

## **Industrialization of Agriculture; Consequences and Challenges of Sustainability<sup>1</sup>**

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The modern sustainable agriculture movement in the U.S. was born in the mid-1980s from the merging of three different streams of public concern. Many traditional family farmers were faced with large debts at high interest rates at a time of rising input costs and falling commodity prices. Organic farmers had long been concerned about the negative impacts of chemically-dependent, industrial farming operations on human health and the natural environment. Rural advocacy groups were concerned about the negative economic and social consequences of the financial failure of family farms on rural communities. These three groups joined forces to bring political attention to the emerging questions of agricultural sustainability.

The sustainable agriculture movement has come a long way since the 1980s. It has not replaced industrial agriculture as the dominant paradigm of American agriculture, as its proponents had expected, or at least hoped. But neither has it been a passing fad, as its skeptics had expected, and its opponents had hoped. In the early days of the movement, a lot of time and energy was spent attempting to define sustainable agriculture. Most people understood that sustainable agriculture was part of the larger movement for sustainable development. Sustainable development was defined in a 1987 United Nations Report as “development which meets the needs of the present without compromising the ability of future generations to meet their own needs.” Thus, sustainable agriculture became generally accepted as a commitment to intergenerational equity; to an agriculture that can maintain its productivity and value to society indefinitely, forever; to a *permanent* agriculture.

The cornerstones of sustainability are ecological, social, and economic integrity. An agriculture that destroys the productivity of its natural resource base – soil, water, or air – eventually will destroy its ability to produce. An agriculture that fails to meet the needs of society – not only as consumers, but also as producers, and citizens – will not be supported by society. Finally, farms that are not profitable, at least periodically, are not financially viable, no matter how ecologically sound or socially responsible they might otherwise be. Simply addressing specific environmental, social or economic problems, while commendable, is not enough. Ecological, social, and economic integrity – wholeness, completeness – are all necessary. No one of the three is more important or less critical than another. Any farming operation that lacks *permanence* – as virtually all now do – is not sustainable. More important, any approach that doesn't accept *permanence* as its ultimate goal will not lead to sustainability.

The sustainable agriculture movement was and is a response to the growing realization that the conventional, industrial approach to agriculture is not sustainable. Admittedly, the industrial

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strategies of specialization, standardization, and consolidation of control have yielded impressive results, at least in terms of productivity and economic efficiency. However, industrialization also has resulted in an agriculture that degrades natural resources, depletes human resources, and destroys economic opportunities. An industrial agriculture is inherently incapable of maintaining its productivity and usefulness to society. It fails every test of sustainability.

This is not just a personal opinion. It's rooted in the most fundamental laws of science and economics. Sustainability is ultimately a matter of energy. Our houses, automobiles, clothes, food, all things of use to us... require energy to make and energy to use. In fact, all material things are concentrated forms of energy. This is what Einstein's famous equation  $E=MC^2$  is about: E equals energy, M is matter, and C is the speed of light. All useful human activities – working, thinking, creating, innovating... – also require energy. The brain accounts for about one-fifth of the energy used by the human body. Moreover, people are not born as productive individuals; they must be nurtured, educated, and socialized by families and communities, by society. All of this takes energy, including “social energy,” including the energy needed to maintain an equitable and just society. Therefore, the sustainability of human life on earth depends on sustaining the usefulness of energy.

According to the first law of thermodynamics, energy can neither be created nor destroyed, which might suggest that sustainability is inevitable. However, according to the second law of thermodynamics, each time energy is used, some of its *usefulness* is lost – the law of entropy. Whenever energy is used, it always changes in form, specifically from more concentrated, organized forms to more dispersed, disorganized forms, as when gasoline explodes in the engine of an automobile. In fact, this natural tendency to disperse is what makes energy useful. Each time it is used and reused, it becomes less concentrated and less organized, and thus, less useful.

Energy can be reconcentrated and restored, but this requires energy, which is then unavailable for other uses. No matter how efficiently energy is used and reused, energy inevitably tends toward uselessness, toward entropy. Solar energy is the only source of new energy available to offset the loss of useful energy to entropy. Consequently, the sustainability of human life on earth ultimately depends on capturing and storing sufficient quantities of solar energy to offset the loss of useful energy to entropy.

