DEFINING AND IMPLEMENTING SUSTAINABLE AGRICULTURE

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ABSTRACT

This report gives an overview of sustainable agriculture. It compares various definitions and dispels some myths. Issues related to implementing sustainable agriculture are discussed. A list of institutions (mainly in Kansas) that support sustainable agriculture is provided.

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INTRODUCTION

Until World War II, increases in agricultural production throughout the world, including North America, primarily involved bringing more land into cultivation. However, during the last 50 years, the rate at which new land has been brought into cultivation has declined sharply. New cropland worldwide expanded at only 0.3% per year in the 1970s compared with a rate of 1% in the 1950s [Hanrahan et al, 1984]. Future increases in agricultural production will have to come primarily from increasing output per unit of land rather than increasing the area cultivated. Remarkable increases in agricultural productivity have occurred in many parts of the world, including North America, during the last two to three decades. However, concerns are increasing as to whether these gains can be maintained in a sustainable manner.

A major reason for these concerns is the increasing energy cost per bushel of crop produced (including energy to make the chemicals and machinery) in the face of declining fossil energy reserves, meaning that the output/input energy ratios are becoming progressively less favorable. Conventional modern farming has had a steadily declining output/input ratio since the 1940's, going from 3.0 to less than 1.8 by 1980 [Gever et al, 1987]. Thus, land-use strategies using concentrated, finite, energy inputs will not be sustainable in the long run. In light of such concerns, the critical issue is whether agricultural production per acre and per kilocalorie (a measure of energy use) can be increased simultaneously.

The objectives of this short report are to define what is meant by sustainable agriculture and to discuss a few issues relating to the complexities of implementing and monitoring its progress. A brief description of some of the major organizations currently addressing issues relating to sustainable agriculture in Kansas also is provided. First, however, we consider why discussions concerning sustainable agriculture often raise strong feelings.

COMMON IMPRESSIONS ABOUT SUSTAINABLE AGRICULTURE

Discussions about sustainable agriculture are apt to be lively, emotional, and sometimes controversial. Those who have sustainable agriculture as a stated goal sometimes feel that those who don't mention it directly are not concerned about it. At the same time, those who don't mention it directly often claim they have it as an assumed goal or feel that short-run economic necessity prevents giving it the attention it deserves. Indeed, a commonly held view has been that increasing the productivity of agriculture was compatible and largely synonymous with sustainable agriculture. However, there is mounting evidence that one of the major ways of increasing farm production, through use of chemicals on-farm, can accelerate ecological problems. Unfortunately, many researchers still do not openly concern themselves much with sustainability issues and have the common attitude that "everything we do is sustainable." Many advocates of sustainable agriculture would not agree and argue that success in moving toward sustainable agriculture depends on using the limited nonrenewable resources (e.g., fossil energy fuels, certain chemicals) as sparingly as possible and getting maximum return from their application by using the biological cycles that exist in nature and are largely ignored in present-day agriculture.

The following impressions have contributed to a lack of support for sustainable agriculture.

1. It is similar to the type of agriculture that was practiced in the early 1900's and involved purchasing few inputs and marketing little of the product(s) produced. Such agricultural systems were found commonly where abundant agricultural land was available. Good examples are the crop rotations practiced by the early pioneers in various parts of the United States. Another example is the shifting cultivation system (i.e., letting land lie fallow for 10 to 15 years to regenerate fertility) in many parts of Africa. However, increasing population pressures are reducing the potential for extended fallowing of land, which was the major principle underlying the system, thereby making the system increasingly unsustainable.

2. Farmers value their freedom of action, and the recent interest in sustainable agriculture by governmental agencies has been viewed negatively rather than positively by some. Major governmental thrust in this direction has been understood, perhaps unjustifiably, as involving restrictions on farm practices rather than incentives and/or voluntary compliance. Fortunately, some of the

provisions in the 1996 Farm Bill [U.S. Government, 1996] appear to be moving toward softening this philosophy.

3. Until very recently, those directly associated with sustainable agriculture were viewed as hippies who were out of touch with so-called modern/progressive agriculture. The history of such attitudes goes back to the 1970s when the alternative agriculture movement, which often was used interchangeably with sustainable agriculture, started emerging. Fortunately, this attitude of "them" and "us" has broken down to some extent in recent years.

