Teaching Sustainability: The Role of Education in the Creation of Sustainable Agricultural Systems

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Introduction

The youth of today face a complex and harrowing future. They will encounter a world shaped by decades of decisions by industry, agriculture, and society. Faced with the issue of whether mankind can continue to exist on the planet in its present state, youth will be required to make drastic changes to ensure a safe future. Agriculture has a larger role in securing of the potential quality of life than any other industry on the planet today. As Kirschenmann and Bird (2006) state "As we enter the twenty-first century, agriculture faces at least nine major challenges that are likely to force it to move beyond the industrial paradigm of the twentieth century. They include the loss of biodiversity, a devastated farm economy, unchecked and geographically concentrated population growth, persistent poverty, energy transformation, food security, environmental degradation, climate change, and an unprecedented explosion of infectious diseases." With impacts in energy consumption and production, water usage, pesticide and fertilizer application, as well as erosion and desertification, every sector of environmental degradation or destabilization is affected by agriculture in some way (Horrigan, Lawrence, and Walker, 2002). If young people wish to ensure a high quality of life for their generation and those to come, the transition to sustainable agriculture is necessary.

Primed for Change

Youth have a greater vested interest in the practices and decisions of modern agriculture than any other segment of society. Additionally, young people by nature are more apt to envision and effect change. With this outlook, youth of today can maximize today's resources without sacrificing future potential. This mindset is exactly the one needed in the creation of sustainable world systems. Today's young people are arguably more motivated than prior generations to make sacrifices and changes for what they believe in. The issues of the day, in contrast to the suffrage controversies of the 1920s, or the peace and civil rights movements of the 1960s, confront not only civic justice but also address the very question of our continued existence. It appears that there is a divergence of thought between the young people of today and the experienced agriculturalist. While the youth of today are willing to make sacrifices, intently watching the global community, they are hindered by an ignorance of the practices of modern industrial agriculture. Meanwhile many farmers armed with the knowledge and pride surrounding "achievements won by the present and past generations of agriculturists" (Tiffany, 1930), continue with time-honored

practices, unaware or skeptical of the problems they are creating. These two mindsets must be reconciled and brought together to form a consensus between the consumer (the farmer's urbanized, disconnected, and perhaps benighted fellow human being) and the producer (the farmer), thus creating a sustainable agricultural system. In essence what this would do is simultaneously address many of the ills that both farmers and consumers face. Counteracting agricultural trends focused on increased efficiency while relying on expensive external inputs that have strong environmental and social costs, low input farming methods used by a fully sustainable farm could increase the quality of life for many farmers (Ikerd, 2006). As sustainable farming practices are implemented, strain on the environment will decrease, the quality of food will increase, and the public at large will benefit, creating a win-win scenario for both the public and the agricultural community. The desire of a generation of youth to have more environmental security combined with the agricultural community's desire to find a way out of the industrial paradigm has created a scenario ripe for the introduction, utilization, and mainstreaming of sustainable agriculture.

The Hurdle

Teaching sustainable agriculture does not simply involve promoting the methods and strategies of sustainability; it includes educating people on the flaws of the prevalent mechanistic worldview and the merits of an ecological worldview. The mechanistic worldview is in direct conflict with the ecological worldview upon which sustainability is grounded. In the former, our environment is viewed as a set of physical parameters that we can set and adjust to our liking at any time; that every resource is seen as infinite or capable of being replaced through new technology (Bird and Brewer, 2006). Since the publication of Justus von Liebig's 1840 article entitled *Chemistry in the Application to Agriculture and Physiology*, modern economics and industry, including the modern farm has viewed the world in a simple input-output paradigm. It has reduced agriculture to a science in which we input fertilizers, pesticides, machine and human hours, seed, and feed to get food and fiber. "Mechanized man," as Aldo Leopold (1949) called him, does not take into account many of the natural systems that are in place. While over the past decades the mechanistic view has been largely successful, allowing for extensive growth in world population and an improvement in the quality of life for many people, it "…can no longer be justified by modern science" (Kirschenmann and Bird, 2006). We have reached the limit of its feasibility. While the amount of arable land decreases over time (Eswaran, Lal, and Reich, 2001) we are beginning to realize that soil is much more than just sand and nutrients. It is instead a complex ecosystem that needs to be managed and conserved like any other resource (UN POPIN, 1995). One thing is certain: the present rate of human population growth and resource utilization cannot withstand the test of time.

