THE COMPONENTS OF SUSTAINABLE AGRICULTURE

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Sustainable agriculture has become a rallying phrase for many concerned about agricultural profitability and environmental quality in the rural sector. Advocates of sustainable agriculture seem to be convinced that the policies and structure of the agricultural industry are responsible for increasing environmental problems, low farm profitability, declining farm numbers, and reduced quality of life in rural America. The agricultural popular press has published numerous stories about those concerned with these issues and success stories of how farmers have stopped using chemical inputs to increase farm profits and environmental quality. Sustainable agriculture has also received considerable attention from both public and private research agencies. A federal program, administered through the USDA, labeled Low Input Sustainable Agriculture (LISA) has made $8 million over two years available for research and demonstration projects. In Wisconsin, oil over-charge monies were used to fund a state Sustainable Agriculture program, while in Iowa fertilizer and chemical check-off dollars have been used to fund the Aldo Leopold Center for Sustainable Agriculture. In addition, many foundations and private research agencies committed to environmental quality have provided millions of dollars for research and demonstration projects.

What is sustainable agriculture? Can it be defined? Why has sustainable agriculture received so much attention? What is different about sustainable and profitable agriculture? Is it a resurgence of practices discarded decades ago? Is it a radical, or only a subtle, departure from the current cultural practices and policies of the agricultural industry? Does the use of a particular set of practices make a farm sustainable? Are public institutions doing enough research and education in sustainable agriculture? Or, are public institutions already doing considerable work in the area under another name?

Answers to these questions are not easy to find. In fact, there are strong and often opposed philosophical viewpoints being drawn upon to address these questions. Whatever one's philosophical feelings about agriculture, the underlying issues are certain to become increasingly important to all in agriculture.

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Why Has Defining Sustainable Agriculture Been So Difficult?

The concept of sustainable agriculture embodies several disciplines. Environmentalists may use the term with respect to the protection and/or renewal of agricultural natural resources. Organic farmers and consumers of their products may use the term to imply food stuffs produced without traditional agricultural chemical inputs (pesticides and chemical fertilizers). Family farm advocates see sustainability as production or marketing methods and agricultural policies to preserve an agriculture industry based on single family operations. Each of these groups represents an important component of sustainable agriculture. This somewhat heterogeneous group of individuals and ideas has made defining the term sustainable agriculture difficult. The use of other terms (regenerative, low-input, alternative, renewable, organic) synonymously for sustainable illustrates the existing confusion.

People identified or associated with sustainable agriculture probably represent a relatively small proportion of farmers and consumers, yet they have received much public attention. This attention is likely due to both the people involved and, more importantly, to the underlying issues involved. While these components and issues often represent concerns important to those advocating sustainable agriculture, many of these concerns are an intensified expression of the same issues important to all of agriculture.

The Components

The components of sustainable agriculture include environmental resource protection; product quality, profitability of individual farms; policy questions related to the competitiveness of medium sized, family farms; and the viability of rural communities. The perceived problems associated with these components and their solutions may, in some cases, be contradictory. To understand and resolve these contradictions, we must examine each component, define the potential conflicts between the components, and evaluate the trade-offs associated with sustainable agriculture.

Environmental Protection:

The primary basis for and continuing main emphasis of sustainability is the over-riding concern for at least minimum natural resource protection, and ideally towards resource renewal. For some, concerns exist that the agribusiness industry, may be more motivated by sales volume and margins than by actions which favor resource protection.

Current environmental quality issues include maintaining or renewing the soil base by limiting or eliminating soil erosion, proper nutrient use or nutrient depletion, and reducing groundwater contamination from both pesticide and soluble nutrients. Sustainable agriculture advocates argue that recycling available on-

farm resources such as manure or inclusion of legumes in the rotation, use of green manure for soil and nutrient conservation, and use of mechanical or biological pest controls are all viable management choices which would potentially enhance the farm's profitability and the environment. These arguments have considerable merit in some farming situations such as on dairy farms and may have limited applicability on others. However, the returns from all crops in the rotation and the additional costs, if any, of substituting inputs need to be considered in a profitability analysis.

In these authors' opinion, it is this environmentally driven skepticism of current agricultural production practices which is the central theme of the sustainable agriculture movement. However, other components exist as well.

Profitability:

Throughout the mid-1980s, agriculture has been under severe economic pressure. Cutting inputs in order to lower the unit cost of production was one method used to improve profits. This method works as long as the reduction in costs does not result in a larger decrease in income. Cutting purchased inputs, fertilizer as an example, and substituting an under-utilized resource such as manure will improve profitability if (a) an equal amount of nutrients are made available and (b) the application cost of manure is less than the fertilizer cost.

