

## Sowing the Seeds of Sustainable Agriculture<sup>1</sup>

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American agriculture is in the midst of a “great transition.” The agriculture of the past, with its family farms, diverse landscapes, and viable rural communities, is rapidly disappearing. It is being replaced by an industrial agriculture with factory farms, monochromatic landscapes, dying rural communities. However, the signs of an industrial agriculture are becoming clearer only because agriculture is now in the final stage of industrialization. However, the process of industrialization is not sustainable, neither in agriculture nor for in other form of economic development. Beyond the corporate phase of industrialization lies only economic, social, and ecological desolation. We have fifty years, perhaps less, to create a new sustainable paradigm for agriculture. For if our agriculture is not sustainable, neither is our society.

The industrialization of agriculture is not a new phenomenon, having begun with the mechanization of farming in the early 1900s. However, the chemical technologies that emerged from World War II, particularly commercial fertilizers and pesticides, accelerated the process. Until recently, however, the most obvious consequence of industrialization had been larger farms, fewer farms, and fewer farm families. Until recently, farmers were still making the decisions concerning what was produced, how it was produced, and whom it was produced for. And most farmers considered how their decisions might affect the land and their neighbors as well as their own bottom line. Today, however, the important agricultural decisions increasingly are made in the boardrooms of giant, multinational corporations. The needs of families, communities, and the land are considered secondary, if at all, to the needs of the corporation.

Industrialization is characterized by specialization of function, standardization of process, and consolidation of control. Once-diverse crop and livestock farming operations first specialized in either crops or livestock, next in one or two crops or a single livestock species, and for many, in a single phase of production of a crop or livestock species. Specialization allowed the various production processes to be broken down into their basic elements so they could be standardized, routinized, and in many cases mechanized. In fact, processes had to be standardized so the various specialized elements of production would fit together in producing a single product – just like activities at each position on an assembly line must be standardized so they all work together.

Finally, specialization and standardization make the production process far easier to control. Each person involved in the process simply carries out a predetermined specialized function according to some standard operating procedure, greatly simplifying management. Management decisions are then reduced to deciding how much land, labor, and capital will be invested and how these resources will be allocated or employed. Through industrialization, each decision-maker or manager can effectively control a larger business organization. This allows consolidation of control into fewer and larger production units, meaning fewer and larger farms in the case of agriculture.

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Corporatization is but the final stage of the industrialization process. As the new industrial technologies invariably require larger and larger operations to justify the new investments, capital requirements eventually exceed the credit capacity of all but the largest of individual investors. In agriculture, many farmers formed family corporations to enhance their ability to raise investment capital. Increasingly, however, only the “publicly owned” corporations are able to meet the agricultural capital requirements of an increasingly industrial agriculture. Economists now proclaim corporate contracts as farmers' only means of gaining access to the technology, capital, and markets they will need to be competitive in the 21<sup>st</sup> century. Most of the land and basic production facilities are still owned by individual farmers and family corporations, but production is carried out under direction of agri-business corporations. Through contracts, the agribusiness corporations, many of them multinational, are making the critical decisions concerning both the productivity and sustainability of agriculture.

So, what's wrong with a corporate, industrial agriculture? Why should we be concerned? First, many people don't see anything wrong with a corporate, industrial agriculture, and they are not particularly concerned. As long as the corporations can give them food that is quick, convenient, and cheap, they are not going to ask too many questions. They aren't all that concerned about where their food comes from, who produces it, how it is produced, and what the consequences are for rural people and the land. Many trust the competitive forces of our “free market” economy to ensure that the needs of society are met.

However, a growing number of people are concerned about the corporate industrialization of agriculture. They are concerned about what it is doing to the lives of farm families who are losing control of land that has been in their families for generations. They are concerned about people in rural communities who have supported and been supported by those family farms. They are concerned about the landfills, toxic waste dumps, and giant livestock feeding operations that pollute the once pristine rural environment with dangerous chemicals, biological wastes, and hazardous stench. They are concerned about the ability of the soil to continue to produce after the topsoil is eroded and it is saturated with chemicals. They are concerned about the chemical and biological pollution of groundwater, streams, and air. They are concerned about the safety of their food and safety of the people who produce it.