In contrast to the mechanistic worldview, sustainability takes a holistic, cyclic view of nature, acknowledging that resources are finite, take time to develop or renew, are cycled in complex systems, and cannot be used indiscriminately (Bird and Brewer, 2006). The ecological worldview focuses on the value of natural systems and acknowledges that we as humans possess a very limited understanding of our planet and hence cannot create

artificial replacements or additions to the natural world without some kind of negative ramifications. While huge strides have been made within the agricultural community with the advent of reduced or no-till farming and crop rotation (McVay, 2006), these methods are still contrary to dominant mechanistic minded culture and have yet to be accepted across the board. Mechanistic concepts are ingrained in the social fabric of our society. Evidence is clear in our consumption of oil and water, as well as our mistreatment of airsheds and forests. If the ecological worldview is not supported by our society, support will also be lacking for the concepts of sustainability. We must not only ask how we can introduce youth to sustainable agriculture, but we must show them the flaws of the mechanistic worldview and how the ecological worldview allows for a better existence in the future.

The biggest enemies of sustainable agriculture are ignorance and apathy. A majority of the world's population has little or no direct contact with anything outside of an urban setting and hence does not see or appreciate the effects of their actions. Richard Louv (2006) writes in the introduction to his book *Last Child in the Woods*, "Our society is teaching young people to avoid direct experience in nature. That lesson is delivered in schools, families, even organizations devoted to the outdoors..." A large portion of people are disconnected from the natural world, and as such they are disconnected from the impacts and changes to the natural world occurring around them. Before the term sustainability was even coined, Aldo Leopold in *A Sand County Almanac* and John Storer in *The Web of Life* wrote about soil quality and natural cycling of nutrients. These individuals were not only scientifically interested in the nature they wrote about, they were bound by a love of nature and a desire to spend time with and experience it. Many of today's young people are detached from the natural world, and thus possess an apathy that creates little appreciation for or understanding of natural systems.

It is here that the challenge of promoting sustainable agriculture is fully apparent. If people do not have the basic knowledge of how the world works and a feel for the ecological impacts of their actions, they will not only fail to understand what sustainability means, they will not care and will hence be far less likely to make the changes and sacrifices needed to attain and support sustainable agriculture. Hopefully once young people realize that it is not just penguins and sea turtles that are on the line, they will begin to take their own actions into account.

The Gap

Since the industrial revolution and the popularization of the mechanistic worldview, the urbanization of the world's population has created a polarization between consumers and agricultural producers. Consumers have become completely disconnected from the food they consume and the impacts they are having by the miles of road traveled by products they use, the series of factories that alter their appearance and an armor of cellophane that holds the product on the market shelves. We cannot continue this trend; youth must not only understand agriculture, but its impacts and their connectedness to it as well. Once this is established in the minds of young people, they will naturally accept

sustainable agriculture. Educating people on the benefits and practices of sustainable agriculture is something that must be addressed on two levels. The first to be addressed is the level of the consumers, those who will never spend any significant time on a farm, and the producers, those who live on a farm or make a living through agriculture. The business of agriculture, like any other, is driven by consumers. If we are to achieve sustainability, the consumer must be aware of the impact that sustainability, or a lack of it, has on our health, prosperity, and ultimate survival.

Ending the Ignorance

In a study of Iowa middle-school children conducted by Iowa State University in 1992 and 1993, children demonstrated skewed and stereotypical views of agriculture and its importance to daily lives (Holz-Clause and Jost, 1995). Children recognized that agriculture produced food, primarily grains and vegetables. But wider and more overreaching issues of genetic engineering, research, and the effects on the economy were rarely mentioned by the children as relating to farming. Farmers are viewed "…as wearing bib overalls and chewing on a straw." Needless to say, public knowledge of agriculture is fairly lacking among children and young adults. Children without backgrounds in agriculture showed little interest in farming and agriculture. This survey brings to light the ignorance of youth and the public in general. Combine the detrimental opinions of farming with a school system that fails to teach children science, math, and geography, and the outlook is bleak for the promotion of sustainable agriculture. But while this lack of knowledge can be seen as a problem, it can also be utilized as an opportunity.

