Social and Ecological Implications of Sustainable Agriculture

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Introduction

Globalization and the industrialization of agriculture over the past half-century have changed the composition and nutritional value of food cultures around the world. Rather than seeking out new technologies in the form of genetically modified organisms to increase our food security we, as a global community, might assess our attitudes and relationships with ourselves, each other and nature, adjusting our behavior to lead more sustainable lifestyles. Community supported agriculture and sustainable agriculture are exemplary methods of how this can be accomplished. This paper will explore the different methods of sustainable, community supported agriculture that are currently being employed worldwide and how they can be put into practice at larger scales in order to mitigate human impact on the environment while providing necessary sustenance and basic human interactions.

Artisanal forms of harvesting food are being abandoned in favor of corporately owned and operated methods of resource extraction that seek to maximize profit and yield at the expense of the environment. As a result consumers have become increasingly disconnected from the farmers, ranchers, and fishers who produce the food they eat. These changes however have given rise to global initiatives, such as the slow foods movement and community supported agriculture, which aim to increase the utilization of sustainable agricultural techniques and the reinstatement of local food systems.

Small and large-scale implementation of sustainable, community-based agriculture is being conducted throughout the globe; from Cuba to Africa to East Lansing. Through the use of case studies and empirical evidence this paper will investigate how a shift from the current global-industrial model of agriculture to a locally-based sustainable model can increase food security and assist in alleviating pressures associated with environmental degradation and energy consumption. Sustainable agriculture, when applied in the context of local food systems, may diminish the amounts of environmental pollutants emitted without compromising the ability to produce suitable amounts of food. Furthermore, regionally grown and consumed foods are less susceptible to economic and climate variations than their industrial counterparts due to the decreased dependence on long-distance delivery systems. These types of systems also have the potential to bring communities closer and stimulate regional economies while preserving traditional food cultures.

Industrial versus Sustainable Agriculture

Koc et al. (1999) identified four major challenges to food security, the first of which is growing urban populations worldwide. It is predicted that by the end of this century over half the world's population will live in urban centers, further stressing urban food availability and competition for space. Furthermore, the growing commodification of the agrifood system is increasing the physical and psychological distance between urban dwellers, nature and the people who produce their food. This has led to a lack of understanding among urban residents regarding how their food is produced and transported as well as to the effects that industrial agriculture is having on the environment. Additionally, the current food systems of many developed nations lack the ability to respond to the diverse social and cultural mosaic of large cities. Supermarkets are often located in suburbs, out of reach of the poor, those who depend on public transportation, the elderly, and individuals with disabilities. This is directly related to what is perhaps the most prevalent issue concerning food security; uneven access to food.

Sustainable agriculture and local food systems are emerging as methods by which individuals and governments are dealing with environmental degradation, food security, and dependence upon non-renewable resources. Sustainable agriculture does not refer to a prescribed set of practices; rather it challenges producers to consider long-term implications of their actions. A key goal of community supported and sustainable agriculture is to understand agriculture at an ecosystem level where nutrient and energy cycling, plant and animal interactions, and biological pest control are all managed in order to balance community and consumer needs (Horrigan et al. 2002). In order for the benefits of low-impact agriculture to be felt however, there must be a large-scale shift from the current industrial model of agriculture, backed by governments and citizens alike. This will require changes in policies, values, attitudes, and behaviors across cultures and national boundaries.

The modern global food system is deeply flawed and extremely illogical. Humans have practiced agriculture for over 10,000 years, but within the last fifty years or so farmers have become increasingly dependent upon the input of synthetic chemicals, equipment that consumes fossil fuels, and genetically modified seeds in order to maximize yield (Horrigan et al. 2002). The success of modern agriculture in recent decades has often masked significant externalities, affecting natural capital, human health and agriculture itself (Pretty & Hine 2001). Chemical runoff, soil erosion, groundwater depletion, wildlife habitat destruction and economic inequality are just a handful of the unintended consequences associated with intensive industrialized agriculture.