Increasingly, people are becoming concerned about the negative impacts of an industrial agriculture on the people who farm the land, who live in rural areas, and who eat food produced by industrial systems. They are concerned about those of future generations who will still be as dependent upon the land for their sustenance, their very survival, as we are today. They are concerned about the sustainability of agriculture.

A sustainable agriculture must be capable of meeting the needs of present, while leaving equal or better opportunities for those of the future. Thus, a sustainable agriculture must be ecologically sound, economically viable, and socially responsible. The concept of sustainable agriculture was first promoted, in the public policy arena, during the 1980s by the organic farming community – led by the Rodale Institute, a long-time advocate of environmental causes. So, it's only natural for most people to relate sustainability with the environmental movement. However, sustainable agriculture gained its initial credibility in the public policy arena as an economic issue. During

the farm financial crisis of the 1980s, American farmers were caught in a financial squeeze between chronically depressed commodity prices and continually rising costs of production inputs – fertilizers, pesticides, fuels, etc. A compromise between conventional farmers, who wanted to reduce input for economic reasons, and organic farmers, who wanted to reduce inputs, for philosophical reasons, resulted in the USDA's LISA (Low Input Sustainable Agriculture) research and education program. Agribusiness opposed the LISA program because of the implication that the sustainability of agriculture depended on farmers using fewer purchased inputs. Ultimately, USDA abandoned the Low Input aspect of LISA and shifted the emphasis from reducing inputs to natural resource management through a new Sustainable Agriculture Research and Education (SARE) program.

The social dimension of sustainable agriculture rose to public awareness out of the USDA SARE program. Sustainable agriculture was defined in the SARE legislation, as systems of farming that, among other things, would “enhance the quality of life for farmers and society as a whole.” In the legislative discussion, “quality of life” was defined to mean, to “increase income and employment – especially self-employment – opportunities in agricultural and rural communities and to strengthen the family farm system of agriculture, a system characterized by small and moderate sized farms which are principally owner operated.” Thus, sustainable agriculture was defined to include social responsibility – to increase self-employment opportunities in rural communities and on owner-operated, small- and moderate-sized, family farms.

So, sustainable agriculture is about environmental integrity, about economic viability, and about social responsibility, but ultimately, it's about people. The fundamental purpose of agriculture is to meet the needs of people – to tip the ecological balance in favor of humans relative to other species. However, agriculture is rooted in nature – in soil, air, water, plants, animals, and the other elements of natural ecosystems. The earth and everything upon the earth, including people, are parts of that natural ecosystem. And, according to the fundamental principles of ecology, if we attempt to tip the balance of nature in favor of humans too far or too fast, we will destroy the integrity of the ecosystems of which we ourselves are a part.

In other words, a healthy, diverse environment is necessary for the long run well-being of humans. If we degrade the natural environment – the soil, air, or water – we degrade its ability to provide for the food and fiber needs of people. If we destroy the quality of the environment, the purity of our air or water, we degrade the health and well-being of people. If we destroy other living species of the earth, we may ultimately destroy the ability of the earth to support human life. We must maintain the integrity of the natural ecosystem in order to sustain its ability to sustain the life and health of people, because we are a part of the natural environment.

However, the economy provides the means by which we relate to the natural environment, and relate to each other, within complex human societies. In primitive self-sufficient societies, people relate directly to each other. They provide most of their own needs, they work together, and they barter to acquire the things they cannot produce for themselves. In such societies, people also relate directly with the natural environment, they farm the soil, cut lumber from the forests, and dig minerals from the earth to meet their needs. However, as societies move beyond self-sufficiency, they develop “money” and “markets,” and other impersonal systems of “economics” to facilitate greater specialization and trade. As economies emerge, relationships between people and the

natural environment become impersonal and indirect. Farmers, foresters, and miners sell their products to other specialized producers and receive money in return. The economy then determines who gets to make decisions about how the natural resources are used – who gets to be farmers, foresters, miners, etc.