Many studies on the advantages of using agricultural examples within education suggest that an agricultural approach to topics such as science allow for vast improvements above standard methods of education in both rural and urban children (Mabie and Baker, 1996; Balschweid, 2001). For example, the study done by Mabie and Baker demonstrated an increase of observational ability within 37% of students when given a task after rearing chicks, watching seeds germinate, and baking bread. Studies also show significant interest in science when utilizing agricultural scenarios for experimentation. Many programs have been created in the United States, such as Wisconsin's *Toward a Sustainable Agriculture* (CIAS, 1991), and the USDA's Agriculture in the Classroom website (www.agclassroom.org), containing lesson plans and tools for both students and teachers.

Though resources and examples abound there is little motivation for teachers to teach things that are viewed as outside the curriculum handed them by the school or government (Kauffman, 2005). The topics of agriculture and sustainability are both relevant to children and are helpful in creating a better understanding of the world at large, but because they are not seen as being within curriculums or within areas of interest to teachers there is little push to have them taught. What is necessary is a wholesale introduction of these topics into the educational system, rather than simply isolating the study of agriculture to rural students pursuing agriculture as a vocation.

The concept of sustainable agriculture is not one that stands alone. It is tied to many concepts currently studied by students but needs to be augmented and highlighted to foster a holistic view of the world and an understanding of ecological systems. One does not have to posses an in-depth knowledge of agriculture to understand these principles and tie them to the world at large. Chemistry classes should discuss and emphasize soil and pesticide chemistry. Biology classes should look at agroecology and discuss trophic relationships of animals, explaining how certain foods are naturally more energy intensive than others. Geography classes need to teach the distribution of agriculture across the world and foster an awareness of how the world's water supply is allocated and used.

One exemplary program that uses agricultural context to emphasize concepts taught in the classroom is The Edible Schoolyard program of Martin Luther King, Jr. Middle School in Berkeley California (www.edibleschoolyard.org). The program, spearheaded by chef and organic food aficionado Alice Waters created an organic garden complete with chickens for snail and insect control as well as eggs, and composting on the school's grounds. The garden serves as a laboratory in which the school's children have lessons on a myriad of subjects that include topics such as composting, plant biology, and ecology. Everything taught in the garden is an extension of the regular curriculum and is reinforcing as opposed to extraneous. The garden gives the school a format to teach hands on science lessons, provides each class with a box of fresh produce every week, and allows for special events such as sherbet and pizza making, utilizing the resources of the garden.

Concepts pertaining to sustainable agriculture also need to be explored in the context of social science classes. History and social science classes can be used to demonstrate that the industrialized input-output farming of today is a product of the industrial revolution and has only come to fruition within the last several decades. Agriculture cannot be integrated into the classroom unless there is a top down recognition of the issues and an implementation of them by governments and boards. Individual teachers can attempt to demonstrate the ecological worldview to children, but in order for it to become mainstream, it needs to be supported and integrated in schools nationally.

By getting children interested in agriculture and engaged with the food system we create an environment where individuals are reconnected to the natural world and to the farm. If we can reconnect individuals with their food and with the environment we can rekindle interest and excitement.

Beyond K-12; Into Careers

Sustainability education should continue beyond the scope of the secondary school system and reach into the college classroom. Sustainability has an effect on many careers usually unassociated with agriculture. Fields such as engineering, economics, and dietetics all play a role in assessing the problems of modern agriculture and have places in bringing about sustainable systems. For those interested in chemistry, biology, and other sciences, sustainability creates a complex and tantalizing puzzle to be studied. Even though these individuals may not have backgrounds in agriculture, they can impact agricultural practices from within academia. Many of the biggest innovations in agriculture of the past several