Since 1945 synthetic fertilizer and pesticide use in the United States has risen tenfold, now accounting for roughly 15% of total worldwide pesticide usage. Runoff from these agrochemicals is polluting the air, water, and soil as well as threatening human health. It is estimated that only 0.1% of pesticides applied actually reach target pests, leaving the rest to leach into the surrounding environment. Non-target species such as honeybees can suffer large declines in populations and, considering that they provide $10 million in projected ecosystem services, it is important to reflect on the economic significance

of not only bees but other ecosystem services that are being degraded (Horrigan et al. 2002). Additionally, agrochemical runoff can result in the pollution of surface and groundwater, which are already stressed under industrialized agricultural practices.

Agricultural irrigation accounts for more than 70% of the world's total water usage, compared with 7% used for municipal purposes. Moreover, The U.S. government estimates that 70% of the pollution in the country's watersheds is due to agricultural runoff (Horrigan et al. 2002). Groundwater is being withdrawn faster than it can be recharged and with less than 1% of the world's water being potable, industrial agriculture is not only threatening food security, but also water security (Infante 2009). In general, industrial agriculture does not require the same intimate knowledge of crop conditions on the farmer's part as sustainable agriculture (Rosset 1997). Consequently, many crops are overwatered to the point that crops only use about 45% of the irrigated water, while the rest leaches pollutants into watersheds or saturates the soil to the extent that growth is actually inhibited. This can be particularly devastating to large monocultures which do not have the same wide range of tolerance that mixed sustainable farms tend to have. In this way monocultures also become more susceptible to drought and floods as well as disease and pest outbreaks (Horrigan et al. 2002).

In response to the industrialization of agriculture and the negative impacts that have come along with it, there has been a movement toward community-based and sustainable agriculture, where producers and consumers become more socially and economically connected. Pretty & Hine (2001) found that there are around 8.98 million farmers practicing sustainable agriculture on roughly 28.29 million hectares of land worldwide. Sustainable agriculture is part of a much larger global ideology of sustainable development which: recognizes that resources are finite, places a limit on economic growth and encourages equity in resource availability (Horrigan et al. 2002).

Local food systems offer long-term sustainable solutions, for the environment and for local and regional economic development. By linking production activities directly to consumers in rural and metropolitan areas, local food systems can reduce greenhouse gasses and other pollutants caused by long-distance transportation and storage. They can also reduce the vulnerability of food-supply chains to the impacts of weather and market-related supply problems to which industrial agriculture is more susceptible (Koc et al. 1999).

Sustainable agriculture has many characteristics which set it apart from modern agriculture, principally the dynamic, system-wide approach to farm management and food system issues (Horrigan et al. 2002). Pretty et al. (1996) describe sustainable agriculture as a system which pursues,

> "a thorough incorporation of natural processes, such as nutrient cycling; a minimization of the use of external and non-renewable inputs; participation of farmers and consumers in all processes production; equitable access to resources and opportunities; increase in self-reliance amongst farmers and communities."

These principles go in the face of most of the previously mentioned practices of modern industrial agriculture and consequently there is much resistance to large-scale conversions to sustainable agriculture.

The sale of hybrid seeds, synthetic fertilizers, and machinery which consume fossil fuels is a very profitable business and as such there are those who stand to lose a significant amount of wealth if industrial agriculture goes by the wayside. In the United States for example, agricultural lobbyists contributed more than $24.9 million to presidential and congressional candidates in the 1992 election in return for advancing the interests of the industry (Allen 1999). The distribution of wealth has become increasingly disparate, favoring big business over family owned farms. Between 1910 and 1990, the amount of profit going to farmers declined from over 49% to less than 9%, with the majority going to multinational corporations. This reduction in profit forces farmers to either increase the scale of their operation or farm their land more intensively with unsustainable methods (Horrigan et al. 2002).

