10-8-2005

Spirituality in Agriculture

Frederick L. Kirschenmann
Iowa State University, leopold1@iastate.edu

Spirituality in Agriculture

Abstract
The United Nations "Millennium Ecosystem Assessment Synthesis Report" published in March of 2005 detailed some disturbing conclusions. Produced by 1,360 of our leading scientists from 95 countries the report's core findings can't help but alarm us. The report found that over the last half century, humans have polluted or over-exploited two-thirds of the earth's ecological systems on which life depends, dramatically increasing the potential for unprecedented and abrupt ecological collapses. And the report determined that most of these ecosystem damages were the direct or indirect result of changes made to meet growing demands for ecosystem services---in particular the growing demands for food, water, timber, fiber and fuel.

Disciplines
Agriculture | Rural Sociology

Spirituality in Agriculture[1]

Frederick Kirschenmann

One basic way to expand our efficacy is through modern science and technology. But another is through integrated (emotional, mental, physical, and spiritual) growth and enhanced wisdom. This means growing in our sense of connection with nature and one another and learning to live in ways that naturally cultivate our capacity to be human.
---Peter Senge

Science can be quite correct, but real life can't always afford to act according to scientific "correctness."
---Rudolf Steiner

The Untied Nations "Millennium Ecosystem Assessment Synthesis Report" published in March of 2005 detailed some disturbing conclusions. Produced by 1,360 of our leading scientists from 95 countries the report's core findings can't help but alarm us. The report found that over the last half century, humans have polluted or over-exploited two-thirds of the earth's ecological systems on which life depends, dramatically increasing the potential for unprecedented and abrupt ecological collapses. And the report determined that most of these ecosystem damages were the direct or indirect result of changes made to meet growing demands for ecosystem services---in particular the growing demands for food, water, timber, fiber and fuel.

In other words the means by which we have met our basic human needs during the past half century is now the bane of our existence. And the agriculture we have practiced is at the heart of that outcome.

The report goes on to point out that there is no simple fix for this impending disaster. We have now set in motion a series of changes----climate change, biodiversity loss and land degradation---that make it extremely difficult to *restore* ecological health. These changes, together with the loss of both species diversity and genetic diversity, has now severely damaged the *resilience* of ecosystems---the level of disturbance that an ecosystem can undergo without crossing a threshold to a different kind of structure or functioning. So not only have we degraded the productive capacity of the planet, we have also undermined the planet's capacity for self-renewal and self-regulation.

And as if that news were not sobering enough, the report goes on to suggest that additional *new* challenges are now on the way. The report anticipates that during the next 50 years demand for food crops will grow by 70-85% and demand for water by between 30 and 85%.[2]

---

[1]This paper was prepared for The Concord School of Philosophy, Concord, MA, October 8, 2005.
[2] United Nations. 2005. "Millennium Ecosystem Assessment Synthesis Report," March. http://www.millenniumassessment.org/en/index.aspx

How did we get here? What happened to that world of unending prosperity predicted by modern science just a few years ago? What happened to that cornucopia of increasing health and abundance we were promised?

Contrast, for example, the world the UN report says we now *have,* with the world J.B.S. Haldane promised us we would *get* with our modern science and technology. "Civilization as we know it is a poor thing," he wrote. "And if it is to be improved, there is no hope save in science . . . Physics and chemistry have made us rich, biology healthy, and the application of scientific thought to ethics by men such as Bentham has done more than a dozen saints to make us good." And then he went on to say that "The process can only continue if science continues."[3]

So what went wrong? Why did science deliver such a different world from the one we expected?

The Cartesian Paradigm

The cause of any event is, of course, always complex so we dare not oversimplify the problem. The reason that we got a very different world from modern science and technology than the one we were promised is probably due to a diverse set of circumstances. Yet behind complex causes there is always a general outlook (a philosophy, if you will) that guides both our perception and our actions. And our outlook for the past several centuries has been shaped by two great revolutions---the Scientific Revolution of the 17th century and the Industrial Revolution of the 18th century. The former was, of course, the foundation for the latter.

The scientific revolution was introduced into the Western world by some of the great scientific minds of the modern era---Galileo, Descartes, Bacon, and Newton. Bacon and Descartes provided much of the intellectual framework that shaped the prevailing paradigm of the modern world. In fact their influence on our culture has been so pervasive that we may be tempted to conclude that they *invented* science and technology. But science (the systematic pursuit of knowledge based on observation, study and experimentation) and technology (the mechanical and industrial arts) has been practiced by humans for as long as they have been on the planet.