In a market economy, if a farmer can't make a living farming, he or she will be forced to find another line of work. So, if their current method of farming isn't profitable, or otherwise financially viable, farmers are forced to either find a profitable alternative to their current system or find something else to do for a living. Therefore, ecologically sound farming methods will not be used unless they are also economically viable. If the farmer goes broke, his or her farming operation is not sustainable, no matter how ecologically sound it may be.

Ecological integrity and economic viability are necessary, but not sufficient to ensure sustainability. Civilization is based on the premise that people are capable of rising above a “survival of the fittest” way of life. Certainly, there are some aspects of civilized societies in which it is deemed appropriate that people be rewarded in relation to their ability – whether it is physical strength, mental ability, or economic cunning. However, one mark of a civilized society is the ability to define and defend those rights that accrue equally to all, regardless of their physical or mental ability or their ability to earn an income or accumulate wealth.

A socially responsible agriculture must provide for the food and fiber needs of people. But, social responsibility goes beyond simply making sure that enough is produced to meet the needs of those who are willing and able to pay. In America, all people have a fundamental right to sufficient food to ensure their life, growth, and health, regardless of their ability to pay. In a “civilized society,” to the extent that such minimum levels of nutrition are available for any, they must be available for all. A society that is unwilling to accept this responsibility could hardly be called civilized. A socially responsible agriculture must ensure “food security” for all, without regard to income or wealth.

A socially responsible agriculture must ensure that the people who produce the food have an opportunity to lead successful, productive lives. This does not mean that society has a responsibility to ensure the success of everyone who might choose to farm by any means they might choose. However, it does mean that farmers should be protected from unfair competition in the market place. Farmers should not be forced to exploit their land, their neighbors, nor their customers in order to maintain the economic viability of their farming operation. The people, through government, have a responsibility to protect both people and nature from economic exploitation. The concept of “free markets” was never meant to imply the freedom to degrade the earth or its people.

If an agricultural system fails to support the needs of a society, then society will not support that form of agriculture. A system that is not socially responsible ultimately will degrade its resource base, will lose its ability to produce, and thus, cannot survive economically. We need look only to the communistic farming systems of Eastern Europe for clear evidence of farming systems that were not socially responsible, could not sustain society, and thus, could not be sustainable by society.

So a sustainable agriculture must be capable of meeting the current food and fiber needs of people, all people, while leaving equal or better opportunities for people of the future. To be sustainable,

agriculture must be ecologically sound, economically viable, and socially responsible. The three dimensions of sustainability are not a matter of formal definition or legal precedent, but are a matter of common sense. If the land loses its ability to produce, the farm is not sustainable. If the farmer goes broke, the farm is not sustainable. And if a system of farming fails to support society, it will not be supported by society, and thus, is not sustainable. The economic, ecological, and social dimensions of sustainability are like the three dimensions of a box. All three are necessary. A box that is lacking in height, width, or length, quite simply is not a box. A farming system that is lacking in ecological integrity, economic viability, or social responsibility, quite simply is not sustainable.

Some people see questions regarding the sustainability of agriculture simply as a challenge to make the current industrial food system more environmentally sound and socially responsible. They view biotechnology, for example, as a means of reducing reliance on agricultural chemicals, and thus, of reducing environmental risks. They believe that corporations can be encouraged to be more responsive to the needs of their workers, their communities, and of society as a whole. However, such people fail to recognize the inherent conflict between industrialization and sustainability.

The sustainability of life on earth, including human life, depends of the health and viability of the living systems of the earth. All living things and are made up of cells and cells are distinguished and defined by their boundaries. Each cell is surrounded by a membrane or cell wall. The walls of living cells let some things pass through, but keep other things in and out – so they are called “semi-permeable” membranes. If the cells in our body were permeable or non-permeable, rather than semi-permeable, they would not support life. If they didn't keep anything in, we would dry up. If they didn't let anything out, we would blow up. If they weren't semi-permeable, they wouldn't be able to retain moisture or minerals; they wouldn't be able to metabolize food, release energy, or eliminate waste. We would die.

