29

Animals in Sustainable Agriculture

Learning Objectives

After you have studied this chapter, you should be able to:

- Define and describe sustainable agriculture.
- Describe sustainable practices.
- Explain the "systems philosophy" of sustainable agriculture.
- Elaborate on the place of animals in sustainable systems.
- Identify a monoculture system and contrast it to a diversified system.
- Identify areas of concern for making livestock systems more sustainable.
- Explain the "lifestyle element" of sustainable agriculture.

Sustainable agriculture Agriculture that meets the needs of the present generation without jeopardizing the ability of further generations to meet their own needs and without limiting their choices.

Key Terms

Agroforestry
Crop rotation
Diversification
Ecology
Environmentalism
Integrated pest management
Lifestyle
Monoculture
Organic agriculture
Recombinant DNA technology
Sustainable agriculture

INTRODUCTION

There is an active movement in the United States and other industr countries to make modern agriculture more sustainable in nature, the term **sustainable agriculture.** At the core of the movement belief that modern agriculture, with its technologically driven, petroch dependent specialization that is designed to maximize produ has brought costs that in some cases may outweigh the benefi costs, often referred to as external costs, most frequently men are to natural resources such as:

1. Soil damage from erosion, topsoil depletion, and contaminati
2. Loss of soil health from reduced microbial populations, loss tilth, increased soil compaction and loss of organic matter
3. Habitat loss and loss of species
4. Groundwater depletion, pollution from lagoons, nitrogen i wells, and risks associated with increased oil and metals as by-products
5. Damage from animal waste, usually associated with water especially municipal surface water supplies

Social costs assessed to modern agriculture include:

1. The decline of rural areas, which has come about with the los family farm
2. The tendency of corporate farming to transport profits communities and provide mostly minimum-wage jobs
3. Community structure changes as packing plants employ mig
4. Reduced human satisfaction with and within agriculture, as with quality of life for farmers and their neighbors as well as fort of greater society with agriculture's means of producing

BOX 29–1

USDA'S NATIONAL ORGANIC PROGRAM

The Organic Foods Production Act (OFPA) of 1990 required the U.S. Department of Agriculture (USDA) to develop national standards for organically produced agricultural products to assure consumers that agricultural products marketed as organic meet consistent, uniform standards. The OFPA and the National Organic Program (NOP) regulations require that agricultural products labeled as organic originate from farms or handling operations certified by a state or private entity accredited by USDA. The NOP is a marketing program housed within the USDA Agricultural Marketing Service.

The NOP developed national organic standards and established an organic certification program based on recommendations of the 15-member National Organic Standards Board (NOSB). The NOSB, appointed by the secretary of agriculture, is comprised of representatives from the following categories: farmer/grower, handler/processor, retailer, consumer/public interest, environmentalist, scientist, and certifying agent. The NOP regulations are flexible enough to accommodate the wide range of operations and products grown and raised in every region of the United States.

The NOP regulations address organic crop production, wild crop harvesting, organic livestock management, and processing and handling of organic agricultural products. Organic crops are raised without using most conventional pesticides, petroleum-based fertilizers, or sewage sludge-based fertilizers. Animals raised on an organic operation must be fed organic feed and given access to the outdoors. They are given no antibiotics or growth hormones. The NOP regulations prohibit the use of genetic engineering, ionizing radiation, and sewage sludge in organic production and handling. As a general rule, all natural (non-synthetic) substances are allowed in organic production and all synthetic substances are prohibited. The National List of Allowed Synthetic and Prohibited Non-Synthetic Substances, a section in the regulations, contains the specific exceptions to the rule.

The NOP regulations further address labeling standards, certification standards, accreditation standards, and the rules under which imported products may be sold as certified organic.

Source: Adapted from http://www.ams.usda.gov/AMSv1.0/getfile?dDocName=STELDEV3004443&acct=nopgeninfo as updated April 2008.

Sustainable agriculture is often characterized as simply "organic farming" (Box 29–1) by people who are unfamiliar with its complexities. However, sustainable agriculture is vastly more complicated than that term implies. Yet defining sustainable agriculture is perhaps the most difficult chore of this chapter. There seems to be no single definition to which all agree, perhaps because the concept is still actively evolving. A definition your author likes is this: Agriculture that meets the needs of the present generation without jeopardizing the ability of further generations to meet their own needs and without limiting their choices.

Sustainable agriculture is as much concept as anything else, and it blends the social with the scientific in a way that many of us are either unwilling to think about or, because it is difficult to assign values to external costs, choose to reject. All wrapped up in the concept are elements of environmentalism, economics, ecology, and social concerns. Furthermore, the complexities of the topic will prevent this chapter from dealing with this timely topic in a comprehensive way. However, it will lay out the fundamentals. You are encouraged to look at the lists of articles and books at the end of the chapter and to take advantage of other sources of information to pursue the topic further.

WHAT IS SUSTAINABLE AGRICULTURE?

A good place to start in understanding sustainable agriculture is with a document from the Alternative Farming Systems Information Center titled "Sustainable Agriculture: Definitions and Terms" (Gold, 1994). In that paper, Gold points out that "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 set of long-term objectives for food and agricultural sciences." She goes on to sa: "The goal of sustainability requires addressing philosophical, economic, and socic logical issues, as well as environmental and scientific questions." This last sentenc demonstrates the complexity of understanding the underpinnings of the sustainab agriculture movement by pointing out its many elements. It is also instructive t note that the first item in her list of what "requires addressing" is *issues* from the so cial sciences, and the last item is biological *questions*. It seems that the essence of th sustainable agricultural movement can be found here. That essence is the struggle t bring a set of social issues to modern agriculture with the goal of changing some o the current and most common biological approaches to agriculture so that they pa muster as being ecologically sound, economically viable, and socially responsibl These three items are often referred to as the "triple bottom line" of sustainabilit The three "lines" represent society, the economy, and the environment. (The phra was coined by John Elkington in his 1998 book *Cannibals with Forks, the Trip Bottom Line of 21st Century*.)