What the Scientific Revolution did was to radically change our *outlook* on science and technology and therefore our perception of nature and our relationship with the rest of the biotic community. Francis Bacon saw little value in the study of nature. Such endeavors, only helped us understand "the variety of natural species" and were consequently of little benefit to humans. On the other hand "the mechanical arts" held great promise for the human species.[4]

---

[3] Quoted in Katy Redmond, 2003. "Science and Spirituality: Complementary or Contradictory," *Resurgence*, September/October. No 220. p. 8.

[4] Francis Bacon, *New Organon*, Book I, Aphorism XCVII, in Hugh G. Dick, ed., 1955. *Selected Writings of Francis Bacon* (New York: The Modern Library.

In other words for Bacon understanding the way the world *is* holds much less promise for the human species than inventing technologies that modify the world to our liking. Descartes provided the philosophical framework for a scientific perspective---based on a mechanization of the human intellect---that provided the perfect fit for Bacon's new technology-driven world. Descartes' assertion that "man's activity as a thinking being . . . is purely mechanical,"[5] was perfectly compatible with the notion that the world should be manipulated by technological interventions.

And both Descartes and Bacon operated on a similar assumption, namely that it was possible (indeed *necessary*) to *separate* subject from object, mind from body, conscious from unconscious, fact from value, and human from nature. It was assumed that we could achieve certainty in knowledge *only* through such separation. This doctrine of separation taught us to see the world in *fragments* instead of *relationships*. And that changed everything![6]

This fragmentation theory still shapes most of our modern life today. It is evident in the rigid academic disciplines of our educational systems where it is assumed that the most reliable knowledge is knowledge that is isolated from its context and reduced to discrete pieces of data. It can be seen in the way most businesses are managed. Success in most businesses is measured by the single indicator of return on investment on a quarterly basis with little thought given to the relationships on which those businesses are based.

And that same fragmentation has become the template for modern agriculture. Yield, separate from everything else on a farm, has become the only important indicator of successful farming. Paul Thompson has, in fact, concluded that the single ethical principle which now informs farmers' decisions is "produce as much as possible regardless of the cost."[7]

This fragmentation doctrine is now deeply embedded in our culture. Consequently our educational systems have now produced several generations of engineers who invent technologies with little attention to the ecological consequences of their inventions. Our industries are inclined to think of consumers as targets of carefully designed messages that are broadcast *at* them to manipulate their buying decisions, rather than marketing *with* them as proactive participants in the market. John Ralston Saul argues that this marketing paradigm, now firmly entrenched in our global corporate culture, has alienated many consumers. It leads them to increasingly experience the free market as a "tyranny" leaving them frustrated, cynical and angry. They must now often come up with the "hardest of hard scientific evidence" just to *not* put something into their collective stomachs that they choose not to eat.[8]

---

[5] Morris Berman, 1981. *The Reenchantment of the World*. Ithica, NY: Cornell University Press. p. 34.
[6] Berman, *Op. Cit*.
[7] Paul Thompson, 1995. *The Spirit of the Soil: Agriculture and Environmental Ethics*. New York: Routledge Publishing Company.
[8] John Ralston Saul, 2004. "The Collapse of Globalism," *Harper's Magazine*. March. P. 37.

In agriculture the same fragmentation doctrine has led us to so narrowly focus all of our resources on increasing the yields of a handful of crops that we failed to notice that the very ecological resources needed to *maintain* productivity had been undermined. And as a consequence we have produced such a brittle landscape that it leaves us on the edge of collapse.

In sum, the separateness and fragmentation doctrine embedded in the world view of the Scientific Revolution, led us to overlook vital pieces of information about our world---information about relationships, interdependencies and emergent properties---all vital, as it turns out, to economic, social and ecological sustainability.

Toward a Postmodern Agriculture

The modern predicament in which modern science leaves us need not, indeed *must not*, lead to the conclusion that science and technology is evil. Probably none of us would be too excited about going back to living in a pre-technological world when humans had little protection from natural disasters or ravenous beasts of prey. As Steve Talbott reminds us, our pre-industrial ancestors, in all likelihood, developed technologies *precisely* to protect themselves from nature.[9] Inventing the technologies that enabled early technological humans to develop safe enclaves to live in, which protected them from the threats of the wild, was a natural evolution that I suspect none of us would care to reverse.

