nalusda.gov

Jayne MacLean, Sustainable Agriculture Network Coordinator,  
Beltsville, MD  
Phone: 301.504.6425  
FAX: 301.504.6409  
Internet: san@nalusda.gov

Gabriel A. Hegyes, SAM Coordinator, Manhattan, KS  
Phone: 913.532.5778  
FAX: 913.532.5315  
Internet: ghegyes@oz.cznet.ksu.edu

**ATTRAC**  
Fayetteville, AR  
Phone: 1.800.349.9140  
FAX: 501.442.8942
The Sustainable Agriculture Research and Education (SARE) program is a USDA effort to further the development and adoption of sustainable agricultural practices. It encourages more efficient use of production resources through agricultural systems which are socially acceptable, environmentally sound and economically viable.

The competitive grants program, formerly known as the Low-Input Sustainable Agriculture (LISA) program, was created in the 1985 USDA farm bill and funded in 1988. It is administered through four USDA regions: North Central, Northeast, Southern and Western.

The program encourages research and education grants which address reduced use of purchased inputs such as manufactured pesticides and fertilizers which may harm the environment, impair food safety or decrease the farm's profitability. It promotes production systems which often may require increased management and a change in operations. The systems approach to research encourages an interdisciplinary plan which involves researchers and producers working together to solve production problems consistent with the whole farm.

In 1990 the Environmental Protection Agency joined with the USDA to fund the Agriculture in Concert with the Environment (ACE) Program, which is administered through SARE. ACE grants help producers reduce the risk of pollution from pesticides and soluble fertilizers and safeguard environmentally sensitive areas such as critical habitats and wetlands. Through ACE projects, researchers and producers have addressed water quality issues related to chemical use and soil erosion; nitrogen needs of various grasses; environmental and biological pest control measures and tillage systems to control weeds with fewer chemicals.

"Research, education, implementation — working toward a more sustainable agriculture" is at the core of the North Central Region's Strategic Plan, a plan to provide grants for the research, development and education of production systems that are based in a more sustainable agriculture. Projects cover the range of agricultural production in the region, from fruit and dairy production to cover crops, and low-input crop and beef cattle production. Other projects address cultural and educational issues ranging from the social factors affecting the
adoption of sustainable agriculture to policy questions related to the farm bill.

The North Central Region includes the states of Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin. The program is administered by an Administrative Council which sets policy and program goals and annually evaluates grant proposals. The region’s Technical Committee evaluates proposals for technical merit and makes recommendations to the Administrative Council.

The two boards are comprised of a diverse mix of 35 of the region’s leaders in sustainable agriculture, including researchers, educators, producers, and representatives of non-profit groups and government agencies.

Each year these groups review, prioritize and award grants for one or two-year projects related to sustainable agriculture and determine future programming needs in relation to the region’s Strategic Plan.

Grantmaking

When the program was initiated six years ago, projects addressed the use of sustainable cultural practices, reduced chemical production alternatives, biological control options, and crop and livestock combinations. Increasingly projects also are addressing better ways to link producers, universities, non-profit organizations, and communities interested in a more sustainable environment.

Projects supporting mentoring programs, producer networks and educational groups, and developing high school curriculum were funded to help build an infrastructure among the agricultural community that will significantly reduce the isolation often reported among early practitioners. In 1993 the Administrative Council added a special section in its Call for Proposals to give priority to projects addressing community development, agricultural policy and quality of life. In 1994 it created a special grant division to address socio-economic issues related to sustainable agriculture and the structure of agriculture or quality of life issues.

During its first seven years the North Central Regional program awarded SARE and ACE grants of about $8 million. These funds were used to leverage more than $9 million in additional funds dedicated to research and education in sustainable agriculture in the region. Since 1988 the program has funded 97 LISA projects and 24 ACE projects. (Several projects are cofunded through both programs.)