Although aspects of these impressions may still exist among some people, they are no longer major barriers to constructive dialogue on sustainable agriculture. Most people now recognize the need to be directly concerned about the sustainability of agriculture, although opinions differ on how it could or should be achieved. Thus, another issue is agreeing on a definition.

DEFINING SUSTAINABLE AGRICULTURE

Many definitions of sustainable agriculture have been proposed, but one of the first to be adopted in the US was published by the American Society of Agronomy [1989, pg 15]:

"A sustainable agriculture is one that, over the long term, enhances environmental quality and the resource base on which agriculture depends; provides for basic human food and fiber needs; is economically viable; and enhances the quality of life for farmers and society as a whole."

In the following year, the United States Congress also defined sustainable agriculture in the 1990 Farm Bill [US Government, 1990]. Under that law, the term sustainable agriculture means an integrated system of plant and animal production practices having a site-specific application that over the long term will:

- 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.
- Enhance the quality of life for farmers and society as a whole.

Thus, the official, or legal, definition has five parts, emphasizing productivity, environmental quality, efficient use of nonrenewable resources, economic viability, and quality of life. Under this definition, a farm that emphasizes short-run profit, but sacrifices environmental quality, would not be sustainable in the long run. From the

other end, pursuing environmental quality without ensuring viability of short-run returns also would be unsustainable. A farm that is very productive but uses large quantities of a nonrenewable resource, such as fossil fuel or a non-rechargeable aquifer, to achieve and maintain that productivity would not be considered sustainable in the long run.

In 1996, focus group discussions were held with some Kansas farmers who are practicing sustainable agriculture [Norman et al, 1997]. For them, agricultural sustainability consists of three components: ecological, economic, and social/institutional (quality of life). In order to achieve these, they recognized three important "processes": full use of the natural biological cycles, reducing as much as possible the use of purchased inputs, and reducing the frantic work schedules of many farm families. Thus, their perception of sustainable agriculture is similar to the more formal definitions mentioned earlier.

COMPARISON OF SUSTAINABILITY WITH OTHER TERMS

Other terms sometimes have been associated with sustainable agriculture. To avoid possible confusion, some similarities and differences are discussed.

Some people believe that the terms *organic* and sustainable are the same. In fact, the word organic refers to particular farming practices that have been followed and certified by a third-party inspector. This organic certification is found on the product in the marketplace, indicating to consumers that it has been grown in a specific way. Briefly, organic guidelines have been written in an attempt to be as sustainable as possible (using the definitions above), while assuring the consumer that the amount of pesticide residue on the food product is minimized. Organic guidelines require that a crop rotation and soil-building practices be used; that pest control rely primarily on cultural, mechanical, and biological controls; and that pesticides used as a last resort are from plants and are short-lived in the environment. Soil amendments should come from renewable resources as much as possible and only nonrefined mined products used, when manure, composts, or other sources of nutrients are not available.

The term *low input* also has been associated with sustainable and, in fact, the first USDA funding for sustainable agriculture research in the 1985 Farm Bill [United States Congress, 1985] used the acronym LISA for ‘low input sustainable agriculture’. The term LISA was somewhat misleading and indeed unfortunate. For some it implied that farmers should starve their crops, let the weeds choke them out, and let insects clean up what was left. In fact, the term low-input referred to purchasing fewer off-farm inputs (usually fertilizers and pesticides), while increasing on-farm inputs (i.e., manures, cover crops, and especially management). Thus, a more accurate term would be *different input* or *low external input* rather than low-input.

In Europe (e.g., the Netherlands), the term *biological* often refers to *organic* farming, whereas the term *ecological* refers to organic plus environmental considerations such

as on-farm wildlife management (i.e., the relationships between parts of the agroecosystem). The term *integrated* is used both in the US and in Europe, generally to refer to a system of *integrated pest (or crop) management*, which can demonstrate some aspects of sustainable agriculture but may or may not fit the other parts of the sustainability definitions given above.