It was also very likely the development of technologically protected enclaves that gave rise to agriculture. As Ernest Schusky points out, hunting and gathering was a very efficient way for humans to feed themselves.[10] And as long as humans lived in small tribal communities that could readily move from landscape to landscape hunting and gathering likely was the preferred food acquisition strategy. But once they transitioned to more technologically protected, settled enclaves, humans needed to develop a secure, reliable, supply of local food that could adequately feed settled populations. Developing domesticated plants and animals must have presented a viable solution despite the additional energy required to produce food from agriculture. Selecting appropriate seeds and breeds to domesticate plants and animals, cultivation and animal husbandry all required massive inputs of additional energy not required in hunting and gathering.

One might argue, as Wes Jackson at the Land Institute does, that this early application of science and technology, which focused on converting the landscape from perennials to annuals, was already the beginning of the problem of agriculture. Yet the problem was not science and technology. The problem was the *way* science and technology was applied. And the core problem with the Scientific Revolution was that it adopted a world view that was simply too narrowly conceived. It is as if we decided to conduct our research and develop our technologies from inside an intellectual silo that prevented us from seeing anything outside the walls of matter and motion.

---

[9] Steve Talbott, 2004. *In the Belly of the Beast*. Ghent, New York: The Nature Institute. P. 11.
[10] Ernest L. Schusky, 1989. *Culture and Agriculture: an Ecological Introduction to Traditional and Modern Farming Systems*. New York: Bergin & Garvey Publishers.

From this narrow perspective we were blinded to the way the world actually worked. As we have since learned from quantum physics and evolutionary biology, the world is not a machine that can be precisely manipulated and controlled with our technologies. It is rather a very dynamic, indeterminate system of highly complex, interdependent organisms with incredible emergent properties. Consequently the question we might ask is whether it may not now be time to move beyond the Cartesian paradigm---especially with respect to agriculture.

Of course not every scientist embraced the Cartesian perspective. Johann Wolfgang von Goethe, for example, rejected the reductionist approach proposed by Descartes and advanced a much more imaginative and holisitic science. For Goethe the whole could never be reduced to the sum of its parts, indeed the whole was always making itself *present* in the part. Nor could nature be reducible to matter and motion for Goethe, and it was certainly *not* mechanistic. For Goethe nature was a very dynamic, living system, invested with emergent properties.

It was this dynamic quality which attracted Rudolf Steiner to Goethe's world view and led him to question the validity of the "materialist" science that had become popular among agriculturalists. In his Agriculture Lectures delivered in 1924 Steiner suggested that we embrace a more "spiritual" science. Steiner recognized the potential danger that the modern materialist science posed for agriculture because it changed the way farmers perceived and managed their farms. In his Lectures he urged his listeners to actively oppose the farming practices that were "bound up with the modern materialistic world-view" and to ignore studies based solely on "farm productivity." Such research, he argued, was "really nothing more than studies on how to make production as profitable as possible" while ignoring the more important issue of how to achieve a "healthy farm." He argued that "spiritual science" helped farmers recognize that farms are "rooted in the whole household of nature."[11]

Of course Steiner was not the only intellectual to question the industrialization of agriculture. Like Steiner other critics questioned aspects of the new agriculture and suggested alternatives. Some of those alternatives are now being incorporated into the sustainable agriculture movement that began to emerge during the 20th century.

The roots of industrial agriculture are, of course, embedded in the historic publication of Justus von Liebig's *Chemistry in the Application to Agriculture and Physiology* (1840). Von Liebig argued that we could maintain the productivity of agriculture without resorting to the laborious task of manuring soils by substituting chemical fertilizers for such nutrient cycling practices. The ability to substitute chemical fertilizers for nutrient cycling practices encouraged farmers to specialize in the production of a few high-value crops and abandon the mixed farming practices which incorporated green manures and livestock into farming systems. Von Liebig's proposal

[11] Malcom Gardner, ed. 1993. *Spiritual Foundations for the Renewal of Agriculture*. A course of lectures by Rudolf Steiner, held at Koberwitz, Silesia, June 7 to June 16, 1924. (translated by Catherine Creeger and Malcom Gardner) Kimberton, PA: Biodynamic Farming and Gardening Association, Inc. pp 89, 75.

was a perfect example of the application of Descartes and Bacon's science and technology to agriculture.