It is important for the long-term implementation strategy of sustainable systen that producers not be backed into absolutist corners where it appears that adoptir sustainable practices is an all-or-none proposition. For example, sustainable agricu ture, in its pure definition, refers to any farming system that can be productive ar can last forever. The movement often seems to take the view that much of mode: agricultural practice is nonsustainable, and presumably has the goal of convertir current agriculturists away from modern practices that it deems as nonsustainab to those that will last forever. In reality, all farming practices can be viewed on continuum from not sustainable to very sustainable. In addition, there is plenty ground for disagreement on what is and is not sustainable. A multitude of ration arguments can be made defending many modern practices as meeting Ikerd's 19! standard that sustainable agricultural systems "must be resource conserving, social supportive, commercially competitive, and environmentally sound." It is the absolu ism of movements that often turns otherwise rational people away. The best intere: of all sides get lost when purist "all-or-none" thinking and philosophy dominate.

The definition for a sustainable agriculture found in the 1990 Farm Bill "an integrated system of plant and animal production practices having a site speci application that will, over the long term: (a) satisfy human food and fiber neec (b) enhance environmental quality and the natural resource base upon which the ag cultural economy depends; (c) make the most efficient use of nonrenewable resourc and on-farm resources and integrate, where appropriate, natural biological cycles ar controls; (d) sustain the economic viability of farm operations; and (e) enhance t quality of life for farmers and society as a whole." In the view of the author, there much in this definition to like and support. This view leaves us the option of incorp rating farming practices that are more sustainable without having a perfectly sustai able system. This frame of reference paves the way for a mind-set that allows all objectively review and consider sustainability as something we might have a stake and move toward incrementally. Keeping an open mind is the key to learning.

One of the central tenets of some who promote sustainable systems is that crc land used for animal feed is less efficient in producing calories and protein for hum use than if the land were to be used to produce food crops. Several examples th dispute this conclusion can be found in the literature. The following is from Beck and Oltjen (1996). "[I]n California, alfalfa yields average 15 t/ha annually wher wheat averages 5.4 t/ha. . . . Alfalfa is about 20% protein; wheat is about 12% p: tein. Hence a hectare yields 3,010 kg of protein from alfalfa, or 647 kg of prot from wheat (21.5% that of alfalfa). Dairy cows convert the protein in alfalfa to m protein at about 25% efficiency, giving 753 kg of food protein per hectare, compared to 647 for wheat. In addition, milk and milk protein is of much higher quality and biological value." A study of the various estimates with different species in different systems actually yields several examples of systems of animal production that produce more protein and/or energy than those same resources would have produced from the common, humanly edible grains found in those same areas. From these examples we learn that animals yield the most sustainable use of certain resources. Those who work to bring about a more sustainable overall agriculture would do well to keep this in mind.

This illustrates a drawback to achieving sustainability and something that should also be pointed out to the reader. Not everyone who supports and/or practices sustainable agriculture agrees on exactly what is sustainable, on the best methods to reach sustainability, what practices are acceptable, which are best, and in what direction the movement should go. This should not be interpreted negatively. Thinking people don't necessarily reach consensus overnight. This lack of consensus is rather a sign of life in a movement that many say has reached a critical social threshold and is here to stay. Mature social movements tend to get boring. This one still has lots of "interest factor" left in it, with the probability of a few surprises yet to come.

Practices That Are Part of Sustainable Farming

Ideally, you have not been drawing the conclusion that sustainable agriculture means going back to milking cows by hand, choppin' cotton, sloppin' hogs, and sheathing cornstalks. Nothing could be further from fact. Sustainable farming practices can be simple but don't have to be simplistic. They can actually be quite sophisticated (Figure 29–1). The following list of some commonly used practices, and some not-so-commonly used practices, provides but a few examples of sustainable practices that can be implemented as a part of modern agricultural systems:

1. Rotating crops to reduce weeds, disease, and insect pests. This practice also provides alternative sources of soil nitrogen, reduces soil erosion, and reduces risk of water contamination by agricultural chemicals (Figure 29–2).
2. Using intensive grazing and rotation systems for pasture and range management to improve carrying capacity and build the land rather than take from it (Figure 29–3).

Figure 29–1
This picture illustrates many of the practices used in sustainable agriculture: crop rotation, pasture rotation, the use of animal and green manures to augment fertilizer, and the use of trees as windbreaks to protect the soil. (Photo by Tim McCabe. Courtesy of USDA-Natural Resources Conservation Service.)

Figure 29–2
Alternating strips of alfalfa with corn on the contour. Rotating the crops reduces weeds, disease, and insect pests. The alfalfa provides alternative sources of soil nitrogen, reduces soil erosion, and reduces risk of water contamination by agricultural chemicals. (Photo courtesy of USDA-Natural Resources Conservation Service. Photographer unknown.)

Figure 29–3
Intensive grazing system where cattle graze at heavy stocking rates for a short time and then are moved to new pasture. Using intensive grazing and rotation systems for pasture and range management to improve carrying capacity and build the land rather than take from it. (Photo by Jeff Vanuga. Courtesy of USDA-Natural Resources Conservation Service.)