In addition to resistance from corporations, there is hesitation from farmers who may feel that sustainable agriculture may not provide adequate income. Delate et al. (2002) demonstrated that organic farms which produce their own compost and manure are more economically competitive than conventional forms of agriculture. Soybean yield in particular was significantly higher in systems which adhered to organic farming principles. Owing to the fact that soy is already an important monoculture, farmers might examine the type of mixed-crop methods detailed in the study to produce soy for biofuel production while benefiting from the inter-planted food crops.

A lack of adequate infrastructure in most areas is also preventing the large-scale implementation of sustainable and community supported agriculture. Current market and transportation structures favor goods produced by industrial agriculture whose costs are kept low due to subsidies, making it nearly impossible for sustainable products to compete on the open market. Low prices at the grocery store may give consumers a false sense that food comes cheap. These prices do not reflect the cost of cleaning up farm pollution for example, or the cost of vast government subsidies which contribute to the low price tag (Horrigan et al. 2002).

Kingsolver (2007) points out that many consumers complain about the higher price of local and organic foods as compared with industrially grown foods. In the U.S. there is a national subsidy which supplies the industrial agriculture sector with a minimum of $80 billion dollars or about $725 per household annually. These subsidies are used for the mitigation of things such as food- related illnesses, agrochemical cleanup, nutrient loss due to soil erosion, and collateral costs of pesticide use. Because of these subsidies consumers do not see the true environmental and health costs of industrial food production and tend toward purchasing the less expensive goods (Kingsolver 2007). In order for sustainable and organic agriculture to have a chance on the open market equal subsidies must be supplied or subsidies should be removed altogether.

Critics of low-impact agriculture claim that the notion of feeding the world's hungry with sustainable methods is naïve and elitist, pointing out that it is massive amounts of monoculture grains which are providing nourishment (Kingsolver 2007). They fail to recognize however that industrial agriculture is not feasible over the long-term in developing nations due to the high cost of synthetic nutrients and pesticides which

become necessary inputs. Sustainable agriculture on the other hand provides empowerment to impoverished and rural communities while also delivering many non-food functions that cannot be produced by other sectors such as in situ biodiversity, groundwater recharge, urban to rural migration and greater social cohesion (Pretty & Hine 2001).

National, Regional, and Local Approaches

The country of Cuba provides a valuable case study by which the rest of the world can learn from and use to adapt its own models of sustainable agriculture. Prior to 1989 Cuba relied heavily upon the international socialist economy for the majority of its resources. At the time the former Soviet Union was paying Cuba 5.4 times more than the global average price for sugar, which was being produced on large, industrial monoculture plantations (Rosset 1997). These plantations required the import of farm equipment, fossil fuels, and synthetic inputs in order to maintain a practical output. The income generated from this trade however allowed Cuba to improve living standards and increase human capital. Though Cuba only makes up 2% of Latin America's population, it has 11% of its scientists, a result of the industrially dependent monoculture outputs. This capital proved to be a crucial asset in rebuilding the nation after the collapse of the socialist bloc (Altieri et al. 1999).

Following the fall of the Soviet Union, Cuba, which had relied on imports for 60% of its food, was faced with a crisis. The sugarcane monocultures which had allowed Cuba to prosper previously turned out to be an initial obstacle. 95% of the pesticides and fertilizers used to grow the sugarcane had been imported to Cuba, thus after trade ceased in 1989 Cuba could no longer produce its largest export. In its previous model of agriculture, the same group of workers was never responsible for the same plot of land throughout a growing season, resulting in a lack of accountability or recognition for one's work. As a result the government had to completely restructure the nation's agricultural sector (Rosset 1997).

Urban residents, in response to the looming crisis, took part in a grassroots movement to produce their own food. Families converted whatever open spaces they could find to gardens and when laws concerning the sale of garden food were relaxed many families were able to supplement their income by selling excess produce. The Cuban government now considers these gardens to be an integral part of the country's food system and encourages families, schools, and other local organizations to take part in urban agriculture (Altieri et al. 1999).

