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„An Analysis of the History of Industrial Agriculture, its Environmental Impacts, and Sustainable Alternatives in the United States“

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Jennifer Smith

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Abstract English:

Under the auspices of three different Food Regimes, a combination of political, economic, and social transitions over the last century and a half have led to a rapidly growing human population, diminishing energy reserves, and a food system that is environmentally and socially unsound. Today, agriculture is dominated by transnational agribusiness, whose methods of production and distribution include environmentally harmful practices such as heavy use of fossil fuels, fertilizers and pesticides, monocrops of transgenic seeds, and factory farms. These developments are damaging to ecosystems and human health. In order to mitigate these effects, it is necessary to work towards a global restructuring of the agriculture system. Food policies that support organic, local, and small-scale agriculture need to be developed at the national and global level. As consumers, it is important to eat lower on the food chain and avoid industrial products as much as possible. These actions will help to preserve energy and mitigate pollution while ensuring food security and sovereignty throughout the world.

Abstract German:

Unter der Schirmherrschaft von drei unterschiedlichen Nahrungsmittelregimen führte eine Kombination von politischen, ökonomischen, und sozialen Veränderungen während der letzten 150 Jahren zu einer schnell anwachsenden menschlichen Population, schrumpfende Energiereserven, und zu einem Narhungsmittelsystem, dass weder sozial- noch umweltverträglich ist. Heute wird die Landwirtschaft von transnationalen Agrarkonzernen beherrscht, deren Methoden der Produktion und Verteilung umweltgefährdende Praktiken beinhalten, wie hohe fossile Brennstoffverwendung, Dünger und Pestizide, Monokulturen von transgenen Saatgut und Fabriksfarmen. Diese Entwicklungen beschädigen sowohl die Ecosysteme als auch die menschliche Gesundheit. Um diese Effekte zu lindern, ist es notwendig an einer globalen Restrukturierung der agriculturalen Systeme zu arbeiten. Es müssen auf nationaler und globaler Ebene Nahrungsmittelpolitiken entwickelt werden, die organische, lokale Nahrungsmittel und kleine landwirtschaftliche Produktionen fördern. Für Konsumenten ist es wichtig auf einer niedrigeren Ebene der Produktionskette zu konsumieren und industriell gefertigte Produkte soweit es geht zu meiden. Diese Aktivitäten werden helfen Energie zu sparen und die Umweltverschmutzung zu lindern, während sie Nahrungsmittelsicherheit und Souveränität überall in der Welt gewährleisten werden.

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Chapter One: Introduction

Food, one of the most important essentials of life, is one of the world's largest industries. The land on which food is grown is also where people care for their economic, social, and environmental health (Weber 2009, p.17). However, as the human population continues to grow rapidly in the twenty-first century, so does the strain on the natural resources used for food and energy. The United States Census Bureau estimates that there are just over seven billion people living on Earth. With a growth rate of 1.1% recorded in 2011, the global population is expected to reach between nine and ten billion by 2050. As a result, producing food for the world population will be a monumental challenge in the near future. Many argue that we are already in a state of overpopulation in regards to our ecological demands on the Earth and its sustainable carrying capacity. Moreover, the same agricultural developments that created a plethora of food in the twentieth century have over the years weakened ecosystems so much that it is uncertain how long current output can be sustained, let alone how we will manage to feed ten billion people by mid-century (Roberts 2008, p.xii).

The combined interaction of several political, economic, and social processes that began in the mid-nineteenth century fostered today's global agricultural crisis. These include industrialization, urbanization, and the consolidation of agribusiness. Economic policies which led to the rise of global capitalism and progressive liberalization of trade also coincided with the transition to fossil fuels as a primary

source of energy for agriculture, transportation, and industry. These developments fundamentally transformed food production, distribution, and consumption.

The industrialization and corporatization of the food system distanced societies from their relationship with food and nature. In 1870, seventy to eighty percent of the United States population was employed in rural agriculture. By 2008, only two to three percent of Americans farmed for a living. Over this time period, the average farm size dramatically increased while the number of farms decreased. By the mid-1980s, over two-thirds of U.S. agricultural output came from less than one-third of the nation's farms (Conklin, Dimitri, and Effland 2005, pp.2-12). Local, small-scale agriculture was replaced in many parts of the world with the mass-produced, globalized, uniformity of industrial foods (Kiple and Ornelas, eds. 2000, p.1278).

The growing market power of agribusiness and supermarket chains in the early twentieth century led to less autonomy in the food system as well as the disappearance of direct links between producer and consumer. Today, a select few petrochemical and biotechnology corporations supply most of the seed, fertilizers, and pesticides used in the world. In the United States, the major commodities - wheat, corn, and soy - are controlled by just four companies. More than eighty percent of the U.S. meat supply is also managed by only four firms (Cook 2012, p.1). According to Wendell Berry, an influential American lecturer, activist, and farmer, this explains why the typical consumer in an industrialized country consequently no longer knows "that eating is an agricultural act...no longer...imagines the connections between eating and

the land...and is therefore necessarily passive and uncritical.” (Berry 1989, p.126)

The environmental impacts of industrial agriculture, which include water, soil, and air pollution as well as a loss of biodiversity, are significant and wide-reaching. Industrial food production disturbs the food chain at all levels through its artificial, fossil fuel-based inputs and its environmentally harmful outputs. Fertilizers, pesticides, and herbicides are known to have adverse effects on soil microbes, plants, and animals. Desalinization and loss of topsoil result in a decreasing amount of productive land available for agriculture. The development of transgenic seeds in combination with monocropping - growing one crop on vast amounts of land - also poses risks to plant and animal health. According to the United Nations Food and Agriculture Organization (FAO), the livestock sector, which constitutes a major part of food production, is one of the top two or three most significant contributors to the most serious environmental problems we face today (Steinfeld et al., 2006). Michael Pollan, a professor and food journalist in the U.S., justly states about this unhealthy cycle:

> ”When the health of one part of the food chain is disturbed, it can affect all the other creatures in it. If the soil is sick or in some way deficient, so will be the grasses that grow in that soil and the cattle that eat the grasses and the people who drink the milk from them.” (Pollan 2008, p.103)

The combined effects of overpopulation, unsustainable agricultural practices, and dwindling energy supplies are leading to irreversible environmental damage and food insecurity throughout the world. One of the most pressing challenges we will face

to ensure global food security for future generations is to overcome our dependency on petroleum products and to protect biodiversity and natural resources. Implementing sustainable practices, such as organic, local, and small-scale food production as well as eating less meat, will help mitigate the social and ecological impacts of agriculture and ensure the future productivity of the land.

Chapter Two: **Methodology**

This paper is based on analysis of prominent scholarly texts in the fields of history, sociology, and environmental science. It focuses on the United States, as it not only played an important role in the nineteenth and twentieth centuries in the industrialization of food production, but continues to be a leader in the twenty-first century in technological developments in agriculture as well as overall output. According to the International Monetary Fund (IMF), current agricultural production of the U.S. is the fourth largest in the world. The behavior of producers, consumers, and marketing firms in the U.S. therefore continues to have a large influence over global markets (Summer 2003, p.100).

The historical structural patterns that established current agricultural practices around the world are examined using the Food Regimes Theory. Developed by Harriet Friedmann and Philip McMichael, the theory conceptualizes the economic, political, cultural, and environmental forces which have collectively shaped food production and consumption over the last century and a half. A food regime can be understood as “an

international food order, a stable set of complementary state policies... and resulting patterns of consumption and trade." (Winders 2009, pp.125-158) This paper specifically examines three of Friedmann and McMichael's texts, *Agriculture and the State System - The rise and decline of national agricultures, 1870 to the present*; *Feeding the Empire: Pathologies of Globalized Agriculture*; and *Global Development and the Corporate Food Regime*. The transition to the current Food Regime, characterized by corporatization and neoliberal politics in the United States, is explored using two articles, *Cheap Food & Bad Money - Food, Frontiers, and Financialization in the Rise and Demise of Neoliberalism* and *Ecological Crises and the Agrarian Question in World-Historical Perspective*, written by Jason Moore. The changing relationship between humans, agriculture, and cities over the past century and a half is approached using Carolyn Steel's *Hungry City: How Food Shapes Our Lives*. The effects of industrial agriculture on human health and diet are well documented in Michael Pollan's book *In Defense of Food*.

After exploring how certain global socio-economic and political processes have influenced agriculture, specific developments in farming methods and their impacts on the ecosystem are examined. The effects of oil dependency, copious use of artificial fertilizers and pesticides, monocropping, transgenic seeds, and increasing meat consumption are each in turn discussed. Already in 1899, Karl Kautsky, an influential Czech-German journalist and Marxist theoretician, documented the ecological damage caused by agriculture's growing reliance on industry. In *The Agrarian Question*, Kautsky argues that human selection of the fastest growing, largest crops is

leading to increased risk of plant disease, pests, and crop failure. He also notes that soil is quickly becoming exhausted from intensive, industrial farming methods. Paul Roberts' book *The End of Food* is helpful in investigating why current methods of agricultural production and distribution are no longer compatible with the natural capacity of land. Roberts argues that the rise of agribusiness and industrial methods of growing food are leading to quickly diminishing reserves of fossil fuels, pollution of soil, water, and air, and outbreaks of deadly human and animal disease.

In order to prevent further ecological damage caused by industrial agriculture, this paper argues that it is necessary to revise U.S. and world food policy. Some solutions to ensure self-sufficiency and security, as well as a healthier relationship with our bodies and the environment, include developing policies to support organic and regional food production, distribution, and consumption. Solutions on how to combat the environmentally and socially destructive practices of agribusiness are offered by Horrigan, Lawrence, and Walker in *How Sustainable Agriculture Can Address the Environmental and Human Health Harms of Industrial Agriculture*. The authors argue that focusing on small-scale agriculture outside of the industrial sector will reduce fossil fuel use as well as the polluting outputs of the current system. Another important aspect of sustainable agriculture includes eating less meat, especially from industrial sources. The FAO and the United Nations Environment Programme (UNEP) contend that lowering meat consumption will help conserve resources and reduce pollution from agriculture.