3. Using integrated pest management, which uses advanced entomology agronomic practices of pest scouting, resistant cultivators, biological cont and other methods to reduce pests and lessen pesticide use.
4. Increasing mechanical/biological weed control, more soil and water conserva practices, and using animal and green manures to replace and augment chen fertilizers.
5. Using swine to scavenge behind ruminants in intensive dairy or beef operati
6. Using ruminants to manage small-grain crops through the winter prior to g harvest.
7. Using ruminants to eat food-processing wastes such as citrus pulp, beet pulp, cannery wastes that would otherwise present huge disposal problems.
8. Using mixed ruminant species to graze stockpiled forages and "wild" growth the plant-growing season in dry areas. The animals return the nutrients to th and reduce the danger of and need for burning.
9. Using ducks and geese to eat grass between rows, and flocks of chickens to c an insect buffer zone around plantings for market gardening operations.
10. Using riparian buffer strips to protect water quality and to provide habita wildlife and beneficial insects (Figure 29–4).

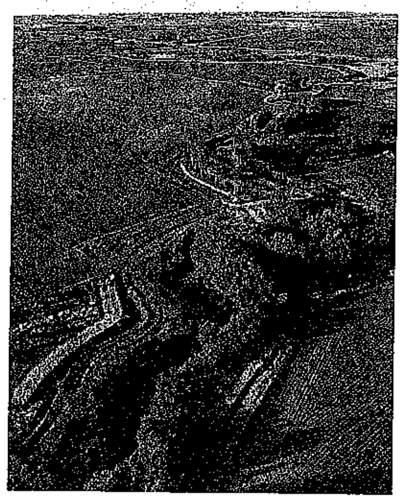

Figure 29–4
Riparian buffer strips protect water quality and provide habitat for wildlife and beneficial insects. Here, multiple rows of trees, shrubs, and a native grass strip combine to protect a creek. (Photo by Lynn Betts. Courtesy of USDA-Natural Resources Conservation Service.)

The Systems Philosophy

To understand and practice sustainable agriculture, it is essential to have an appreciation for the systems philosophy. Feenstra et al. (1998) explain it this way: "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."

Ample evidence supports the idea that sustainable systems can work (Figure 29–5). Sustainable agricultural systems using both animal and plant crops have been in place in some parts of the world for thousands of years. In these systems, animal and plant interactions combine to cycle carbon, nitrogen, minerals, and energy to create a sustainable system. The animals eat surplus plant material and in turn return waste products that the plants use to the plant system. Body wastes from animals contain

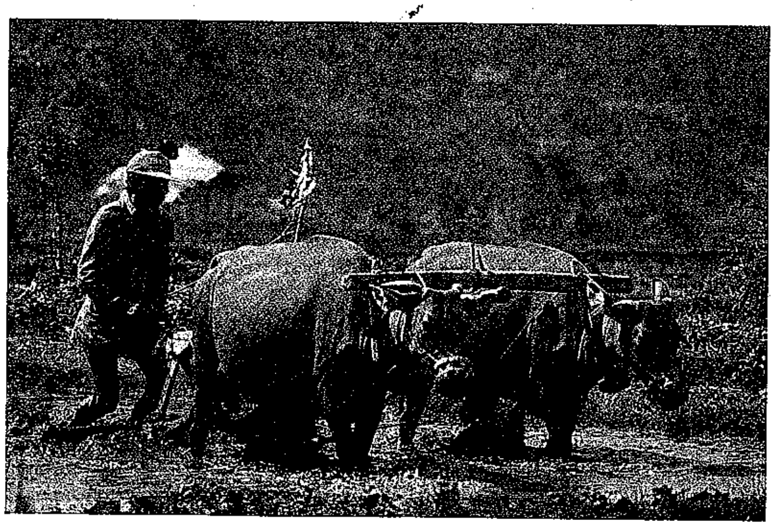

Figure 29–5
Sustainable agricultural systems using both animals and plant crops have been in place for millennia. Animal and plant interactions combine to cycle nutrients to create a sustainable system. The animals eat surplus plant material and, in turn, return waste products to the plant system. Large animals may be used for draft purposes as is the case with these cattle tilling a rice field in Indonesia. (FAO photo 17346/ Roberto Faidutti. Used with permission by the Food and Agriculture Organization of the United Nations.)

virtually all of the nutrients plants need to grow. In these agricultural systems humans have been able to take those things we need with little noticeable damag to the environment. The only part of the "resource conserving, socially supportive commercially competitive, and environmentally sound" test those historically successful sustainable systems do not meet for modern times is commercial viability, an that is because the concept is vastly different in the subsistence systems where thi agriculture has existed for so long. There is a problem in making such systems commercially viable. However, it is a misconception to say that none of the sustainabl or near-sustainable farming systems are economically viable. Admittedly, most of th viable systems tend to be smaller, but in many areas of Canada and North Dakot in the United States there are large-scale farms (some even organic) that are doin very well. A healthy market has developed for consumers who will pay a premium fo produce that they perceive as fresh. These consumers also value knowing who grew their food and how it was grown. The number of farmers' markets around the Unite States has markedly increased in the last few years and is still doing so. Because o such successes, some in sustainable agriculture pose an interesting question: "Wha if we had invested more heavily in agroecological farming systems research? Wher would we be?" Instead, we have directed the bulk of our research efforts to the industrial system.

In the not-so-distant past, U.S. agriculture came much closer to meeting th goals of sustainability. This has been changing fairly rapidly since the early 1950 when agriculture began moving away from the small family farm to much more specialized systems. As Feenstra et al. (1998) point out, it was at this time that "productivity soared due to new technologies, mechanization, increased chemical use specialization and government policies that favored maximizing production. Thes changes allowed fewer farmers with reduced labor demands to produce the majorit of the food and fiber in the U.S." In this sense, then, the current increased emphasi on sustainable systems can be viewed as "back to the future" in terms of both knowledge and practice.