Producers are included in every LISA project and most ACE projects to ensure that research is applicable to real-life farm situations. (See Project Reports 2 and 4 for specific project descriptions.) Producers are further involved through a separate grant program: Producer-Initiated Sustainable Agriculture Grants. (See Project Report 5 for details.) This producer grant program, the first in the SARE program, was created in 1992 to provide grants of up to $5,000 to help producers identify and overcome barriers they face in adopting sustainable agriculture practices. During the first three years it has funded 87 projects.

Resources

The national and regional SARE Offices offer a variety of resources to help individuals learn more about sustainable agriculture and specific SARE projects. In addition a regional Speaker's Bureau lists members of the NCR SARE Administrative Council and Technical Committee who will serve as speakers at regional meetings.

For more information contact:

North Central Region SARE
13A Activities Building
University of Nebraska
Lincoln, NE 68583-0840
Phone: (402) 472-7081
Fax: (402) 472-0280

This material was prepared with the support of USDA Agreement No. 92-COOP-1-7266. Any opinions, findings, conclusions or recommendations expressed herein do not necessarily reflect the views of the U.S. Department of Agriculture. The United States Department of Agriculture (USDA) prohibits discrimination in its programs on the basis of race, color, national origin, gender, religion, age, disability, political beliefs, and marital or familial status.
Questions on University Extension Regional Resource Information

A database of Extension resources you can search directly from your computer

- No charge, no passwords
- Fast & easy access
- User friendly keyword search
- All subject areas
- Resources from north central states
- Videotapes & publications
- Bibliographic (not full text)

Internet Access:

At your Internet command prompt, type

telnet exnet.iastate.edu

then at login prompt, type querri

*Use lowercase characters.*

Dial-in Access:

Type atdt + your long distance access code + 515294 [baud speed], then at DIAL prompt, type exnet and login as querri

*Example:*

If using a 2400-baud modem, type atdt15152942400

DIAL: exnet login: querri

Extension Access:

Several north central Extension computer networks have QUERRI listed as a menu item:

- IL (IDEA), IN (CERF), IA (EXNET), MI (CEENet), MO (ETCS), ND (ExtNet), OH (AgVAX), WI (WISPLAN)

*Communications Software Settings:*

- 8 bits • one stop bit • no parity • full duplex

Maintained by the North Central Region Educational Materials Project

Sorrel Brown, coordinator (515) 294-8802

E-mail: x1querri@exnet.iastate.edu

24 hours a day
7 days a week

Supported by the Extension Services of North Central States
QUERRI

"Questions on University Extension Regional Resource Information"

You now have access to an online source of bibliographic information on Extension education resources. QUERRI is a database that contains approximately 13,500 educational resources produced by Extension specialists in the north central states. Using keywords, you can retrieve references related to your interest within seconds.

References cover agriculture, community development, 4-H & youth, families & consumers. When you view the bibliographic details of a title you’ve found, you’ll see:

ID: B 713
Title: Farm, Rural Economy, and Policy Implications of Sustainable Agriculture in South Dakota
Abstract: Summarizes a study of sustainable agriculture in South Dakota. Includes effects of alternative farming, environmental policies on the profitabilities of different farming systems, and the economic implications of each system.
Format: Publication
Source: South Dakota State University
Year: 1992
Pages: 20
Author: Dobbs, Thomas; Taylor, Donald; Smolik, James
Keywords: agricultural economics, alternative agriculture, crop rotation, cropping program, cropping system, economic analysis, economic condition, environmental, farm economics, farm policy, low input farming

NCREMP does not produce or distribute resources. Actual production is carried out by the authoring university. You order copies directly from the authoring university. QUERRI links you directly to the publication distribution office of the producing institution, and also provides you with the address and phone number.

The North Central Region Educational Materials Project (NCREMP) maintains QUERRI. Organized in 1976 to promote and facilitate regional cooperation, NCREMP is comprised of 13 land-grant universities in Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin.
Quick Bibliographies:
The bibliographies in the Quick Bibliography series are produced from edited computerized searches of the AGRICOLA database on topics that have proven to be of particular interest to our audience.