To conclude, this paper looks at further questions about the state of agriculture today. It examines other possible alternatives to ensure more sustainability within the food system. These include but are not limited to further development of green energies such as solar, wind, geothermal, and tidal energies. Focusing on reducing human population growth, as opposed to simply increasing supply to meet demand, will also help ensure adequate energy and food supplies and sustainable agriculture practices.

Chapter Three: **Food Regimes Theory**

The Food Regimes Theory lends to contextualization of the role of agriculture in national development, industrialization, and the construction of a global capitalist economy. Friedmann and McMichael categorize three regimes, throughout which capital accumulation and certain geopolitical interests were associated with specific agricultural production and consumption patterns. The first of such, the Settler-Colonial Regime, began in 1870 and culminated in 1914. The second phase, the Mercantile-Industrial Regime, lasted from the end of World War II until the mid-1970s. The last regime, the Corporate Regime, began in the mid 1970s and continues to this day.

3.1 The Settler-Colonial Food Regime

The Settler-Colonial Regime emerged at the peak of British global supremacy. It was

centered on colonial organization and Atlantic trade between England and the Americas, which was consolidated after 1870. Three specific effects of government policy drove this regime: emigration from Europe, settlement on property converted from indigenous use to commodity production of European staple foods, and long-distance shipments of low priced wheat and meat (Friedmann 2005, pp.2-3).

In Europe, especially in Great Britain, the growth of booming cities and the massive expansion of a class of impoverished wage laborers at the end of the nineteenth century led to increasing demand for inexpensive, standardized products. With more than half of the British population living in cities by the 1870s, new efficiencies and economies of scale were needed to satisfy urban consumers' demands (Steel 2009, p.34). In order to supply cheap foodstuffs for a quickly growing population, Britain turned to countries such as Canada and the United States for use of resources (McMichael 2005, p.274). After forceful displacement of indigenous peoples from the land, specialized export regions were established (Friedmann 2005, p.2). Previously subsistence-orientated cropland was replaced by European wheat farmers growing grain for export or animal feed, as well as by cattle ranchers. This led to the global extension of agro-ecological control in the form of deeply commodified farms, plantations, and monocrops (Moore 2011, p.16).

Another defining feature of the Settler-Colonial Regime was the expansion of a simplified diet of wheat and beef. British capital investments in railways and shipping were made profitable by monoculture farming and exports of these commodities.

According to Michael Pollan, the introduction around 1870 of steel roller mills for grinding grain, more than any other invention, marked the beginning of the industrialization of food. He claims that refined wheat flour was actually the first fast food, a product that provided quick energy and lasted for months longer than ground-up whole grains (Pollan 2008, p.107). Refrigeration also allowed cheaply produced, unprocessed meat to be shipped across the ocean for the first time. In the twenty years after 1870, British meat consumption increased threefold, with most of the increase accounted for by imported meat (Steel 2009, p.14).

In order to secure a dominant position in the trans-oceanic market of these basic foods, Great Britain heavily promoted liberalization of trade, as well as a global monetary system based on its own currency. McMichael describes this model as “free trade imperialism”. During the nineteenth century, many industrialized countries and their colonies backed their currency to gold as a legal standard. Toward the end of the century, some of the remaining silver standard countries also began to peg their silver coin units to the gold standards of the United Kingdom. Britain was then able to gain access to the economies and colonial empires of rival European states by backstopping the gold standard and temporarily manipulating countries’ sterling balances in London to deepen the circulation of capital (Friedmann 2005, pp.2-3).

Through the incorporation of lands and resources from its settler-colonies, as well as the enactment of the sterling gold standard, Britain was able to expand cheap food supply chains across the world. The ability to procure meat and grain directly

from off-site producers through new preservation and shipping techniques also allowed food production to become a truly international process (Roberts 2008, p.18). The Settler-Colonial Regime thus saw Britain facilitating the first global capital market and establishing commercial dominance in the world economy (McMichael 2005, pp.274-276).

3.2 The Mercantile-Industrial Food Regime

As it was incapable of adapting to a global depression and two world wars, the Settler-Colonial Food Regime lasted less than half a century. It did, however, pave the way for the next reign of political and ecological control, as well as further expansion of capitalism. During the transition between regimes, British hegemony and free trade in agriculture succumbed to the growing power of the United States and its policies of embedded liberalism and heavily managed and protected agriculture (Friedmann 2005, p.4).

In the first few decades of the twentieth century, the U.S. government played a critical role in the growth of industrial, mass-scale agricultural production. In the 1930s, President Roosevelt's New Deal farm support programs aimed to feed the entire nation by providing the means for large, corporate farming, as well as by protecting farmers from crop failure and overproduction (Goodman and Redclift 1991, p.xii). This involved an influx of tractors, trains, and trucks on the farm. Mechanization allowed for crops to be grown on larger fields, as farming tasks could be done with a

speed and on a scale that was previously impossible.

Roosevelt's policies also supported the Green Revolution, a series of U.S.-led agricultural research, development, and technology transfer initiatives that occurred from the end of the 1930s to the 1970s (Hazell 2009, p.1). Working closely with the U.S. government, the Rockefeller Foundation, one of the richest and most influential non-governmental organizations in the world, proved to be an important agent in promoting novel agriculture science based on higher-yielding practices. The Rockefeller Foundation viewed rapid population growth as the main source of hunger and political subversion. Accordingly, the organization funded research into new agricultural techniques that increased global agricultural productivity. The Green Revolution's main initiatives involved the use of hybridized (controlled cross-pollinated) high-yielding varieties of seeds, irrigation, and synthetic, petroleum-based fertilizers and pesticides.

In order to convert countries throughout the world to the U.S. agro-export model, mass-food production and Green Revolution techniques were progressively globalized, first in Mexico and then in Southeast Asia. The Rockefeller Foundation supported programs based on Green Revolution techniques in Mexico in 1941, where the first high-yield, semi-dwarf wheat varieties were developed and grown. In 1956, the program was then taken to India (Dowie 2001, pp.105-106). This spread of new technologies to developing countries earned the name Green Revolution from William Gaud, the former director of the United States Agency for International Development

(USAID), who noted:

> "These and other developments in the field of agriculture contain the makings of a new revolution. It is not a violent revolution like that of the Soviets... I call it the Green Revolution." (Gaud 1968)

Beginning in the 1940s, the U.S. government enacted mercantile rules and practices in the agricultural sector. According to Friedmann, the foundation of the Mercantile-Industrial Food Regime was based on these heavy state-protectionist measures. The government set prices and conditions for domestic farmers, controlled the distribution and prices of food, and managed imports and exports (Friedmann 2005, p.4). Heavily managed and protected markets in the U.S., as well as the new emphasis on commodity programs, quickly led to a surplus of crops, for which the U.S. desperately needed to find new outlets (Winders 2009, 129-158).

As the newly established leader of the Western world after World War II, U.S. interests also included politically legitimizing a state-building process in the Free World, as well as attracting newly independent states to the U.S.-centered trading system. At the beginning of the Cold War between the Western world and the Communist world, the United States adapted a new regime of foreign and food policy. Seeing an opportunity in the political situation in Europe at the end of World War II, the U.S. developed the Marshall Plan in 1948. Marshall Aid provided industrial and agricultural assistance to Europe, forty percent of which consisted of food, feed, and fertilizers (Friedmann 2005, p.4). The Marshall Plan was very much linked to the

United States' desire to curb the spread of Communism throughout the world.

Later, as European markets recovered, the United States began to seek out additional markets to dispose of its enormous agricultural surplus. To this purpose, the U.S. instituted developmental aid, using food politically to create alliances and markets for its agribusiness (McMichael 2005, pp.274-276). The Agricultural Act of 1949 created the legal basis for donating surplus food to friendly foreign countries (Morely 2008, p.4). Senator Hubert Humphrey, one of the leading advocates of food-aid at the time, was known to have said:

> “And if you are looking for a way to get people to lean on you and to be dependent on you, in terms of their cooperation with you, it seems to me that food dependence would be terrific.” (Roberts 2008, p.119)

The U.S. also played a major role in the creation of international trade organizations that favored its agricultural policies. The General Agreement on Tariffs and Trade (GATT), for instance, was a multilateral agreement that regulated international trade. It was signed into law at the United Nations' Geneva Round of 1946. The initial objectives of the GATT were to promote “reciprocal and mutually advantageous arrangements directed to the substantial reduction of tariffs and other barriers to trade and to the elimination of discriminatory treatment in international commerce.” (World Trade Organization, 1968) It hardly proved to be mutually advantageous, however. The passage in 1954 of the bill PL480 in the GATT, which

supposedly promoted economic assistance for newly decolonized nations in Asia, Africa, and the Middle East, actually set the framework for agricultural dumping from the North. This refers to the selling or donating of agricultural surpluses to developing nations at prices less than the cost of production (Morely 2008, p.4).

The expansion of transnational food manufacturing and processing firms and the consequential vertical integration of the world food market were also important transformations of this time (Barkema, Drabenstott and Welch 1991, pp.25-26). By mid-century, growing access to land, labor, and markets in the global South had led to the development of corporate-driven, cross-border food supply chains (Friedmann and McMichael 1989, pp.94-95). Land that was previously used for local food production was bought up by large firms and converted to commodity production, mostly for export to wealthy nations. Companies exercised tight control over supplying farmers by providing them with their own brand of seed and laying down strict cultivation procedures (Harvey, Quilley, and Beynon 2003, p.17).

The growing power of food manufacturers and service industries, as well as the expansion of industrial food production, further transformed diets. While the Settler-Colonial Regime introduced a diet based on wheat and beef to the United Kingdom and North America, the Mercantile-Industrial Food Regime facilitated a complete globalization of these two commodities, as well as a manufactured diet based on fats and sweeteners, supplemented with starches, thickeners, and synthesized flavors. Many scientists and nutritionists agree that a nutritional regime of this sort does not

bode well for our health: four of the top ten causes of death today - coronary heart disease, diabetes, stroke, and cancer - are chronic diseases with well-established links to an industrial diet (Pollan 2008, p.10).