As the movement to industrialize agriculture took hold, numerous agriculturalists took issue with the fundamental premises upon which it was based and proposed alternatives. One such alternatives was the "humus farming" movement which insisted that agriculture could never maintain its productivity without sustaining the humus content of the soil. Several works contributed to this school of thought. Browne's *The Field Book of Manures or the American Mulch Book* was published in 1855 and outlined the principles of humus farming A subsequent contribution to the humus farming movement was the 1881 publication of Charles Darwin's *The Formation of Vegetable Mould, Through the Action of Worms, With Observations on Their Habits*. Darwin's detailed description of earthworm activity established, for the first time, the critical role that soil fauna play in the development of fertile soils. Darwin's work was one of the great examples of Bacon's folly. There *is* value in the study of nature.

In 1943 Sir Albert Howard published *An Agriculture Testament* which became a standard text for many humus farmers. Howard argued that the maintenance of soil fertility was essential to the survival of human civilization and stressed the importance of humus farming in maintaining soil health. In 1945, J.I. Rodale, who corresponded with Howard, published his *Pay Dirt* which came to similar conclusions. Meanwhile in Japan, Mochichi Okada developed his post-war "nature farming" practices which employed similar humus farming techniques. And in 1979 the Rodale Institute published its *Rodale Guide to Composting* which served as a practical guide for many humus farmers and gardeners.

A second movement which could perhaps be called "complex farming systems" emerged in the early 20th century largely in response to the writings of F. H. King who questioned the oversimplification of industrial agriculture. The two works for which King became famously known were *Farmers of Forty Centuries* (1911) and *Soil Management* (1914). King understood that productivity could not be maintained indefinitely without attending to the ecological restoration of the soil.

The philosophy of organic agriculture emerged in the 1940's. Lord Northburne first used the term "organic" to describe the farm as an "organism" in which the parts of the farm are orchestrated into a functioning whole. These ideas were presented in his *Look to the Land* (1940). In 1943, Lady Eve Balfour published *The Living Soil* which has long been a favorite of organic farmers, and E. Faulkner published his *Plowman's Folly* the same year. Faulkner's work also was widely read by agriculturalists who were suspicious of industrialization. Subsequently Faulkner's work became a resource for sustainable agriculture advocates.

The work of Liberty Hyde Baily, Dean at Cornell University's College of Agriculture, especially his *The Holy Earth* (1915), Louis Bromfeld's *Pleasant Valley* (1946), and Aldo Leopold's *Sand County Almanac* (1948) all contributed to a broader understanding of the "spiritual" qualities of agriculture. Leopold's assertion that we would probably never be able to have any meaningful conservation without cultivating an "ecological conscience" established the need to develop a spiritual component, a land ethic, in agriculture.

Spirituality and Agriculture

Since Descartes insisted that facts and values must be kept in separate worlds, both scientists and farmers have been reluctant to use the word "spirituality" in connection with anything having to do with science or agriculture. Perhaps that is one of the reasons that Rudolph Steiner and Liberty Hyde Baily's work on agriculture were never given serious consideration in mainstream modern agriculture.

But that is beginning to change. The "spiritual" word is now beginning to show up in numerous intellectual circles. Peter Senge and his colleagues consistently refer to the spiritual aspects of organizational behavior in their new book *Presence*.[12] Morris Berman unabashedly calls for a "re-enchantment of the world" which would "embrace value without sacrificing fact."[13] Harold Morowitz suggests that our universe has gone through 28 stages of emergence to achieve itspresent state of existence and that the 28th stage that we are presently in is "the spiritual" which he describes as "an attempt to ascribe meaning to the other emergences."[14] Anthropologist Jeremy Narby, after traveling around the world to visit with some of today's leading scientists, concluded that there is "intelligence" in all of nature---even in plants which communicate through chemical signals that are not all that different form the chemical signals used by neurons in the human brain.[15] And Marcia Bjornerud even suggests that there is not that much separation between us and rocks. "Our mistake," she writes, "is forgetting that we [humans] are simply the youngest children in a generations-old dynasty."[16]

So it turns out we may not be all that "separate" from the rest of the cosmic community after all.

It is becoming clear, in fact, that the "spiritual" dimension of the world is not as "separate" from the physical as Descartes and Bacon imagined. It could, in fact, be argued that the "spiritual" is simply a way of understanding our world that acknowledges the connection and relationship to the rest of the expanding universe. And with respect to agriculture this suggests that we need to begin to pay at least as much attention to how the rest of the world works as we do to determining how to acquire our food, shelter and energy. We need to begin to develop production systems that are consistent with earth's functioning and discontinue fashioning an agriculture that only attends to how to produce the maximum yield of a single crop in a single growing season. Doing agriculture within the context of spirituality will lead us to pay attention to all of the relationships in which farming is involved. How do our farms affect the birds and bees and earth worms and air and water and soil micro-organisms? How do our production systems affect the cows and corn and native grasses on our farms? We must, in other words, begin paying attention to relationships.