During the initial period following the fall of the socialist bloc, the Cuban government was developing methods by which it could regain food security for its citizens using domestically available resources. The collective human capital of Cuba, not just that of the educated, allowed for the growth and improvement of sustainable agriculture techniques across the country. The state initiated a large-scale conversion of farmland from industrial agriculture to low-input, self-reliant agriculture complete with biofertilizers and biological pest control. 80% of the land once owned by the state for

sugar production is now cooperatively owned and operated among communities and organizations (Rosset 1997).

Out of a desperate situation came a self-sufficient, low-impact, agrarian-based economy which the World Wildlife Fund considered to be the only sustainably developing country in the world (WWF 2006). Other countries of the world need not wait until they are faced with a similar crisis. Turning to low-input, sustainable food systems in the same large-scale manner as Cuba will afford more countries greater levels of food security and overall ecosystem and human health. Pretty & Hine (2001) demonstrated that sustainable agricultural practices such as crop rotation, cover crops, low-till/no-till farming, and integrated nutrient management can have dramatic effects on crop yields. Over their four year study they found that of the sustainable farms surveyed there was an increase of 75-150% in output over conventionally grown crops. More governments and intergovernmental organizations must recognize that they are guilty of having implemented policies that have undermined agricultural productivity and destroyed national food security, adjusting national policies accordingly (La Via Campesina 2008).

Indeed, there are many nongovernmental and government-assisted programs aiming increase food security and reduce regional impacts on the environment. The Cheha Integrated Rural Development Project in south-western Ethiopia is a prime example of how small-scale initiatives can work to improve regional food security. Since 1984 about 12,500 farming households have taken up sustainable techniques, increasing crop yield by 60% and nutrition levels by 70% in the area. The participating households have since been able to make money off excess crop production, making their adherence to their sustainable model more likely (Pretty 1999).

Community supported agriculture (CSA), which originated in Japan and Europe, is gaining momentum in the United States as a means by which individuals and communities may live more sustainably. CSA shortens not only the physical distance between producers and consumers, but also the psychological distance. Rather than consuming remotely, anonymously produced food, shareholders are directly connected to a piece of land and the individuals who rely upon it for their livelihood. Farmers, in return for investments, must actively engage stakeholders to maintain enrollment and thus ensure income. Most CSA farms require participation from stakeholders beyond payment and Cone & Myhre (2000) found that in general those who contributed more to the operation had a higher level of satisfaction.

Michigan State University's Student Organic Farm currently participates in a year-round CSA program where members purchase a share of the farm and in return receive weekly assortments of fresh produce. There are presently more than 50 shareholders and an extensive waiting list, demonstrating consumers' willingness to pay more in the short-term to conserve the integrity of the local environment. The program does suffer from the issue of uneven access to food. The size of the program and share costs make participation unavailable to low-income individuals and those without means to travel to pick up locations (MSU 2007).

The limitations of the programs in Ethiopia and East Lansing, Michigan are a reflection of the need for greater support from governments, communities, and individuals. As more people make the decision to buy locally and sustainably produced food, the market will be forced to respond to demands. Only when subsidies favoring corporations and industrial agriculture are abolished will the true potential of sustainable agriculture be realized.

Conclusion

The benefits of sustainable and locally-based agriculture are clear: improvements to natural capital including increased water retention in soil, improvements to water table levels, reduced soil erosion, increased soil organic matter, better carbon sequestration, stronger social organizations and ties at local levels, new rules and norms for managing collective natural resources, better connectedness to external policy institutions, and bottom-up management (Pretty & Hine 2001). This comes in stark contrast to industrial food production in which government and corporations tend to take an authoritative role, dictating most aspects of production. The structure of sustainable and local agriculture on the other hand increases human capital allowing for greater regional capacity to solve problems, increases empowerment among formerly marginalized groups, increases the status of women, provides better child health and nutrition, as well as more local employment. Incentives such as these increase the likelihood that social processes related to sustainable agriculture and development will persist (Pretty & Hine 2001).