The intensive use of chemicals and fertilizers in the production of many agricultural commodities has increased production and, arguably, profits when implemented during times when demand increased at a rate high enough to "absorb" the increased production. In many instances, use of these practices was largely based on improved efficiency for an individual, and therefore the opportunity to generate more income for that family unit. However, the side-effects, or externalities, associated with these cultural practices have resulted in increased attention in terms of not only the effect on profitability but also the associated environmental consequences. Furthermore, demand for the products being grown may not be increasing sufficiently to absorb the increased production resulting from technological advances. As a result, increased chemical and fertilizer use along with increased intensive crop farming practices have led to proposed institutional regulations and policies designed to control or eliminate certain practices and even limit production.

This is not to say that the industry has ignored these concerns. Technologies have been developed that enhance profits and protect resources. Conservation tillage and integrated pest management systems and the development of genetically engineered plant materials are examples of technological advances capable of reducing farm costs increasing profits and protecting resources. However, some single resource focused technologies (e.g., conservation tillage in general and no-till in particular) may shift

the resource problem from one area (soil erosion) to another (water contamination).

Social Structure:

Sociologically, the survival of family farms is also a critical issue in sustainable agriculture.[2/] Over the past 40 years, there has been a movement towards a bi-modal distribution of farm size. Large commercial farms with annual sales of $100,000 and greater produce a large portion of the national food supply. Many of these large farms are multi-family operations that evolved from medium sized farms in order to take advantage of managerial specialization and/or capital economies. On the other hand, there is a large, increasing number of smaller farms (annual sales less than $40,000) that have some portion of their income coming from off-farm sources. These operations may be viewing farming as a life-style as opposed to an income generating enterprise. Furthermore, some of these farmers have supplemental off-farm income that increases their willingness to sacrifice certain efficiency or profit benefits by using practices seen as sustainable. These trends in farm size distribution and off-farm income may pose a significant barrier to the continued survival of single operator, family farms.

Economic Structure:

The concern for the socio-economic rural structure is the fourth component of sustainable agriculture and is really a combination of the three previously discussed components. The performance of the agricultural sector is quite important in determining the economic health of rural communities. The number of families involved in farm operations and the supporting agri-industries have a major bearing on the local community. A movement towards fewer, larger farms could mean fewer families involved in agriculture. Furthermore, if these farms tend to buy inputs and sell products on a wholesale (not local) basis, then the number of supporting agri-business firms and employees could also be decreased. However, these farms may be owned and operated by multiple families and may employ local residents, thus dampening the negative economic impact on the community.

The socio-economic health of rural communities depends on more than just agriculture. The ability of a community to develop a diversified economy; based on agriculture, manufacturing (light industry and high technology, for example), retailing, and associated support services may be at least as important as the agricultural industry alone. These non-farm community economic development issues need to also be considered in discussing the sustainability of rural communities.

2/ A family farm is defined as an agricultural unit where family members provide nearly all of the farm labor and where almost all net household income is derived from sales of farm products.

A Usable Definition

Before sustainable agriculture can be defined, a basic question must be answered: What is meant by agriculture? Is the focus on the industry itself, participants in the industry, consumers of products produced by the industry, or consumers of the by-products (externalities) produced within the industry?

In a sense, the industry itself will survive in some form. The concern of sustainable agriculture advocates is that this form will not be sustainable. That is, agricultural policies and production practices will result in environmental degradation; a decline in medium sized, family farms; and continued economic hardships for rural communities.

One of the most complete definitions of sustainable agriculture that we have seen comes from Iowa in their development of the Aldo Leopold Center for Sustainable Agriculture:

> "For the purpose of this Act, sustainable agriculture means the appropriate use of crop and livestock systems and agricultural inputs supporting those activities which maintain economic and social viability while preserving the high productivity and quality of Iowa's land."

The key components of this definition include profitability, resource protection, and viability of rural America. Recent evaluation of sustainable agriculture issues in the University of Wisconsin-Extension has resulted in the following working definition:

> "Agriculture is sustainable when the systems and strategies employed enhance or maintain the ability of agriculture to meet broadly defined human needs indefinitely within the context of profitability and competitiveness. These systems must function such that soil does not erode beyond its replacement rate. Water supplies must not be depleted or threatened. Pest control strategies must not further threaten endangered species or pose significant health hazards to farmers and their families, their neighbors, or consumers. These strategies must have long-term effectiveness and be adaptable as pests and problems change. Therefore, sustainable agriculture is based on using best available management within the complexity and interdependency of natural systems. Sustainable agriculture cannot be confined to organic or low-input definitions. These (sustainable agriculture) systems are management-intensive, eco-sensitive, and people-oriented."

One could argue that these definitions are not vastly different from what has always existed in the agricultural sector. However, the importance of the issues, because of increased environmental and profitability problems, has increased. The key policy questions are:

(1) Should, or can, farm production practices and policies be altered in order to improve environmental quality, farm profitability, and rural viability?
(2) If so, should these changes in practices and policies be carried out voluntarily or by statute?

