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The New Veggie Tale: Increasing Access to Sustainably-Grown Food in the U.S.

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Abstract

Since the mid-twentieth century and the green revolution, industrialized agriculture has required fertilizer, pesticides, excess water and added energy that typically comes from fossil fuels, all of which contribute to climate change while threatening human and environmental health. The goals of this thesis are to illustrate the well-documented environmental degradation caused by various industrial farming techniques; to suggest alternative, sustainable farming practices that preserve and promote the vitality of soil and other natural resources; to examine the unequal power of large agribusiness corporations to influence food production and distribution policies; to assess the current federal policies in place that have created low accessibility of sustainably-grown food; and to propose changes to the U.S. food system that would increase the prevalence of sustainably-grown food to improve the health of the average U.S. consumer. Chapter 1 uses the Millennium Ecosystem Assessment and environmental history to describe how specific industrial agricultural practices harm the environment. Chapter 2 uses environmental science to suggest various sustainable alternatives to food production such as using organic farming and planting perennial crops. Chapter 3 employs environmental economics to emphasize the dominant role of agribusiness in the current food system. Chapter 4 uses environmental politics and law to assess the current accessibility of sustainably-grown food in the country. Finally, Chapter 5 proposes reforms to the Farm Bill that emphasize soil vitality and community-based food systems to increase access to sustainably-grown food in the country and to resolve associated issues with the current food system discussed throughout this thesis.

Keywords: industrial agriculture, sustainable agriculture, monoculture, perennial plants, agribusiness, subsidy, food desert, community-supported agriculture (CSA)

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Introduction: You Are What You Eat

The Dollar Menu—whether at McDonald's or Taco Bell—is a fast, convenient, and most importantly, cheap source of food for many U.S. consumers. But just one meal of fast food can inhibit digestion, can raise blood pressure by constricting arteries, and causes a surge in insulin which later drops blood sugar, leaving one tired and hungrier. The beef in a hamburger from any given fast food chain typically comes from animals raised on a combination of corn and soy, both of which cows did not evolve to eat; confined to pens where they cannot move and stand in their own manure; and regularly received injections of artificial growth hormones and antibiotics. These animals are neither happy nor healthy, and the humans who eat them experience these conditions in the form of negative health effects. The good news is that eating one healthy meal can improve one's overall feeling of health by reducing bodily inflammation. The typical image of a healthy meal for U.S. consumers is some variation of a salad with greens, various vegetables, and perhaps a lean meat such as chicken. This food provides the nutrients necessary for the body to function well, but many people in the U.S. believe it is too expensive and time-consuming to prepare healthy meals. The sad reality is that sustainably-produced, healthy foods are only accessible to few communities even though the sustainability of the food system is integral to the future vitality of the earth and to human health.

Urban communities are disadvantaged under the current U.S. food system. Given that agriculture traditionally requires large plots of land, cities must rely on food imported from rural areas. This extra step of shipping adds greenhouse gas emissions to a city's ecological footprint and encourages agribusinesses to apply preservatives to produce, which not only can negatively impact human health but also can degrade the environment when they are washed off. Furthermore, cities must determine the distribution of grocery stores across various communities.

This decision-making process often ends with a poor distribution of food stores in low-income communities and can create food deserts, which will be examined in more detail in chapter four. The sustainability of urban communities' food sources are crucial to the sustainability of the food system given that at least sixty-three percent of the population lives in cities.[1] Therefore, urban communities must have access to responsibly-grown food that is produced relatively close to the city for the U.S. food system to be considered sustainable.

This thesis aims to describe how the current national industrialized agricultural system harms the environment by contributing to climate change and purposely limits consumers' choices of food products to unsustainably-produced foods. It will examine current federal policies and laws regarding accessibility and production of food to propose nation-wide policies that would increase the accessibility of sustainably-grown food to consumers. Chapter One will use quantitative data from the Millennium Ecosystem Assessment to illustrate the degenerative impact that specific industrialized farming practices have on the environment. Chapter Two will draw on soil science and ecology to present methods of sustainable food production such as cover cropping and growing perennial plants. Chapter Three will assess how agribusiness corporations harm small-scale farmers, the environment, and communities. Chapter Four will examine current federal food-related policies by using environmental politics and law to assess the availability of healthy, sustainably-grown food in the United States. Chapter Five will conclude by proposing federal policy recommendations that promote the production and consumption of sustainably-grown food by reforming the Farm Bill to emphasize soil integrity and to focus on establishing and maintaining community-based food systems.

[1] "U.S. Cities Home to 62.7% of Population but Comprise 3.5% of Land Area," US Census Bureau, March 4, 2015, https://www.census.gov/newsroom/press-releases/2015/cb15-33.html.

Chapter 1: Feeding the Masses: Industrial Agriculture Practices

While it may be easy to understand that the environment affects agricultural production because crops' growth depends on the amount of sun and rain received, many people in the U.S. seem unaware of the impact of their food on the natural world. The environment provides humans with essential ecosystem services, which are benefits that humans obtain from ecosystems, and they include provisioning, regulating, cultural, and supporting services. Provisioning services are materials such as food, water, timber, and fiber that can be exploited for economic gain.[2] Regulating services are basic ecosystem functions that make human life possible, including "climate, floods, disease, wastes, and water quality."[3] Cultural services provide humans with "recreational, aesthetic, and spiritual benefits;" and supporting services are processes that keep the ecosystem running, such as soil formation, photosynthesis and nutrient cycling.[4] Human wellbeing depends on these ecosystem services not only because they provide resources for food and shelter but also because our interaction with the physical environment increases feelings of happiness given that humans are a part of the ecosystem. Although western thought tends to separate humans from the natural world, there is a dynamic relationship between the ecosystem and the built environment in which human actions directly and indirectly cause changes in the ecosystem, which in turn provoke changes in human well-being. Industrial agricultural practices aim to maximize economic gain from provisioning services by increasing food and fiber production. Through the use of monocultures, added chemicals, irrigation, and heavy machinery, industrial agriculture impacts supporting services such as soil formation and nutrient cycling. These practices also negatively impact regulating services by decreasing the ecosystem's

[2] Millennium Ecosystem Assessment, *Ecosystems and Human Well-Being: Synthesis*, Web 2005, v.
[3] Ibid. v.
[4] Ibid. v.

resiliency because they interrupt ecosystem services that regulate natural phenomena. This chapter details the effects of industrial agricultural practices such as monocultures, chemical inputs, heavy machinery, and irrigation on the natural environment.

Dominant U.S. culture tends to frame the agriculture industry's transformation over the 20th century as one of increased efficiency. Consolidation of farmland, increased chemical inputs, and more heavy machinery all contributed to the sharp rise in food production in the second half of the twentieth century. At the same time as farms began rapidly growing, fewer people were being employed by the agricultural industry and the agricultural sector started contributing less and less to the total U.S. GDP. In 1900, 41% of the workforce was employed in agriculture, while in 1930 only 21.5% of the workforce was employed in agriculture and this sector accounted for 7.7% of U.S. GDP. Farm employment dropped to 16% of the workforce in 1945 and agricultural GDP was 6.8% of total GDP; 1970 saw 4% of the employed labor force working in agriculture and 2.3% of total GDP; and 1.9% of the labor force worked in agriculture in 2002 while agriculture accounted for 0.7% of total U.S. GDP.[5] In 2017, on-farm employment accounted for 1.3% of the total U.S. employed workforce and "about 1 percent of GDP" was attributable to the agriculture sector.[6] This trend of decreasing employment in the agricultural industry is due to the consolidation of farmland: today, there is a smaller number of farms that are much larger than when there were many more farms of smaller scale. With the rise in farm size came a decrease in commodities produced per farm as well: the average number of commodities per farm in 1900 was five, whereas the average was one commodity per farm in

[5] Carolyn Dimitri, Anne Effland, and Neilson Conklin, "The 20th Century Transformation of U.S. Agriculture and Farm Policy," *USDA Economic Information Bulletin* no. 3, (2005): 2.
[6] "Ag and Food Sectors and the Economy," United States Department of Agriculture Economic Research Service.

2002. This decrease in the number of commodities produced per farm is attributable to the rise in monocultures and all of its associated practices.

Monocultures. As crops like wheat, corn, soybeans, and cotton rose in popularity, farmers began planting fields with one crop to maximize their economic gains; this phenomenon is referred to as monocropping or the use of a monoculture. Between 1960 and 2000, "yields for all developing countries rose 208% for wheat, 109% for rice, [and] 157% for maize,"[7] numbers that illustrate the appeal of monocultures to farmers. Although humans can eat an estimated 50,000 plant species, only 14 of those supply 90% of the world's calories.[8] Furthermore, rice, wheat, and corn constitute 48% of the calories that people consume directly, and two-thirds of the world's population survives primarily on these three plants.[9] This lack of diversity in the food system makes humans vulnerable to large-scale famine if any of these crops were to suffer from disease, environmental degradation, or climate change. Not only does monocropping put food security at risk, but it also places individual farmers in economic instability because their income is dependent on the successful production of a single crop.

Chemical Inputs. The use of chemical inputs, which author Gary Holthaus calls "chemical mortuary services,"[10] arose in conjunction with the rise in monocropping. Once crops were no longer allowed to grow symbiotically with each other, fertilizers, herbicides and pesticides became necessary to perform functions that organisms used to do. Inorganic fertilizers aim to provide the main nutrients necessary for plant growth that are not readily available in the soil or air: nitrogen, phosphorus, and potassium. Some sources of nitrogen include ammonium

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[7] Prabhu L. Pingali, "Green Revolution: Impacts, Limits, and the Path Ahead," *PNAS* vol. 103, (2012): 12303.
[8] G. Tyler Miller and Scott Spoolman, *Living in the Environment: Principles, Connections, and Solutions*, 17th ed., Belmont: Brooks/Cole Publishing, (2011): 280.
[9] Miller and Spoolman, *Living*, 280.
[10] Gary Holthaus, *From the Farm to the Table: What All Americans Need to Know about Agriculture*, (Lexington, KY: University Press of Kentucky, 2006), 125.

nitrate and ammonium phosphate, both of which are manufactured by the Haber process which requires the input of natural gas. Nitrogen fertilizer production accounts for 90% of the nutrient's requirement—the other 10% is found in the processes of packaging, transportation, and application—and requires 70,000 KJ per kg of nutrient, or 30,000 Btu per pound.[11] The main phosphorus fertilizer is phosphate (P_2O_5), while potash (K_2O) is most commonly used to supply plants with potassium. The phosphate production process requires around 7,500 Btu/lb or 17,500 kJ/kg energy, and potash takes 6,000 Btu/lb and 14,000 kJ/kg.[12] The vast majority of energy consumed with fertilizers is accounted for in the production phase, followed by transportation, packaging, and application. Between 1960 and 1995, global use of nitrogen fertilizers increased sevenfold and phosphorus use increased 2.5-fold,[13] which in turn increased worldwide energy consumption.