3.3 The Corporate Food Regime

By the mid-1970s, industry and technology had outgrown the mercantile framework. The U.S. also experienced its first trade deficit of the century. This led the nation to aggressively pursue agro-export. Agricultural policy was targeted at building new market shares and promoting international reliance on American exports (Foreign Policy in Focus, 1996). In the 1980s, U.S. agribusiness joined efforts to reduce governmental management and control of agricultural commodities in the developing world (Friedmann 2005, p.6). This led to a restructuring of the global food system into a Corporate Food Regime, characterized by unprecedented market power of agri-food corporations and the politics of neoliberalism. Neoliberalism involves enforcement of structural adjustment policies which include deregulation, the opening of markets, and the privatization of nationalized industries. Privatization comprises transferring ownership of an enterprise, public service, or property from the government to the private sector.

During the latter half of the twentieth century, the U.S. was a crucial advocate of international trade regulations whose objectives included moving towards a more liberalized trading environment, or free trade (Lee 2007, pp.1-3). The neoliberal

project that took shape during the 1980s strove to include food and agriculture within these trade agreements (Friedmann 2005, p.8). The Uruguay Round Agreements Act did just this. The Uruguay Round, the eighth session of multilateral trade negotiations within the framework of the GATT, lasted from 1986 to 1994 and resulted in the creation of the World Trade Organization (WTO). The WTO became the only global international organization dedicated to administrating the rules of trade between nations (World Trade Organization, 2012). In 1995, the WTO established the Uruguay Round Agreement on Agriculture, which brought food trade more fully under original GATT measures and allowed liberalization of international agricultural trade to proceed.

A consequential result of this was a shift in the site of food security from the nation-state to the world market. As one of the most influential nations in the WTO, the United States played a large role in redefining food security as smooth functioning of a world market (McMichael 2005, p.281). Whereas nations aspired for centuries to be self-sufficient in food production, the twentieth century saw centers of demand and supply increasingly becoming separated. The idea of autonomy in agriculture had become impractical in the business world, countering new ideas of globalism (Roberts 2008, p.19). In the WTO Agreement on Agriculture of 1995, it was announced that states no longer had the right to food self-sufficiency as a national strategy. The WTO's minimum import rule declared that all member states must allow imports of food up to at least five percent of the volume of domestic consumption. The WTO also stated in 2002:

> “History has shown that food security does not equal self-sufficiency of a country. It has more to do with international trade in food products that makes them available at competitive prices and sets the right incentives for those countries where they can be produced most efficiently... Food security nowadays lies… in a country's ability to finance imports of food through exports of other goods.” (Mendoza, 2002)

Developing nations were accordingly pressured during trade negotiations to exchange domestic food security policies for access to the world trade market and debt-servicing arrangements. In order to increase earnings, developing countries were encouraged to expand production of single commodities, such as coffee, sugar, cocoa, and bananas, mainly for export to the North (Friedmann 2005, p.9). Many developing countries also shifted manufacture and distribution from public channels to private outlets. The South opened its domestic markets to subsidized food from the North by liberalizing import quotas on raw materials. These types of demands increasingly became the conditions for receiving food aid from the IMF and loans from the USAID. In many cases, IMF structural adjustment programs and conditions of bank loans also restricted developing countries from spending their own resources on agricultural development and support for poor farmers (Polaski 2008b, p.4).

McMichael argues that these kinds of regulations have led to political decomposition of food sovereignty and global displacement of peasant cultures (McMichael 2005, pp.269-277). Farmers in developing nations, unable to compete with the influx of subsidized, below-cost staple foods, have lost domestic control of food production to large-scale agribusiness. Furthermore, countries and regions that

continue to specialize solely in monoculture crops for export have a very high risk of food insecurity from potential disruptions in transportation and crop failures. As prices of grain rise steeply as a result of population growth, a decline in production, and increasing allocation to livestock and ethanol, nations that have abandoned self-sufficiency will also find it increasingly difficult to afford imports of food they are lacking at home (Roberts 2008, pp.xx-xi, 129, 172).

And while the WTO obliged developing countries to remove agricultural protections, import staple foods and fertilizers, and export high-value food, it at the same time guaranteed farm subsidies for First World countries. For example, between 1995 and 2005, the U.S. treasury allotted one hundred fifty-five billion dollars in subsidies for its crops and livestock. This was more than America's total foreign aid budget. Even today, the United States continues to restrict or outright ban imports that would undermine its own food supply. These government price supports and interventions in U.S. agriculture have amounted to a rejection of a truly free food market and have led to unfair trade relations between wealthy and developing nations (Roberts 2008, pp.117-136).

By the 1980s, the interests of transnational corporations had become far more complex than trade alone. In order to increase profits, the corporate agenda increasingly focused on intellectual property as the means for a global reorganization of agriculture. In the U.S., the Supreme Court ruled on June 16, 1980 in the case of

Diamond v. Chakrabarty that life forms could be patented based on their genetic coding. This greatly extended the commercial viability of the biotechnology industry. Companies that previously had no interest in seeds, primarily chemical and pharmaceutical firms, immediately began purchasing seed companies. For example, Monsanto, an American chemical company which throughout the twentieth century developed products such as saccharin, polychlorinated biphenyl (PCBs), DDT, Agent Orange, and nuclear weapons, spent over thirty billion dollars buying up numerous seed firms. In 1982, Monsanto scientists became the first to genetically engineer a plant cell. The biotechnology agenda was then further expanded though the Agreement on Trade Related Aspects of Intellectual Property Rights (TRIPS). Established at the end of the Uruguay Round in 1994, the agreement allowed companies to patent newly developed, genetically engineered (GE) plant varieties.

Regulations such as these resulted in an unprecedented ownership of plant genetics by a handful of multinational companies (Organic Seed Alliance, 2005). Communities that previously stored and freely exchanged grains over multiple generations are now effectively forced under the TRIPS Agreement to buy new seed each year (Shiva 2000, pp.8-9). Additionally, many farmers who continue to save seed, or who find their crops contaminated with GE material (due to cross-pollination and seed dispersal), are being faced with unbearably expensive lawsuits by biotechnology firms. Monsanto alone has filed suit against farmers one hundred forty-five times for patent infringement, and yet the company itself even admits that “a certain amount of incidental, trace level pollen movement occurs.” (Hauter 2012, pp.

260-261) To the chagrin of many farmers, international agriculture laws tend to favor corporations at the cost of biodiversity, food security, and the right to produce and consume according to cultural priorities and safety concerns.

3.4 Current Outlooks of Corporate Control

Through the creation of global trade policies in the twentieth century, transnational corporations and international organizations of trade, finance, and development have become the majority vote in critical decisions about food, energy, and other resources. Corporate ownership of agriculture now encompasses everything from seeds, fertilizers, and machinery to processing, transportation, and retailing (Moore 2011, p.11). In the U.S., twenty food corporations produce most of the food eaten by Americans, and four chains control more than half of all grocery store sales (Hauter 2012, p.3). This concentration of corporate power has threatened the democratic process, driven up costs for farmers and consumers, and destroyed the livelihoods of millions of rural farmers. In many developing nations, consumers can barely afford raw commodities anymore.

The influence that agribusiness now wields over global politics and economics was in large part achieved through corporate lobbying practices. The United States especially has demonstrated that its economic policies and foreign business relations are highly responsive to special interests. The food lobby in the U.S. is so successful because it is controlled by corporations and trade groups that have massive reserves

of financial and political assets. According to the Center for Responsive Politics, American agribusiness spent 125.7 million dollars on lobbying in 2012. Many American corporations have also used their financial reserves to influence policies not only on the national level, but in international monetary and trade organizations.

Other important aspects in the rise of corporate power include the links between agribusiness and government, also known as the revolving door. In the late twentieth century, the U.S. saw an increasing movement of personnel between agribusiness and legislative and regulatory agencies. Today, top officials at agencies like the U.S. Department of Agriculture (USDA) and the U.S. Food and Drug Administration (FDA) are often appointed straight from personnel of the same food industries those agencies are supposed to regulate. Many influential individuals have been known to move back and forth between government and industry (Robert 2008, p.293). In 2006, the Consumer Project on Technology reported that since 1998, forty-three percent of the one hundred ninety-eight members of Congress who left government work to join the private sector registered to lobby.

In particular, Monsanto provides a telling example of the connections between industry and government. The most convincing indication that the company's strategy has been an overwhelming success is the number of its employees who have been given jobs in the FDA, the United States Environmental Protection Agency (EPA), and other regulatory agencies that monitor Monsanto's products. For example, Michael Taylor, a lawyer who spent the past few decades moving between Monsanto, the

FDA, and the USDA, was reappointed by President Obama in 2010 as Deputy Commissioner for Foods at the FDA. Even the highest court in the United States has tight links to the company: Clarence Thomas worked as an attorney for Monsanto in the 1970s prior to his appointment to the Supreme Court in 1991. In the 2001 case J.E.M. Ag Supply, Inc. v. Pioneer Hi-Bred International, Inc, Justice Clarence Thomas wrote the majority opinion that found that "newly developed plant breeds are patentable under the general utility patent laws of the United States." This decision directly benefited companies that profit from transgenic crops, especially Monsanto.

Revolving door connections, along with current lobbying practices and large financial donations, are known to lead to unaccountability within the system. This hinders the development of ecologically sound and socially just business. While there are a few exceptional companies that include principles of social and environmental responsibility within their practices, most large firms externalize their costs to the environment and communities in order to maximize profits and market shares. Moreover, corporations generally refuse to voluntarily give up unsustainable practices.