ANIMALS IN SUSTAINABLE AGRICULTURAL SYSTEMS

In the big picture, the uses of animals in sustainable agriculture mirror the arguments put forth for animal use in various places earlier in this text. Those uses includ adding value to crops, serving as a buffer against fluctuating grain prices and supplies providing storage of food against catastrophe, creating year-round employment increasing the number of products from the production unit, storing of capital, providing capital for purchase of inputs, using lands not fit for cropping, and so on. I fact, animals are indispensable in maintaining highly functioning sustainable system where there are dense populations (Figure 29–6).

The inclusion of both crops and animals has been at the heart of many of th world's historically successful sustainable systems. These systems were/are sustainabl because they rely on the interrelationships between diverse plant, animal, and huma segments of the system to nurture each other. These systems were the pre-1950s family-farm model in this country. The small farms that had adequate cropland wer sustainable. In turn, the entire network of small rural communities that once flourished in this country were sustained by these farms. As Baker et al. (1990) point out in these family farms "human and community systems can be integrated with th agroecosystem into a larger system." Although this type of farm still exists in thi country, specialized systems with many fewer enterprises are much more prevalen

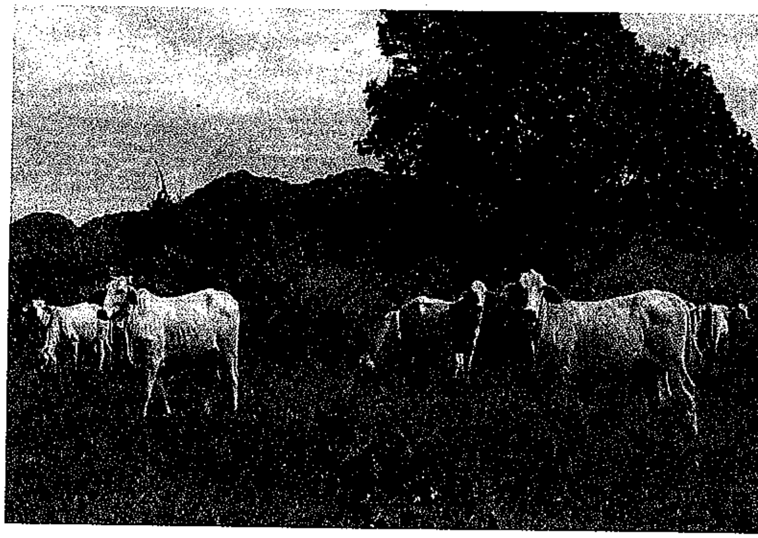

Figure 29–6
Animals are an indispensable part of an overall sustainable system. In some cases, animal use is the only means of creating value from renewable vegetation.

in all of agriculture, both plant and animal. Some farmers grow thousands of acres of corn to the exclusion of all else. Others have tens of thousands of chickens, thousands of dairy cows or pigs, and nothing else. As Feenstra et al. (1998) observed, "The integration now most commonly takes place at a higher level—between farmers, through intermediaries, rather than within the farm itself." In the process, some of the elements of sustainability have been lost (Figure 29–7). Bringing a more sustainable approach to the current system certainly presents challenges. Yet, there are recommendations for doing so. Not all fit the rubric of being perfectly sustainable. However, being more sustainable is a goal that most could achieve if they chose to.

One of the basic tenets of sustainable systems is that they are "site specific." Because sites vary, it then follows that sustainable production practices must include different techniques. Even so, the general principles listed in Table 29–1 may guide producers.

Diversity has its advantages. Diversified operations have more sources of income than do modern, specialized operations, so they are not as susceptible to the unexpectedly low prices that occur from time to time in virtually all products of crop and livestock farms. It is unusual for many farm products to have bad prices at the same time. For example, the price of pigs and the price of wheat aren't usually low at the

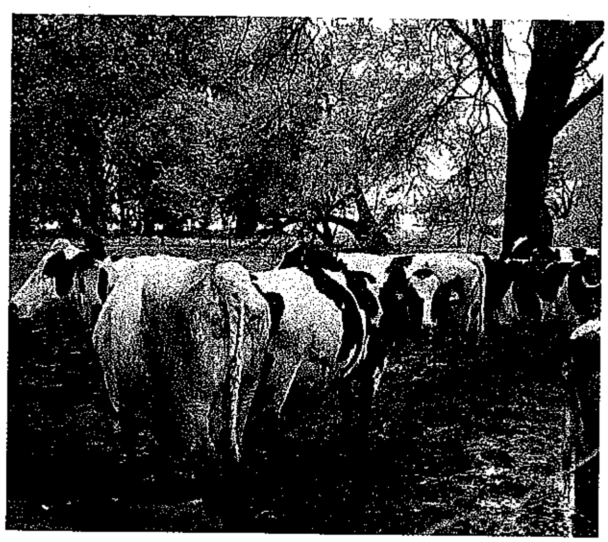

Figure 29–7
Concentrating livestock also concentrates wastes. Recycling wastes in a revenue-neutral fashion is a pressing need to make animal agriculture more sustainable.

Table 29–1
PRINCIPLES OF SUSTAINABILITY

1. Select species and varieties that are well suited to the site and to conditions on the farm.
2. Diversify crops (including livestock) and cultural practices to enhance the biological and economic stability of the farm.
3. Manage soil and water to conserve, protect, and enhance their quality.
4. Manage livestock waste and other agricultural system by-products.
5. Manage pests ecologically and with minimal effects on the environment.
6. Protect wildlife habitat and encourage biodiversity.
7. Maximize solar energy use and place less reliance on petroleum-based chemicals and fuels.
8. Use inputs efficiently and humanely.
9. Restore farm economic profitability.
10. Consider the farmer's goals and lifestyle choices.
11. Ensure that sustainable farm communities are built and that those communities are resilient.
12. Ensure social equity in today's actions and ensure intergenerational equity for our actions.