Fertilizers began to be used in agriculture alongside monocultures starting with the Green Revolution in the 1950s and onwards in an effort to increase food production to feed the rising population. As of 2014, the U.S. uses 137.60 kilograms of fertilizer per hectare of arable land.[14] The main harm to the ecosystem is concerned with fertilizer runoff polluting the broader ecosystem; "today, only 20-50% of applied nitrogen fertilizer and ~45% of phosphorus fertilizer is taken up by crops"[15] while the rest escapes as runoff. According to the Millennium Ecosystem Assessment, "since 1960, flows of reactive (biologically available) nitrogen in terrestrial ecosystems have doubled, and flows of phosphorus have tripled."[16] When fertilizers are carried

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[11] Clark Gellings and Kelly Paramenter, "Energy Efficiency in Fertilizer Production and Use," *Efficient Use and Conservation of Energy* vol. II (2009): 130.
[12] Gellings and Paramenter, "Energy," 130.
[13] David Tilman, Kenneth Cassman, Pamela Matson, Rosamond Naylor, Stephen Polasky, "Agricultural Sustainability and Intensive Production Practices," *Nature* vol. 418 (2002): 673.
[14] "Countries Ranked by Fertilizer Consumption." Index Mundi.
[15] Tilman et al., "Agricultural Sustainability," 673.
[16] Millennium Ecosystem Assessment, *Ecosystems*, 2.

into waterways and out to the sea or lakes, algae thrive on the excess nutrients, particularly nitrates. So many algae can grow that they block light from reaching down into the body of water, which kills plants growing below the surface. Upon the eventual death of these algae, they sink to the bottom where they are decomposed by aerobic bacteria, a process that depletes dissolved oxygen in the water. Most fish and other organisms in the immediate area die from the lack of oxygen and the body of water is left with a dead zone.[17] This phenomenon, known as eutrophication, attacks the provisioning services that water provides and regulating services from water quality. It also damages cultural services because it takes away opportunities for recreational activities such as swimming, fishing, and boating, and a lake full of dead fish is not exactly aesthetically pleasing. Finally, eutrophication damages supporting services because nutrient cycling cannot occur in a dead zone. Agricultural and home fertilizers can also pollute drinking water supplies, which requires cleanup that costs nearly $2 billion every year.[18] Nitrogen fertilizers also contribute to air pollution because nitrogen oxides combust through soils, which increases atmospheric ozone, a chemical that allows more UV-B radiation to reach the Earth and disrupt biological processes.[19]

In the natural environment, plants growing around a crop can actually act as food sources to insects and animals that, in monocultures, feed on the crop instead because it is the only plant available to them. Industrial farmers therefore rely on pesticides and herbicides to prevent crop loss. The environmental issues with the application of these chemicals are their potential to be blown into the surrounding ecosystem and in turn reducing natural biodiversity. For example, the

[17] Miller and Spoolman, *Living*, 535-6.
[18] "Hidden Costs of Industrial Agriculture." Union of Concerned Scientists.
[19] Tilman et al., "Agricultural Sustainability," 673.

recent decline in honeybee population has been linked to bee exposure to agropesticides.[20] These pesticides tend to be insect neurotoxins, and long-term "pesticide exposure has a significant negative impact on bee learning and memory at field-realistic doses."[21] The reduction in honeybee population endangers the ecosystem because bees play an important role in many plants' reproduction, so it is very concerning that pesticides harm these beneficial insects. Additionally, as the climate is changing, crops are becoming more vulnerable to stress from weeds, diseases, and insect pests, which in turn requires a greater input of pesticide and herbicide chemicals.[22] Roughly 1.25 billion pounds of pesticides are used annually in the U.S., and nearly half of those are herbicides.[23] While it is difficult to quantify exactly how much energy is used to formulate and produce pesticides and herbicides, many of these chemicals are derived from petroleum and most require the burning of fossil fuels.[24]

Heavy Machinery. When monocultures are used, acres upon acres of land are planted with uniform rows of the crop, and machines are often used to tend all of the land. Tractors, harvesters, crop sprayers, plows, and seeders are all examples of heavy machines used on industrialized farms. While they make the work a lot easier for humans, these machines require energy that usually comes in the form of fossil fuels, which means that they emit carbon dioxide and further contribute to climate change. Since 1750, the concentration of carbon dioxide in the atmosphere has increased by more than 32%: from 280 ppm to 376 ppm in 2003.[25] Land use, land-use change, and forestry account for 11% of greenhouse gas emissions in the United States,

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[20] Harry Siviter, Julia Koricheva, Mark Brown, and Ellouise Leadbeater, "Quantifying the Impact of Pesticides on Learning and Memory in Bees," *Journal of Applied Ecology* vol. 55 (2018): 2812-2821.
[21] Siviter et al., "Quantifying," 2816.
[22] "Agriculture Highlights," National Climate Assessment.
[23] Zane Helsel,"Energy Use and Efficiency in Pest Control, Including Pesticide Production, Use, and Management Options," Extension (2016).
[24] Helsel, "Energy Use."
[25] Millennium Ecosystem Assessment, *Ecosystems,* 4.

and agriculture specifically accounts for 9%.[26] The heavy weight of machinery also compacts the soil: "Bigger tractors become necessary because the compacted soils are harder to work—and their greater weight further compacts the soil. More and bigger machines, more chemical and methodological shortcuts are needed."[27] The use of industrial machinery on farms harms supporting services because compacted soil cannot recycle nutrients or retain water effectively and this then affects plants' ability to photosynthesize.

While technological and industrial farm activities began to occur in the U.S. around 1920,[28] World War II provoked the widespread use of these practices. The agricultural engineers of the early twentieth century applied the factory model to farms to increase efficiency: "farm work, like craft work before it, seemed at last amenable to the application of power…Many engineers felt that mechanization was an inevitable outcome of progress, merely a developmental stage on the road to modernity."[29] They advocated for methodically planting one crop in straight rows over a large field so that heavy machinery could move between the rows to irrigate, harvest, till, and seed. Tractors—to which a plow, tiller, harvester, etc. can be attached—grew popular around the 1920s because agricultural engineers heavily promoted farm efficiency, and these machines continued to grow in popularity. In 1930, just 920,000 tractors were on farms in the U.S., while by 1945 that number rose to 2.4 million[30], and hit the highest of 5.47 million in 1966. Since the mid 1960s, tractor use has decreased slightly: as of 2007, 4.4 million tractors were in use.[31] Because heavy machinery such as tractors is motorized, it requires energy input. In 2014, the agricultural sector consumed 1,714 trillion Btu of energy, which accounted for 1.74% of total

[26] "Sources of Greenhouse Gas Emissions," EPA, 2018.
[27] Wendell Berry, *The Unsettling of America: Culture & Agriculture* (San Francisco: Sierra Club Books, 1996): 11.
[28] Deborah Kay Fitzgerald, *Every Farm a Factory: The Industrial Ideal in American Agriculture* (New Haven: Yale University Press, 2003).
[29] Fitzgerald, *The Unsettling*, 109.
[30] Dimitri et al. "The 20th", 6.
[31] "Agricultural Machinery, Tractors," The World Bank: Data.

U.S. energy consumption.[32] When the indirect uses of energy in agriculture—such as the production of chemical inputs like fertilizer and pesticides, transportation, and manufacturing and packaging foods—are accounted for, the agricultural industry consumes 19% of fossil fuel energy in the U.S. each year.[33] Furthermore, in 1940 it took one unit of fossil fuel energy to put 2.3 units of food on the table, whereas now it takes ten units of nonrenewable energy resources to produce one unit of food.[34] The use of heavy machinery on farms, therefore, strongly contributes to climate change by emitting greenhouse gases.

Irrigation. Industrialized farms use irrigation to water plants in areas that receive little or insufficient rainfall to support the growth of the crop. Agriculture accounts for 80 percent of the United States' water consumption, and over 90% in many Western states.[35] In 2013, irrigated agriculture applied 88.5 million acre-feet of water to the land,[36] which is equal to over 28 trillion gallons (my calculation). Soils that rely on irrigation during the growing season and are left bare for the rest of the year have poor drought resistance, which increases the input of water necessary.[37] Industrialized agriculture furthermore tends to over-irrigate: "60% of the irrigation water applied throughout the world does not reach the targeted crops."[38] The flood irrigation method, which is the most common type of irrigation, sends water through unlined ditches in fields to be absorbed by crops, but about 40% of the water delivered this way is lost to evaporation, seepage, and runoff.[39] Because only 0.007% of the earth's water is freshwater that is

[32] Claudia Hitaj, "Energy Consumption and Production in Agriculture," United States Department of Agriculture Economic Research Service (February 6, 2017).
[33] Miller and Spoolman, *Living,* 288.
[34] Ibid. 288.
[35] "Irrigation & Water Use," USDA ERS - Food Environment Atlas (July 19, 2018).
[36] Ibid.
[37] "Hidden Costs of Industrial Agriculture." *Union of Concerned Scientists.*
[38] Miller and Spoolman, *Living,* 334.
[39] Ibid. 334.

available to support the world's ever-increasing population, wasteful irrigation practices endanger the future of humanity by misusing provisioning resources.

Irrigation has been used on agricultural crops practically since the birth of agriculture 10,000 years ago. From Roman aqueducts to Mayan canals, the simplest way to administer water to croplands has been through flood irrigation. This is the practice where water obtained from a well, surface water source, or aquifer flows by gravity through unlined ditches to seep into soils for crops to use.[40] A slightly more water-efficient irrigation practice is the use of pressure-sprinkler systems, which can put as much as 95% of the water where crops need it.[41] 56 million acres of land, or 7.6% of U.S. cropland and pastureland, were irrigated in 2012, and in 2013 88.5 million acre-feet of water were applied nationally. Of these irrigated lands, 59% was irrigated by a pressure-sprinkler system, an increase from 28% in 1984; in the same time period, flood irrigation systems decreased from 71-41%.[42] Western states account for the majority of irrigated lands: three-quarters of irrigated cropland are in the seventeen western-most contiguous states and they received four-fifths of the irrigated water applied nationally.[43] Furthermore, more than half of irrigated croplands in western states are irrigated with less-efficient application systems. According to the USDA (United States Department of Agriculture), "fewer than 10 percent of irrigators make use of soil- or plant-moisture sensing devices or commercial irrigation scheduling services" and "fewer than 2 percent make use of computer-based simulation models to determine irrigation requirements based on consumptive-use needs by crop-growth stage under local weather conditions."[44] These careless irrigation methods threaten the world's water

[40] Ibid. 335.
[41] Ibid. 336.
[42] USDA ERS, "Irrigation."
[43] Ibid.
[44] Ibid.

supply, for "roughly 20% of the irrigated area of the United States is supplied by groundwater pumped in excess of recharge, and over-pumping is also a serious concern in China, India and Bangladesh."[45] Irrigation thus is an unsustainable use of water because it uses more water than what is available as a provisioning ecosystem service and because most irrigation is inefficient.