As American agriculture has become more industrial, it has become increasingly dependent on fossil energy and other finite natural resources. The total food system currently claims about twenty-percent of all fossil energy used in the U.S., with farming accounting for about one-third of the total percentage. In fact, our industrial food system requires about ten calories of fossil energy for every calorie of food energy produced. Supplies of fossil energy are finite, and there is a growing consensus that fossil energy in the future will be far less plentiful and more costly.

Pollution represents negative energy, in that it destroys the usefulness of other energy resources or requires energy to mitigate its negative impacts. Industrial agriculture pollutes the air, water, and soil with toxic agrochemicals and livestock manure. It is a major source of pollution, accounting for more than twenty-percent of total greenhouse gas emissions – even more than transportation. In fact, agriculture has become the number one nonpoint source of

pollution in the U.S., creating huge “dead zones” in the Chesapeake Bay and Gulf of Mexico. An industrial agriculture is not ecologically sustainable.

Industrial agriculture also is a significant contributor to the depletion of “social energy.” Farm workers today are among the lowest paid workers in the U.S., while working under dangerous and disagreeable conditions, most without adequate health care or other fringe benefits. A growing reliance on migrant farm workers also creates cultural and political conflicts, particularly in times when good paying jobs are few. Many farm families fare little better, as independent farmers are periodically forced out of business to make room for further corporate consolidation. As a consequence, rural communities in agricultural areas have suffered decades of economic and social decline and decay.

These negative ecological and social impacts are defended as being necessary to ensure an adequate supply of safe and healthful food for the benefit of all people. However, there are no fewer hungry people in the U.S. or in the world today than at the beginning of the industrial era in agriculture. There are also growing indications that many of industrially produced foods are not healthful or even safe to eat. Outbreaks of salmonella and E-Coli have become commonplace. Millions of Americans suffer from diet related illnesses, such as obesity, diabetes, heart disease, and various forms of cancer, all of which are most common among those with the lowest incomes. An industrial agriculture is not socially sustainable.

Economists have shown little interest in sustainable agriculture because contemporary economic thinking is based on the unspoken premise that humans will always be capable of finding substitutes for anything we use up or solving any problem we create. They assume that all farmers need to create a sustainable agriculture is an economic incentive to do so. However, things have economic value only because they are useful, and their usefulness ultimately is derived from energy. All economic value is derived from either natural or human resources – from nature or society – the only sources of useful energy. Once all of the useful energy in nature and society is used up, there will be no source of economic value. Once the productivity of the land and of rural people has been depleted, there will be no source of economic value in farming.

The fundamental problem in relying on economic incentives to ensure sustainability is that the economy places a premium on the present relative to the future. Economic value is inherently individualistic. There is no way for an individual to realize economic value after he or she is dead. Since life is inherently uncertain, we value things we can enjoy today more highly than things we might or might not be able to enjoy in the future. It simply makes no economic sense to invest in anything for the benefit of someone of some future generation. Based on everything we know about nature and society, economics places too little value on the future to ensure sustainability. Industrial agriculture is an economic bottom-line business. It is not a way of life that gives equal weight to ecological, social, and economic concerns. The industrialization of agriculture is destroying its natural and human resources. An industrial agriculture is not economically sustainable.<sup>3</sup>

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<sup>3</sup> The ecological, social and economic consequences of agricultural industrialization have been well documented in best-selling books, such as *Fast Food Nation*<sup>3</sup> and *Omnivore's Dilemma*,<sup>3</sup> less popular books, such as *The End of Food*<sup>3</sup> and *America's Food*,<sup>3</sup> and documentaries such as *Future of Food*,<sup>3</sup> *Broken Limbs*,<sup>3</sup> *Food Inc.*<sup>3</sup> and *Fresh; The Movie*.<sup>3</sup> All provide graphic examples of the negative ecological and social impacts of industrial agriculture.

Continued tinkering with industrial agriculture – as with biotechnology – cannot make it sustainable. Agricultural sustainability will require a fundamental change in thinking. As Albert Einstein once observed, we can't solve problems using the same thinking we used when we created them. The fundamental problem with industrial agriculture is that it reflects a mechanistic way of thinking. Machines are very efficient means of extracting useful energy, but they are fundamentally incapable of self-renewal or regeneration, which are absolutely necessary for sustainability. The industrial way of thinking is incompatible with sustainability.