MYTHS ABOUT SUSTAINABLE AGRICULTURE

As indicated earlier, even today, sustainable agriculture sometimes gets bad press. Sometimes this is due to impressions based on what we term myths or misconceptions about sustainable agriculture. Three commonly held myths are the following:

Myth 1*: Sustainable agriculture means going back to what our grandparents did or involves rejecting appropriate technology.* In fact, sustainable agriculture seeks to combine some of the wisdom of past practices, like crop rotation and green manure crops, with careful use of current technology, including equipment that leaves residue on the surface, modern pest-resistant crop varieties, and the vast array of information technologies now available

Myth 2: *Adoption of sustainable agriculture will inevitably involve losing money.* Studies from both a real-life case study approach and from economic "what if" type models have documented that sustainable agriculture can be as profitable in the short run as conventional or less sustainable alternatives. For examples of these, see Hanson et al [1990], Diebel et al [1993], Smolik et al [1993], Dobbs et al [1988], and Helmers et al [1986].

The question then arises as to why practices consistent with sustainable agriculture are not adopted more widely. One reason has been that many production questions about sustainable agriculture are unanswered, partly because of continuing low levels of research funding available for directly addressing sustainable agriculture issues. Other factors that limit acceptance have included the base acres requirement in the pre-1996 Farm Bills and the amount of learning required for nonchemical pest control and biological changes that occur when one begins using manures and legumes on soil that has had no recent, significant, organic amendment.

Economic survival during the transition period is crucial. Obvious biases (e.g., the pre-1996 Farm Bills) and hidden biases (e.g., market prices not reflecting short-run changes in the quality and quantity of natural resources) in the current economic system often have made conventional agriculture more profitable for individual producers. This has been supported by the development of economies of scale that encourage specialization and, hence, larger farms characteristic of conventional agriculture. The economic pressures encouraging the development of larger farms, according to Smith [1992], have resulted from producers losing control of the input (i.e., increasing purchase of inputs from off the farm) and processing/marketing of the product. Thus, it

is not surprising to find sustainable agriculture practitioners establishing greater control of aspects of production and marketing (e.g., reducing levels of purchased inputs and collaborating to develop niche markets for their products). Certainly, the economies of scale associated with specialization (resulting in short-term financial advantages) mean greater challenges for large farms to adopt sustainable agricultural practices. Also, the adoption of sustainable agriculture practices is viewed by practitioners as fairly management intensive [Norman et al., 1997]. As Dan Nagengast, Executive Director of the Kansas Rural Center, has observed: "though farming sustainably can be less expensive, and more profitable, it will require intensive management, which is another way of saying, it requires an engaged mind."

Myth 3: *Sustainable agriculture increases soil erosion because of greater use of tillage.* Sustainable agriculture practitioners must meet conservation compliance guidelines but can emphasize some methods of soil conservation over others. For example, cropping under no-till systems generally does not work well for organic agriculture farmers, because of the inability to reduce herbicide use. On the other hand, a tillage rotation system, where no-till can be alternated with reduced-till and conventional-till practices, is feasible. Another alternative is ridge tillage, which potentially can reduce both tillage and chemical use. Sustainable agriculture practices also involve having a higher percentage of crop land protected with a living cover crop during winter months, as well as some rotation with perennial crops, sods, or alfalfa that help hold the soil and improve the water infiltration rate, thus reducing run-off when the field is put back into an annual crop. Row crops can be cultivated for weed control, but rapid canopy closure and overseeding with fall cover crops help reduce erosion potential during the rest of the cropping season.

COMPLEXITY OF IMPLEMENTING SUSTAINABLE AGRICULTURE

Although ultimately the decision as to whether or not to practice sustainable agriculture is the made by the farmers and their families, the ease and practicality of doing so are affected heavily by a number of factors, some of which they can influence, but some of which are completely out of their control. Generally, progress made toward sustainable agriculture is determined by what happens at five different levels: international, national, community, farm, and field. Another level is involved that cannot be fitted easily into the above classification. This is the watershed level, which may be at the field, farm, or community level or some combination of the three.