This chapter has presented data, both historical and present, on the impacts of industrialized agriculture on the environment. The emphasis on efficiency and increased output that capitalism demands encourages farmers to adopt an operations model in which "every farm is a factory." This model champions the use of monocropping which requires chemical inputs such as fertilizers, pesticides and herbicides, all of which require (nonrenewable) energy input to produce. Furthermore, these chemicals degrade soil quality by killing the living organisms that naturally produce nutrients for plant growth, fertilizers runoff can contaminate drinking water and cause eutrophication in wild habitats, and pesticides and herbicides decrease natural biodiversity. Monocultures also encourage the use of heavy machinery operated by nonrenewable energy and which further degrades soil by compacting it and causing erosion. Finally, irrigation tends to be applied inefficiently and promotes over-pumping of freshwater sources. All of these practices combined cause irreparable environmental degradation and contribute to the unsustainability of human life on earth. Agriculture's impact on the natural environment can be reduced, however, by radically changing our standard for productive farming methods, which are presented in the following chapter.

Chapter 2: Soil: The Root of Sustainable Farming

[45] Tilman et al., "Agricultural Sustainability," 674.

Sustainable Agriculture's Focus. Sustainable agriculture has several different components and can be defined in various ways. For the purposes of this thesis, "sustainable agriculture" encompasses the integration of ecologic, economic, and social concerns in agriculture. It is "oriented toward a cyclical process focusing on interrelated nutrient, water, plant, and energy cycles,"[46] and aims to imitate these cycles that occur in nature. Sustainable agriculture is dynamic and place-specific, "meaning that it must evolve to respond to changes in its physical environment or its social or economic context," and that practices that work in one area may not be as successful on another farm in a different part of the country given different soil and climate characteristics.[47] This thesis stresses a systems approach to agriculture, which "recognizes the importance of interconnections and functional relationships between different components of the farming system (for example: plants, soils, insects, fungi, animals, microbiota, and water)."[48] The systems approach focuses on agroecosystems, which are "communities of plants and animals interacting with their physical and chemical environments that have been modified by people to produce food, fiber, fuel, and other products for human consumption and processing," and agroecology "applies ecological concepts and principles to the design and management of agricultural systems to improve sustainability."[49] Some scholars and farmers have proposed the term "regenerative agriculture" in place of "sustainable agriculture" due to its emphasis on reversing the negative effects that agriculture has had on the environment. This thesis considers

[46] John Ikerd, *Crisis and Opportunity: Sustainability in American Agriculture* (Lincoln: University of Nebraska Press, 2008), 116.
[47] Leo Horrigan, Robert S. Lawrence, and Polly Walker, "How Sustainable Agriculture Can Address the Environmental and Human Health Harms of Industrial Agriculture," *Environmental Health Perspectives* no. 5 (2002): 452.
[48] *Toward Sustainable Agricultural Systems in the 21st Century* (Washington, D.C.: National Academies Press, 2010): 221.
[49] *Toward Sustainable,* 221-2.

regenerative agriculture to be one aspect of sustainable agriculture, for regenerative agriculture's emphasis on soil health is necessary to ensure the future viability of farming on Earth.

The number one goal of sustainable agriculture is to promote and conserve soil and its fertility, while other priorities include conserving other nonrenewable resources such as energy, clean air, and clean water for future generations. Soil is considered to be a nonrenewable resource because it is produced at a rate somewhere between less than one ton per year to a fraction of a percent of a ton per year, depending on what part of the soil profile is considered in the study.[50] A soil profile consists of the O (organic) horizon followed by A, B, and C horizons. Soil itself is formed from the weathering of bedrock, which is the parent material for soils and determines the nutrient components in a specific soil. The deposition of minerals from rain and wind, as well as decomposed organic matter, also contribute to the elements found in soils. The O horizon, or the top layer of soil, is where fresh organic matter from recently-dead plants and animals is found. The A horizon (also called topsoil) contains a lot of organic matter that is more broken down than in the O horizon, and biological activity—such as plant roots, earthworms, microorganisms, and insects—occurs there. The A horizon contains humus (the product of broken-down organic matter) which retains water and nutrients well. Following the A is the B horizon, which is often called subsoil and contains fewer nutrients and has less biological activity than the A horizon. The C horizon is the transition layer between the soil and its parent bedrock, and mostly contains larger chunks of rock. It is important to note that the mineral fraction of soil is a nonrenewable resource because "it cannot be recreated or renewed within any realistic future time frame."[51] The organic component (mostly the O and A horizons), on the other hand, can be renewed over decades through practices that return nutrients to the soil, which

[50] Ikerd, *Crisis*, 108.
[51] Ibid. 105.

are presented below. As more organic matter is added to soils and chemicals are used up by plants, soil profiles grow. Soil is the base of all life because it provides the nutrients that plants require to grow; therefore, the fact "that we must have soil to live is as fundamental as the fact that we must have air to breathe, water to drink, and food to eat. It's just less obvious."[52]

Although soil is often believed to be simply a mix of elements required for life, it is in fact a living, breathing organism full of micro- and macro-level life. It has been estimated that in one teaspoon of soil, there are as many as 75,000 species of bacteria, 25,000 species of fungi, 1,000 species of protozoa, and 100 species of small worms called nematodes.[53] Many of these organisms have reciprocal relationships with plants in which the plant's roots provide carbon sugars for the microorganisms to eat and the organisms in turn supply nutrients and protect the plant from pests and diseases. For example, plants emit carbon sugars from their roots to attract bacteria and fungi that "secrete enzymes that liberate minerals from the clay, silt, and sand, as well as from stones and actual bedrock."[54] Fungi then deposit these minerals inside the plant roots' walls, but the minerals consumed by bacteria "must be mediated by biology for the plant to be able to use them."[55] The bacteria that consume minerals are then eaten by a protozoa, nematode, or microarthropod which then expel the minerals in a chemical form that the plant's roots can absorb through diffusion.[56] Some plants—mostly legumes such as alfalfa, clover, lupine, beans, and locust trees—"attract a certain kind of bacterium that converts atmospheric nitrogen to a form that the plants can absorb."[57] The nitrogen is dispersed into the soil when the plant dies and decomposes, and thus can be used by other plants.

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[52] Ibid. 108.
[53] Kristin Ohlson, *The Soil Will Save Us: How Scientists, Farmers, and Foodies Are Healing the Soil to Save the Planet* (New York: Rodale Books, 2014), 28.
[54] Ohlson, *The Soil*, 37.
[55] Ibid. 37.
[56] Ibid. 37-8.
[57] Ibid. 38.

In addition to their nutrient-providing role, bacteria and fungi in the soil also have the important task of regulating water flow. Bacteria use the plant's carbon sugars to produce a glue that anchors them to the plant's roots to keep themselves in place when water moves through the soil.[58] Once they are solidly attached to the roots, they "glue more particles to themselves—another piece of silt or maybe a decayed bit of plant material," and a small structure, called an aggregate, forms.[59] Fungi make use of bacterial aggregates by gathering them to "make their own lopsided aggregates" that protect their reproductive parts.[60] These aggregates protect bacteria and fungi from predators and essentially form air pockets for gases and water. These air pockets slow the percolation of water into groundwater reserves, ensuring that it is available to all soil life and preventing floods, wildfires, and erosion from wind and water.[61] On top of retaining water in the soil, the open space created by aggregates allows microbes to consume pollutants before the water reaches streams and aquifers, thus performing the ecosystem service of maintaining water quality.[62] All of these soil organisms rely on plants secreting carbon sugars, which they consume and integrate as part of their bodies: "fungal hyphae snake that carbon throughout the soil as if they were railroad tracks; when they die, that far-reaching network of carbon stays in the soil to be nibbled at by other creatures."[63] Soil organisms provide essential nutrients to plants, protect plants from diseases and pests, retain water in air pockets created by aggregates, purify water, and maintain soil structure by preventing erosion. Unfortunately, the industrial agricultural practices described in chapter one have killed many of these vital soil microorganisms.

[58] Ibid. 40
[59] Ibid. 40.
[60] Ibid. 41.
[61] Ibid. 41.
[62] Ibid. 126.
[63] Ibid. 45.

Soil Carbon Sequestration Methods. One way to improve poor soil quality is to increase its organic matter content by sequestering carbon in it. The two most effective methods of soil carbon sequestration are the use of perennial crops and agroforestry. Perennial crops are those that live for at least three years (ideally longer), and they can produce food, animal fodder, and fuel.[64] Eric Toensmeier's *The Carbon Farming Solution* divides perennials into classes based on protein, fat, and carbohydrate contents: basic starch crops, balanced carbohydrate crops, protein crops, protein-oil crops, edible oil crops, and sugar crops. Toensmeier's textbook is a valuable resource to discover which perennial crops grow well in particular regions and effective growing practices. Some examples of perennial crops include "trees, palms, bamboos, shrubs, vines, succulents, and cacti, as well as non-woody species such as grasses, herbaceous perennials, and ground covers."[65] The carbon sequestration potentials of perennial plants depend on the type of plant and harvest methods, so Toensmeier promotes those that do not need to be killed when harvested. Perennial plants have incredible carbon sequestration potentials: "annual aboveground biomass sequestration ranges from 3 to 13 tons per hectare and total annual sequestration between 13 and 30 tons per hectare."[66] Potential soil carbon sequestration for perennials is so high because they are not killed when harvested, so they continue taking in carbon dioxide and turning it into carbon sugars for their own growth and for soil microorganisms to consume. Furthermore, their roots continually extend into the soil, fostering more bacteria and fungi to form aggregates around them and promoting the structural integrity of the soil.

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[64] Eric Toensmeier, *The Carbon Farming Solution: A Global Toolkit of Perennial Crops and Regenerative Agriculture Practices for Climate Change Mitigation and Food Security* (Vermont: Chelsea Green Publishing, 2016).
[65] Toensmeier, *The Carbon Farming*, 45.
[66] Ibid. 100-1.