It is surprising that employees from a company like Monsanto, which has produced extremely toxic products for over a century, have been allowed to take jobs in agencies which supposedly work to protect the environment, food supply, and human health. A clear example of this can be seen in Monsanto’s involvement with PCB production. In 1935, Monsanto bought up Swan Chemical Company and its polychlorinated biphenyl factory in Anniston, Alabama. In the following decades,

Monsanto knowingly poisoned thousands of Anniston's residents through PCB production and disposal of its waste products. Monsanto hid internal documents from the public testifying to the damaging health effects of exposure to PCBs, which include many forms of cancer, cardiovascular disease, diabetes, immune deficiency, reproductive problems, and serious neurological disturbances. Monsanto knew about these dangers as early as 1937, and yet from 1929 to 1971, around three hundred ten million kg of PCBs were produced in Anniston. During this time, approximately twenty-seven thousand kg of PCBs were released into the atmosphere, eight hundred sixteen thousand kg were dumped into streams, and thirty-one million kg of contaminated wastes were disposed of in an open pit located on site, in the center of Anniston's African-American community (Robin 2008, pp.11-23). By hiding evidence, ignoring and denying the health problems of thousands of residents in Anniston, and continuing sales of toxic products, Monsanto has proven that its agenda does not include protection of the biosphere or long-term sustainability. And yes this company's control over the global agricultural system continues to rise through connections to the government and monopolistic control of pesticide and seed sales.

Chapter Four: **Environmental Developments and Impacts of Industrial Agriculture**

For thousands of years, humans have had a symbiotic relationship with multiple animal species. According to the UNEP Global Environmental Alert Service, humans provided certain animals with food and shelter in exchange for labor and products

such as meat, milk, and leather. These animals fed themselves from land that was otherwise of little use to humans, fertilizing the ground with their excrement in the process. This created a cycle of co-existence between plants, animals, and human needs (Global Environmental Alert Service 2012, pp.1-6). Organic, closed-circle agricultural systems also revolved around diversified crops and rotation, as well as natural herbicides and pesticides. Traditional farming relied on manual labor and was difficult to do on a large scale. Most farms were thus small family-owned operations producing just enough food to sell locally.

One of the most significant changes industrialization brought to agriculture was the complete separation of crops from livestock and thus the complementary functions of plants and animals. By mid-twentieth century, operations that were traditionally carried out on a single farm had been separated and distributed into a global system. The modern farmer was encouraged to specialize in a single crop or livestock species (Roberts 2008, pp.22-23). This led to the development of Concentrated Animal Feeding Operations (CAFOs), which the EPA describes as “agricultural operations where animals are kept and raised in confined situations [and] feed is brought to the animals rather than the animals grazing or otherwise seeking feed in pastures, fields, or on rangeland (U.S. Environmental Protection Agency, 2012b). Today, the livestock sector congregates millions of live and dead animals, as well as their manure and urine, on very small land areas. Developments of deadly, antibiotic-resistant strains of bacteria and new animal diseases transmissible to humans, as well as accumulation of animal waste products in ground and surface waters, are just some of the results of

CAFOs.

Industrial methods of cultivating crops, which are increasingly being produced as feedstuff for CAFOs, focus on intensifying agricultural production through farm machinery powered by fossil fuels, chemical fertilizers and pesticides, and monocrops of genetically engineered seeds (Friedmann 2005, p.5). In 1899, Kautsky, who wrote about the politics of agriculture and peasantry under capitalist growth, described this technical progress in agriculture as improving methods for “wringing the goodness out of the soil.” (Kautsky 1899, pp.214-215) Some of the ecological consequences of industrial food production and distribution systems include massive pollution as well as global warming. The laborsaving mechanization and chemicals on which the industrial agriculture system relies have also made farming and other food-production jobs among the most dangerous occupations in the world (Roberts 2008, p.25).

4.1 Fossil Fuels

Oil is a unique endowment upon humankind. There is no alternative energy source that returns the same amount of net energy at the scale that oil is used. According to The Levin Institute, by 2009, fossil fuels accounted for approximately eighty percent of the world’s primary energy use and supplied around ninety percent of the world’s commercial energy (The Levin Institute, 2013). Agriculture became dependent on fossil fuels in the early 1940s, at the same time that the U.S. secured a dominant position in world agriculture. Today, the United States’ food supply is driven almost

entirely by non-renewable energy sources; petroleum products are used for planting and harvesting, as well as processing, packaging, and distribution. According to the Earth Policy Institute, U.S. food production alone consumes as much energy as all of France (Shore, 2007). Every year, each American requires approximately two thousand liters of oil to supply their food, which accounts for about nineteen percent of the total energy use in the U.S. According to a report published by Cornell University, about one third of the oil used in agriculture is for manufacturing fertilizer, about twenty percent for constructing, operating, and repairing farm machinery, sixteen percent for transportation, thirteen percent for irrigation, eight percent for raising livestock, and five percent for pesticides (Pimental, et al., 2008).

One of the main issues with petroleum products is that they are a finite resource. Fossil fuels are the remains of organisms that lived two hundred to five hundred million years ago. Organic matter from dead plants and animals was buried and converted by heat and pressure into coal, oil, and natural gas. Since the discovery of these energy sources, we have been consuming them at faster and faster rates. In many oil-producing regions, we have already reached what is known as peak oil, or the highest production point. Most of today's supply flows from fields that were found before 1973, and the great majority of them are declining (Pimental, et al., 2008). Many of these known reserves also exist in regions and countries that are geopolitically and socially unstable, which makes the global energy market unpredictable. Further unexploited supplies of oil are limited; it is estimated that industry has already found about ninety percent of the crude oil in the world (Campbell

and Laherrère, 1998). Remaining reserves of conventional oil are located primarily in unexplored sedimentary basins and areas that are difficult to access, which makes extraction problematic and expensive (Gagnon, Hall and Brinker, 2009). As a consequence, in the near future, the energy spent in extraction will actually exceed the energy yielded from the oil itself.

Relying on fossil fuels for agricultural production and distribution is therefore neither energy-efficient nor sustainable in the long-term. Steel estimates that ten calories of energy are needed to produce just one calorie of food (Steel 2009b). Some foods, such as grain-fed beef, require thirty-five calories of energy for every calorie of food produced. And for every unit of energy used by agriculture itself, five more are utilized in processing, storage and distribution (Sustainable Table, ca. 2010). Although agricultural output has increased enormously over the last century as a result of industrialization, the energy input needed to produce a crop has increased faster. This means that the ratio of crop production to the energy input needed has decreased over time, leading to less efficiency within the system.

Over the past few decades, conditions of the world's oil supply have also entered a new, less secure phase. Increasing demand pressure, worries about consistent supply from important oil producing countries, and clear indications of quickly diminishing reserves have caused unanticipated and high increases in prices. Analysis of the discovery of oil fields around the world suggests that within the next decade, the supply of conventional oil will be unable to keep up with world’s needs. By

2006, oil demand already averaged eighty-five million barrels per day. Demands are increasing at especially high rates from economically emerging countries with rapidly growing populations, such as India and China. By 2025, world needs are projected to increase thirty-three percent, and demand in India and China alone will increase ninety-eight percent from current levels (Securing America's Future Energy, 2006).

The U.S. as well is likely to play a large role over the next century in increasing demand for fossil fuels. According to Solar Energy International, although the U.S. constitutes less than five percent of the world's population, it uses twenty-six percent of the world's energy (Solar Energy International, 2012). By 2004, around sixty-five percent of petroleum products used in the U.S. was imported from other countries. Unless the nation dramatically changes the way it produces and consumes energy, its dependency on foreign sources of fossil fuels will continue to grow. This will increasingly threaten the stability of American government, business, and daily life (Sustainable Table, 2009). Moreover, continued expansion of conventional, energy-intensive agricultural methods will put increasing pressure on diminishing reserves of petroleum products, radically aggravating food security issues.

Not only are fossil fuels non-renewable, they are also a major source of pollution. Some of the problems of extraction, refining, transportation, and combustion of petroleum, coal, and natural gas include toxic runoff and water pollution, accumulation of solid waste, land degradation, oil spills, and human illness. Fossil fuels also contribute greatly to climate warming. For example, when nitrogen from

petroleum-based fertilizers circulates into the air, it bonds with oxygen, creating nitrous oxide. This pollutant, which is a greenhouse gas three hundred times more potent than carbon dioxide, causes smog and depletes the ozone layer. The Intergovernmental Panel on Climate Change states that energy-related greenhouse gas emissions are the dominant contributor to climate change and are projected to increase fifty-seven percent by 2030 (Intergovernmental Panel on Climate Change, 2007) If the earth becomes even slightly warmer as a result, we will see catastrophic and possibly permanent effects on the earth's biological and ecological systems, including more frequent extreme weather events (Roberts 2008, pp.217, 225-226). This will lead to pressures arising from population migrations, altered food supplies, and new growing seasons.

4.2 Fertilizers and Pesticides

Agricultural productivity was amplified dramatically in the last century and a half mainly due to the use of mechanization, hybridized seeds, fertilizers, and pesticides. Intensification of agriculture quickly exhausted soil, however. Traditional methods for maintaining soil fertility, such as application of manure and crop rotations, could no longer replace nutrients as quickly as the new, high-yielding crops could absorb and use them (Roberts 2008, p.20). It therefore became necessary to use supplementary fertilizers.

After World War II, when nitrogen was no longer needed to create bombs,

leftover stockpiles of chemicals were in need of a domestic market. It turned out that nitrogen-rich ammonia could be used to fertilize the United State's crops. DDT, another military weapon, was also refashioned for domestic use as a pesticide. Industrial agriculture therefore greatly benefited from the peacetime conversion of munitions to chemical fertilizer and nerve gas research to pesticides (Pollan 2008, p. 101). According to Moore, chemical inputs on farms soared nearly twenty-fold in the four decades after 1935 (Moore 2011, p.8). It is estimated that nearly half of the extra food produced since 1950 (and more than two-thirds of the extra people) came as a direct result of the availability of this synthetic nitrogen (Roberts 2008, p.21).

Fertilizers, which are synthesized from atmospheric nitrogen and natural gas, require a considerable amount of energy to produce. According to the organization Sustainable Table, manufacture and distribution of these farm chemicals require an average of 2.2 liters of fossil fuels per hectare of land (Sustainable Table, 2009). Despite the substantial amount of inputs needed for production, global nitrogen fertilizer use for all crops is continuing to rise from its current level of approximately one hundred billion kg per year (Glass, 2003). According to a 2003 FAO study, fertilizer application will increase annually by at least one percent, reaching approximately 170.5 billion kg by 2030 (Bruinsma, 2003). The world also uses approximately 2.75 billion kg of pesticides (formulated from about 1,600 different chemicals) per year (Horrigan, Lawrence, and Walker 2002, p.4).