decades have come from academics studying these topics in a laboratory and then taking then into the field as an application for farmers. For example, transgenic varieties of plants have been pioneered and studied by academics with dramatic impacts on the way agriculture has been practiced (Horrigan, Lawrence, and Walker, 2002). Research has been conducted on everything from pest management (Bird and Brewer, 2006; Norris and Cogan, 2000) to fertilizer inefficiencies (Tilman, 1998) allowing for more information and new ideas to further sustainability. We are in the midst of a biotechnological revolution and sustainability will have a part in it. Academically minded people can help to play a role in the paradigm shift needed to move towards sustainability, away from a mechanistic worldview in agriculture and elsewhere. Sustainability must be marketed not just to those who will work in agricultural settings, but to those who will help to study its impacts and the methods that will make it work. It will also be considered by the engineer designing water and fuel-efficient farm implements, the economist studying externalities, or the dietician dealing with the homogeneity of the modern diet. The concepts of sustainability cross over into many fields, the realm of the university system is a perfect locale to demonstrate how sustainability affects everyone.

Outside The Walls

More education needs to occur outside of the classroom as well. Many of the organizations and opportunities stereotypically utilized by rural youth can also be enjoyed by a less agrarian segment of society. Activities such as 4-H and county fairs need to involve children and youth from farming communities as well as urban youth. Showing livestock such as rabbits, chickens and dogs can get youth not associated with farms involved in understanding livestock rearing and markets. This knowledge can translate into understanding the differences between traditional livestock rearing and free range practices today, allowing people to develop informed opinions on these practices, thereby encouraging individuals to make personal steps as consumers to support sustainable farming practices. People are much more likely to make and support changes in their lives if they are knowledgeable of the effects and ramifications of both action and inaction.

4-H programs need not be limited to livestock rearing and showing: there is also a great need to instruct children and youth on growing and producing plants for food or other use. Youth can create backyard or school gardens to help produce food or flowers for show at fairs and utilization as supplemental food. Urban gardening shows much promise and can have a huge impact on food systems. Michael Ableman, the director of The Center for Urban Agriculture, estimates that urban gardens can contribute 15 times more food per acre than rural counterparts. Many large cities outside of the United States such as Berlin, Germany and Accra, Ghana already utilize urban agriculture. The tools and knowledge created through these experiences can help youth have the knowledge to start growing some of their own food as well as creating a respect for present food systems. These programs are great doorways into agricultural careers and can help to alleviate general agricultural illiteracy.

Feeding the Giant

On the other side of the market-gulf of agriculture is the producer. Consumers, ignorant and separated from the agricultural system, constantly demand more of a smaller variety of products while expecting lower prices. This forces agriculturalists towards large, seemingly efficient monocultures. Like any other business, the farm is concerned with profit margins and bottom lines. Because industrial agriculture can appear to be more profitable, with the cost and risk of transitioning to more sustainable practices seemingly prohibitive, many farmers remain skeptical of sustainable agriculture.

Mind The Farm

Most individuals connected to agriculture are involved with family farms. Approximately 90% of the nation's farms are owned by individuals or families (USDA, 2002). But in recent times the trends have shown that consolidation of farms is becoming common, allowing for a smaller portion of individuals to have greater control over the nations land and food production (MacDonald et al, 2007). Between 1997 and 2002 the number of farms over 2,000 acres increased by 3,544, while the number of farms between 50 and 180 acres decreased by 35,784 farms (USDA, 2002). Of these farms 79% are run and owned by individuals over the age of 45 (USDA, 2002). This means that within several decades a large portion of the nation's farms will be changing hands as these farmers age and retire. Trends demonstrate that in all likelihood these farms will be consolidated or utilized as large industrialized farms unless a younger generation of farmers is willing to take over the industry. This demonstrates the greatest challenge within the agricultural community in relation to sustainable agriculture. If sustainable agriculture is to be successful, model farms would consist of smaller, locally owned and supported enterprises. The large-scale industrial farm would be less conducive to sustainability. These smaller farms are only possible if we can convince younger farmers to take on the challenge. Sustainable agriculture represents an industry different than that which many of these youth are accustomed. If we can demonstrate to them the higher quality of life that can be achieved through sustainable agriculture, these trends can likely be reversed.