Agroforestry is a specific method of employing perennial woody plants in agriculture. It is the intentional, intensive, and interactive "integration of trees on farms and in the agricultural landscape."[67] Mixing trees with annual crops can increase the sustainability of annual crop production by reducing erosion, fixing nitrogen into the soil, and building biomass above and belowground.[68] Trees help to reduce erosion by acting as windbreaks that slow wind speed to protect exposed soils and crops from damaging winds, and by anchoring the soil in place with their sturdy roots.[69] One way to practice agroforestry is by using tree intercropping systems, which intersperses trees and other woody plants with annual crops such as in alley cropping, contour hedgerows, and windbreaks.[70] Another practice is silvopastoralism, which "integrate[s] trees or other woody plants with livestock."[71] Silvopastoral systems represent more efficient land use than typical pastures, and they are estimated to sequester 6.1 tons of carbon per hectare annually in North America.[72] Finally, multistrata agroforestry systems "consist solely of perennials or integrate trees or other woody plants with annual crops and livestock".[73] Although this thesis mainly focuses on plant production for clarity and due to the author's personal belief that humans should subsist on plants, it is important to mention that diversified agricultural systems (which integrate plants and animals) best mimic natural ecosystems. For example, grasslands evolved along with the animals that inhabit them, so it is necessary to have "lots of hooves breaking up the hard surface of the soil, lots of grasses trampled into the ground, lots of grasses being tugged and bitten and causing the plants to pulse carbon sugars into the soil, and lots of nutritious dung, urine, and hair spread around for the insects and microorganisms to break

[67] Ibid. 39-40.
[68] Ibid. 40.
[69] Ibid. 80.
[70] Ibid. 40.
[71] Ibid. 40.
[72] Ibid. 94.
[73] Ibid. 40.

down" to have healthy grassland soil.[74] Animals do have a place on the farm given that plants naturally exist in harmony with animals, but only as members of the farm ecosystem and not as food for humans.

No-till Farming. Given that ploughing releases stored soil carbon into the atmosphere as carbon dioxide and that tillage disturbs the soil life, sustainable agriculture does not break up the soil once it is formed. Farmers often plough to weed fields or after each harvest to prepare the soil for new plants, but neither of these are necessary. Weeds can be pulled up by hand, with a hoe, or consumed by livestock. Mulch can also be applied on top of soil to discourage weed growth, and it has the added benefits of reducing erosion, conserving soil moisture, and maintaining an even soil temperature.[75] Organic mulches such as grass clippings, straw, and bark chips will also slowly decompose over time and add organic matter to the soil.[76] In sloping areas, terracing is beneficial for it prevents erosion and protects soil structure. Reducing tillage is a vital method to maintaining healthy, living soil and merits the extra manual labor. On top of not disturbing the soil structure essential to healthy crops and waterways, farms that do not plough also rely more directly on solar energy to produce food, as opposed to industrialized farms that employ heavy machinery that burns fossil fuels.

Organic Farming Methods. Farming practices that emphasize soil vitality and conservation of natural resources are exemplified by the organic model, though many of them can be employed on non-organic farms and before organic certification. Organic farming prohibits the use of synthetically-produced inputs such as fertilizers, pesticides, and herbicides, and follows the "philosophy of using biological processes to achieve high soil quality, control

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[74] Ohlson, *The Soil*, 96.
[75] "Mulching," USDA Natural Resource Conservation Service, https://www.nrcs.usda.gov/wps/portal/nrcs/detail/?cid=nrcs143_023585.
[76] Ibid.

pests, and provide favorable growing environments for productive crops."[77] Some organic farmers spray naturally-derived fertilizers or pesticides on their crops, but good organic farming foregoes this approach for one that "works with biological processes and regards the soil as a complex system of living organisms."[78] To supply nutrients to crops and maintain soil fertility, organic agriculture uses compost, animal manure, and green manure. Compost is a mix of organic matter (leaves, crop residues, food wastes, paper, and wood) in the process of being decomposed by soil microorganisms. Animal manure is the dung and urine of farm animals and when applied to soils, it "adds organic nitrogen and stimulates the growth of beneficial soil bacteria and fungi."[79] Green manure also increases organic matter and humus in soil, and "consists of freshly cut or growing green vegetation that is plowed into the topsoil."[80] The application of compost and manures to soil allows the natural cycling of energy and materials to continue, which promotes soil quality and eliminates the need for synthetic fertilizers. Adding compost on top of planted soil delivers microorganisms that are "eager to exchange their gifts of phosphorus, nitrogen, and other nutrients for a sip of carbon" from plants.[81]

The next method that organic farming uses to promote and conserve soil fertility is the use of cover crops in conjunction with strip cropping, which also prevent erosion and minimize weed growth. Strip cropping is the practice of planting alternating rows of a row crop, such as cotton or corn, and rows of cover crops. Cover crops such as alfalfa, clover, oats, and rye completely cover the soil and "[trap] topsoil that erodes from the row crop and catches and reduces water runoff."[82] The cover crops are left in place when the row crops are harvested to

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[77] *Toward Sustainable*, 222.
[78] Ohlson, *The Soil*, 166.
[79] Miller and Spoolman, *Living*, 306.
[80] Ibid., 306.
[81] Ohlson, *The Soil*, 205.
[82] Ibid., 304.

prevent erosion and return nutrients to the soil. This way, the micro- and macroorganisms below surface level are fed year-round and they continue to build aggregates to increase the absorbency of the soil.[83] Research shows that a two- or three-species cover crop reduces sediment runoff by ninety percent, cuts fertilizer runoff in half, and sequesters a metric ton of carbon dioxide per acre.[84] Similar to strip cropping, alley cropping is the practice of planting rows of trees or shrubs between the rows of crops to be sold to support the annual crop's growth.[85] Alley cropping provides shade to the crops to prevent evaporation, promotes the retention and slow release of soil moisture, and prevents erosion by locking the soil in place.[86] Given that cover, strip, and alley cropping all promote soil moisture retention and reduce evaporation, the need for irrigation is reduced. This allows many organic farms to employ drip irrigation, which delivers a small amount of water directly to the plant's roots when the soil becomes dry. Sustainable agriculture systems infrequently irrigate and do so during cooler times of the day so the water can be absorbed by the plants instead of evaporating.

Biodiversity. Organic agricultural production methods emphasize biodiversity to promote crop growth. On the farm, biodiversity can be promoted by planting several different strains of the same plant on a field, by planting various crops in the same area, and by encouraging animal and insect presence. Not only is biodiversity necessary to prevent mass famine resulting from poor weather conditions or disease, but growing a variety of crops together "provides a buffer against both ecologic and economic problems," creates niches for beneficial insects, and reduces the impact of pests and weeds.[87] Integrated Pest Management (IPM) systems, which are often

[83] Ohlson, *The Soil*, 94.
[84] Ibid. 107-8.
[85] Toensmeier, *The Carbon*, 78.
[86] Miller and Spoolman, *Living*, 305.
[87] Ibid. 452.

used on organic farms, emphasize the intercropping of plants highly-resistant to pests with plants with lower pest resistance. IPM is the combined use of "cultivation, biological, and chemical tools and techniques" to prevent pests from damaging crops.[88] An example of IPM is ranging poultry directly consuming harmful insects or ranging pigs consuming fallen fruit containing pests and diseases.[89] Crop rotations are another pest-control mechanism. When a field is planted with the same crop every year, "the diseases and pests that prey on that crop take up residence there, too,"[90] so moving the crop annually interrupts pests' reproductive cycles, in turn reducing the need for pest control.[91] Crop biodiversity also helps to balance available soil nutrients and attract a variety of beneficial microorganisms. Biodiversity within agriculture is vital not only to mimic natural ecosystems but also to encourage healthy crop growth.

Vertical Farming. No discussion on sustainable food production methods is complete without the inclusion of urban food production. Currently, 55% of the world's population resides in urban areas, and this number is projected to increase to 68% by 2050.[92] Urban areas historically have not produced their own food, but rather they import food grown in rural areas. This practice of transporting food from one part of the country to another usually burns fossil fuels, for the trucks and other vehicles that transport food run on gasoline. Therefore, urban food systems that fail to produce any of their own food are unsustainable, and they will be forced to become more self-reliant as their populations grow in response to climate change. There are two main types of urban agriculture: horizontal and vertical. Horizontal urban farming mimics traditional agriculture in a field and includes rooftop gardens and greenhouses. These farmers

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[88] Miller and Spoolman, *Living,* 301.
[89] Toensmeier, *The Carbon,* 91.
[90] Ohlson, *The Soil,* 166.
[91] Horrigan et al., "How," 452.
[92] "68% of the World Population Projected to Live in Urban Areas by 2050, Says UN," United Nations, last modified May 16, 2018, https://www.un.org/development/desa/en/news/population/2018-revision-of-world-urbanization-prospects.html.

can grow on rooftops or empty lots in a community, and horizontal urban farming has been found to encourage community growth and development, which will be discussed further in chapter five.

Vertical farming, on the other hand, is the practice of growing crops indoors, stacked vertically on top of each other. This type of sustainable farming eliminates nonpoint source water pollution, frees up agricultural land to return to its prior state, and drastically reduces the amount of water required to produce food crops. Hydroponics, one method of vertical farming, consumes only ten percent of the water that conventional agriculture requires.[93] Hydroponics is the practice of growing crops not in soil, but instead "expos[es] their roots to a nutrient-rich water solution."[94] Aeroponics consumes 95% less water than conventional agriculture does, and 40% less then hydroponics.[95] In aeroponics, the plant's roots are exposed to the air, and directly misted with a water-nutrient solution. Both hydroponics and aeroponics require UV lights for plants to photosynthesize, but electricity from renewable sources can make this a sustainable system. Nutrients to grow plants indoors can be mined, which cannot be continued forever, or they can come from composted food scraps and even treated human waste. All types of vertical farming are sustainable alternatives to the intensive agriculture that dominates the food system.

Although organic farming methods tend to produce yields around 8% lower than conventional farming techniques do, they are necessary to reduce the impact of agriculture on the natural environment. Organic fields have been found to have better overall soil quality "as measured by soil properties such as more organic matter, better structure, less compaction, more

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[93] "5 Environmental Benefits of Hydroponic Growing (Explained in Detail)," Get Green Now, last modified August 25, 2018, https://get-green-now.com/hydroponics-environmental-benefits/.
[94] Miller and Spoolman, *Living,* 282.
[95] "Growing with Hydroponics, Aeroponics and Aquaponics," AgriTech Tomorrow, last modified December 26, 2018, https://www.agritechtomorrow.com/article/2018/05/1-article-for-2018-growing-with-hydroponics-aeroponics-and-aquaponics/10733.

earthworms, and greater microbial activity and diversity, than their conventional counterparts."[96] Organically-managed soils store nitrogen more efficiently and therefore have reduced levels of leachable nitrates that can cause eutrophication.[97] Furthermore, organic systems have net greenhouse warming potential of "less than half that of conventional with full tillage, but higher than for no-till due to the higher soil carbon gains from no-till."[98] Organic farms have the potential for higher profits than conventional farms do because, even though they have greater labor requirements, organic farms have much lower purchased input costs (of chemicals and water) and higher potential market prices.[99] Organic farmers use fewer agrochemicals that can pose risks to their health than conventional farmers do. Finally, studies have shown that organic farming can produce enough food on a global scale to sustain the current human population, "and potentially an even larger population, without increasing the agricultural land base."[100] For these reasons, organic farming methods are essential to ensure the future vitality of agriculture. Sustainable food production methods generally emphasize the quality of life within the soil, and there are various practices to promote soil health. Not all practices are suited for all climates and soil qualities, however, so farmers must adapt their practices given local conditions. The next chapter will explore why these practices have not been widely implemented in the United States due to the role of agribusiness.