This principle of healthy boundaries extends to many other aspects of life. All living organisms, plants, animals, people, etc. are defined by boundaries – skin, bark, leaf surface, scales, etc. – which give them form and identity. As with cells, the boundaries of organisms must be semi-permeable or selective with respect to what they allow to pass through and what they keep in or out. An organism that lets nothing in will starve from lack of nutrition and energy. An organism that allows nothing out will be poisoned by its own waste.

Larger living organizations, such as families, communities, and nations, have boundaries that are social or cultural rather than physical. The relationships we have with people within the boundaries of families, communities, or nations are different from those with people outside our family. We let some things pass through; we keep other things in or out. Without these personal, cultural, and political boundaries, human civilization, as we know it, could not exist. Without civilized human behavior, life on earth might well cease to exist. Good boundaries are necessary for life.

Business organizations are living organizations, and the boundaries of a business define its span of control. Economic relationships within a healthy economic organization are inherently different from relationships between organizations. For example, relationships among the

various economic enterprises on a healthy farm are managed differently than are business transactions between the farm and its suppliers of inputs or markets for products. As with all living organisms, semi-permeable economic boundaries – neither self-sufficiency nor economic dependency – are necessary for the economic health of a farm.

Another fundamental characteristic of living things – plants, animals, insects, bacteria, etc. – is their ability to recreate and to reproduce themselves. They create new cells, new organisms, and thus, new boundaries. In fact, the natural tendency of all living systems is toward the creation of greater biological diversity – meaning multiple identities and forms of things, and thus, more boundaries. For example, after a field has been stripped of all vegetation, the first life to return likely will be a single, or possibly a few, species of “weeds.” The weeds will mature, reproduce, and die, but their rotted residue will create a favorable environment for other plant species. As a succession of regeneration processes continues, an increasing diversity of plant species will create a favorable habitat for an increasing diversity of microorganism, insect, and animal species. And, this increasing diversity of form and structure is defined by a multitude of new boundaries.

Unlike living things, the natural tendency for “dead things” – including inanimate, mechanistic things – is toward the dissolution or destruction of boundaries. In physics, this is called a natural tendency toward “entropy.” Entropy is defined as “the ultimate state reached in degradation of matter and energy of the universe; a state of inert uniformity of component elements; absence of form, pattern, hierarchy, or differentiation.” Entropy is characterized by the complete absence of boundaries.

In the definition of entropy, “degradation of energy and matter” refers to the fact that boundaries are destroyed in the process of releasing energy from matter and new energy then is required to rebuild boundaries. For example, when an oak log is burned, energy, in the form of heat, is released from the wood and the structure of the wood is turned to ashes. The boundaries that once defined the structure of the log are destroyed through the releasing of energy. The human body converts food to energy by a similar process of digesting or breaking down the structure of the things we eat. In both cases, the energy consumed is renewable because the energy lost can be replaced by new energy captured by plants from the sun.

Each time energy is released from matter some energy must be used to restore the boundaries of matter, leaving less “useful energy” than before. Lacking a new infusion of energy from “outside” – as from the sun – systems slowly lose their ability to restore the structural boundaries of matter, and thus, slowly lose their ability to store and release energy. This is the essence of entropy – the degradation of energy and matter, as systems lose their form, structure, and diversity through the destruction of boundaries.

This may all sound a bit esoteric; however, the concept of entropy is critical in understanding why an industrial agriculture is not sustainable. Industrialization achieves its tremendous productivity through the dissolution of boundaries and by using no energy to restore them. The dissolution of biological, social, and economic boundaries that define different fields, enterprises, farms, families, etc., removes all restraints to specialization, standardization, and consolidation, and thus, allows maximum productivity and economic efficiency.