These inputs induce human and animal illness, as well as air and soil pollution.

As ecosystems are dynamic and interdependent, chemicals that are released into the environment enter various cycles and pathways, changing forms along the way. They are metabolized and concentrated as they make there way through the entire food chain (Steingraber, 2012). For example, the Soil Conservation Council of Canada estimates that making and transporting one kilogram of nitrogen fertilizer releases 3.7 kg of carbon dioxide into the atmosphere (Soil Conservation Council of Canada, 2001). The introduction of millions of tons of artificial chemicals into the ground changes soil chemistry and kills off important microorganisms necessary for the regeneration of soil. This deteriorates its productive capacity; when soil loses macronutrients and carbon-rich organic matter, its particles can no longer retain water and stick together (which is important for reducing the risk of wind and water erosion). Hyperintensive farming is ravaging millions of hectares of farmland per year through soil degradation and erosion. The consequences of this are so severe that by 2050, levels of topsoil will be depleted by half (Roberts 2008, pp.154, 208-214).

Industrial agriculture is also one of the leading causes of water pollution and eutrophication in the United States. Farmers frequently apply more nutrients than crops can take up, which leads to a significant outflow of fertilizers to groundwater, rivers, and oceans. By conservative estimates, of the forty-two kg of synthetic nitrogen applied to the typical hectare of U.S. corn, as much as twenty-three kg will leave the soils and enter the surrounding environment (Roberts 2008, p.216). According to a National Water Quality Inventory conducted by the EPA in 2000, agricultural activity accounts for forty-eight percent of pollution in streams and rivers and forty-one

percent of lakes. These powerful fertilizers and pesticides disrupt ecological systems so much that ponds, lakes, and coastal waters are converted into enormous dead zones barren of almost all plant and animal life. Farm chemicals are so potent and lethal to aquatic life that entire frog and fish populations have been known to die off in streams and lakes. In 2005, the UNEP reported in its Global Environmental Outlook Year Book that the number of dead zones worldwide is nearly one hundred-fifty, which is nearly twice the amount from 1990. In a 1989 report by the National Academy of Sciences, it was estimated that the United States spends at least sixteen billion dollars every year to deal with the consequences of surface-water contamination (National Research Council, 1989).

Using fertilizers and pesticides also poses risks to human health; farm chemicals are associated with elevated cancer risks, endocrine disruption, and reproduction dysfunction in workers and consumers (Horrigan, Lawrence, and Walker 2002, p.1). It has also been shown that concentrated nitrogen leached into drinking water can contribute to human cancers. According to the Centers for Disease Control and Prevention, farmers are at high risk for work-related lung and skin diseases. (Centers for Disease Control and Prevention, 2012) The most commonly applied herbicides in the U.S. have been linked to heart and lung congestion, muscle spasms, and degeneration of the retina (U.S. Environmental Protection Agency, 2012b). Studies by The American Associate for the Advancement of Science have found that farmers with a higher lifetime exposure to pesticides also have more neurological problems (Hirshon, 200-). Nearly a quarter of farm workers in California - one of the

world's most productive agricultural regions - who had been in contact with pesticides reported suffering from at least one musculoskeletal problem (Aguirre International, 2005).

Along with the various health issues related to pesticides and fertilizers is the worrisome fact that fungi, insects, and weeds are becoming resistant to even the strongest chemicals. Despite claims that seeds engineered for tolerance to herbicides and pests reduce the need for artificial, petroleum-based chemicals, research has shown that their use has actually increased. Farmers using transgenic seeds are likely to apply only the associated herbicide, which then allows weed populations to quickly adapt and become resistant. Farmers must then either find alternative herbicides (often returning to older, more potent products) or apply increasing amounts of chemicals to their crops. Even with these additional inputs, crop losses due to pests continue to rise at alarming rates. They have already increased by twenty percent since 1960 (Roberts 2008, pp. 218-219, 256).

4.3 Large-Scale Monocrops

Industrialization of the U.S. agriculture system over the last century and a half has led to a major consolidation of farms. According to a USDA report, early twentieth century agriculture took place on a large number of small, family-sized farms, each growing an average of five commodities. In the twenty-first century, the agricultural sector was concentrated on a small number of large plots of land; by 2005, the number of farms

had fallen sixty-three percent to around two million, while the average farm size had risen sixty-seven percent to around four hundred-fifty acres (Conklin, Dimitri, and Effland 2005, p.2).

The consolidation of farms during this time period coincided with retailers' increasing demands for conformity in quality and delivery time of food products. The necessity for consistency in the global market led to increasing specialization and efficiency on farms; farmers responded to demands by upgrading operations and equipment to focus on one or two crops (Roberts 2008, p.79). The current agriculture system is based on vast fields of nearly genetically identical crops - to the exclusion of all potentially competing organisms. Methods of planting, cultivation, and harvesting on these types of farms are all geared to the growth of uniform plants. Monocrops allow for savings on labor-power, as equipment can be adapted to only one crop (Kautsky 1899, p.246). Application of fertilizers and pesticides, as well as irrigation and harvesting, can be done concurrently over the entire crop because all plants are at similar stages of growth and will respond similarly (Goodman and Redclift 1991, p.xii).

Although the uniformity of monocropping may simplify certain aspects of production, it also works against the organic system of nature, which includes a wide range of animals and plants living together symbiotically. Monocropping in fact leads to a higher risk of crop disease. One example of this was the outbreak of southern corn leaf blight in the United States in the 1970s (Weber 2009, p.22). In 1970, almost

eighty-five percent of U.S. corn fields were planted with one variety of corn, the Texas cytoplasmic male sterile. Unfortunately, this type of corn was highly susceptible to a new type of the pathogenic fungus *B. maydis*. A combination of very wet weather conditions and the corn's high susceptibility to disease led to a rapid spread of the fungus and a devastating epidemic (APSnet, ca.2012). Farmers attempted to control the disease by spraying their fields with fungicide, but this was only partly successful. Southern corn leaf blight led to production cuts of more than fifty percent and cost U.S. farmers and consumers hundreds of millions of dollars (Powledge, 2003).

In cases such as these, the economics of labor-saving uniformity work against the genetic safety in biodiversity. Although in the short term the best economic option may be to grow only one crop variety at a time, farmers risks losing entire crops due to disease and crop failure (Anderson 2005, p.91). According to a 2011 report by the FAO and the Platform for Agrobiodiversity Research, ecologically sound farming means maximizing the number of crops and varieties in order to ensure soil and plant quality. Diversification and rotation of crops are also known to play an important role in controlling soil erosion. For example, rotating crops of wheat or corn with nitrogen-fixing legumes helps to increase organic matter in soil. This also reduces the need for external, chemical inputs.

4.4 Hybridized and Transgenic Seeds

In the late nineteenth century, as human population boomed and global demand for

food and energy increased, Americans sought to make dramatic improvements in agriculture. Food was so physically incompatible with mass production, which was crucial for supporting burgeoning urban populations, that it was necessary to redesign plants and livestock for easier harvesting and processing (Roberts 2008, p.xiv). In order to facilitate cultivation, storage, and transportation, original varieties of seeds were dramatically modified. This marked a critical transition in the history of food; hybridization, which gave way in the following decades to transgenic modifications and patenting of life forms, forever changed the ways in which farmers grew food, as well as the quality of the product itself (Martineau 2002, pp.12-18).

In the early twentieth century, agricultural researchers at land-grant universities and new federal and state-supported centers developed technologies for faster and larger-growing plant varieties. Scientists hybridized seeds that set fruits which ripened at the same time, were more uniform in size, and were tough enough to be mechanically harvested. These seeds produced foods that could withstand longer shipping times. However, this often came at the expense of flavor and, according to some research, nutritional quality. Additionally, the specially bred traits in hybridized seeds were unstable, as they tended to become denatured if farmers reused seeds over several harvests. Initial boosts in yields from Green Revolution technologies also decreased after a short amount of time unless farmers dramatically increased their use of fertilizers. For example, in Africa, farmers needed to double nitrogen inputs over a period of twenty years just to maintain yields at original levels (Roberts 2008, pp.20-21, 65, 154).

Between the 1950s and 1970s, scientists began to induce genetic mutations into food products with X-rays and chemicals (Smith 1994, p.155). In the 1980s, a more sophisticated method using horizontal gene transfer, the direct transfer of genetic material to unrelated species, was developed. In a project funded by Campbell's Soup Company, Calgene, a California-based bio-tech company, genetically engineered the first whole food. The MacGregor's tomato, developed from Flavr Savr seeds, was slow-ripening and transportable over great distances (Smith 2003). It was also the first commercially grown transgenic food to be granted a license for human consumption. The tomato was submitted to the United States Food and Drug Administration (FDA) in 1992. In 1994, the evaluation concluded that the transgenic tomato was as safe as fruits bred by conventional means. The FDA's decision laid the groundwork for the entire biotechnology industry (Martineau 2002, p.x).

Since this breakthrough, bio-tech companies have concentrated mostly on altering genes in staple crops like corn, potatoes, and soybeans so that they can survive high doses of herbicides. For example, one of Monsanto's first breakthroughs in biotechnology came at a time when the patent for their glyphosate herbicide Roundup was expiring. The company introduced glyphosate-resistance into seeds and then employed a marketing strategy that coupled their Roundup herbicide with new Roundup Ready seeds. This ensured the company's continued sales of herbicides; today, Roundup is the world's most-used glyphosate herbicide by volume of sales (GMWATCH, 200-). Monsanto, which accounts for almost a quarter of the

global proprietary seed market, now also owns ninety percent of the transgenic seed sold worldwide (Montague, 1999). About seventy percent of this carries the genetic trait for Roundup resistance (Robin 2008, p.4). Currently in the United States, where corn and soy are by far the leading crops, half of all maize plants and more than ninety-three percent of soybean acreage are grown from their herbicide-tolerant seeds (Roberts 2008, p.243).