Chapter 3: Agribusiness Calls the Shots

[96] *Toward Sustainable,* 226.
[97] Ibid. 227.
[98] Ibid. 228.
[99] Ibid. 228.
[100] Ibid. 231.

As in many industries in the United States, large corporations have taken over the agricultural production landscape. These corporations are collectively referred to as *agribusiness* throughout this thesis, but there are actually two distinct groups within this term: "(i) large-scale industrial farmers, many of whom are tied with marketers through contracts; and (ii) firms that sell and market the products of others (many of whom have substantial land in production, too)."[101] The presence of these large corporations in food production has created a "bi-polar industry structure, with a handful of large firms capturing most of the revenue and a large number of small operations capturing relatively little."[102] In fact, around ten percent of all farms accounts for nearly 75 percent of all agricultural output because they specialize in commodity crop production.[103] In 2015, 90% of U.S. farms were small family operations with under $350,000 in annual gross cash farm income (including sales of crops and livestock, government payments, and other farm-related income), but they accounted for only 24% of the value of agricultural production.[104] Large-scale family farms with at least $1 million gross cash farm income made up only 2.9 percent of all farms in the U.S. but contributed 42% of the total production.[105] These numbers clearly indicate that agricultural production and earnings from production are concentrated heavily within few hands, which negatively affects small farms.

Agribusiness has increasingly concentrated its ownership of agricultural production and cropland over the past few decades. In 1991, farms with over $1 million gross cash farm income accounted for one third of the value of U.S. farm production, which increased to half the value by 2015. Similarly, "small family and nonfamily farms accounted for 46 percent of production in

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[101] Julie Guthman, "Room for Manoeuvre? (In)organic Agribusiness in California," in *Agribusiness & Society*, ed. Kees Jansen and Sietze Vellema (New York: St. Martin's Press, 2004), 124.
[102] Guthman, "Room for Manoeuvre?," 125.
[103] Imhoff, *The Farm Bill*, 76.
[104] James MacDonald et al., "Contracts, Markets, and Prices: Organizing the Production and Use of Agricultural Commodities," last modified November 2004, https://www.ers.usda.gov/publications/pub-details/?pubid=41704.
[105] MacDonald et al., "Agricultural Commodities."

1991, but by 2015, that share had fallen under 25 percent." The midpoint size of farms in the U.S.—which marks the middle of the distribution of cropland, with half of all cropland operated on farms above and half on farms below the midpoint—increased from 589 acres in 1982 to 1,234 acres in 2012. This increase in midpoint farm size occurred in almost all states across the nation and accounted for all crops in production. Despite the increase in midpoint farm size, the average farm size stayed relatively stable: average farm size increased from 222 acres in 1982 to 257 in 1992, and 251 acres in 2012. The relative stability in average farm size is due to a decrease in the number of midsize farms as cropland became more consolidated into larger farms, but this trend was offset by an increasing number of very small farms (under 20 acres of cropland) since the 1990s. The number of very small farms has been increasing to meet consumers' demands for more fruit and vegetables, which are not well-suited to be grown on huge industrialized farms. Currently, there are a few large and very large farms that produce the majority of food for the United States because they employ industrialized crop production methods discussed in Chapter 1 to grow commodity crops such as corn, wheat, and soy. The vast majority of farms, however, are small operations that account of a smaller share of agricultural production but grow specialty crops such as fruits and vegetables that support a balanced diet.[106]

An issue related to the concentration of cropland and production is the power that processing firms have over farmers and consumers. Many crops, particularly commodity crops, must be processed before consumption, and "the four largest firms process from 57 to 76 percent of the corn, wheat, and soybeans in the United States."[107] The influence of these processing firms is well-detailed in the following quote:

> Like the narrow opening of an hourglass which controls the flow of sand from the top to the bottom,

[106] MacDonald et al., "Agricultural Commodities."
[107] William D. Heffernan, "Concentration of Ownership and Control in Agriculture," in *Hungry for Profit,* ed. Fred Madgoff, John Bellamy Foster, and Frederick H. Buttel (New York: Monthly Review Press, 2000), 66.

> the processing firms are positioned between the thousands of producers and millions of consumers in the United States and in the world. These firms have a disproportionate amount of influence on the quality, quantity, type, location of production, and price of the product at the production stage and throughout the entire food system.[108]

Processing firms have strict standards for the agricultural products that they accept, and farmers must comply with the standards if they want to sell their crops. Farmers also lack choice in processing firms, for there is usually only one firm within a reasonable distance. This disenfranchises farmers because it forces them to sell their crops to the closest processing firm instead of to the highest bidder, and as a result farmers often receive minimal remuneration for their time, labor, and input costs. They then try to make up the difference in input costs and earnings by producing as much as possible on their land. This whole system encourages farmers to utilize industrialized farming methods to receive a sufficient return on their investment, and thus acts as a disincentive for farmers to produce within their land's capacity.

Another way that processing firms discourage farmers from producing sustainably is through the system of contract production. Although this thesis focuses on crop production, the contract production system is most effectively explained in the context of livestock production, where it is most visible. In the 1950s and 1960s, feed companies began hatching their own chicks and hiring farmers to grow them on their own land, which created the system of contract production. Growers are required to provide buildings for the animals "and equip the buildings to the integrating firm's specifications while providing all of the labor for the production state of the system." The integrating (or processing) firms own the birds and feed, and make all major decisions including how much to feed the chickens, when to feed them, and medication administration. In order to build the buildings required by the integrating firms that cost over $100,000 each, farmers mortgage their land and repay it over ten to fifteen years. Contracts with

[108] Heffernan, "Concentration of Ownership," 66.

integrating firms last only as long as the chicken production cycle, however, which only takes six weeks. Farmers thus can lose their contracts at any time, which makes them extremely vulnerable. Furthermore, "by the time the buildings are almost paid off, the equipment needs to be replaced and the buildings need to be modernized." Contract production thus keeps farmers in debt, dependent on each short-term contract to pay off their mortgaged land.[109]

Crop farmers face similar challenges with contracts with biotechnology companies that produce seeds and other inputs used on the farm. One major agricultural biotechnology firm was Monsanto (acquired by Bayer in 2018), well-known for producing Roundup, a glyphosate-based herbicide that became widely used beginning in the 1970s, and accompanying Roundup-Ready crop seeds. Monsanto expanded upon its existing products such as Roundup to produce the following additional agricultural products: "Roundup Ready soybeans, canola, cotton and other crops resistant to the Roundup brand family of non-selective herbicides" as well as "insect protected crop seeds, including Bollgard and Ingard insect-protected cotton, Yield Guard and Maisgaurd insect-protected corn, and NewLeaf insect-protected potatoes."[110] These products were marketed as alternatives to applying herbicides and insecticides to the crops, which would reduce farmers' production costs, and they were quickly employed across the country. On top of the negative environmental effects that these seeds can have, "Monsanto's most controversial action was to demand that farmers who bought a bag of Roundup Ready seed should pay a special 'technology fee' and sign a contract which stipulated that they would not use any of the harvested crop as seed for the next year."[111] This contract thus required farmers to buy new seeds

[109] Heffernan, "Concentration of Ownership," 70.
[110] Sietze Vellema, "Monsanto Facing Uncertain Futures: Immobile Artefacts, Financial Contraints and Public Acceptance of Technological Change," in *Agribusiness and Society*, ed. Kees Jansen and Sietze Vellema (New York: Zed Books Ltd., 2004), 46-7.
[111] Vellema, "Monsanto," 48.

from Monsanto year after year instead of buying seeds once and saving the seeds from the harvested crop for the following season. Additionally, "the contract required farmers to apply only the Roundup formulation of glyphosate, and Monsanto representatives were allowed to inspect and test farmers' fields," further limiting farmers' choices.[112] Monsanto and other agricultural biotechnology firms profess that they aim to support farmers and make their job easier, but they end up taking advantage of farmers in various ways through contracts. Similar to processing and integrating firms, biotechnology companies limit farmers' independence and their ability to make decisions that benefit their land.

The emergence of agribusiness's influence in rural farming communities affects not only farmers and their families but also the health of the community. When family businesses were the main economic systems in rural agricultural communities as they were for most of history, "money generated in the agricultural sector would circulate in the community, changing hands from one entrepreneurial family to another three or four times before leaving the rural community."[113] Agricultural income allowed rural communities to remain vibrant and to flourish economically. When farmers become tied to agribusiness, profits are "immediately taken out of the local rural community. They usually go to the firms' headquarters and on to stockholders or, if the corporation is a [Trans-National Corporation], the profits are very likely invested in the food system somewhere else in the world."[114] The resulting lack of monetary circulation has important social consequences for rural communities and partly accounts for the decline of rural communities' vitality in recent decades. A study in the 1940s by Walter Goldschmidt "showed a strong relationship between the structure of the food system and the social condition of the

[112] Vellema, "Monsanto," 48.
[113] Heffernan, "Concentration of Ownership," 73.
[114] Heffernan, "Concentration of Ownership," 73-4.

community, revealing that the well-being of communities dominated by large-scale, absentee-owned, corporate farms was greatly inferior to that of communities in which family farms predominated."[115] Goldschmidt's results have been confirmed by various other studies, as well as by demographic inquisition. The vibrancy of rural communities depends greatly on farmers' incomes, but agribusiness decreases farmers' impacts on their communities.

Agribusiness began to infiltrate the organic market around two to three decades ago, depending on the product, in conjunction with the rise of health food stores. Some organic corporations "became leaders by the historic accident of having been involved in flagship commodities such as salad mix; others aggressively pursued growth strategies while the industry was in its infancy, first by expanding their own production, later by bringing these new growers in through 'cooperative arrangements.'"[116] Regardless of how firms entered the organic industry, "the effect is the same: the organic sector in California has become more oligopsonistic (where a few buyer firms have control) in its structure than the conventional one."[117] The following discussion on organic industry is based on its presence in California, which has over five million acres under organic production and has the most organic sales, farm numbers, and acres of any state in the United States.[118] California thus serves as an exemplar to evaluate the influence of organic agribusiness. The state was able to flourish as the nation's center for produce production not only due to its favorable weather but also because of the availability of cheap labor from migrants. The availability of migrants from Mexico and the Pacific Rim allowed Californian farmers to become "capitalist producers, either employing their own wage labor or contracting

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[115] Ibid., 74.
[116] Guthman, "Room for Manoeuvre?," 130.
[117] Ibid., 130.
[118] "Organic Survey: Certified Organic Acreage in California Tops 1 Million Acres; Sales Approach $3 Billion," California Certified Organic Farmers, last modified September 25, 2017, https://www.ccof.org/blog/organic-survey-certified-organic-acreage-california-tops-1-million-acres-sales-approach-3.

for labor."[119] Although the seasonal migration of farm laborers from places like Mexico has decreased due to border tensions and heightened security, many farms employ undocumented immigrants and pay them far below minimum wage. The precarious nature of these laborers' citizenship makes them especially vulnerable to abuses such as not receiving minimum wage or being paid for overtime, being forced to live in small, temporary dwellings with several others, and the constant threat of deportation and a loss of their income. The United States' food system cannot become sustainable as long as it relies on human rights abuses in California and other states across the nation, yet the result of migrants' low wages is that consumers can buy food at relatively affordable prices. This issue must be addressed sooner or later, and the community-based agriculture proposed in chapter five aims to resolve this conundrum.