If global populations continue to increase at exponential rates while consumption habits remain unchanged, humans will undoubtedly be faced with food, water, and land shortages. Unfair subsidies and government procedures which favor industrial agriculture must be eliminated so that sustainably produced goods may have equal opportunities to compete on the market. While under current practices it may cost more for free-range animal products and organic produce, it far outweighs the consequences of industrial food production.

In the mean time, small, personal acts can have profound impacts on these issues. One is reducing meat consumption. To produce 1 pound of feedlot beef requires about 2,400 gallons of water and 7 pounds of grain. Considering that the average American consumes 97 pounds of beef each year, even modest reductions in meat consumption in such a culture would substantially reduce the burden on our natural resources (Horrigan et al. 2002). Furthermore, if every U.S. citizen were to consume one meal a week composed of locally and organically raised meats and produce, the nation's oil consumption could be reduced by over 1.1 million barrels of oil weekly (Kingsolver 2007). Slight changes in dietary habits can make an immense difference on the environment.

References

Allen, P. 1999. Contemporary Food and Farm Policy in the United States. Pages 177-181 *in* Koc, M., R. MacRae, L. J.A. Mougeot, and J. Walsh [editors]. For Hunger-Proof Cities. International Development Research Centre, Ottawa.

Altieri, M. A., N. Companioni, K. Cañizares, C. Murphy, P. Rosset, M. Borque, and C. Nicholls. 1999. The greening of the "barrios": Urban agriculture for food security in Cuba. Agriculture and Human Values 16:131-140.

Cone, C.A. and A. Myhre. 2000. Community-supported agriculture: A sustainable alternative to industrial agriculture? Human Organization 59(2):187-197.

Delate, K., M. Duffy, C. Chase, A. Holste, H. Friedrich, and N. Wantate. 2002. An economic comparison of organic and conventional grain crops in a long-term agroecological research (LTAR) site in Iowa. American Journal of Alternative Agriculture 18: 59-69.

Horrigan, L., R. S. Lawrence, and P. Walker. 2002. How Sustainable Agriculture Can Address the Environmental and Human Health Harms of Industrial Agriculture. Environmental Health Perspectives 110(5):445-456.

Infante, Dana. Human Water Demand in this Globalizing World: Impact of Water Use on Natural Resources with a Focus on Groundwater. Michigan State University, MC/FW 481 Global Issues in Fisheries and Wildlife. Available: http://angel.msu.edu/login.aspx (April 22, 2009).

Kingsolver, B. 2007. Animal, vegetable, miracle: A year of food life. HarperCollins Publishers, New York.

Koc, M., R. MacRae, L. J.A. Mougeot, and J. Walsh [editors]. 1999. For Hunger-Proof Cities. International Development Research Centre, Ottawa.

La Via Campesina. 2008. Food Crisis in South East and East Asia. International Seminar on Food Crisis in Seoul, South Korea, August 2008. Available: http://viacampesina.net/downloads/PDF/Booklet_Food_Crisis_ENGLISH.pdf (April 30, 2009).

Michigan State University. 2007. Student Organic Farm. Available: http://www.msuorganicfarm.org/about.htm (April 2, 2009).

Pretty, J. N. 1999. Can Sustainable Agriculture Feed Africa? Environmental Development and Sustainability 1:253-274.

Pretty, J. N., and R. Hine. 2001. Reducing Food Poverty with Sustainable Agriculture: A Summary of New Evidence. Final Report from the SAFE-World Research Project. Essex University, Colchester, England. Available: http://www.essex.ac.uk/ces/esu/occasionalpapers/SAFE%20FINAL%20-%20Pages1-22.pdf (March 30, 2009).

Pretty, J. N., J. Thompson, and F. Hinchlcliffe. 1996. Sustainable Agriculture: Impacts on Food Production and Challenges for Food Security. International Institute for Environment and Development, London.

Rosset, P. M. 1997. Alternative agriculture and crisis in Cuba. Technology and Society Magazine 16(2):19-25.

World Wildlife Fund. 2006. Living Planet Report: 2006. Available: http://assets.panda.org/downloads/living_planet_report.pdf (March 30, 2009).