Despite the enormous success in sales of transgenic seeds, this technology is not without its risks. There are concerns that these new seeds constitute a major source of genetic pollution. Genetic engineering works by moving genes across species by using vectors. These vectors are a recombination of natural genetic parasites from different sources, including viruses that are tagged with one or more antibiotic resistant marker genes. Critics warn that it is unrealistic to think that we can foresee all possible health or environmental effects of this technology. The biochemistry behind the influence that genes have on cellular behavior and expressions is so complex that researchers cannot fully understand the molecular processes that occur when gene are manipulated. One concern is that molecular engineering of plants and animals could create unexpected substances in genes that are harmful to human or plant health (Roberts 2008, pp.240, 246, 254). Vandana Shiva, a physicist and internationally renowned food activist, argues that the development of transgenic seeds could create new pandemic strains of bacterial pathogens (Shiva 2000, p.26).

The use of transgenic seeds can also create superweeds and superpests. It has been shown that herbicide resistant traits can be transferred to wild, weedy relatives of crops. In 1994, research scientists in Denmark reported strong evidence that after only two generations, transgenic rapeseed plants transmitted their herbicide resistance to a weedy relative (Shiva 2000, p.16). Moore argues that there are now at least ten other plant species to which this has happened (Moore 2011, pp.14-17). Genetically engineering crops for pest resistance also fails to control fungi and bug infestation and instead creates chemical-resistant superpests.

4.5 Increasing Meat Consumption and Animal Factory Farming

Throughout many regions in the world, the ability to procure meat for one's family or society is an indication of prowess, health, and power. For thousands of years, however, the difficulties posed by hunting or expensive prices in the market meant that for many, meat could only be an occasional part of meals. This served to further increase its value as an important source of protein and nourishment. Accordingly, rising incomes and economic mobility have consistently led to an increase in consumption of animal products. Warren Belasco, professor and author of *Food: The Key Concepts*, calls this process "nutrition transition" (Belasco 2008, p.11).

Over the last century and a half, industrialization and increasing efficiencies in agriculture have made meat an affordable, everyday product for many. Laborsaving innovations in the meat industry at the end of the 1800s led to a revolution in livestock

production, which in turn influenced many other mass production industries. For example, the slaughterhouse disassembly line, perfected in Chicago, Illinois in the late nineteenth century, moved carcasses along a conveyor while hundreds of workers butchered the animals, each specializing in one task. This model allowed the Union Stockyards to process five thousand hogs or more a day, the efficiency of which later inspired the first mass production of Ford Model T cars (PBS, 2003).

Tightly controlled production methods also allowed for animals that previously foraged outside for grass and weeds to be locked up in large CAFOs and fed a grain and legume based diet (Roberts 2008, p. 24). Early in the twentieth century, scientists and animal nutritionists discovered that combining soybean meal with grains such as corn considerably increased the efficiency with animals converted grain into meat protein. Being able to fatten up animals faster led to increases in production to hundreds or even thousands of animals per operation.

Largely due to these innovations, meat supply has rapidly expanded in most regions around the world, especially in the last few decades. According to UNEP, U.S. citizens consume the most meat, averaging three hundred twenty-two grams per person per day, or about one hundred-twenty kg per year (UNEP Global Environmental Alert Service 2012, pp.1-3). In the United States, meat consumption continues to rise by about a half kilogram per person per year, while Europe is a close contender. The dietary patterns of developing countries are also catching up with the West; between 1960 and 2002 per capita meat consumption more than doubled

(Roberts 2008, pp.211, 234). Meat consumption is growing especially quickly in Asia, where total meat consumption has increased about thirty-fold in the last fifty years. In China alone, total meat consumption has increased by one hundred sixty-five percent since 1990 (UNEP Global Environmental Alert Service 2012, p.3). Because the developing world has the largest and fastest growing population, even small increases in meat consumption there mean astronomic increases in overall global demand. As a result, in the next few decades, demand for meat will rise considerably faster than the actual human population. According to the FAO, global meat consumption will increase sixty-five percent by mid-century to reach approximately four hundred-sixty million tons per year (Steinfeld et al., 2006).

This rapid expansion of industrial meat production, especially in the developing world, has many significant consequences for the natural world and human health in terms of pollution, outbreaks of disease, and depletion of resources. This is due to the massive amounts of space, energy, water, and chemicals that are necessary for large-scale production of livestock, as well as from the enormous amount of contaminating outputs that come from CAFOs (Roberts 2008, p.232). Air, water, and soil pollution are some of the main problems of industrial meat production, as well as a sharp reduction in biodiversity. Huge inefficiencies of energy and land use also plague the system. According to the FAO, the farm animal sector is by far the single largest anthropogenic user of land; livestock and animal feedcrop production account for seventy percent of all agricultural land and thirty percent of the total land surface of the planet (Steinfeld et al. 2006, p.xxi).

Meat is also one of the least efficient ways to obtain calories. According to the UNEP Global Environmental Alert Service, it takes approximately thirty-five kilojoules (kJ) of fossil energy to produce one kJ of CAFO-raised beef (UNEP Global Environmental Alert Service 2012, p.6). A meatier diet also increases overall food demand, as food and land that could be used to nourish the human population is diverted to use as animal feed. For example, it is estimated that to make a single pound of beef, twenty pounds of grain are needed. Today, more than a third of the approximately two billion tons of grain produced annually world-wide is fed to animals. As human population reaches its peak around mid-century, global meat demand will more than double, which in turn will necessitate an additional one billion tons of feed grains per year. This will prove to be a monumental challenge, especially since global grain reserves are already at their lowest levels in thirty years (Roberts 2008, pp.206-211).

Because of the need for so much grain and land to feed animals, the livestock sector is one of the foremost causes of loss of biodiversity and destruction of natural habitats. Currently, feedcrop production accounts for thirty-three percent of total arable land use in the world. As little new grassland existed to support the growing livestock industry in the early twentieth century, farmers increasingly turned to use of grains and soybeans. A large portion of agriculture research and funding has since been directed toward making corn and soy production cheaper and more efficient (Belasco 2008, p.12). In order to grow large quantities of these crops, vast areas of forests and fields have been cleared around the world. This is especially true in Brazil, where twenty-

one million hectares of rainforests have already been cut down and destroyed for soy production. The Amazon rainforest hosts one of the largest concentrations of biological diversity in the world, and as deforestation progresses, valuable natural resources are being lost. Deforestation also causes enormous amounts of carbon to be released into the atmosphere, which directly affects the entire planet (Earth Policy Institute, 2009). Industrial meat production is therefore a driving factor of air pollution and climate change. According to the FAO, meat production compromises almost eighty percent of all agricultural-based GHG emissions and nearly a fifth of all human-caused GHG emissions. The UNEP estimates that consuming one kilogram of domestic beef is equivalent to the emissions of driving an automobile for a distance of one hundred-sixty kilometers (UNEP Global Environmental Alert Service 2012, pp.4-6).

Water pollution from runoff of manure and chemicals used for feedcrops also poses huge problems for the ecosystem and human health. As CAFOs concentrate hundreds or thousands of animals, manure is generated in enormous quantities. In the United States alone, livestock and poultry operations generate about five hundred million tons of manure annually. This is three times more than the quantity of human sanitary waste that is produced in one year (EPA 2009). The accumulation of hundreds of millions of tons of nitrogen-rich manure from huge livestock feedlots is then stored in enormous lagoons. The runoff and contamination of surface and groundwater from these manure lagoons pose a serious threat to neighboring communities (UNEP Global Environmental Alert Service 2012, pp.6-7). According to

the FAO, U.S. livestock is responsible for a third of the nitrogen and phosphorus that leaches into freshwater resources (Steinfeld et al. 2006, p.xxii).

Chapter Five: Sustainable Alternatives

As agriculture increasingly relies on fossil fuels, synthetic fertilizers and pesticides, monocrops, transgenic seeds, and factory farming, natural resources such as forests, farmland, and water are quickly being contaminated and destroyed. The environmental advocacy group World Wildlife Fund states that the global ecological footprint already surpasses the planet's biocapacity by approximately twenty-five percent. Especially over the last century, pollution and loss of diversity have threatened the entire global food system and made it more vulnerable to disruption. Currently, the amount of food that is produced in the U.S. in a safe and environmentally sound manner is only one percent. If we continue with business as usual, environmental threats from industrial agriculture as well as energy scarcity will lead to significant food shortages, sharp increases in prices, and irreversible environmental damage (Roberts 2008, pp.232, 288, 301).

In order to protect ecological systems, human health, and social order, it is imperative to establish a sustainable food system. According to Friedmann, one of the most important steps in solving today’s global agricultural problems is encouraging healthy human relations with the interdependent web of air, water, soil, and organisms (Friedmann 2005, p.1). This means creating a completely new system that takes into

account natural limits and external costs and ensures ecological richness. Many argue that food security is directly linked with biodiversity and local control of agriculture (Akhter 2001, pp.52-55). One of the main goals of sustainable food production is to therefore to create smaller-scale farm systems that mitigate or eliminate environmental harms that are associated with industrial agriculture (Horrigan, Lawrence, and Walker 2002, pp.14-17). Encouraging diversity and competition in food production has also been shown to generate healthier economies as well as ecologies (Organic Seed Alliance, 2005).

To achieve this, it is necessary to make structural policy changes in the U.S. Farm Bill, as well as in the regulations of international trade organizations. U.S. subsidy policies, which mostly benefit large-scale, industrial agriculture, need to be reprioritized. Federal funding is needed to boost development of regional and local organic food production and distribution systems. Grassroots social movements can play a large role in politicizing disadvantaged groups and educating people about agriculture and health. We must also cut down on meat consumption and improve the conditions of the livestock industry. Consumers who value quality, variety, and healthiness of food products can also make a difference with their purchases.