Organic agribusiness created conditions that influence the practices that organic farmers can employ. While the holistic meaning of organic encompasses not using industrialized production practices such as monocultures or heavy machinery on the field or in processing, USDA standards focus mostly on inputs in the production processes. The USDA's organic standards include a long list of practices for production, handling, and labeling, such as not employing synthetic fertilizers, pesticides or other chemicals, sewage sludge, or genetic engineering. Codification of organic standards and enforcement mechanisms "enhanced the division between an organic movement, which seeks to retain the holistic meanings of organic farming, and an organic industry, which seeks to bring organic to a broader audience."[120] These tensions rose because organic producers "effectively internalize costs that have been progressively externalized with modern farming," and farmers must sell their crops for more (either through price premiums or with agricultural policy support) in order to make up for their

[119] Guthman, "Room for Manoeuvre?," 123.
[120] Ibid., 131.

increased costs.[121] California lacks policy support for organic farmers, so they depend on price premiums to make a profit, but "in the last decade the organic sector has been plagued with rampant price competition."[122] Furthermore, agribusiness influenced California's land values to be based on the highest-value crop that can be grown in any given region, so small-scale organic farmers in this state consistently fall into debt.[123] Organic agribusiness faces significantly fewer challenges than smaller-scale organic farmers do, yet they are subject to the same standards. Chapter four will examine agricultural and nutrition legislation, focusing on the Farm Bill. It will continue the discussion of agribusiness by highlighting how large corporations disproportionately benefit monetarily from federal agricultural subsidies, while at the same time the federal government encourages unsustainable production methods.

Chapter 4: How Accessible Is Sustainably-Grown Food in the U.S.?

The Farm Bill is a massive piece of federal legislation that manages the production and distribution of food in the United States. It has two primary goals: (1) to support farmers who grow commodity crops such as corn, soy, wheat, rice, cotton, and dairy, and (2) to ensure that citizens have access to the nutrition they require. Food nutrition programs now use eighty percent of the Farm Bill's overall funding, while crop insurance programs account for thirteen percent of spending, and conservation incentives receive about six percent of the Farm Bill's budget.[124] The Farm Bill is a descendant of the Agricultural Adjustment Act of 1933, which was passed by President Roosevelt during the Great Depression as a method to "keep food prices fair for farmers and consumers, ensure an adequate food supply and protect and sustain the country's

[121] Ibid., 134.
[122] Ibid., 134.
[123] Ibid., 135.
[124] Daniel Imhoff, *The Farm Bill: A Citizen's Guide* (Washington: Island Press, 2019), 11.

natural resources."[125] Up through the 1960s, the Farm Bill—as the Agricultural Adjustment Act became to be known—was periodically evaluated by Congress but did not have a set schedule for readjustment.[126] Between the 1970s through 1980s, the Farm Bill was reevaluated every four years, and since the 1990s has been on a schedule of reconsideration roughly every six years.[127] Given that its original purposes were to support farmers and distribute food to citizens, the Farm Bill did not address conservation or sustainability until more recently. No federal funds were allocated to conservation in agriculture until 1985 when the Farm Bill included conservation as one of its titles and distributed one billion dollars per year to conservation efforts.[128]

Currently, the Farm Bill addresses issues of credit, trade, renewable energy, rural development, horticulture, agricultural research, forestry, local food programs, crop insurance, and conservation in addition to supporting farmers and nutrition programs. It is comprised of twelve titles that cover a wide range of food-related topics, and each title contains various programs that receive federal funding. Some programs receive mandatory funding status—such as the Supplemental Nutrition Assistance Program (SNAP), the Specialty Crop Research Initiative, Organic Research and Extension Initiative, Community Food Projects, and Bioenergy Programs[129]—which means that they do not receive annual funding from Congress but rather from the Commodity Credit Corporation (CCC). The CCC is a national (U.S. government-owned) business that was created to support and stabilize farm prices and incomes, and it funds mandatory programs as needed. Although Farm Bill programs with mandatory funding status are not considered by Congress when funding Farm Bill programs annually, House and Senate

[125] "The Farm Bill and Other Food Policy," FoodPrint, https://foodprint.org/issues/farm-bill-and-other-food-policy/.
[126] "Farm Bill 2018: A Primer," National Sustainable Agriculture Coalition, 1.
[127] Ibid. 1.
[128] Ibid. 4.
[129] "The Farm Bill," National Institute of Food and Agriculture, https://nifa.usda.gov/farm-bill.

Appropriations Subcommittees can pass changes in funding to mandatory programs.[130] One way this occurs is through Changes in Mandatory Program Spending (ChIMPS), which can delay funding mandatory programs for a year or alter the amount of funding a program receives.[131] For example, funding of the Environmental Quality Incentives Program was cut by $274 million due to ChIMPS in 2014, "and an additional $126 million was slashed as part of an attempt to reduce the federal deficit."[132]

The majority of Farm Bill programs receive discretionary funding status, and their funds are determined through the annual appropriations process. First, the president sends a budget request to Congress and then the House and Senate Appropriations Committees send the agricultural budget to the agricultural subcommittees in each chamber to decide on funding for the Farm Bill. Once the subcommittees' appropriations bills are drafted, they each vote to pass on the bill to the full Appropriations Committees that edit them. Eventually, the House and Senate Appropriations Bills are combined, and both chambers must vote on it before the president signs or vetoes it. During the appropriations process, all programs with discretionary funding are at risk of debilitating funding cuts. For example, programs that aim to serve the broader public—such as conservation incentives, sustainable agriculture research funds, beginning farmer supports, farm-to-school distribution arrangements, and food assistance for mothers and children—tend to be the first to suffer from funding cuts.[133] Commodity price supports, on the other hand, are generally "the only untouchable spending categories in the appropriations process" for the Farm Bill.[134] The combined effect of (1) consistently cutting

[130] Imhoff, *The Farm Bill*, 19.
[131] Ibid. 19.
[132] Ibid. 22.
[133] Ibid. 20.
[134] Ibid. 20.

programs that support the sustainability of the United States' food system and (2) steadily funding the production of commodity crops is that the U.S. government promotes the use of the unsustainable food production practices that are discussed in Chapter One. What follows is a discussion of key policy issues in the Farm Bill and their impact on the sustainability of the U.S. food system and/or on the accessibility of nutritious food, as well as an examination of the implementation of agricultural policy at lower levels of government.

Crop subsidies. The system of farm subsidies is intended to protect the country's food supply and to strengthen rural communities by acting as an income safety net for farmers, whose profession is vital to individuals' survival yet is unpredictable. Since Roosevelt's Agricultural Adjustment Act of 1933, there has been a trend of increasing federal payments to the food sector. The 1996 Farm Bill, known as Freedom to Farm, aimed to incrementally decrease farm subsidies over seven years "and return to free-market agriculture not seen since the early days of the New Deal."[135] The result, however, was "more than a decade of the largest agribusiness payouts in history," and Freedom to Farm contributed to a farm economy crash.[136] This Farm Bill removed acreage set-aside requirements that had been in place previously, which served not only as a supply management strategy but also as a tool to promote soil conservation.[137] Additionally, Freedom to Farm eliminated the grain reserve which had acted as a strategic "relief valve for surpluses" for decades.[138] Farmers therefore flooded the markets with their exceptionally high-yield harvests due to favorable weather conditions in 1997. The international crisis also reduced the demand for exports. Markets became oversaturated due to these unanticipated factors, and

[135] Ibid. 61.
[136] Ibid. 61.
[137] Ibid. 61.
[138] Ibid. 61.

the farm economy degenerated quickly.[139] Commodity subsidy programs cost between three and four billion dollars per year during the few years before 1996 due to high crop prices, but after the passage of Freedom to Farm their cost grew to between 15 and 25 billion dollars.[140]

Freedom to Farm also introduced the concept of decoupled payments to the relationship between the government and farm operators. Decoupled payments were given to landowners "based on their subsidy history, whether or not they grew commodity crops" at the time.[141] The goal of direct payments was to give farmers the freedom to plant new crops and explore alternative approaches to farming while phasing out government subsidies. The 2002 Farm Bill solidified the temporary decoupled payments into a permanent form: direct payments. The recipients of direct payments were "the largest and most aggressive [farm] operators" who "used subsidies to drive up cash rents and arable land values."[142] Large farmers enrich themselves and grow from subsidies while many small- and medium-sized farmers depend on subsidies. In this way, large corporations exerted more financial pressure on small and beginning farmers while simultaneously benefitting more from the Farm Bill than the majority of farmers do.

The main issue with crop subsidies in terms of sustainability is that they overwhelmingly support the production of commodity crops. For example, "corn farmers received $2 billion in federal direct payments in 2007" despite high yields and favorable market prices.[143] In 2014, corn became the predominant crop due to $2.4 billion in direct payments and crop insurance.[144] The federal government pays "an elite group of mega-farms along with the food processors, confinement feeding operations, grain distributors, and what others that purchase" commodity

[139] Ibid. 62.
[140] Ibid. 62.
[141] Ibid. 61.
[142] Ibid. 64.
[143] Ibid. 64.
[144] Ibid. 4.

crops "at prices that sometimes fall below what it cost to grow them"[145] through commodity crop subsidies, thereby promoting the unsustainable industrial practices discussed in chapter one. Additionally, three out of four farmers receive no commodity payments.[146] Finally, commodity growers frequently "successfully lobby for more money, not less, through supplemental disaster payments in response to floods, droughts, market fluctuations, or other circumstances."[147] It is clear that the current crop subsidy system is structured to benefit agribusiness, which relies on farming methods that degrade natural resources.