Other Series:
These information products, including Special Reference Briefs and Agri-Topics, have been researched and produced to meet special needs of our clientele. One copy of each title requested is provided at no charge.

(Note: includes Supplement Updates, 11/93, 1/94).

Unnumbered Publications:
☐ Calendar of Events Related to Sustainable Agriculture, G. Hegyes, updated monthly
☐ Horticultural Journals Currently Received at the National Agricultural Library, S. DeMuth, April 1993, 49 p.

☐ Check here if you wish information about the AFSIC series of videotaped oral history interviews with leaders in sustainable agriculture.

ORDERS MAY BE MADE BY E-MAIL, TELEPHONE, FAX OR SURFACE MAIL
(please include self addressed mailing labels whenever possible, one label for each 4 publications; do not send stamps or stamped envelopes)

Alternative Farming Systems Information Center
National Agricultural Library, Room 304
10301 Baltimore Blvd., Beltsville, MD 20705-2351
Telephone (301) 504-5724 - FAX (301) 504-6409
e-mail: afsic@nalusda.gov
WWW access: http://www.inform.umd.edu/EdRes/Topic/AgrEnv/AltFarm
Gopher access: gopher to gopher.nalusda.gov
-Information Centers/Alternative Farming Systems

NAME________________________
ADDRESS_____________________

2/95

236
Alternative Agriculture: Selected Information Sources—Part I:
Databases, Abstracts and Indexes, Periodicals, and Newsletters and Newspapers
Irwin Weintraub

ABSTRACT. An annotated bibliography of selected sources of information in alternative agriculture. Part I cites and describes databases, abstracts and indexes, periodicals, and newsletters and newspapers that include full or partial coverage of alternative agriculture. The sources chosen represent a diversity of approaches and viewpoints regarding alternatives to conventional agriculture.

KEYWORDS. Sustainable agriculture, bibliographies, primary sources, secondary sources, databases

INTRODUCTION

Alternative Agriculture

Alternative agriculture refers to ecological farming practices that reduce or eliminate the need for chemical or nonrenewable inputs
Alternative Agriculture:  
Selected Information Sources—  
Part II:  
Bibliographies, Reports, and Directories  
Irwin Weintraub

ABSTRACT. An annotated bibliography of selected sources of information in alternative agriculture. Part II covers bibliographies, reports, and directories that include full or partial coverage of alternative agriculture. The sources chosen represent a diversity of approaches and viewpoints regarding alternatives to conventional agriculture.

INTRODUCTION

As indicated in Part I, in the previous issue of JAFI, this bibliography consists of selected information resources in English representing the philosophy, practices, and issues related to alternative agriculture. Part I covered databases, abstracts and indexes, periodicals, and newspapers and newsletters.

Part II cites and describes bibliographies, reports, and directories containing information on alternative agriculture. The agencies that issue these publications are actively pursuing their agendas in the

---

Irwin Weintraub is Agriculture Resource Librarian, Library of Science and Medicine, Rutgers University, Post Office Box 1029, Piscataway, NJ 08855-1029. Irwin Weintraub received a BS in Agriculture from the University of Georgia, an MS in Agriculture from New Mexico State University, an MS in Rural Sociology from Penn State University, an MLS from Long Island University, and a PhD in Library and Information Studies from the University of Wisconsin.

Journal of Agricultural & Food Information, Vol. 1(4) 1993  
© 1993 by The Haworth Press, Inc. All rights reserved.
The Study Circle Handbook

A Manual for Study Circle Discussion Leaders, Organizers, and Participants

A publication of the Study Circles Resource Center, sponsored by Topsfield Foundation, Inc.
The Study Circle Handbook: A Manual for Study Circle Discussion Leaders, Organizers, and Participants is a publication of the Study Circles Resource Center (SCRC). It is an abridged version of A Guide to Training Study Circle Leaders, which also includes detailed suggestions for people conducting training programs. Both A Guide to Training Study Circle Leaders and this handbook are available at no charge for small quantities and at cost for larger quantities. You are also welcome to photocopy these programs as needed so long as proper credit is given to SCRC.