5.1 Structural Changes in Food Policy

Over the last century and a half, research programs financed by the general public have driven advances in food-production technologies. Currently, it is the U.S. Farm

Bill that determines the direction of U.S. food policy. The U.S. Farm Bill was founded in 1933 as a part of President Roosevelt's New Deal policies. Since its creation, this important piece of legislation has done little to encourage sustainable agricultural practices and environmental and public health. Instead, public policy has been adapted to facilitate the control of every aspect of the food system by a small group of companies (Hauter 2012, p.3). Today, the USDA allots between ten and thirty billion dollars in subsidies, more than ninety percent of which are for production of five commodity crops: wheat, corn, soybeans, rice, and cotton (Sumner 2003, p.101). A large percentage of these crops come from Monsanto's genetically engineered seeds. Additionally, the majority of governmental funding for scientific agricultural research is allocated to transgenic corn and soybeans (Conklin, Dimitri, and Effland, 2005). In this fashion, the Farm Bill supports overproduction of artificially cheap food, monoculture cropping of GE seeds, and heavy dependence on petroleum products. It also creates distortions in the global economy and impedes innovation and diversification of land use.

Alternative programs find it difficult to get federal financial backing, and protection for the rest of U.S. agriculture is quite low. Since the beginning of the U.S. farm bill, subsidy programs have never included fruit and vegetable production. To impel the market to engage in a more sustainable and healthy model of food production, new agricultural regulations are needed. Congress must be encouraged to increase funding for research into alternative agriculture, and farm subsidies that encourage a surplus of commodity crops need to be removed. In terms of global

agricultural policies, decreasing subsidies in the North will also correct global agricultural market distortions. Markets in the South will no longer be flooded and undermined by agriculture dumping. Food aid policies of the North need to be adjusted so that poor countries, especially those that rely on exports of single cash crops, can boost their own agricultural sectors and increase local food supply.

In the U.S., more support should be allocated to small and medium-sized fruit and vegetable producers, organic agriculture, and the development of local markets. The Farm Bill should invest in urban agriculture, which would allow for widened access to fresh and nutritious foods (Morley 2008, pp.14, 18). According to Roberts, measures such as country-of-origin labeling, an intensive education program for consumers, and improved school lunch programs would be helpful. The government should also work with and support the many organizations that are already building regional food systems (Roberts 2008, pp. 291-297, 320).

However, promising innovations in sustainable agriculture continue to come up against significant and wide-reaching economic and political resistance. Many politically influential companies have spent considerable sums of money to maintain the large-scale, low-cost industrial agriculture model. Because of extensive counter-lobbying measures taken by large agribusiness, Congress was recently incapable of passing even one bill that would have reduced farm subsidies (Roberts 2008, pp.xxi, 233, 296). Change must therefore also be driven from outside the system by

grassroots organizations. In the past few decades, international social movements that promote food sovereignty rather than the trade-driven notions of food security are becoming more prominent. The food sovereignty movement, made up of a large network of NGOs, renounces industrial agriculture, corporate control, and biotechnology (Lee 2007, p.1). La Via Campesina, an international movement founded in 1993, represents over two hundred million farmers. It rejects corporate driven agriculture and neoliberal and patriarchal policies, while supporting small and medium-scale organic farming. It works to protect the rural livelihoods of small farmers, who make up almost half of the world population. The organization is recognized as “a main actor in the food and agricultural debates. It is [even] heard by institutions such as the FAO.” (La Via Campesina, 2011) Participating in and supporting these kinds of groups is one step toward changing the system from below.

5.2 Organic

The organic movement developed in the 1940s as a countermeasure to large-scale industrial food production. Its original principles were founded on the idea that healthy food should be provided to consumers in a way that minimizes human impact on the environment. Sir Albert Howard, considered the father of modern organic agriculture, promotes small farms that use on-site resources as much as possible, integrate animal and plant production where appropriate, and maintain higher biodiversity. Typical organic farming practices include a wide variety of natural methods to distribute energy and nutrients, maintain soil and plant quality, and interrupt pests. A

closed loop system takes advantage of natural cycles, including the use of manure and compost as fertilizers. Cash crops are alternated with cover crops, such as legumes, whose roots work symbiotically with soil bacteria to fix atmospheric nitrogen in the dirt. This allows for regeneration of important microbes and nutrients. Crop rotation also deters weeds and insects from establishing themselves. According to U.S. and European standards, organic agriculture prohibits the use of GE crops and has strict limitations on synthetic fertilizer and pesticide use as well as livestock antibiotics and growth hormones. Organic livestock production includes free range, open-air systems and organic feed (European Commission, 2013).

As organic farming uses far fewer pesticides and fertilizers than conventional agriculture, fossil-fuel use is also much lower. Energy efficiency in organic production is thus much higher. In a study comparing organic and industrial farming systems in the U.K., ADAS, an environmental consultancy, found that organic production saved on average forty-two percent more energy (Church, 2005). These kinds of dramatic reductions in resource consumption can be achieved globally through management-intensive, sustainable farming practices. It has been estimated that reducing repetitive fertilizer application on the two hundred-fifty million acres of major cropland in the U.S. would save the government and tax payers approximately one billion dollars per year (Sustainable Table, 2009).

Organic farms also emit far fewer greenhouse gases than conventional systems. Small-scale sustainable farms have been found to emit between one-half

and two-thirds less carbon dioxide for every acre of production. Recent studies show that organic farming also helps fix carbon in the soil, which could help mitigate air pollution and global warming. According to Sustainable Table, ten thousand medium-sized organic farms can sequester the same amount of carbon as would be saved by reducing the amount of cars on the road by one million (Sustainable Table, ca. 2010).

Of special concern to farmers is high productivity of crops. Although Green Revolution techniques increased yields enormously in the mid-twentieth century, production on organic farms now rivals industrial farming for many crops. In Iowa, organic corn yields are between ninety and ninety-two percent of conventional yields, while organic soybeans have reached ninety-four percent of their counterpart (Roberts 2008, p.251). Organic crops have also been found to do considerably better than conventional farms during drought years and in major catastrophic events such as hurricanes, as more topsoil is retained on organic farms. A study published by Cambridge University that compared both systems found that "organic methods could produce enough food on a global per capita basis to sustain the current human population, and potentially an even larger population, without increasing the agricultural land base." The researchers found that although organic systems in developed countries produce slightly less than conventional farms on average, they produce eighty percent more in developing countries. This is because there is often greater access in poor countries to organic, natural farming materials than synthetic chemicals and GE seeds (Badgley et al., 2007).

However, many of the benefits of organics agriculture are assumed to come from small-scale, local farms, as imagined by Sir Albert Howard and other leaders of the movement. This is not actually a requisite under organics regulations, though. By the 1990s, many of the core values of the movement had been co-opted by transnational agribusiness. Many of the same large enterprises that produce and sell processed foods bought up small organic companies, further aggrandizing their control over the food industry. In the U.S. today, just one company, Walmart, dominates the organic grocery industry (Hauter 2012, pp.3, 79). The growing power of large retailers and the increasing demand for organics in the past three decades pushed the market to favor larger, low-cost producers. This means that retailers increasingly source organically grown food from around the globe (Hill 2008, p.9). The term organic therefore no longer necessarily entails pure and local ingredients from small family farms; today, a large percentage of organic foods are produced with the same high-volume, low-cost methods as conventional industrial products and then transported over long distances (Roberts 2008, pp.xxi, 251, 266). The many benefits of organic farming are often overshadowed by the effects of long distance transport.

5.3 Local and Small-Scale

Today, seasonal variety of fresh produce hardly exists anymore, as supply chains source from farms all over the world to ensure that crops are continuously being harvested. To ensure freshness, suppliers ship much of their produce by air, often thousands of kilometers. In the United States, about two hundred seventy-five billion

kilograms of food are imported every year, which is almost a seventh of the nation's entire food supply (Roberts 2008, pp.xi, 64, 65). In 2005, more than one hundred-twenty billion dollars of agricultural imports and exports crossed U.S. borders (Sustainable Table, 2009). Currently, the average distance food travels before being consumed, whether in refrigerated trucks, airplanes, ships, or by railcar, is about 2,415 kilometers (Hill 2008, p.1). This means that even organic products that are transported long distances by plane can be as damaging to the environment as their conventional air-freighted counterparts.

Part of the reason that food must shipped so far, even within the United States, is that eighty percent of the U.S. population lives in densely populated urban areas. These cities are often hundreds of kilometers from major centers of food production. It is no wonder then that less than five percent of the food consumed in any one region in the U.S. is actually produced there. And even in areas where farms still exist near urban centers, the roads and supply chains that previously connected the two have largely been appropriated by national and global supply chains (Roberts 2008, pp.123, 285).

Although the United Nations predicts that by 2050, the entire world's population will be eighty percent urban, it is not further expansion of the global food market that will ensure increased food security and availability (Steel 2009, p.8). At a time when the world's oil supplies are waning and fuel prices are spiking, conserving resources and thinking smaller-scale should be made a priority. Focus needs to be shifted to

small and medium scale food production at the city and regional levels. Farming systems should be adapted to the natural economic, social, and cultural conditions of small farming units. As it is, small and middle-sized farms already provide for the majority of the world population, and increases here will have a much greater impact on food availability at the local and regional levels than the predicted increases for corporate-controlled, large-scale monocultures (Vanhaute 2011, p.59). This is largely because small farmers focus on autonomy, family labor, and a self-controlled resource base (Van der Ploeg 2010, p.100). Small-scale production units are more likely to be orientated towards sustainable use of natural resources, using fewer mechanics and agrichemicals. Expanding these kinds of farms would be much more secure, energy-efficient, and less damaging to the ecosystem and natural resources than the current model of food production (Roberts 2008, p.307).

A prevalent notion of food sovereignty, as discussed earlier, is to ensure the maintenance and accessibility of food sources in and around the immediate environment. Becoming more reliant on regional farming will protect societies from possible disruptions from national and global suppliers. Communities must therefore regain control from transnational companies of the production, distribution, and exchange of food. Roberts argues that societies should be able to produce at least a third of their own food supplies locally (Roberts 2008, pp.307, 309). It is also important that communities have the right to develop their own policies and protective measures in order to ensure culturally and ecologically appropriate ways of obtaining adequate and nutritional food sources (McMichael 2009, pp.32-47).

The locavore movement, which developed in the San Francisco Bay Area out of interest in sustainability and eco-consciousness, encourages consumers to pay attention to the distance their food has traveled, to purchase from local farmers' markets, and to grow their own food as much as possible. Locavores argue that foods grown close by, within approximately one hundred-sixty kilometers of purchase, are more fresh, nutritious, and environmentally friendly (Stringer and Umberger, 2008). Expanding local food systems and supporting local economies also subsequently directly reconnects producers and consumers and increases employment and income in communities (Martinez, et al., 2010).