As Craig Holdredge reminds us, when we treat a cow like a milk factory whose milk production can be increased by tweaking some isolated part of the cow's physiology, we lose sight of the

---

[12] Peter Senge, C. Otto Scharmer, Joesph Jaworski, and Betty Sue Flowers, 2004. *Presence: Human Purpose and the Field of the Future*. Cambridge, MA: The Society for Organizational Learning.
[13] Berman, *Op. Cit.*
[14] Harold Morowitz, 2002. *The Emergence of Everything*. New York: Oxford University Press.
[15] Jeremy Narby, 2005. *Intelligence in Nature*. New York: Jeremy P. Tarcher/Penguin Publishers.
[16] Marcia Bjornerud, 2005. *Reading the Rocks: The Autobiography of the Earth*. Cambaridge, MA: Westview Press. p. 6

fact that for every additional quart of milk that the cow is forced to produce, an extra 300 to 500 quarts of blood must flow through the udder of the cow. To then pretend like increasing the milk production of the cow will have no effect on the cow, the environment in which the cow exists, or the community of which the cow is a part is, if nothing else, bad science. We simply must begin paying attention to these complex relationships.

Might the UN Millennium Ecosystem Assessment Synthesis Report have described a different world in 2005 if some of these alternative views had been adopted more widely at the beginning of the 20th century? Contemporary apologists for industrial agriculture of course continue to insist that *any* alternative to industrial agriculture will doom civilization because only industrial agriculture can produce the yields needed by an expanding human population. They insist that ecologically based systems are *necessarily* much less productive then the industrial factory-type systems. But peer reviewed research is now increasingly showing that such dire assessments are far from true.[17]

Furthermore, a few farmers are now designing new complex, on the farm, farming systems based on biological synergies that are demonstrating incredible efficiencies. Takao Furuno's duck/fish/rice/fruit farm in Japan serves as a prime example of such productivity and efficiency. He now produces duck meat, duck eggs, fish meat, fruit and rice in a highly synergistic system of production on the same acreage where he previously only produced rice---all without any exogenous inputs. And in this new production system his rice yields have increased up to 50 percent over the yields he was getting from his former high-input, industrial, mono-crop rice farm. His new farm, he writes, is based on the concept of producing "a variety of products within a limited space to achieve maximum overall productivity" by introducing multiple species into the same environment in ways that allow "all components to influence each other positively in a relationship of symbiotic production."[18] Such complex, synergistic systems are proving to be much more productive than mono-cropping systems, while using far fewer, potentially environmentally damaging, inputs. It is about replacing separation with relationships.

As we enter the 21st century, mainstream agriculture faces many challenges which may nudge agriculture in these new directions. As fossil fuels are depleted, the ratio of energy produced to energy required to produce it continues to diminish, making that source of energy increasingly costly. So agriculture will have to find an alternative energy source to sustain its productivity. Agroecologists are increasingly convinced that the most viable alternative technology will be the biological synergies inherent in multi-species systems and that additional research might make such systems the next new technology.[19]

Meanwhile nature's sinks are rapidly filling up. The "hypoxic zone" in the Gulf of Mexico increased to 8,200 square miles in 2002, largely due to excess nutrients from agricultural activities. Climate change is likely to have a major impact on agricultural practices in many areas. In the meantime the cost of production for highly specialized,

---

[17] See, for example, John P. Reganold, Jerry Glover, Preston K. Andrews and Herbert R. Hillman, 2001, "Sustainability of Three Apple Production Systems." *Nature*. 19 April, Vol 410. 926-930.
[18] Takao Furuno, 2001. *The Power of Duck*. Sisters Creek, Tasmania, Australia: Tagari Publications. p. 73.
[19] Masae Shiyomi and Hiroshi Koizumi, ed, 2001. *Structure and Function in Agroecosystem Design and Management*. New York: CRC Press. p. 2, 6.

monoculture farming systems continue to increase, leaving farmers with less net farm income, in real dollars, in both the United States and Canada, than they had in 1929.

The problems and challenges confronting agriculture as we enter the 21st century are all clues that we need to move beyond the Cartesian paradigm in science and in agriculture.