Knowledge is Power

In the K-12 classroom, the needs of children who hope to work in the agricultural sector are identical to those who will never work in it at all. Knowledge of chemistry, biology, and economics is needed to understand the issues sustainability attempts to address. If one does not have the knowledge of earth science, how can one comprehend climate change? Once this general foundational knowledge is established youth can understand how the agriculture they are involved in can affect their surroundings But if these connections are not made, the default action is for the process of mechanized, large scale agriculture prevalent today to continue unabated.

The agriculturally minded youth would greatly benefit from education after high school with either technical school, college, or through an extension program. Statistics show that the number of rural youth who pursue college is 11% lower than urban youth who complete high school (USDA, 2003). This is attributed to the fact that many of the jobs available to rural youth can be attained by technical or vocational school, causing many of the youth to not seek college coursework. When they do, they quite often attain employment in urban areas, abandoning agriculture. This is the point at which land-grant universities and college level coursework in agriculture become important. These settings are important venues for topics such as organic farming, and can be used to introduce new sustainable methods. These youth within decades will most likely be the owners and managers of the nation's farms. If youth are educated properly and are aware of the ecological worldview, they will naturally gravitate towards sustainable agriculture and will be able to affect change in their family farms.

As with the non-agriculturally focused there needs to be programming outside of the school system that encourages sustainability. Whereas with urban youth the goal is agro-literacy, with rural youth the goal is a greater understanding of farming not only as a potential career, but as a way to shape the world. Organizations such as the National FFA and 4-H have a strong role in shaping the minds and decisions of youth. Youth-oriented agricultural organizations along with extension agents can help youth to understand the impacts their actions have and can impact their future paths when deciding whether or not to utilize more sustainable practices on their farms. These organizations also have the task of encouraging more youth to continue on in agriculture and slow the trend of farm consolidation by empowering younger generations to continue the work of their parents and grandparents by making a living in agriculture. For if these individuals can take over the industry with a knowledge and interest in running a sustainable business, our nation can take a huge step towards being more sustainable.

Synergy

Although the challenge is great, youth are the strongest candidates for promoting sustainability. Because sustainability speaks to the future and offers hope of security and permanence it naturally resonates with youth. When all of the elements are in place, the transition toward sustainable agriculture will become seamless and natural. A youth educated in science and economics, having an understanding and appreciation for our biosphere, and wishing to have a secure future will ultimately make proper choices as a consumer. For example, she might buy local produce and support local organic farms, allowing farmers to make a profit while farming sustainably. Local farm markets and organic vendors will be able to make good livings as the population learns to value this produce, willing to pay appropriate prices, closing the gap and ending the ignorance. This will go a long way toward alleviating the lack of communication, and shortening the distance between the farm and the dinner table. If this happens, the percentage of money spent per unit of food that reaches the sustainable farmer's pocket would be greater than that of an industrialized farmer, encouraging farmers to become more sustainable and

market their goods at a local level. If these farmers were educated along with the rest of the population in sustainable practices then this transition would occur seamlessly.

The popular knowledge is already slowly shifting toward sustainable practices. Organic food, once seen only as a fringe option for consumption, has moved from the shelves of the small health food store to being commonly available in supermarkets with comparable prices and choices (Kirschenmann and Bird 2006). This market change has been fueled by increasing the public awareness of the impacts purchasing makes and creates a demand for such products. All of these things occurred among a population that has relatively limited understanding of what things such as organic actually mean. When all of the pieces of the equation are together, knowledge of the status of the ecological health of the world at large, as well as the soils in our own back yards, combined with the knowledge and understanding of the roles and impacts of agriculture, gives rise to a synergistic effect, making sustainable agriculture the standard.

The Hope

In the past youth have impacted change in their lives and in their countries; the American social landscape is completely different today that it was even 50 years ago and there is hope. In the past, strong societal changes have been enacted by a young generation with a knowledge of the world and a strong sense of social responsibility. Both the ‘80s and the ‘90s passed with Generation X being placated with Metallica and the advent of the personal computer, influencing much change but little progress.

The children and young adults of today have that sense of social responsibility and are beginning to feel uneasy about the future. Because sustainable agriculture helps to address many of these issues, the children of today, and of future generations will be hard pressed to not pay heed to it. Because it has such an important role in altering our precarious position it is in an advantageous position to shape the future of tomorrow. If we can educate youth and make them aware of sustainable agriculture, as well as the faults and damage created by the mechanistic worldview, change will follow.