One of the most important ways to create a more locally based food system is to shift sites of food production closer to urban centers. Studies already show that farm growth and economic development in communities prosper mostly through regional trade from rural producers who are close to cities. In terms of food security, it has been estimated that peri-urban agriculture - growing food twenty to forty kilometers around each city or town - could achieve up to seventy percent of a city's supply of food. To achieve this, food production just outside of cities should be expanded and distributed to local markets, schools, hospitals, and restaurants. Urban agriculture, or growing food directly in cities, is another way to ensure local food security. This includes backyard, rooftop, and community gardens. Growing food in abandoned construction sites and on school campuses is also becoming more popular. Many nonprofit organizations are already working to bring farming to urban environments, local, unprocessed food to school cafeterias, and cooking skills to

community members (Roberts 2008, pp.xxii, xxiii, 163, 308, 309).

This version of local, urban food production also needs to be combined with medium-scale regional agriculture. Creating a system that goes beyond either small urban farmers' markets or global supply chains and large retailers means developing regional systems that link consumers to a variety of urban, suburban, and regional food producers. Small and medium-sized farms in the U.S. already provide about three quarters of the food sold directly to consumers through farmers markets and community-supported agriculture (CSA) programs, but only seven percent of the local foods in supermarkets and restaurants. More midsize farming operations are needed to provide for these larger markets. Innovation of small and medium-scale farms will require significant research, investment, and support, as regions often lack the infrastructure needed to harvest and process foods, as well as the distribution networks to bring the food to local markets (Hauter 2012, p.4). Federal funding is therefore needed to revive the short-distance supply chains that once existed in and around most cities in the U.S. (Roberts 2008, p.307-310).

It is sure that local and regional markets will reduce the environmental burdens associated with transportation as well as lower the risks associated with dependency on exports and imports. However, because the global population is growing so rapidly and many people live in places where it is simply not possible to be self-sufficient in food production, some food trade is still essential. Also, sustainability is not only determined by the distance food travels from the site of production to consumption.

According to Roberts, getting food from the farm to grocery stores accounts for only two percent of that product's total environmental impact. The way the food itself is farmed, processed, and packaged contributes much more significantly to a product's sustainability (Roberts 2008, pp.133, 285). Highly processed and packaged foodstuffs use far more energy than fresh foods. Consumers must therefore not only make a conscious choice to buy more local, organic, and seasonal products, but also to eat more fresh and unprocessed foods that are lower down on the food and energy chain.

5.5 Reducing Meat Production and Consumption

Current levels and methods of meat production, as well as the increasing demand for meat products from a quickly growing population, contribute to environmental problems on such a massive scale that it has become an urgent situation to address. Some steps to be taken include changing the industrial process of the livestock industry. Producing meat can be done in a more sustainable fashion by diversifying operations and integrating livestock and crops (Roberts 2008, pp.289, 290). Also, when animals are reared according to organic standards, a greater proportion of their diet is derived from grass. Relying on pasture for feed results in meat and dairy products that are much more nutritious and environmentally friendly than grain-fed, factory-farmed animals (Anon, 2011). In terms of milk production, studies show that organic systems are almost five times more energy efficient than in CAFOs (Church, 2005). Cows' rumens are also evolved to eat grass, so sickness that is a result of a corn-based diet - and the consequential necessity for high antibiotic use in the

livestock industry - can be reduced from returning to their natural diet.

However, even if current methods of livestock production are modified, it is impossible to sustainably produce meat at current, let alone rising, volumes. In order to meet future food demand in an environmentally responsible manner, it is imperative to actually lower world-wide meat consumption. It is estimated that current global levels of grain supply would only be able to feed the nine to ten billion people expected by 2050 if the entire population reduced meat intake to about 5.5 kilograms per year. And it is especially consumers in the West who will need to change their dietary practices to be able to approach sustainable levels (Roberts 2008, pp.209, 234).

Convincing the world to voluntarily change eating habits will be challenging, however. The meat industry has become such a strong and powerful force in the economy that any kind of large transformation will be met with significant resistance. Authorative figures from the government, medical, and scientific fields will need to take a strong public position about the environmental and health consequences of high meat intake (Roberts 2008, p.316). In order for consumers to be able to make more informed decisions about food and diet, they need to know where their food comes from, how it is produced, and what its true costs are.

As eating less meat is not just important for protecting the planet, but for

individual health, too, campaigns and education programs that focus on nutrition, disease, and well-being can help motivate people to change their habits. There are already many attempts in cities around the world to introduce meat-free days in schools and work places. For example, Meatless Monday, an inititative that started in 2003 in the U.S., has been gaining global popularity. Many of the world's leading health and environmental organizations such as UNEP and FAO also recommend reducing meat intake. A 2010 study by Oxford University's department of public health found that eating meat three or fewer times a week could prevent thirty one-thousand deaths from heart disease, nine-thousand deaths from cancer, and five thousand deaths from stroke (Meat Free Monday, 2012). The U.S.-based environmental organization Live Earth reports that if people ate vegetarian for just one day: "the U.S. would save: 100 billion gallons of water, enough to supply all the homes in New England for almost 4 months and 70 million gallons of gas, enough to fuel all the cars of Canada and Mexico combined with plenty to spare." (2009) This shows what just a slight change in diet can do for the world.

Chapter Six: **Further Research and Conclusion**

Over the last century and a half, social and political developments have profoundly changed the way humans grow, harvest, process, package, trade, and distribute foodstuffs. At the end of the 1800s, the U.S. introduced mechanization and mass-production to agriculture. The application of science to seeds, growing, and harvesting during the Green Revolution further revolutionized food production. Industrialization

and globalization led to vertical integration and the growth of corporate-controlled farms. By mid-twentieth century, international trade organizations were also promoting liberalized global trade and large-scale, industrial farms (Lee 2007, pp.1-3).

These developments have led to an unsustainable agricultural system. In many parts of the world, food production is now based on large monocrops of genetically engineered seeds and enormous amounts of petroleum products for energy as well as pesticides and herbicides. Industrial farming methods have led to huge amounts of air, soil, and water pollution, decreased plant and animal diversity, and increased rates of crop failure (Weber 2009, p.22). As the human population continues to grow rapidly and energy sources and land become more scarce, farmers and consumers are finding themselves in a world with less food security.

It is therefore necessary to create a sustainable food system that uses less energy and pollutes less. To do so, policies must be adjusted to promote locally-controlled, diverse, and small-scale agriculture in all regions of the world (World Forum for Food Sovereignty, 2007). The development of organic, seasonal food systems - in which a large percentage of demand is met within close proximity - is an important step toward mitigating climate change and food insecurity, as it will reduce the vulnerability associated with dependency on food exports as well as imports (Horrigan, Lawrence, and Walker 2002, pp.14-17). Peasants and small farmers will be able to gain back sovereignty of their own food production and consumption.

As individuals, we can get involved in food movements that are working to change the way our food system works, whether through politics, grass-roots movements, or educational campaigns. We can demand labeling of food products, the end of agribusiness lobbying, and the passage of a new Farm Bill. It will be difficult but necessary to challenge transnational food companies and hold them accountable for their unsustainable practices. Eating vegetarian more often will also help reduce pollution and anthropogenic climate change, as fewer forests and natural habitats will be cleared for livestock and feedcrops.

Developing alternative sources of energy is also an important part of building future sustainability and food safety. Because fossil fuels are finite resources that create colossal amounts of pollution, accessible, inexpensive, and environmentally-friendly energy must provide the foundation for future economic growth and prosperity. Some alternative, renewable energy sources already available to us include solar energy, wind energy, geothermal energy, and tidal energy. Before alternative energy can become mainstream, though, we need to increase our understanding of how renewable resources work and why they are beneficial (Biswas 1975, pp.291-293). The same can be said about sustainable agriculture: in order for it to be a success, we must put our resources, time, and energy toward developing a just system that can provide healthy food now as well as for future generations.

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Jennifer Smith

83 Robinhood Drive
San Rafael, CA 94901 USA
Phone: (415) 497-1866 Email: jennifersarahsmith@gmail.com

Qualification Highlights

- Proven organizational and leadership skills
- Cross-cultural communication expertise; trilingual in English, French, and German
- In-depth knowledge of research and data analysis, strong writing and editing skills
- Relevant knowledge in environmental protection and sustainable agriculture though Master thesis on "An Analysis of the History of Industrial Agriculture, its Environmental Impacts, and Sustainable Alternatives in the United States"
- Organized and effective presenter
- Proven ability to promote academic excellence and international exchange
- Excellent computer skills

Education:

Master of Arts: Erasmus Mundus Global Studies – A European Perspective

- International, research-based Master combining perspectives, methods, and theories developed in history, the social sciences, and economics to investigate phenomena of global connectedness

Universität Wien, Austria 2011-2012

Universität Leipzig, Germany 2010-2011

Bachelor of Arts: Global Studies and French

University of California, Santa Barbara (UCSB) 2006-2010

Université de Grenoble, France 2008-2009

Study abroad through the Education Abroad Program at UCSB
at Sciences Po Grenoble and Université Pierre-Mendès-France

- Dean's Honor List: 2008 and 2009
- Other relevant courses: German (2 years)

Professional Experience:

Teaching Assistant Program in France (TAPIF) Strasbourg, France
English Teaching Assistant October 2012 – April 2013

- Designed and implemented lesson plans to improve English proficiency at the high school and middle school levels
- Organized speaking, reading, and writing activities and group work to increase cross-cultural

communication and interest between the U.S. and France
- Moderated classrooms of 14-28 students as well as one-on-one conversation sessions

UC Santa Barbara Education Abroad Program (EAP) Santa Barbara, CA
Global Intern October 2009 – April 2010

- Shared experiences and expertise from studying abroad with advisers and students
- Promoted EAP on the UCSB campus, familiarized students with education abroad opportunities
- Spoke at informational meetings for prospective international students