Source: Adaped from Feenstra et al., 1998, and Horne and McDermott, 2001.

same time. Likewise, it is unusual for multiple crop failures to occur simultaneousl or for egg production to be subpar at the same time that the corn crop fails. Divers fied operations have an added hedge against catastrophe in this way. In addition, pr ducers are generally able to market their multiple products at different times. Whe can be sold in the spring or early summer. Excess hay can be sold whenever cash needed. Corn, milo, and other grains are generally harvested and sold in the fall. Eg from a laying flock or milk from a herd of dairy cows provide year-round incon to help with cash flow. Multiple enterprises also tend to make best use of labor. F example, calves that nurse their mothers and run on pastures in summer with little l bor needed can be put in feedlots and fattened for market for the winter, when mc labor is needed.

Obviously, an excellent opportunity to diversify is to include both animal ar plant enterprises on the same farm. Further diversity is brought about by includi multiple species of livestock and multiple crops. Crop and livestock farms that d just this very thing were once the predominant type of farm across the farming b of the United States. These mixed operations have distinct advantages in best usi the natural resources of the farm and reducing the need for costly inputs. Land w slopes that would suffer from erosion if cropped can be pastured or used for hay a the level land can be tilled for growing crops (Figure 29–8). In addition, livestock c glean crop residue from harvested fields and benefit from them. This residue may in the form of stalks and stover or grain left by harvesting machines. Crop failu can be harvested by animals to provide value from what would otherwise be ru and add the nutrients back to the soil at the same time. Animals allow for a sho term productive use for land that lies fallow so it can rejuvenate. They can graz cover crop for part of the year and put nutrients back as manure. Further, if gra properly, they serve as a natural way to control weeds. An additional use of grazi animals is to use them for grass and weed control under high-growing crops. Sh can graze under corn and geese under cotton. The land benefits because soils can improved and better crops can be raised. The farmer benefits by selling product fr fallow land or additional product from cropland while getting a rejuvenated soil. "system" works to maximum benefit for total productivity (Figure 29–9).

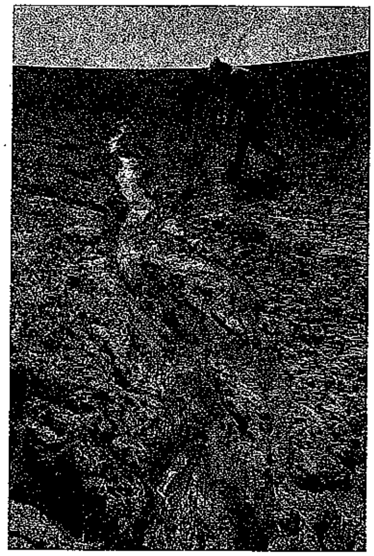

Figure 29–8
Soil erosion is one of the most persistent threats to the long-term productivity of the nation's land. Erodable lands are often best in pasture and used for grazing. (Photo by Jack Dykinga. Courtesy of USDA-Agricultural Research Service.)

Figure 29–9
Secure and movable chicken tractor allows poultry access to sunlight and fresh air while allowing them to forage and scratch the ground for food. Chicken tractors are mobile and are moved regularly to allow the birds access to fresh forage. They may be rotated over vegetable gardens where the birds can till the soil and devour insect pests. The chickens occupy the portion of the vegetable plot resting from the vegetable crop rotation. The birds' manure adds fertility, and their foraging provides pest control. Cover crops also offer forage for the chickens. (Photo courtesy of Kerr Center for Sustainable Agriculture.)

In a single-site, mixed, diverse system the animal enterprises must be chosen with all the maxims of sustainability in mind. The differing goals of a sustainable unit, with its optimum production goals, dictate different choices of species, breeds, feeds, and system inputs than a specialized animal unit might. Careful choices must be made. Wastes and by-products almost certainly form a significant portion of the feed for the animal unit(s). Lower production levels are tolerated for increased longevity and disease and parasite resistance. Maximum production in each livestock unit is not the goal. The goal is that the unit produces as much as possible while contributing to the sustainability of the whole system. However, the greater the biological and physical efficiency of animals and plants, the greater the potential to develop sustain able animal-plant systems.

Agroforestry Includes land-use systems and practices using woody perennials on the same unit as livestock and/or crops.

One of the most exciting approaches to mixed systems is **agroforestry.** I these systems, animal feed and other crops are produced in conjunction with forests orchards, and woodlands. Baker et al. (1990) classified such systems as "(1) producin forage for livestock in land harvested primarily for lumber, (2) producing livestock forage under orchard tree crops such as walnuts, (3) managing forests to increase of take of wildlife used for food, (4) reducing livestock-grazing damage to forests whil maintaining animal off-take, and (5) planting 'fodder trees' for animal feed to slo deforestation in the humid tropics and desertification in the arid tropics."

Monoculture

Monoculture Producing only one crop or livestock species.

Large operations that focus on producing only one type of animal in intensive uni seem to bear the brunt of much objection from those who promote sustainable agr culture. Although not all operations offend to the same degree, the general feeling that there is no place for large **monoculture** operations in a sustainable agricultur Part of the objection seems to be on the heavy dependency on grain usage. Suc animal systems, generally referred to as confinement feeding, concentrated anim feeding operations, and factory farms, are not considered efficient converters of e ergy and protein to human food. This is a case in which generalizations have gotte in the way of examining the facts. Simply stated, the efficiency argument is not val in all cases. Much depends on the particular system in question. Several articles an research studies have demonstrated that animal systems can return edible energy an protein for people at close to or exceeding 100% efficiency. (See Baldwin et al., 199 Beckett and Oltjen, 1996; Bywater and Baldwin, 1980; and Wheeler et al., 1981 However, not all who subscribe to the sustainable paradigm disagree with feedi grain to any kind of animal. Many sustainable agriculturists believe in maximizi forage and the use of limited grain. Normally, sustainable agriculturists are believe in systems such as grass-fed and grass-finished beef, free-range turkey, and pastur self-harvest pig production. Further, these systems are free of many of the ethic concerns related to animal welfare (e.g., the use of crates for sows, layers, and/or vea

Many sustainable agriculturists consider factory farms, especially vertically i tegrated corporations, as exploiters of animals, people, and communities. Althou often located in depressed communities, workers for these operations are frequent brought in from outside the community. Much, or even most, of the profits the operations are exported out of the community. The environmental impact considered significant, and the external costs on community services are high. The vertically integrated companies are also viewed as exploitative of contract farmers. an added negative, large vertically integrated operations, with their emphasis on co sistency in product and standardized production conditions, are contributing to t loss of biodiversity in livestock (Figure 29–10).