On farms, we have seen tremendous gains in productivity and economic efficiency made possible by the removal of such boundaries. Farmers removed fences that had separated fields, as they moved toward more mechanized and standardized systems of farming. The different functional roles of different family members at different stages of life have disappeared as such tasks are now performed by mechanical or chemical technologies. The diversity of crops and livestock enterprises that once defined the structure of typical family farms has been abandoned to achieve greater specialization. The economic boundaries that once defined separate family farms have been erased through farm consolidation. Now, the boundaries between farming and industry are being destroyed through corporate contract farming. The ecological, social, and economic “landscapes” of rural areas today are being left without form, pattern, hierarchy, or differentiation.

This dissolution of boundaries, this industrialization of agriculture, has released tremendous stocks of stored energy that were constrained by the boundaries that once defined different fields, family functions, enterprises, farms, and even farming communities. The boundaries have been removed and the energy has been released. But, once the energy stored over millions of years has been depleted, nothing will be left to sustain agriculture, and thus, nothing will be left to sustain human society. Industrialization is a “dead” system. It destroys boundaries in order to extract the stored energy from land, water, air, plants, animals, and people. But, it has no means of restoring boundaries, of recreating matter, and thus, no means of renewing sources of energy for the future. The amount of fossil energy – fuel, fertilizer, pesticides, etc. – used by today's industrial farming operations far exceed the amount of solar energy they are able to capture from the sun.

Industrial systems inherently tend toward entropy – toward degradation of matter and energy; toward a state of inert uniformity; toward an absence of form, pattern, hierarchy, or differentiation. A lifeless desert is about as close to entropy as most of us have seen. It is without form, pattern, hierarchy, or differentiation – without boundaries. Such will be the ultimate state of an industrial agriculture. An industrial agriculture is not sustainable.

Sustainable farming systems must be living systems – they must be self-renewing, reproductive, regenerative systems of production. Living systems must have boundaries – not barriers that keep everything in or out, but semi-permeable boundaries. Living systems are dynamic. Living boundaries are destroyed, through use and decay, but living boundaries also are restored through regrowth and reproduction. Living systems are able to capture energy from the sun to offset the natural entropy brought about by inevitable death and decay. Living systems tend toward greater diversity of form, structure, and pattern, as they create new boundaries. The process of energy renewal and regeneration, this natural tendency of living systems, is our only means of offsetting the natural tendency of dead systems toward entropy.

Sustainable systems are living systems and the earth is the foundation for all life. All living things require food of one kind or another. Life also requires air and water, but nothing can live with air and water alone. Things that are not directly rooted in the soil – that lives in the sea, on rocks, or on trees, for example – still require minerals that come from the earth. They must have soil from somewhere. Living things other than plants get their food from plants or from other

living things that feed on plants, and plants feed on the soil. By one means or another, all life is rooted in the soil. So, the seeds for a sustainable agriculture must be sown in the earth. And, the seeds that will grow into an understanding of sustainable agriculture, and the sustainability of humanity, must be sown in educational programs that are linked with the earth.

I am an economist, not a soil scientist. So, in talking about the soil, I try to stick to the things that almost anyone might know or at least understand. As I was doing some reading on the subject, I ran across a delightful little book, "The Great World's Farm," written by an English author, Selina Gaye, somewhere around the turn of the 20<sup>th</sup> century. Back then people didn't know so much about everything, so they could get more of what they did know about a lot more things into a little book. The book begins by explaining how soil is formed from rock, proceeds through growth and reproduction of plants and animals, and concludes with cycles of life and the balance of nature. But, the book stresses that all life is rooted in the soil.

Initially molten lava covered all of the crust of the earth. So, all soil started out as rock. Most plants had to wait until rock was pulverized into small particles before they could feed on the minerals contained in the rock. Chemical reaction with oxygen and carbon dioxide, wearing away by wind and water, expansion and contraction from heating and cooling, and rock slides and glaciers have all played important roles in transforming the earth's crust from rock into soil. However, living things also help create soil for other living things.