Thus, agricultural sustainability not only is a difficult concept to define but also is difficult to implement and monitor/measure. This complexity is illustrated in Table 1 by showing the expected interactions among the three components of sustainability and the five levels of influence. Although sustainability tends to be locational or site specific (at the field, farm, and community levels), it is very much influenced by:

Table 1: Interacting Components of Sustainability[a]

Levels Influencing Sustainability	Components of Sustainability		
	Ecological	**Economic**	**Social/Institutional**
International	Secondary	Secondary	Secondary
National	Secondary	Secondary	Primary
Community	Secondary	Primary	Primary
Farm	Primary	Primary	Primary
Field	Primary	Secondary	Secondary

a. The 'primary' cells represent where the component of sustainability is mainly expressed, and the 'secondary' cells represent other factors that can influence sustainability.

1. *What happens at the higher levels.* National policies such as in the 1996 Farm Bill will have a great influence on ecological and economic sustainability at the field/farm levels. Other policies at that level related to social/institutional issues also can have major effects on the viability/welfare of communities and, hence, on quality of life. International markets and influences (particularly in smaller countries) are increasingly affecting what happens at the lower levels. Such influences tend to be relatively greater in countries that are poor (low income) and/or where agricultural production is influenced heavily by the export market. Thus, it is necessary to understand the interaction between these levels, because "each level finds its explanations of mechanism in the levels below, and its significance in the levels above" [Bartholomew, 1964; Hall and Day, 1977].

2. *Interactions among the sustainability components.* In the focus group discussions referred to above, some of the farmers indicated that those who were in conventional agriculture were often on an economic treadmill (e.g., having to raise enough money to service debts) and hence had little time to consider ecological sustainability issues. They also had to make compromises concerning quality of life because of having to work very long hours. In fact, the prevailing attitude among the farmers was that all three components of sustainability (environmental, economic, and social) had to be pursued at the same time, if progress was to be achieved [Norman et al, 1997]. A more extreme example of the potentially negative interactions among the components of sustainability occurs in many low income countries, where a close link has been established between poverty and ecological degradation. In parts of West Africa, for example, population pressures and low incomes are forcing farmers to cultivate

land that is not suitable for agriculture. They are aware of the problems of doing this, but the short-run economic needs of survival are forcing them to sacrifice long-run ecological sustainability. In such a situation, ensuring ecological sustainability without solving the problems of poverty and population pressure on the land is impossible [World Bank, 1992].

ISSUES RELATING TO IMPLEMENTING SUSTAINABLE AGRICULTURE

Given the complexity of sustainable agriculture in terms of both definitions and interactions, it is not easy for farmers to implement and monitor or measure it. A lot of time and space could be spent expanding on these points, but three major issues can summarize much of our thinking relating to implementing sustainable agriculture.

1. The work required to ensure agricultural sustainability, although influenced to some extent by outside forces, is mainly field or farm specific (see Table 1). This implies heavy dependence on decision-making by farmers and their families, which has led those promoting sustainable agriculture to advocate *whole farm planning (WFP).* Farmers and their families go beyond looking at only the economics of their farm "business" and include issues relating to ecological sustainability and quality of life in their planning process [Savory, 1988]. This, in turn, requires much more of a systems perspective in asking the correct questions rather than relying on obtaining recipe-type solutions. Such solutions are most applicable in response to narrowly defined technical and economic problems that occur in conventional systems, where the farm tends to be viewed as a business for ensuring short-run economic gain. A shift to whole farm planning in the approach to farming and life is a major challenge that takes time and energy and often involves questioning conventional wisdom and the status quo. This shift also implies the need for greater empowerment of farmers and their families (and hence their communities), something that is increasingly novel with our current economic system and society!

2. The multifaceted nature of sustainable agriculture, with three interdependent and interactive components, makes measuring and monitoring it extremely difficult. Not surprisingly, a number of indicators are currently emerging that measure the different components. However, at least three major challenges remain.

- The measures currently available generally fall short in terms of assessing the interactions and interdependencies among the three components and the trade-offs of pursuing one component at the expense of another.

- Many of the measures or indicators currently available are not particularly useful to farmers or are too time-consuming to measure in their day-to-day work, making it difficult for them and their families to monitor progress in terms of

agricultural sustainability. This is particularly regrettable because many of the issues relating to sustainable agriculture are location or situation specific.

- Most indicators show progress or no progress towards specific components of sustainability, but they fall short in terms of helping to determine cause/effect relationships to help assess current problems and provide ideas on what needs to be done to ensure continued progress towards sustainability. An additional complication is that some strategies relating to sustainable agriculture require 5 to 10 years (e.g., a full crop rotation) of implementation before they result in visible or measurable signs of payoff.