Even for the systems that do not return energy or protein at greater than 100 efficiency, it is probably unrealistic to expect that U.S. agriculture will return to versified, mixed systems and abandon the current methods on a large scale, at least the short term. The reasons are many, but chief among them are that current pr margins in agriculture are small, current economic and social systems do not prom them, and the world's population is growing and needs feeding. Even if the pub policy, economic institutions, social values, and world population issues are all dressed satisfactorily, there are still production restraints to the mixed systems. Fr a biological perspective, the problem with small, mixed systems is that they lose th efficiency. Generally, they are not able to produce their multiple crops and livest with the same efficiency as larger, specialized operations can. This is true of b

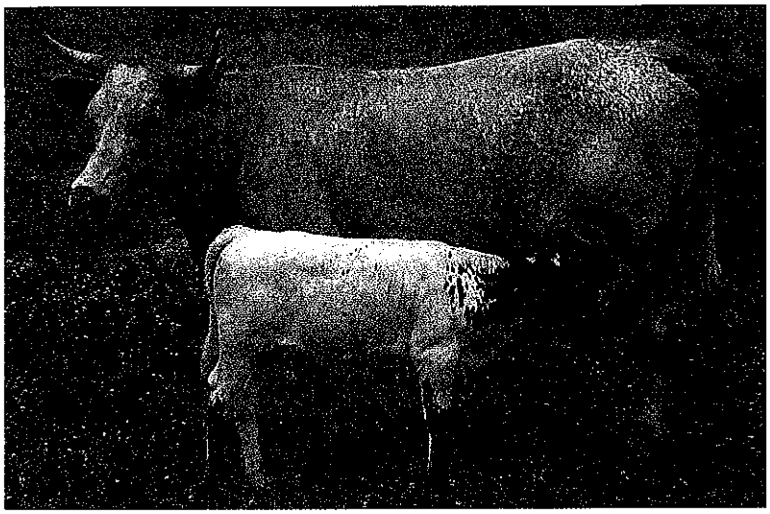

Figure 29–10
Breeds like the Pineywoods cattle (pictured) are rapidly disappearing. Such breeds are often adapted to harsh conditions and are tolerant of parasites and infectious diseases. Large vertically integrated operations, with their emphasis on consistency in product and standardized production conditions, use high-production breeds that require high inputs, skilled management, and controlled environments. Worldwide, multiple livestock breeds become irretrievably lost each month.

agronomic enterprises and animal enterprises. They lose the ability to incorporate the latest technologies, equipment, and techniques into their operations. Farmers and managers of mixed systems are required to stay abreast of rapidly changing information about a wide variety of crops, which is a difficult feat. Thus a more realistic view holds that, for some producers, systems must be viewed from the much larger picture of area, regional, and overall national sustainability rather than as a return to single, diversified, mixed-production units. There are practices that even monoculture production can put into place that are more sustainable than other practices. Although this type of approach will most assuredly not satisfy the purists, it is a positive and realistic approach with a good deal of potential. Areas of concern and needs for creating more sustainable total agriculture using animals include the following:

1. Concentrated livestock systems also concentrate wastes. Recycling these wastes into animal feed, fertilizer, or some other use that provides biological benefit and revenue neutrality is a pressing need (Figure 29–11).
2. Using grazing animals properly as part of agronomic systems increases soil quality, reduces erosion, reduces water runoff, and thus benefits water table levels and water quality. Current agronomic, monoculture practice could benefit from the integration of grazing animals with crops. Use of cover crops with row crops in minimum- or no-tillage systems is gaining in popularity. Using animals

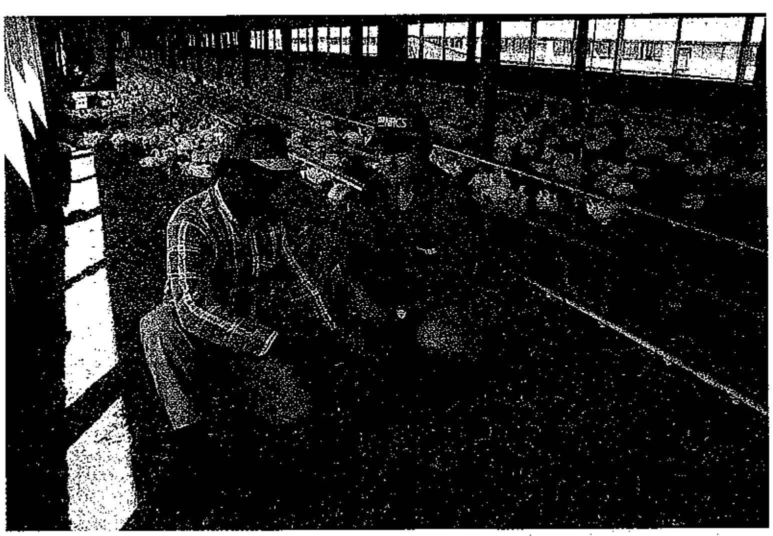

Figure 29–11
To minimize the negative environmental effects of confinement animal feeding operations and create more sustainable agricultural systems, it is clear that the wastes from the animals must be handled correctly. Here, a district conservationist discusses the benefits of composting chicken manure. (Photographer Bob Nichols. Courtesy of USDA.)

as tools to manage the cover crop and/or crop residues is a logical additior to these systems. Using animals to help recycle soil nutrients in this way wa: once common practice. Often residues are now burned as a means of removal Contractual relationships between livestock owners and crop producers fo: grazing services seem a logical solution.