Lichen is a unique sort of plant that can grow directly on rock. Their spores settle on rock and begin to grow. They extract their food by secreting acids, which dissolve the minerals contained in the rock. As lichens grow and die, minerals are left in their remains to provide food for other types of plants. Some plants feeding on dead lichens grow roots capable of penetrating crevices in rocks caused by weathering. Growing roots can split and crumble rock further, exposing more surfaces to weathering and accelerating the process of "soil making."

Specific types of rock contain limited varieties of minerals and will feed limited varieties of plants – even when pulverized into dust. Many plants require more complex combinations of minerals than are available from any single type of rock. So the soils made from various types of rocks had to be mixed with other types before they would support the variety and complexity of plant life that we have come to associate with nature. Sand and dust can be carried from one place to another by wind and water, mixing with sand and dust from other rocks along the way. Glaciers have also been important actors in mixing soil. Some of the richest soils in the world are fertile bottomlands along flooding streams and rivers, loess hills that were blown and dropped by the wind, and soil deposits left behind by retreating glaciers.

Quoting from the "Great World's Farm," "No soil is really fertile, whatever the mineral matter composing it, unless it also contains some amount of organic matter – matter derived from organized, living things, whether animal or vegetable. Organic matter alone is not enough to make a fertile soil; with less than one-half percent of organic matter, no soil can be cultivated to much purpose." After the mixed soil minerals are bound in place by plants, and successions of plants and animals added organic matter and tilled, the mixtures became what we generally refer to as soils.

The first stages of soil formation are distinguished from the latter stages by at least one important characteristic. The initial dissolving, grinding, and mixing required millions of years, whereas, soil binding and adding organic matter can be accomplished in a matter of decades. Thus, the mineral fraction of soil is a “non-renewable” resource – it cannot be recreated or renewed within any realistic future timeframe. Whereas, the organic fraction is a renewable or regenerative resource that can be recreated or renewed over decades or at least over a few generations. Misuse can displace, degrade, or destroy the productivity of both fractions of soils within a matter of years. And, once the mineral fraction of soil is lost, its productivity is lost forever.

If there are to be productive soils in the future, we must conserve and make wise use of the soils we have today. The soil that washes down our rivers to the sea is no more renewable than are the fossil fuels that we are mining from ancient deposits within the earth. In spite of our best efforts, some quantity of soil will be lost – at least lost to our use. Thus, our only hope for sustaining soil productivity is to conserve as much soil as we can and to build up soil organic matter and enhance the productivity of the soil that remains.

In times not too long past, the connection between soil and human life was clear and ever present. Little more than a century ago, most people were farmers and those who were not lived close enough to a farm to know that the food that gave them life came from the soil. They knew that when the soil was rich, the rains came, and the temperature was hospitable to plants and animals, food was bountiful and there was plenty to eat. They knew that when droughts came, plants dried out and died, and the soil was bare, there was little to eat. They knew when the floods came, plants were covered with water and died, and the soil was bare; there was little to eat. They knew very well that their physical well-being, if not their lives, depended on the things that lived from the soil.

Today, the connection between soil and life is no longer so direct or so clear, but it is no less critical. Most urban dwellers also have lost all sense of personal connection to the farm or the soil. During most of the past century many people living in cities either had lived on a farm at one time or knew someone, usually a close relative, who still lived on a farm. Their connection with farming gave them some understanding of their connectedness with the soil. At least they knew that “land” meant something more than just a place to play or space to be filled with some form of “development.” But these personal connections have been lost with the aging of urbanization. One of the most common laments among farmers today is that “people no longer know where their food comes from.” For most, any real understanding of the direct connection between soil and life has been lost. It's sad but true.

Still, all of life depends upon soil. All life requires food and there is simply no other source of food except living things that depend directly or indirectly on the soil. Farmers are the living beings who care for the land, plant the seeds, and nurture the life that springs from the soil. This foundational principle of natural science, of human health, and of social studies should be taught at every level in every school in the world -- beginning in kindergarten and continuing through college. The connection between healthy soils and human health and life is as fundamental as our connection with the air we breathe, the water we drink, and the food we eat. It's just less obvious.