Before leaving the discussion of indicators, we wish to stress one further point. Sustainable agriculture is a dynamic rather than static concept. What may contribute towards sustainability today may not work as the system changes, thus requiring a high level of observation and skills that can adapt to change. Consequently, sustainability is a direction/process and does not by itself result in a final fixed product [Cox et al, 1997], making it even more difficult to monitor and/or measure.

3. The current, conventional, economic system places a great deal of reliance on prices to send the correct signals as far as society is concerned. Sometimes curbs are put in place to modify such prices. However, these generally have not favored or advanced the cause of sustainable agriculture, as defined above. Concerns about how money and market prices send the right signals, in relation to sustainable agriculture, are the following:

- Wealth and the related issue of happiness as viewed in sustainable agriculture consist of more than money, which is the sole measure in conventional economic systems. Therefore, using money as a yardstick or evaluation criterion for sustainable agriculture has deficiencies. For example, it does not ensure ecological sustainability (part of the wealth of future generations), community sustainability, or a certain quality of life (which consists of more than buying happiness).

- Market prices are concerned only with the product that enters the marketplace, whereas quality of life involves more than what can be expressed in the marketplace. The market does not always handle interdependencies very well. For example, cheaper mechanical equipment displaces locally hired labor and reduces community sustainability. Another example of the failure of the market system to address interdependencies relates to nonfarm problems that emerge as a result of a farming practice (e.g., farmers using excessive chemicals to help increase their own short-run production/income and polluting water accessed by others). Also, the market often excessively discounts the future, either implicitly or explicitly (through specific governmental policies).

Therefore, gross or net income is not necessarily a good indicator of "success," and costs do not necessarily reflect the "cheapest" way of producing products, especially in

the long run when non-renewable resources are being used and/or the land is being "mined" (degraded) to produce current profits.

Another way of viewing the above discussion is in terms of three types of "capital" [Flora, 1997; Francis et al, 1997]. Financial or economic capital is reflected in the marketplace. However, the marketplace often does a poor job of reflecting the other two types of capital: natural or ecological and social. Natural or ecological capital includes measures of agroecosystem biodiversity, soil and water quality, and energy source. Social capital includes such things as accumulation of skills, training, education, social connectedness, sharing, and population stability. Currently, the primary "feedback" in determining agroecosystem input use is market force or economics. In an ideal world, the other two sources of capital also would have effective feedbacks in influencing such input decisions [Lanyon, 1997].

Therefore, advocates of sustainable agriculture can argue that the current excessive use of nonrenewable resources (because they are very cheap) that will not be available for future generations inhibits the attainment of sustainability. Sustainable agriculture means less emphasis on extractive methods (and the use of nonrenewable resources) and greater reliance on renewable methods and enhancing the resource base for future generations (that is, exploiting useful biological cycles, thereby saving dollars on externally purchased inputs). This goes against the conventional move towards specialization and economies of scale, which is encouraged by the current economic/pricing system. Sustainable agriculture can survive in the current economic climate by working with nature’s biological cycles (usually through diversification); reducing expenditure for purchased inputs, relying on what Savory [1988] calls solar dollars (income generated through human creativity, labor, and constant sources of energy, especially the sun); and finding niche markets for the products produced. However, given the overwhelming power/influence of the prevailing economic system, popular acceptance of sustainable agriculture in its widest sense will require governmental policies that support farmers not only in the transition to sustainability but in maintaining that commitment once it has been attained. This does not necessarily mean subsidizing of farmers per se but rather implementation of policies that are important to ensuring the vitality and viability of society (i.e., families and communities) today and in the future.

CONCLUDING REMARKS

This is the first report in a series devoted to issues relating to sustainable agriculture particularly for the people of Kansas. Therefore, it includes a brief discussion on institutions emphasizing sustainable agriculture in the state.

In this short report, we have stated how sustainable agriculture is defined and viewed at the present time. We also have discussed some issues relating to its implementation. By clarifying these issues, we wish to promote future discussion of how we, as a society, choose to use our scarce natural resources in the production of food now and in the future.

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