The answer to the first question is obviously critical. Our thinking is that changes are and will continue to be proposed that do alter production practices and agricultural policies. Proposals to regulate pesticide usage and to require some sort of groundwater cross-compliance in the next farm bill are just two examples. If in fact changes are proposed, then answers to the second question become critically important.

With voluntary actions, the socio-environmental-economic conditions are taken as given with participants in the agricultural industry (farmers, agri-businesses, agency personnel) working to minimize the damages to physical and human resources. This process is a longer-term, gradual effort that involves extensive education and a realization on the part of the participants that there are problems that need to be solved. Given the increasing amount of public exposure to sustainable agriculture, this process seems to be working, but is only in the early stage. In addition, the acceptance of solutions for these underlying issues by all groups is not yet clear.

With the statutory approach, the emphasis is placed on developing rules for resource protection and then profits are to be maximized under this changed set of conditions. The emphasis chosen and the direction that is taken is important in determining how the agricultural sector approaches the future.

Structural Constraints

Within the objectives of resource protection there exists several structural constraints that may limit the ability to solve these concerns. Currently, agriculture operates as an industry that is (compared to most industries) highly competitive. Thousands of producers are making independent decisions that influence the profitability of family farms and ultimately the quality of life in rural areas. In addition to this problem, the agricultural industry has become a part of a large world economy in terms of supply and demand of both commodities and credit.

This economic environment provides a set of constraints that needs to be considered in any discussion of sustainability. Individual states will have difficulty addressing these concerns if economic forces throughout the nation and the world are not considered. For example, eliminating particular inputs or limiting production-enhancing technologies in a particular region may help protect natural resources and preserve the number of farms in the region by reducing the use of toxic chemicals and by holding supplies in check. However, unless similar limitations are implemented elsewhere, one might expect a decline in the region's market share and individual farm profits.

Many short-run limitations, such as commodity oriented, government programs also exist that reduce a farmer's flexibility to switch cropping programs. Government commodity programs that focus benefits on a set of commodities (corn, for example) tend to not allow farmers to move towards adopting rotations that include less of these program crops. Furthermore, some enterprise combinations such as those oriented around animals require much greater capital investment and are not easily changed.

Market availability may impact a farmer's ability to change cropping systems. For example, crop rotations that include alfalfa or clover are very good systems for reducing purchased nitrogen fertilizer and some chemicals. However, if there are few ruminant livestock in the area that can utilize the hay, then this rotation may not be the most profitable alternative. On the other hand, using crimson clover as a over-winter, cover crop in warmer climates may be a profitable way of reducing erosion and providing nitrogen for the following crop.

Management abilities may also be a limiting factor. Managing systems with fewer fertilizer and chemical inputs is likely to require more intensive management, hence the term low-input may be inappropriate. Acquiring the needed management skills for sustainable agriculture practices will require either time for education or resources to hire off-farm expertise.

Economics of Sustainable Farming

Whatever policy approach is selected, farmers will be faced with a similar problem, but maybe under different sets of rules: How do I utilize both on and off farm inputs to maximize profits? Sustainable farming by its own definition must be profitable. Profit is defined as volume times the difference between price and cost per unit. In order to be profitable, a farmer must produce efficiently at a level of volume needed to produce the income necessary for an adequate amount of family living dollars and an adequate return to capital investment. A profitable and sustainable family farm must be able to compete with larger farms in order to gain the adequate returns and, at the same time, protect and renew the industry's physical and human resources.

Within this context, farms can be categorized to fall into one of three groups: single enterprise; compatible, multi-enterprise; and non-compatible, multi-enterprise farms. The family farm's ability to compete will be a function of the farm's ability to have per output unit costs and selling prices equal to those of other farm types. Compatible multi-enterprise farms contain complementary crops generally grown in rotation with a livestock enterprise available to utilize the crops grown in rotation. Wisconsin dairy farmers have farms that are quite conducive to sustainable agriculture. Corn, small grains, and legumes can be grown in rotation reducing, and possibly eliminating, pesticides and fertilizers. These cost savings may be increased by substituting labor, fuel, and repairs associated with mechanical cultivation for pesticide use and manure application from the dairy enterprise. To the extent that other farms can utilize rotations and inter-cropping benefits, their operations will also be able to reduce these costs and potentially have higher yields on some of the crops of the rotation. Comparing the economics of alternative farming systems does require the use of whole farm business analysis methods that examines the costs and, more important, the profitability of all of the farm enterprises.

Will family farms be able to compete with larger farms in the future? Obviously, the answer depends on a variety of structural issues as well as on efficiency factors discussed above. It is unclear what future trends might bring the industry in terms of structure. If, however, large farms have economies of size advantages over medium sized, single family farms, then survival of family farms may well depend a combination of (1) their ability to match the efficiency necessary to compete in the production of conventional enterprises, (2) developing specialized niches in the marketing and production of specialized enterprises, or (3) developing a policy scheme that targets benefits to "make up the difference" caused by cost diseconomies.

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