Quite possibly, no aspect of environmental education is more critical to the sustainability of human life on earth than is a broad understanding of the critical linkage between the health of the soil and human life. A sustainable agriculture is but the means by which life is brought from the soil and which sustains the health of the soil to support future life. Even the economic and social dimensions of sustainability may be best understood in terms of ecological principles, such as the concepts of semi-permeable boundaries, regeneration, and entropy. Many students may not be particularly interested in such things as farming, economics, communities, or social responsibility, but everyone can relate to food and everyone experiences the earth.

Learning is a living process, like farming. The seeds of knowledge and understanding must be sown, at the right season, and then allowed to grow and mature into wisdom in their own time. Knowledge, understanding, and wisdom cannot be manufactured, packaged, and distributed for immediate use. The seeds of sustainable agriculture must be sown in the fertile minds of young people, with the right seeds sown in the right season. These young seedlings that spring forth must be nurtured, feed and cared for, until they are strong enough to survive on their own. Only through thoughtful, patient learning processes will we ultimately achieve the collective wisdom to choose to live sustainably.

Beginning in kindergarten, seeds of sustainability can be sown by environmental education programs, with children watching worms and other “creepy crawly things” that live in the soil. The lesson: the soil is alive, and many things live in and from the soil. Later, children in environmental education classes may plant seeds in the soil, give them air, water, and sunlight, and watch them grow. The lesson: a healthy environment for living things depends on healthy soil, in addition to clean air and water. In higher grades, boys and girls could be given an opportunity to plant an “edible garden,” perhaps in raised bed or clay pots, if no suitable land is available. Crops such as lettuce and radishes mature quickly enough in most locations to be harvested during the school year. Other plants could be started indoors and transplanted outside after the threat of frost has passed. Regardless, the opportunity to plant a seed in the soil and watch it transform itself into food represents a powerful lesson of the linkage between the soil and human life. Saving seeds for replanting and composting food scraps, dead plants, and waste paper products, completes the cycle of regeneration and renewal of life from the soil.

Once young people understand the basic concepts of germination, growth, renewal, maturity, use, and reproduction, they will learn much more from field trips to community gardens, local farms, or other places where people work to bring life from the soil. And, once they understand the relationship of soil, plants, and people, the role of food animals can be introduced into the environmental education program. Some soils and climates won't grow crops that people can consume directly but will grow crops that some animals can digest – coarse grasses and legumes being prime examples. So the animals thrive by eating such plants, and humans thrive by eating the products of the animals – eggs, milk, cheese, and meats are prime examples. Livestock wastes are then returned to the land where the crops were grown, completing the regeneration process. Some animals, such as hogs, actually thrive on human garbage, thus, helping to complete the nutrient cycle necessary to sustain life. The educational opportunities linking environmental education and sustainable agriculture would seem to be numerous and promising for the fertile minds of teachers and students alike.

An important point to remember is that learning, like farming, is a living process. The right seeds have to be planted at the right season. The lessons of sustainability should be lessons children are capable of learning at their particular stage of maturity. For example, kindergartners won't see farm animals as anything other than pets and even many high school youth are not sufficiently mature to understand much about economics. Once the seeds of wisdom have been sown, allow them to grow. And, plant seeds for new crops of knowledge to complement those already growing. Each new lesson can reinforce and expand the previous lessons. In the process of teaching, encourage students to learn on their own, and to teach others. The lessons of sustainability don't require laboratories or a lot of teaching aids and equipment. Anybody can plant a seed and watch it grow, can recycle garbage, can raise a food animal, can do something to increase their understanding of the self-making, regenerative nature of life.

Understanding sustainability ultimately is about understanding how to live well, while helping others to live well, and leaving opportunities for those of future generations to live well. If we sow the seeds of sustainable agriculture, making sure the seed is appropriate for the soil and the season, those seeds will grow, and with a bit of nurturing will mature, reproduce, regenerate, and will grow into a sustainable human society. The time to begin sowing the seeds of sustainability is now.