The Study Circles Resource Center is a project of the Topsfield Foundation, Inc., a private, nonprofit, nonpartisan foundation dedicated to advancing deliberative democracy and improving the quality of public life in the United States. SCRC carries out this mission by promoting the use of small-group, democratic, highly participatory discussions known as study circles.

In addition to providing how-to publications such as this, SCRC provides:

- **Consultation**, via phone or mail, for persons seeking advice on organizing and leading study circles.
- **Networking services**, including a comprehensive clearinghouse list of topical study circle material produced by a variety of organizations, a quarterly newsletter, and information exchange with thousands of individuals and organizations.
- **Topical discussion programs** on timely issues such as race relations, the death penalty, and foreign policy.
- **Assistance with material development**, by providing how-to publications and, where there is potential for wide use, direct assistance in developing topical study circle material.

For information, contact SCRC at PO Box 203, Pomfret, CT 06258, (203) 928-2616, FAX (203) 928-3713.
In the overview of Targeting Outcomes of Programs (TOP): An Integrated Approach to Planning and Evaluation, Bennett and Rockwell state that "Extension educators are challenged to develop, conduct, and report programs that address high priority needs and issues." Our reporting system captures numbers of meetings held, participants, publications mailed, and/or calls for educational information following an activity. Although these numbers give some indication of participant attendance and use of educational materials, they do little to assess the impact of an activity or the outcomes of a program. We clearly need to use evaluation tools more effectively to find out what is happening as a result of training.

The Bennett/Rockwell document outlines a process that targets outcomes, tracts the extent to which they are met, and evaluates the program's effectiveness to help meet the outcomes. It uses a 7-level hierarchy that first targets high-priority social, economics, and environmental conditions and sets outcome goals to guide program planning and assess program performance. This logical and sequential approach provides a framework within which program planning and evaluation can be organized.

KEY REFERENCE:

# CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overview</td>
<td>1</td>
</tr>
<tr>
<td>The Framework</td>
<td>3</td>
</tr>
<tr>
<td>Programming perspective</td>
<td>3</td>
</tr>
<tr>
<td>Programming process</td>
<td>5</td>
</tr>
<tr>
<td>Programming model</td>
<td>5</td>
</tr>
<tr>
<td>Program planning</td>
<td>9</td>
</tr>
<tr>
<td>Needs and opportunity assessment</td>
<td>9</td>
</tr>
<tr>
<td>Program design</td>
<td>10</td>
</tr>
<tr>
<td>Questions for program development</td>
<td>12</td>
</tr>
<tr>
<td>Tracking outcomes and programs</td>
<td>14</td>
</tr>
<tr>
<td>Criteria for indicators</td>
<td>14</td>
</tr>
<tr>
<td>Types of evidence</td>
<td>15</td>
</tr>
<tr>
<td>Evaluating program performance</td>
<td>17</td>
</tr>
<tr>
<td>Process evaluation</td>
<td>17</td>
</tr>
<tr>
<td>Impact evaluation</td>
<td>18</td>
</tr>
<tr>
<td>Selection of level of evidence</td>
<td>19</td>
</tr>
<tr>
<td>Designs for attributing program contributions</td>
<td>20</td>
</tr>
<tr>
<td>Outcome tracking</td>
<td>20</td>
</tr>
<tr>
<td>Comparison tracking</td>
<td>21</td>
</tr>
<tr>
<td>Point-in-time comparisons</td>
<td>22</td>
</tr>
<tr>
<td>Cross sectional surveys</td>
<td>23</td>
</tr>
<tr>
<td>Perceptual surveys</td>
<td>23</td>
</tr>
<tr>
<td>Case studies</td>
<td>24</td>
</tr>
<tr>
<td>Questions for evaluating program performance</td>
<td>25</td>
</tr>
<tr>
<td>Summary</td>
<td>27</td>
</tr>
<tr>
<td>Glossary</td>
<td>28</td>
</tr>
<tr>
<td>References</td>
<td>30</td>
</tr>
<tr>
<td>Addendum: Questionnaire to apply TOP in planning and evaluating programs</td>
<td>31</td>
</tr>
</tbody>
</table>
TARGETING OUTCOMES OF PROGRAMS (TOP):
An Integrated Approach to Planning and Evaluation