Of Science and Conversation[20]

Harvard geneticist, Richard Lewontin, reminds us that the environment in which we live exists only by virtue of millions of organisms modifying their environment out of the bits and pieces available to them. In the process of this activity they create challenges and opportunities for other species with whom they share space in an ecosystem.[21] This suggests a picture of the earth which is dynamic, constantly changing, and highly interdependent. The earth, in other words, is a vibrant biotic community. And agriculture is an integral part of that community.

That description of our world would suggest that the most appropriate science is not one that leads us to detach ourselves from this community in the interest of some kind of supposed objectivity, nor one that attempts to oversimplify the complexity of that community, nor one that presumes we can know all we need to know about that community to proceed with our technological innovations with impunity. The most appropriate science would be one that invites us into conversation with that community in all its complexity.

In an enlightening essay entitled "Ecological Conversations" Stephen Talbott[22] suggests some guidelines we might use for such a science of conversation.

First he suggests that every technique we use, every industrial process we initiate, and every technology we introduce is "a question put to nature." In all our innovations we are trying to remedy some ignorance, and for precisely that reason we should act with caution and humility. In other words we should never introduce a technology as an answer to a problem, but as a question put to nature to ascertain its appropriateness.

Second, in a conversation we are always to some extent "compensating for past inadequacies." So part of any conversation involves an attempt to heal what we have harmed in prior conversations. It is always better to admit this at the outset. Ignoring it will likely compound past errors. Part of the task of good science, then, is to learn how to enhance the health of the biotic community as we converse with it. And, as Aldo Leopold reminded us, health is the capacity of the biotic community to renew itself.[23] Our task is not to "save" the environment, nor to preserve things as they are, but to engage the environment in ways that revitalize the biotic community.

---

[20] These final paragraphs were originally presented as part of a the Sigma Xi lecture series at Iowa State University, Fred Kirschenmann, 2002, "What Constitutes Good Science?" December 5.
[21] Richard Lewontin, 2000. *The Triple Helix.* Cambridge, MA: Harvard University Press.
[22] Stephen L. Talbott, 2002. "Ecological Conversations," *Netfurture*. # 127. http://www.netfuture.org/
[23] Aldo Leopold, 1949. *A Sand County Almanac*. New York: Oxford University Press.

Third, in any conversation there is never a single right or wrong response. This is where creativity comes in. The alternatives that exist depend in large part on the alternatives we bring into being. Good science is inventive. Declaring that there is only one way to feed the world is bad science.

Fourth, conversation always takes place in the particular. We cannot have a conversation with an abstraction. We can only have conversations with particular individuals. We cannot reasonably save a species, we can only engage in the work of restoring a particular habitat of a particular species in a particular place. We cannot reasonably feed the world, we can only engage in activities that improve the food security of particular villages or communities.

Conversation is a useful metaphor for describing good science or good agriculture. But much of the science of the modern world has been a monologue. *We* decided what technological innovations to introduce based on what *we* believed would enrich *us* without any regard for the impact such innovations would have on the larger biotic community---and therefore on us! In introducing those innovations we usually assumed we already knew all we needed to know to proceed without caution. We behaved as if the biotic community belonged to *us*, rather than entertaining the possibility that we, together with all other organisms, belonged to the biotic community. Nothing that we now know about *how* we know, or about the workings of the biotic community, justifies continuing down that path. Again, as Leopold reminded us, we are not "conquerors" of the biotic community, we are simply "plain members and citizens" of it.[24]

So in the future, good science, and good agriculture, it might seem, should spend more of its resources mapping nature's interconnections, and less treating organisms like arbitrary collections of interchangeable parts. It might spend more time ensuring the future productivity of agriculture by learning to understand the complex effects operating among organisms, and between organisms and the environment, and less inventing new technologies to address singular production problems, or singular disease problems.

In this regard good science is also local. As David Abram reminds us, "We can know the needs of any particular region only by participating in its specificity---by becoming familiar with its cycles and styles, awake and attentive to its other inhabitants."[25] From this perspective farmers can only manage their farms effectively if they live on their land long enough and intimately enough to engage in such deep conversations with their land. It would begin the transformation from fragmentation to relationships. Such a spiritual transformation would have the potential to bring revolutionary changes to agriculture and set it on a path toward sustainability.

---

[24] Aldo Leopold, 1948. *A Sand County Almanac*.
[25] David Abram, 1996. *The Spell of the Sensuous*. New York: Random House.