Agricultural sustainability must be based on the paradigm or mental model of living organisms rather than inanimate mechanisms. Living organisms are capable of self-renewal and regeneration and thus capable of offsetting the loss of useful energy to entropy. Green plants have the ability to capture energy from the sun and store useful solar energy in their tissues. Plants are biological solar energy collectors. People are also capable of capturing solar energy; we just use windmills, water impoundments, and photovoltaic cells. People, being biological beings, are inherently dependent on the energy stored by green plants. A sustainable agriculture must be based on the principles of living systems.

Organic farming quite logically has received a lot of early attention in the sustainable agriculture movement because the productivity of organic farms depends on collecting and storing solar energy. The early leaders of the organic movement, such as Sir Albert Howard and J.I. Rodale, also emphasized that the fundamental purpose of organic farming is to create a *permanent* agriculture in order to sustain a *permanent* society. They understood the farm as a living organism that includes microorganisms in the soil, insects, plants, animals, and people. The farm, farmer, and community were all viewed as parts of the same dynamic, living system.

Other organic-like approaches to farming, such as biodynamic, holistic, ecological, and permaculture also have all found a home under the conceptual umbrella of sustainability. The sustainable farming movement includes all farmers who are trying to meet the needs of the present without diminishing opportunities for the future. These farmers, not the so called experts or the scientists, are the ones on the new frontiers of agricultural sustainability. Individual farmers may focus on one or more specific aspects of their farming operations at particular points in time, depending where they see the greatest obstacles or opportunities. However, sustainable farmers must always be mindful of the impacts of their individual decisions on the whole of their farming operation, as a complex, dynamic, interdependent, living system.

Starting from the ground up, one popular area of emphasis within the sustainable farming movement is soil mineralization. Industrial farmers feed crops and livestock that are then used as raw materials to manufacture food for people. Sustainable farmers feed the soil, the soil feeds crops, and crops are used to produce food for animals and people. Mineralization is the process by which chemical compounds in the organic matter of soils are made available to plants through decomposition or oxidation. A wide assortment of macro and micro plants nutrients are mineralized through complex, interrelated chemical and biological processes in the soil. These processes allow plants to combine solar energy with energy in the living and nonliving elements of the soil to produce energy that can be metabolized by other living things, including people.

Some farmers attempt to balance macro- and micro-nutrients in the soil to create an ideal soil environment that will support healthy plant growth and development. Others focus on macro- and micro-biological activity in the soil, as soil organisms play a critical role in processes of mineralization. However, both groups are trying to create a healthy chemical and biological balance in the soil with the ultimate objective of producing healthy crops that will provide feed for healthy animals and food for healthy people. They understand the ultimate objective of farming is healthy people, not simply an abundance of cheap feed or cheap food.

Other sustainable farmers focus more directly on the health and productivity of their crops and animals. They use various crop rotations and integrate crop and livestock enterprises to maintain soil fertility and to manage agricultural pests. They may use cover crops and catch crops, which yield no marketable product, but make the farming systems as a whole work more effectively. They attempt to select varieties of crops and breeds of livestock that fit their particular farms' soils, topography, and climate and their particular approach to farming. They also select crop and livestock enterprise combinations that allow them to better utilize available labor and equipment or offset production and marketing risks associated with individual enterprises. Sustainable farmers understand that healthy crops and livestock are just one link in the value chain of a sustainable food system.

Other sustainable farmers may focus on marketing, or more accurately, on their customers. Sustainable farmers tend to produce a diversity of crop and livestock products. They know their customers don't all have the same tastes and preferences and don't need or want the things that are mass produced and mass distributed by today's industrial food system. Their customers may also be concerned about food safety, nutrition, environmental pollution, natural resource degradation, inhumane animal treatment, exploitation of people, or any of a host of other concerns raised by industrial agriculture. Various food retailing surveys indicate that approximately one-third of American consumers are looking for something fundamentally different from the foods in mainstream supermarkets today – and are willing to pay a significant premium to get the foods they want.<sup>4</sup> Organic foods, for example, have been the fastest growing segment of the food market for at least two decades, in spite of persistent price premiums.