Overview

Extension educators are challenged to develop, conduct, and report programs that address high priority needs and issues. This requires concentrating on program outcomes. Targeting Outcomes of Programs (TOP) helps extension educators focus on outcomes throughout program planning and evaluation.

What is TOP?

Targeting Outcomes of Programs (TOP) is an integrated approach to developing and evaluating extension programs. TOP uses a single model to target outcomes, track the extent they are achieved, and evaluate program performance toward achieving them.

TOP helps develop and evaluate programs to address strategically chosen areas of need and issues, e.g., integrated crop management, limited resource families, etc. Within these areas, TOP helps extension educators:

- assess specific needs, issues, and program opportunities;
- target social, economic, environmental, and other outcomes;
- design programs to achieve targeted outcomes;
- track the extent to which targeted outcomes are achieved; and
- evaluate program performance toward achieving targeted outcomes.

TOP suggests an integrated approach to needs and opportunity assessment; program design; outcome tracking; program process evaluation; and program outcome/impact evaluation.

Who Uses TOP?

TOP is intended to help extension staff program in strategically chosen need and issue areas. Extension staff as well as volunteer leaders may collaborate with other organizations/agencies to address the identified needs/issues. Programmers are advised by specialists as well as customers and stakeholders affected by the needs and issues.

How Does TOP Work?

Extension programmers take the ten steps listed below.

1. Accept an assignment to address a strategic need/issue area.
2. Network with customers, stakeholders, and specialists to assess the area's specific needs, issues, and program opportunities.
3. Envision desired social, economic, and environmental conditions and identify specific practice use necessary to achieve these conditions.
4. Recruit program partners as appropriate in order to achieve necessary practice use.
5. Target specific social, economic, environmental, and other outcomes/impacts.
6. Design and assess program strategy, activities, and resources to achieve impact targets.

7. Select indicators and plan their use to track the extent that outcome targets are achieved.

8. Plan program performance evaluation to identify the program's contribution toward achieving the outcome targets.

9. Implement the extension program, track outcomes, and evaluate program performance.

10. Utilize outcome tracking and program performance evaluation in accountability reporting and subsequent programming.

What is TOP's Model of Extension Programming?

TOP assumes that most extension programming follows the model represented in Figure 1.

The model suggests that, in planning programs, extension staff first target SEEC--social, economic, and environmental conditions--then the practices necessary to achieve the targeted condition and the KOSA--knowledge, opinions, skills, and aspirations--needed to realize use of the practices. Next, staff target the reactions needed to ensure sufficient participation in appropriately designed program activities and finally, the resources necessary to support the activities.

The model suggests that, in program performance, extension staff expend targeted resources in order to conduct the program activities intended and obtain targeted participation with positive reactions.

Program participants acquire targeted KOSA--knowledge, opinions, skills, and aspirations--leading to their adoption of targeted practices. Use of these practices helps achieve the targeted SEEC--social, economic, and environmental conditions.

Figure 1. Hierarchy in extension programming.

TOP guides extension program planning, tracking extent of achievement of targeted outcomes, and evaluation of program performance toward achieving these outcomes. TOP's integrative programming model increases the effectiveness and efficiency of program planning and evaluation.