Nutrition. Despite being one of the nations with the most resources in the world, 12.3 percent of households in the United States were considered to be food insecure in 2016.[148] This number decreased from 14 percent of the national population in 2014, or 41.2 million Americans.[149] A household is considered to be food insecure when it struggles at some point in the year to provide enough food for all of its members due to a lack of resources.[150] Inadequate nutrition can cause type-2 diabetes, high blood pressure, heart disease, and can stunt children's growth. At the same time as millions of citizens struggle to fulfill their nutritional needs, 93.3 million Americans, or forty percent of the population, are obese.[151] Obesity can provoke health issues such as type-2 diabetes, heart disease, strokes, and even some types of cancer. The Center of Disease Control and Prevention estimates that only one in ten Americans consumes the recommended five daily servings of fruits, nuts and vegetables; over 13 million more acres of

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[145] Ibid. 62.
[146] Ibid. 62.
[147] Ibid. 20.
[148] Matthew Rabbitt, Alisha Coleman-Jensen, and Christian A. Gregory, "Understanding the Prevalence, Severity, and Distribution of Food Insecurity in the United States," USDA ERS, last modified September 2017, https://www.ers.usda.gov/amber-waves/2017/september/understanding-the-prevalence-severity-and-distribution-of-food-insecurity-in-the-united-states/.
[149] Imhoff, *The Farm Bill* 45.
[150] Rabbitt et al., "Understanding the Prevalence."
[151] "Adult Obesity Facts," Center for Disease Control and Prevention, last modified August 2018, https://www.cdc.gov/obesity/data/adult.html.

"specialty crops" (fruits, nuts, and vegetables) would need to be planted to meet the USDA's dietary guidelines.[152] This is more than two times the amount of land devoted to fruit and vegetable production in the U.S., and three times the acreage of California devoted to fruit and vegetable production.[153]

Moreover, the nutrition guidelines developed by the USDA and the Department of Health and Human Services (HHS) are heavily influenced by agribusiness lobbying. These guidelines must be based on a report from the Dietary Guidelines Advisory Committee, which is made up of experts in public health and nutrition. This Committee examines recent published research regarding food intake and health and then compiles and releases a report with its recommendations for healthy nutrition guidelines. However, this initial report is published for a public comment period and is amended based on comments received before being submitted to the USDA and HHS. This public comment period allows lobbying groups such as public health advocates, doctors, and even agribusiness lobbying groups to comment and influence the Committee's recommendations, which in turn affect the final dietary guidelines. Given that the USDA's primary stakeholders are major food production and manufacturing corporations, it caters the final dietary guidelines to favor these agribusiness firms. As a result, the dietary guidelines have historically not lined up with nutrition experts' recommendations. Red meat, for example, is listed alongside seafood, poultry, and other protein sources as components of a healthy diet despite the fact that nutrition experts have advocated for decreased red meat consumption for years. Creating nutrition guidelines that reflect the most recent scientific

[152] Imhoff, *The Farm Bill*, 86.
[153] Ibid. 86.

conclusions regarding the link between diet and health requires reducing the influence of agribusiness on the Dietary Guidelines Advisory Committee's recommendation to the USDA.[154]

Although food insecurity and obesity may appear to be conflicting issues, studies have shown that food insecurity can lead to obesity.[155] Individuals and households that restrict their food intake to make ends meet tend to overeat when food becomes available, and this can become a cycle of chronic ups and downs in food intake that can contribute to weight gain.[156] Food insecurity is largely attributed to low income, and neighborhoods with limited resources also tend to lack time for or access to locations to exercise. Furthermore, low income neighborhoods lack access to resources that provide fresh, nutritious, affordable food, and individuals are forced to fulfill their calorie needs with cheap food options that lack essential nutrients. For example, 23.5 million Americans live in food deserts,[157] which are defined as "areas that lack access to affordable fruits, vegetables, whole grains, low-fat milk, and other foods that make up the full range of a healthy diet."[158] Nearly half of those who reside in food deserts are also low-income. Food deserts occur where supermarkets are not within walking distance of residents' homes and individuals lack access to a car or other transportation methods. The only sources of food are thus convenience stores and other small outlets that sell foods that may meet calorie intake needs but do not supply the wide range of nutrients essential for a healthy, active lifestyle. When individuals and households struggle to meet their daily nutritional

[154] Markham Heid, "Experts Say Lobbying Skewed the U.S. Dietary Guidelines," Time, last modified January 8, 2016, http://time.com/4130043/lobbying-politics-dietary-guidelines/.
[155] "How Food Insecurity Leads to Obesity," Move for Hunger, 2016, https://www.moveforhunger.org/food-insecurity-leads-obesity/.
[156] Ibid.
[157] "11 Facts About Food Deserts," Do Something, https://www.dosomething.org/us/facts/11-facts-about-food-deserts.
[158] "A Look Inside Food Deserts," CDC, https://www.cdc.gov/features/fooddeserts/index.html.

needs due to a lack of resources, it is inconceivable that they could afford sustainably-produced food marked up with price premiums.

The federal government became involved with food distribution with the first Farm Bill in 1933. It created the Federal Surplus Relief Corporation, whose task was to purchase, store, and process surplus food to relieve hunger and stabilize prices for farmers.[159] The first food stamp program was initiated in 1939 in response to the Great Depression. Participants could purchase $1 of orange stamps that could be exchanged for any food products, and they received 50 cents' worth of blue stamps for free that could only be spent on "select, seasonally available government surplus foods such as dairy products, eggs, fruits, vegetables, and wheat flour."[160] Federal food assistance programs evolved over the years and in 1964 Congress passed the Food Stamp Act that assigned the responsibility of food assistance administration to the USDA, which altered the political environment surrounding Farm Bill negotiations. This program was renamed the Supplemental Nutrition Assistance Program (SNAP) in 2008, and it "attempts to ensure that eligible low-income Americans receive a monthly stipend that affords them a nutritionally adequate diet until their economic situations improve."[161] SNAP also includes nutrition and education programs, as well as grant programs to operate food banks and soup kitchens.[162]

The issue with SNAP and other Farm Bill nutrition programs is that they ensure that citizens are fed, but not necessarily nourished. Adequately addressing hunger and supporting farmers, particularly those who employ sustainable production techniques discussed in chapter two, requires drastically restructuring the U.S. food system to provide "consistent access to

[159] Imhoff, *The Farm Bill*, 41.
[160] Ibid. 41.
[161] Ibid. 43.
[162] "The Farm Bill and Other."

nutrient-dense foods, including daily servings of fresh fruits, vegetables, and whole grains."[163] Specific policy recommendations to do this will be given in chapter five, but one improvement has already occurred. In 2008, the Farm Bill included the Specialty Crop Block Grant Program for the first time, which allocates subsidies to growers of fruits, vegetables, and nuts.[164] This program is essential to promoting the consumption of healthy foods, for policy makers can use it to determine what kinds of crops are produced. In the 2014 Farm Bill, the Specialty Crop Block Grant Program received $72.5 million per year, and while this may seem like a lot of money, it pales in comparison to the $65 billion spent between 2014-2018 on commodity crop subsidies and crop insurance.[165] Despite this minor improvement in federal nutrition programs, policy makers clearly continue to favor funding the unsustainable production of commodity crops that contribute to poor nutrition. There is a lot of room for improvement in the Farm Bill to reduce the number of hungry Americans and to improve the nation's nutrition and health.

Conservation. Despite increasing support for conservation programs over the years, these programs typically receive minimal funding from the Farm Bill. The 2014 Farm Bill devoted just 5.75% of its budget to conservation practices, totaling $28.2 billion, even though the USDA's own Natural Resource Conservation Service (NRCS) reports that two billion tons of cropland soil are lost annually.[166] Soil is the earth's most valuable nonrenewable resource along with water, and chapter one outlines the effect of industrial agriculture on soil and other natural resources. The first conservation programs were established in the 1985 Farm Bill in response to the environmental damage resulting from farmers draining wetlands to expand their productive cropland. This Farm Bill established the Conservation Reserve Program (CRP), which pays

[163] Imhoff, *The Farm Bill*, 45.
[164] Ibid. 70.
[165] Ibid. 14.
[166] Ibid. 13.

farmers to not cultivate a certain amount of land in danger of eroding.[167] Although it may seem counterintuitive to use tax dollars to pay farmers *not* to cultivate land, conservation programs like the CRP should be "viewed as a long-term investment in soil protection, habitat conservation, preservation of healthy water systems, and supply control."[168] In the same way, organic and regenerative farming should be viewed as investments in the earth's future because they preserve and promote the vitality of natural resources upon which humanity relies. Organic farming, however, "has traditionally received less support than conventional production, with research, insurance, and market data collection largely ignored by Farm Bill programs."[169] One small achievement for sustainability was that the 2014 Farm Bill included $60 million in mandatory funding to cover the cost of organic certification for some producers, which allows them to earn a price premium on their products.[170] Policy makers must emphasize conservation programs and allocate more funds to expand them to promote a sustainable food system.

The Farm Bill contains various conservation programs that are administered by the NRCS and the Farm Service Agency (FSA). One category of conservation programs is set-aside and easement programs, which pay landowners or farmers to not cultivate some areas of land to "restore functional grasslands, wetlands, or forests."[171] These programs are either permanent buyouts or long-term (thirty-year) contracts, and they are most effective when they "target large areas of contiguous and high-priority habitat."[172] These set-aside programs include the 1985 CRP, the 2014 Agricultural Conservation Easement Program (ACEP), and the 2014 Healthy Forests Reserve Program (HFRP). Another category of conservation programs is habitat-building

[167] Ibid. 49.
[168] Ibid. 53.
[169] Ibid. 72.
[170] Ibid. 72.
[171] Ibid. 57.
[172] Ibid. 57.

programs, which "offer cost-share assistance to restore land and protect declining species."[173] They include the Wildlife Habitat Incentives Program (WHIP) and the Conservation Reserve Enhancement Program (CREP). The next category is compliance-oriented programs that monitor corporations to ensure their compliance with legislation such as the Clean Water Act and the Clean Air Act. The Environmental Quality Incentives Program (EQIP) is the main example of a compliance-oriented program, though its value has been questioned for it often pays polluting corporations to comply with regulations that most businesses follow without financial assistance.[174] The last category of conservation programs is stewardship-oriented incentives that "combine ecological farming and long-term care for the land."[175] For example, the Conservation Stewardship Program (CSP) comprehensively addresses natural resources such as soil, water, wildlife, and energy by rewarding farming practices that conserve these natural resources "as bases of healthy agriculture rather than as side issues or through costly remediation."[176] The existence of these various conservation programs indicates that the federal government purports to care about the country's impact on the earth, but politicians routinely limit these programs' funding. In 2014, for example, the "Farm Bill cut CRP and CSP by 2 million and 28 acres to save $3.3 billion and $2.3 billion from the budget, respectively."[177] In order for conservation programs to be effective, they must receive adequate funding to carry out their duties.

Program Implementation. Once the Farm Bill is signed into law by the president, the USDA must decide how to implement the programs according to their agreed-upon funding levels. It does so by discussing the administration of new and existing programs with advocates,

[173] Ibid. 57.
[174] Ibid. 57.
[175] Ibid. 57.
[176] Ibid. 57.
[177] Ibid. 53.

and the USDA publishes a set of proposed rules to implement new programs. The public is able to comment on the proposed rules, then the comments are reviewed by the USDA and taken into consideration for finalizing implementation plans.[178] The USDA reviews individual requests for funding under specific programs, but states and local governments are largely responsible for managing the administration of rules within their jurisdiction. Lower levels of government (state and local) are in close proximity to their constituents, so they are better equipped than the federal government to administer programs according to local needs and desires. While local governments may best understand their constituents, local administration of programs or rules can complicate the already complex legislative landscape. The following is an example of how implementing regulations that vary on a state and/or local level can create a burden on farmers to comply with unnecessary rules and regulations.