3. Intensive grazing of forage resources coupled with substantial rest between graz ing cycles has been shown to increase total short-term productivity of the forag by harvesting it at its optimal nutritive value, as well as long-term productiv ity by improving soil and other environmental features of the grazing system These practices can be carried out on higher-quality land to produce milk or o lower producing range or marginal croplands for beef, sheep, or goats. Intensiv grazing systems have spread all across the country in a variety of environment Further education and promotion and subsequent practice of these technique would improve the sustainability of grazing lands as well as their productivity.
4. Recombinant DNA technology and other biotechnological applications hol great promise for sustainable practices. There seems to be a thread that rur through some otherwise reasonable sustainable agriculture writings that ha an "all-natural" overtone that flies in the face of reason. The goal is sustair able agriculture systems, not "all-natural" ones. This mind-set is dangerou to the overall development of sustainable systems when it causes the exclu sion of some of the incredible advancements that this area of inquiry ha brought and will continue to bring. Crops that need no insecticides or he bicides, cereal grains that can fix nitrogen like legumes, tender beef finishe on grass, animals born with a lifetime immunity to disease—all of these an countless more opportunities await the promise of biotechnology. As the: tools become available, their use may prove to be the best means of achievir sustainability.

A factor that must be again mentioned is that monoculture reduces tl biodiversity of a farm. A crop failure is more difficult to overcome on a farm th has only one crop than it is on a farm that has multiple crops and animal produc to market.

Another factor that deserves to be visited again relates to the inefficie cies of many sustainable systems compared to large monoculture systems. Ho would they compare today if there had been a greater investment in research agroecological farming systems? Most agricultural research in the United Stat in the last half century has been directed at making industrial-type agricultu more efficient. The sustainable agriculturist view is that food security is be achieved when there are many participants. This is at every level of productio marketing, processing, and retailing. Sustainable agriculturists further argue tl the use of genetic engineering to produce food must consider ethical, spiritu and societal issues. The conduct of industry may ultimately be the determini factor in whether genetically modified organisms (GMOs) will become mo acceptable.

A final point relates to the applications of biotechnology to sustainable syster Often, GMOs are patented by the companies that developed them. This puts t power of distribution and costs in the hands of a few decision makers. Thus the arg ment that can be put forth is that the issue is not about the GMOs themselves b about who controls them and, by extension, who controls agriculture. Because th same companies also often have tremendous control over traditional breeding p grams for plants and animals, one has to be concerned that traditional animal a plant breeding programs will be neglected in favor of producing more GMOs. Th is still a need for both.

SOURCES OF INFORMATION

Many elements of understanding are needed to comprehend sustainable agriculture completely and how animals work to enhance sustainability. It is outside the scope of this text to present a complete picture of this complex issue. Read the articles listed in the Reference section and seek information from the following sources to get a larger understanding.

Alternative Farming Systems Information Center

http://afsic.nal.usda.gov/nal_display/index.php?info_center=2&tax_level=1&tax_subject=285

Kerr Center for Sustainable Agriculture, Inc.

http://www.kerrcenter.com

National Sustainable Agriculture Information Service

http://www.attra.ncat.org/ Sustainable Agriculture Library
http://www.floridaplants.com/sustainable.htm

Sustainable Agriculture Library

http://www.floridaplants.com/sustainable.htm

University of California Sustainable Agriculture Research and Education Program

http://www.sarep.ucdavis.edu./

SUMMARY AND CONCLUSION

Sustainable agriculture is typical of a new set of concerns and considerations that agriculture is seeking to come to grips with. It is not just about efficient production of food and fiber. There are also ethical, social, philosophical, and lifestyle choices. In fact, these issues are at its core. Consider this passage from Feenstra et al. (1998): "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, (necessarily) nourish the environment, the community and the individual." There is a strong element of personal satisfaction with one's lifestyle and one's own place within the greater scheme of things that forms a common thread within the sustainable agriculture movement. Baker et al. (1990) pointed out how animals fit into this scheme: "Livestock . . . increase the family's pride in their farm and their satisfaction with farm life. Many people find it easy to identify with animals and enjoy being producers and caretakers of livestock. The relationship with animals often brings farm operators in closer association with the biology of farming and with nature." Indeed one of the elements of the definition of sustainable agriculture given in the 1990 Farm Bill is that it will "enhance the quality of life for farmers and society as a whole."

The lifestyle element of sustainable agriculture is something well known to those whose roots are in agriculture. Family farmers of yesteryear in the United States had a satisfaction with what they did and how they did it. Their lifestyle sustained them. Although it is easy to say they lived in simpler times, fairness leads us to concede that they had their share of adversity and issues to deal with. The "good old days" have a tendency to look much better than they actually were to those who lived the life. Every generation defines the elements it holds as important. Every generation defines its own lifestyle and thus defines for itself what will enhance that lifestyle. Those who wish to practice sustainable or more sustainable agriculture in this and future generations will do the same thing. It must be a conscious decision. However, the practice of sustainable agriculture affects many more people than just those who produce the food. Thus decisions must be made by many different stakeholders, including farmers, farm workers, and farm advisers, and also researchers, suppliers, union members, processors, retailers, consumers, and policymakers. In short, all members of society must make these decisions. Achieving sustainability will mean changing laws and public policies, redirecting economic goals, rethinking government's approach to agriculture, and changing the values of millions of people. It is naive to think this will be an easy job. To paraphrase Feenstra et al. (1998), making the transition to su tainable agriculture is a process requiring a series (small, realistic steps. Family economics and person goals influence how fast or how far participants ca go in the transition, but each small decision can mal a difference. The key to moving forward is the will take the next step. Visit Box 29–2 to discover 72 wa to make agriculture more sustainable.