References:

1.) Ableman, M. *Agriculture's Next Frontier: How Urban Farms Could Feed the World.* http://www.fieldsofplenty.com/writings/frontier.php

2.) Balschweid, M.A. *Teaching Biology Using Agriculture as the Context:Perceptions of High School Students*. Proceedings of the 28th Annual National Agricultural Education Research Conference. 2001.

3.) CIAS (Center for Integrated Agricultural Systems). *Toward a Sustainable Agriculture: A Teacher's Guide*. CIAS. 1991.
(See also- http://www.cias.wisc.edu/curriculum/index.htm)

4.) Eswaran, H., Lal, R., & P.F. Reich. *Land Degradation: an Overview*. http://soils.usda.gov/use/worldsoils/papers/land-degradation-overview.html

5.) Horrigan, L., Lawrence, F.W., & Walker P. *How Sustainable Agriculture can Address the Environmental and Human Health Harms of Industrial Agriculture*. Environmental Health Perspectives. 2002.

6.) Holz-Clause, M. & Jost, M. *Using Focus Groups to Check Youth Perceptions of Agriculture*. http://www.joe.org/joe/1995june/a3.html

7.) Ikerd J. *Economic Analysis and Multiple Impact Valuation Strategies*. In C. A. Francis R. P. Poincelot, & G. W. Bird (Eds.), *Developing and Extending Sustainable Agriculture*. Hayworth Press. 2006.

8.) Kauffman D. *Curriculum Prescription and Curriculum Constraint:* Second-Year Teachers' Perceptions. http://www.gse.harvard.edu/~ngt

9.) Kimbrell, A. *Fatal Harvest.* Foundation for Deep Ecology. 2002.

10.) Kirschenmann, F., & Bird, G.W. Future Potential for Organic Farming: A question of Ethics and Productivity. In C. A. Francis, R. P. Poincelot, & G. W. Bird (Eds.), Developing and Extending Sustainable Agriculture, Hayworth Press, 2006.

11.) Leopold, A. *A Sand County Almanac*. Oxford University Press. 1949.

12.) Louv, R. *Last Child in the Woods*. Algonquin Books. 2006.

13.) Liebig, J.v. Chemistry in the Application to Agriculture and Physiology. John Wiley & Sons. 1872.

14.) Mabie R. & Baker B. *A Comparison of Experimental Instructional Strategies Upon the Science Process Skills of Urban Elementary Students*. Journal of Agricultural Education. 1996.

15.) MacDonald, J.M., O'Donoghue, E.J., McBride, W.D., Nehring, R.F., Sandretto, C.L., & Mosheim, R. *Profits, Costs, and the Changing Structure of Dairy Farming.* USDA Economic Research Report, 2007.

16.) McVay, K. *Soil Management in Sustainable Production Systems*. In C. A. Francis, R. P. Poincelot, & G. W. Bird (Eds.), *Developing and Extending Sustainable Agriculture*. Hayworth Press. 2006.

17.) Norris, R.F., & Kogan, M. *Interactions between Weeds, Arthropod Pests, and Their Natural Enemies in Managed Ecosystems*. Weed Science. 2000.

18.)Storer, J. *The Web of Life*. New American Library. 1956.

19.) Tiffany, E.M. *National FFA Creed*, 1930

20.) Tilman, D. The Greening of the Green Revolution. Nature. 1998.

21.) United Nations POPIN. *Population and Land Degredation (Annexes1-5)*. http://www.un.org/popin/fao/land/landanx.html

22.) USDA. *Agriculture in the Classroom.* http://www.agclassroom.org

23.) USDA. Census of Agriculture. US Data. http://www.agcensus.usda.gov/

24.) USDA, *Rural Education at a Glance.* USDA Rural Development Research Report. 2003.

25.) 4-H Youth Development Program. http://www.4-h.org/.

26.) The Edible Schoolyard. http://theedibleschoolyard.org

27.) National FFA. http://www.ffa.org/.

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