Many sustainable farmers sell their products direct to their customers at farmers markets, through community supported agriculture organizations (CSAs), or at on-farm and roadside stands. Face-to-face relationships are very important to many of the consumers who are supporting the sustainable foods movement. Many have lost confidence in government regulators as well as the food corporations. They buy from local farmers because they trust local farmers to produce food with ecological, social, and economic integrity. Many consumers also want to support the local economy and their local community by spending their time and money with people that they know and trust. As a result, the numbers of farmers markets and CSAs in the United States have more than doubled during each decade since the late 1980s. In addition, local foods have recently replaced organic as the most dynamic sector of food retailing.

Other farmers are attempting to move sustainably produced foods into higher-volume markets. Some have joined forces to create multi-farm CSAs and to gain access to locally owned

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<sup>4</sup> Allison Worthington, *Sustainability, the Rise of Consumer Responsibility*, The Hartman Group, Bellevue, WA, Spring, 2009.

and operated natural food markets and restaurants. Some groups have formed cooperatives to sell to restaurants and institutional markets, such as schools and hospitals. The challenge in all such efforts to “scale-up” to higher-volume markets is to maintain a meaningful sense of connectedness between farmers and their customers – to maintain relationships of integrity. Those who are committed to creating a new sustainable food system understand that a healthy food system begins with healthy soils and results in healthy people and a healthy human society.

As a consequence of this commitment, sustainable farming is among the most intellectually and ethically challenging of professions. Industrial agriculture has taken most of the thinking out of conventional farming by moving technological innovation and business management off the farms and into research laboratories and corporate board rooms. Corporate agribusinesses select the livestock breeds and seed varieties, develop comprehensive programs for animal health and fertilizer and pesticide applications for conventional farmers. They provide specialized machines of buildings for every commercial enterprise. Under today's comprehensive contractual arrangements, even the major decisions regarding planting, breeding, harvesting, marketing, and financing are made by the contracting corporation, not by the farmer. In sustainable farming operation, however, the farmer has to make all of these decisions.

A sustainable farm must function in harmony with nature; farms are site-specific, individualistic, and dynamic. The farm must be managed as a living system. The sustainable farmer must understand the chemistry and biology of the unique soils on his or her farm. The sustainable farmer must work out crop rotations and crop and livestock enterprise combinations that will sustain the production of healthy crops and animals to produce healthy food for people. The sustainable farmer must develop and maintain relationships with his or her unique customers and accept responsibility for maintaining ecological, social, and economic integrity.

The sustainable farmer must be able to carry out applied research; what works on another farm for another farmer, may or may not work for another farmer on another farm. They must continually experiment with alternative practices, methods, and enterprises and evolve their operations to accommodate their ever changing ecological, social, and economic environment. In the process of farming, they must be able to collect and translate data into information, information into knowledge, and knowledge into wisdom. They must be thinking workers, working thinkers, and thoughtful, caring people.

The future of humanity depends on the sustainability of its agriculture. Contrary to popular belief sustainable farms can produce just as much or more per acre than can industrial farms. Sustainable farming is just more management intensive, meaning it takes more farmers per acre. An industrial agriculture simply cannot meet the needs of a growing population in a world running out of fossil energy and other natural resources. Chronic and ever increasing food insecurity; this is an inevitable consequence of industrial agriculture. A sustainable agriculture is not an option; it is a necessity. Sustainable farmers can meet the needs of the present without diminishing opportunities for the future, but sustainable agriculture will require more thinking, caring farmers. There can be no higher priority than finding people who know or can learn to restore the natural productivity of the land and who are ethically committed to producing healthy foods for healthy people and a healthy society.

We are moving out of the industrial era of the past two centuries and into a new knowledge-based era of human progress. In the words of Peter Drucker, who practically invented industrial management, *"In the knowledge society into which we are moving, individuals are central. Knowledge is not impersonal, like money. Knowledge does not reside in a book, a databank, a software program; they contain only information. Knowledge is always embodied in a person, carried by a person; created, augmented, or improved by a person; applied by a person; taught by a person, and passed on by a person. The shift to the knowledge society therefore puts the person in the center."*<sup>5</sup> The shift to a knowledge society puts the farmer in the center of global food security. This is the challenge of sustainable agriculture.

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<sup>5</sup> Peter Drucker, *Post-Capitalist Society* (New York: Harper Collins Publishing), 1993.