One of the difficulties raised by local administration of agriculture programs and rules is visible in the case of farmers' market restrictions. States determine their own farmers' market regulations, but cities and towns enforce them and thus can decide to emphasize specific rules. In Newton, Massachusetts, some bagged produce is considered to be "processed foods" at farmers' markets. Processed foods are subject to specific restrictions and regulations to ensure that they are safe to consume. When a farmer wants to market bagged lettuce, they must "comply with a host of additional rules, including additional licensing and inspection requirements" that cost the farmer money.[179] This creates an unnecessary burden on the farmer to comply with regulations for processed foods that should not apply to their products. Additionally, it is difficult for farmers who market their products at different locations (either within the same state or different

[178] "The Farm Bill." FoodPrint. https://foodprint.org/issues/farm-bill/.
[179] Baylen J. Linnekin, *Biting the Hands That Feed Us: How Fewer, Smarter Laws Would Make Our Food System More Sustainable* (Washington: Island Press, 2016), 39.

states, which is common among New England farmers) for they must comply with the farmers' market restrictions that are essentially unique to each location.

This chapter has examined major agricultural and nutrition policy, focusing on the Farm Bill. It explained the complicated funding process and the tools politicians can utilize to prioritize their own agendas when voting on the bill or its funding. A brief history of the Farm Bill was presented, highlighting the inception of major policies and programs as well as their impacts. This chapter stressed that crop subsidies, although historically necessary, currently contribute to the unsustainability of the U.S. food system. The link between food insecurity and obesity was conveyed to communicate the substantial gaps in nutrition policy, and chapter five will provide policy solutions to close these gaps and improve sustainability while reducing food insecurity. This chapter also examined conservation programs included in the Farm Bill and their consistent insufficient funding despite their importance. Finally, a brief overview of program implementation was presented to express the complications that arise when lower levels of government can determine their own policies and regulations. Chapter Five will propose a variety of policy recommendations to fix the inadequacies highlighted in this chapter.

Chapter 5: Community-Based Sustainable Agriculture for the Nation

Given the environmental degradation from industrialized agriculture outlined in Chapter One, it is clear that a national shift to sustainable agriculture is necessary. The historical emphasis on growing monocultures of a few crops led farmers to rely on fertilizers to supply the nutrients necessary to plant growth, use pesticides and herbicides to maximize growth, operate heavy machinery on agricultural fields that further compacts precarious soil, and irrigate fields especially in dry areas such as in western states. Sustainable agricultural practices, on the other

hand, emphasize soil fertility and long-term viability by applying organic materials such as compost to return nutrients withdrawn by crop growth to the soil. Environmental science shows that various methods of intercropping—including strip cropping, cover cropping, alley cropping, and even crop rotations—grow a mix of crops that take nutrients out of the soil while others supply soil nutrients. Although the knowledge and research about sustainable agricultural practices exist, federal policymakers do not produce legislation that emphasizes their use. A few very large farm corporations produce most of the country's food, and these agribusinesses benefit disproportionately from taxpayer dollars. The Farm Bill, which is the major piece of legislation that governs farm-related issues and is discussed in Chapter Four, focuses on commodity crop production, which promotes unsustainable farming practices. The other major aspect of the Farm Bill covers nutrition programs that, while vital, do not promote consumer participation in the agricultural system, resulting in nation-wide apathy about farming and the sustainability of agricultural communities. Federal policies that encourage sustainable farm practices and promote consumer attention on how food is produced are necessary to ensure that farming on Earth remains viable for generations to come. Furthermore, state and local governments can support federal policies and can more effectively engage citizens with sustainable agriculture. The lessons from examining industrial and sustainable agriculture through the lenses of environmental history, environmental economics, environmental science, and environmental policy and law are integrated into policy recommendations that federal, regional, and local governments can utilize to promote the production of sustainable food as well as to distribute that food to citizens.

The federal government has the opportunity to radically change how the U.S. agricultural system operates, and it has been doing so since the beginning of the twentieth

century through the Farm Bill. Historically, the Farm Bill has focused on nutrition programs, commodity crop production, and crop insurance programs with very little emphasis on conservation and sustainable food production. Legislators can use the existing framework of the Farm Bill to promote and eventually mandate sustainable agricultural practices. One major way to improve the Farm Bill is to establish long-term policies, for the Earth exists on timescales much longer than humanity can comprehend. Instituting a Farm Bill that focuses on perennial, ecologically-based farming for the next fifty years would be the first step in aligning human systems with natural ones. Such a long-term Farm Bill may not be politically feasible, however, due to the fact that politicians only think in four year cycles, so the following are shorter-term recommendations for adjusting food and agriculture policy to alleviate environmental degradation, reduce the power of agribusiness, and foster healthy communities.

Environmental Degradation. In order to ensure that taxpayer dollars do not fund the unsustainable agriculture practices presented in Chapter One, all government subsidies for crops, insurance, research, or anything else, should require related commitments to the long-term health of the land. One way to guarantee these commitments is to instate mandatory on-farm soil conservation compliance for farms that receive governmental financial support. The Farm Bill must also incentivize perennial and organic production methods by shifting subsidies away from commodity production and using that money to finance these sustainable farm practices. The National Organic Program under Title X already funds sustainable fruit and vegetable production, which benefit not only the land but also individuals' health. This program requires substantial investment to expand it to adequately fund smaller-scale organic farmers. In addition, an initiative to improve soil health should be added to the Farm Bill, and it must receive at least one billion dollars annually in order to begin to counteract the damage done to soil quality over

hundreds of years of farming. This initiative would reward farmers who employ biological solutions to improve soil vitality such as those presented in Chapter Two. It must also allocate funds for the USDA to conduct research into the best sustainable agricultural practices that are regionally-specific because growing conditions vary greatly across the country.

Until no chemical inputs are used to produce food in the U.S., tradable nitrogen and phosphorus quotas, similar to carbon tradeoffs, could be created. High taxes on chemicals such as fertilizers and pesticides could also be established to discourage farms from using them while simultaneously funding programs that encourage sustainable alternatives. Likewise, food with high carbon emissions could be taxed to dissuade consumers from financially supporting the use of heavy machinery that relies on fossil fuels in agricultural production. The Farm Bill must also increase incentives for farmers to protect watersheds and to use responsible irrigation techniques to ensure that water is available for generations to come.

Agribusiness. Improving the Farm Bill to benefit small and mid-sized farmers instead of enormous agribusiness corporations requires massive changes to the way taxpayer dollars are distributed to food producers and processors. One way to execute this is to shift away from subsidizing surplus production and towards measurable, per-acre stewardship practices. These incentives would not only reward smaller farmers for sustainable methods that they may already employ, but also encourages larger operations to implement methods to improve the quality of their land. Second, the Farm Bill could limit payments to individual recipients, thereby leveling the playing field for all farmers. A third way to reduce the unfair advantage that already-rich agribusinesses have is to reform Farm Bill supports so that they function as safety nets, loans, and stewardship incentives instead of as direct giveaways. Finally, to give consumers more agency in the food system, a food labeling scheme that informs consumers how food items are

produced (i.e. their carbon footprint, what sustainable farming methods are employed, etc.) could be created. Radically restructuring the way that taxpayer dollars are distributed to farmers is imperative to benefit the smaller-scale farmers who have been historically ignored by federal legislation. This redistribution of wealth will not only encourage sustainable farming methods but will also revitalize rural communities that have experienced serious quality declines in recent years.

Healthy Communities. The primary change to public policy that promotes healthy diets among U.S. consumers is to better align crop subsidies with public health outcomes. As discussed in Chapter Four, the USDA's Dietary Guidelines are not always in line with recommendations from scientific research given that they are influenced by agribusiness lobbying, and crop subsidies heavily favor the production of unhealthy foods. Consumers, particularly those of lower-income, are financially motivated to buy cheap food whether or not it is healthy. Therefore, healthy food must be made cheaper in order to address the public health crises of obesity and malnutrition. Additionally, support and expansion of farm-direct distribution systems such as farm-to-school, farm-to-hospital, farmers' markets, etc. is necessary to stimulate healthy nutrition while also supporting farmers. These fresh food distribution programs should include strong educational and fitness components, for lack of knowledge also contributes to poor diets. In addition, public schools should require environmental education starting in kindergarten so that children can learn where food comes from and develop better relationships with their food.

Creating healthy communities goes beyond individual bodily health—it also involves establishing interpersonal ties that are the root of vibrant communities. One major way to promote lively farming communities is to invest in and offer loans to revitalize and diversify the

rural sector. This can be done by allocating funds to incentivize young people to begin farming, and by setting a goal to add 100,000 new farmers over the course of the next Farm Bill. The Farm Bill should also invest in value-added processing and flexible supports for more diversified local and regional specialty crops. Furthermore, the creation of a labor title within the Farm Bill to fund such programs is an excellent way to improve conditions for all food system workers. This title must address the issue of migrant workers, for the U.S. food system currently relies on cheap labor form dramatically underpaid laborers, as discussed in Chapter Three. Enhancing the lives of farmers and subsequently their communities would have effects that would be felt throughout the entire food system.

Although this thesis has primarily focused on the role of the federal government in improving the sustainability of the food system in the U.S., the policies recommended throughout this chapter must be accompanied by associated regional and local policies. Chapter Four pointed out that lower levels of government are often more capable of overseeing and implementing policies given their proximity to affected individuals. Therefore, the most important policy that can be implemented, second only to establishing a fifty-year Farm Bill, is encouraging the establishment and fostering of regional and local food systems. These community-based systems benefit from lower carbon emissions because food travels fewer miles to reach consumers. They also more directly support farmers and the rural communities that rely on farm income to flourish, and these food systems the encourage sustainable farming practices presented in Chapter Two by allowing for direct relationships between farmer and consumer. Individuals in regional and local food systems thus have more power to support smaller-scale farmers who employ sustainable production methods. One way to encourage the creation and bolstering of local and regional food systems is to include a provision in the Farm Bill that

encourages cities and localities to establish their own farm bills that address community-specific issues. A similar way to do this is to create an urban agriculture title in the Farm Bill that would promote food production within cities. Local and regional food systems are imperative to ensuring the future of agriculture in the United States, and these lower levels of government must address the issues of food production. A wide variety of policy tools exist to improve the sustainability and health of the United States' food system, and community-based financial incentives are particularly valuable tools to achieve this goal. The country must immediately address the food system in order to ensure the long-term health of the planet and of humanity.

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