BOX 29–2

72 WAYS TO MAKE AGRICULTURE SUSTAINABLE

Conserve and Create Healthy Soil

- Stop soil erosion by terracing, strip cropping, and repairing gullies
- Add organic matter to soil (with "green manure," cover crops, compost, manures, crop residues, and organic fertilizers)
- Practice conservation tillage
- Plant wind breaks
- Rotate cash crops with hay, pasture, or cover crops

Conserve Water and Protect Its Quality

- Stop soil erosion in field and pasture
- Reduce use of chemicals
- Establish conservation buffer areas
- Grow crops adapted to rainfall received
- Use efficient irrigation methods

Manage Organic Wastes So They Don't Pollute

- Test soil and apply manures and litters only when needed
- Compost dead birds and litters
- Store litter piles out of the rain and snow
- Raise pastured or free-range poultry
- Raise hogs in hoop houses or free range

Manage Farm Chemicals and Trash So They Don't Pollute

- Look for alternatives to chemicals
- Use the least amount necessary
- Buy the least toxic chemicals
- Recycle
- Dispose according to label instructions

Manage Weeds with Minimal Environmental Impact

- Mechanical Approaches
- Mowing
- Flaming
- Flooding
- Tillage
- Controlled burning
- Cultural Approaches
- Crop rotation
- Smother crops
- Cover crops
- Allelopathic plants
- Close spacing of plants
- Biological Approaches
- Multispecies grazing
- Rotational grazing
- Chemical Approaches
- Integrated pest management
- Use of narrow spectrum, least-toxic herbicides
- Properly calibrated sprayers
- Application methods that minimize amount used, drift, and farmer contact

Manage Insects and Diseases with Minimal Environmental Impact

- Introduce or enhance existing populations of natural predators, pathogens, sterile insects, and other biological control agents
- Use traps
- Maintain wild areas or areas planted with species attractive to beneficial insects
- Selective insecticides or botanical insecticides that are less toxic
- Trap crops
- Rotate crops (avoid monoculture)
- Practice intercropping, strip cropping
- Maintain healthy soil (prevents soil-based diseases)
- Keep plants from becoming stressed

Select Plants and Animals Adapted to the Environment

- Grow crops and crop varieties well suited to the specific climate
- Match crops to the soil
- Experiment with older, open pollinated varieties that do well without chemical inputs
- Raise hardy breeds of livestock adapted to climate
- Raise livestock that gain well on grass and native forages

Encourage Biodiversity of Domesticated Animals, Crops, Wildlife, Native Plants, and Microbic and Aquatic Life

- Diversify crops and livestock raised

- Leave habitat (field margins, unmowed strips, pond and stream borders, and so on) for wildlife
- Maintain the health of streams and ponds
- Provide wildlife corridors
- Rotate ro w crops with hay crops

Conserve Energy Resources

- Reduce number of tillage operations
- Cut use of chemical fertilizers
- Develop production methods that reduce horsepower needs
- Recycle used oil
- Use solar-powered fences and machines
- Use renewable, farm-produced fuels: ethanol, methanol, fuel oils from oil seed crops, methane from manures and crop wastes

Increase Profitability and Reduce Risk

- Diversify crops and livestock
- Substitute management for off-farm resources
- Maximize the use of on-farm resources
- Work with, not against, natural cycles
- Keep machinery, equipment, and building costs down
- Add value to crops and livestock
- Try direct marketing (subscription farming, farmers' market, farm stores, mail order)

Source: Adapted from Horne and McDermott, 2000. Used with permission.

STUDY QUESTIONS

1. Write a short paragraph defining organic farming. Then do the same for sustainable agriculture. What is the primary difference in your definitions?
2. What are the "issues" and "questions" mentioned by Gold (1994) relative to sustainable agriculture?
3. Make a table like the one shown here:

Farming Practices	Resource Conserving	Socially Supportive	Commercially Competitive	Environmentally Sound
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

Under farming practices, list 10 common farming practices. Analyze each practice to determine how it fits under the remaining four headings, and answer simply *yes* or *no*.

4. Make a list of resources for which animals are the most sustainable use.
5. Describe some sustainable practices that are part of, or could be part of, modern agricultural systems.
6. Describe the systems philosophy necessary for an understanding of a sustainable agriculture.
7. What are the big-picture reasons for having animals as part of sustainable systems?
8. Describe what site specificity means with regard to sustainable agriculture.
9. Describe ways to integrate both animals and plants into a diversified farm site.
10. Why does efficiency play such a role in whether or not specific plants and animals are useful in a sustainable farm?
11. What is agroforestry?
12. Why is it likely that U.S. agriculture will continue to contain monoculture of plants and animals as part of an overall sustainable agriculture, at least in the near future?
13. How does the lifestyle element factor into sustainable agriculture philosophy and practice?
14. How many ways can you name to make agriculture more sustainable?

REFERENCES

Beginning with the second edition and each thereafter, Dr. James Horne, president of the Kerr Center for Sustainable Agriculture, Inc., Poteau, Oklahoma, has reviewed and contributed new material to the chapter. The author gratefully acknowledges these contributions.

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Baldwin, R. L., K. C. Donovan, and J. L. Beckett. 1992. An update on returns on human edible