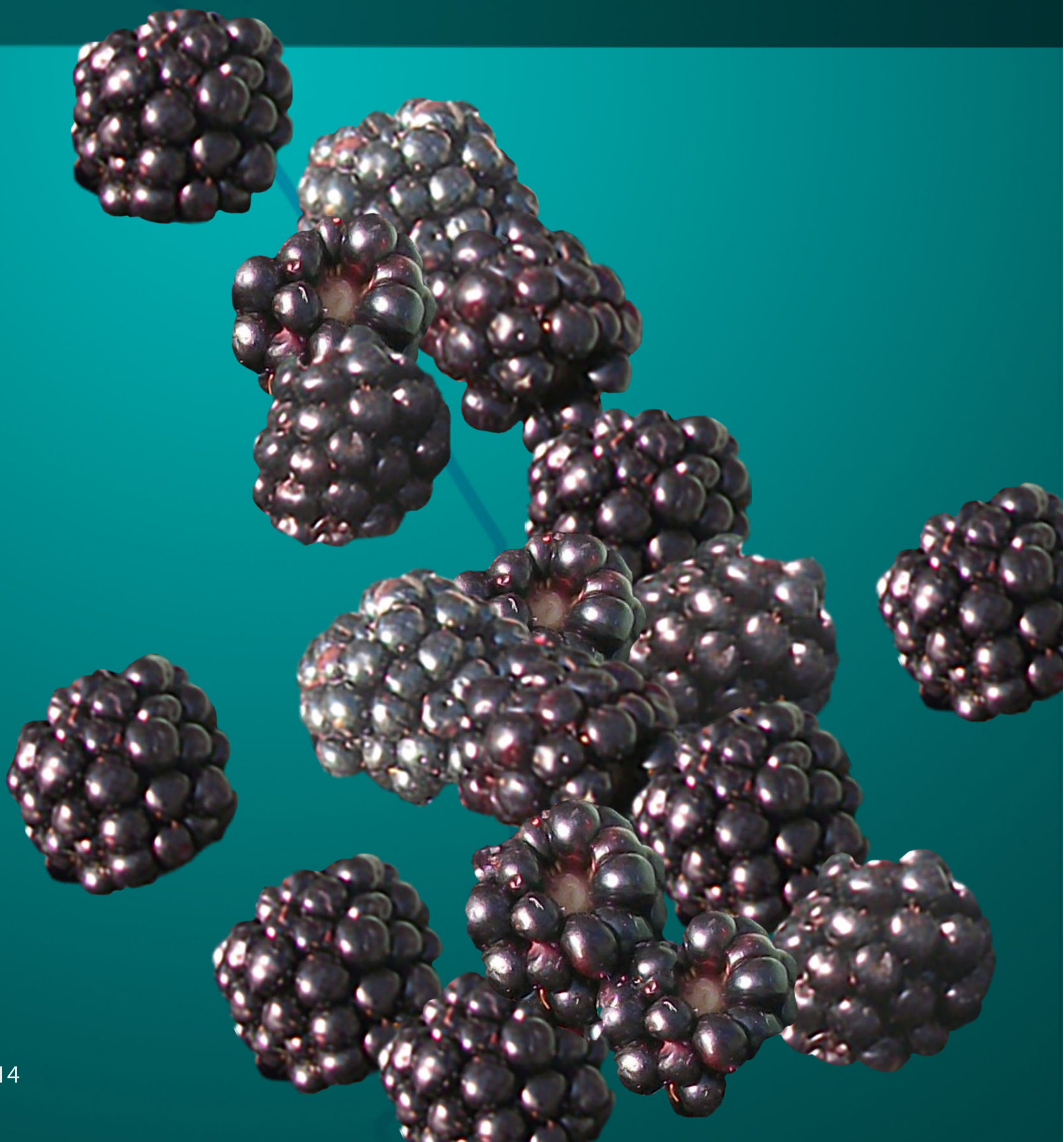
CHAPTER. 7

Food Safety & Security



Food Safety & Security

In promoting healthy food for the four million residents of the Saint Louis Regional Foodshed, food safety and the impacts on our land and water cannot be overlooked. As the farming system has industrialized to meet the current American diet while maximizing profits, the safety of food, water, and the environment are often compromised.

Agriculture is exempted from the bulk of environmental laws. Some resources, like soil, have only the ethics, knowledge, and capability of each individual landowner to protect them. These defenses are often inadequate in competition with financial incentives, intense marketing, and market consolidation that favor short-term gain and exploitation.

Americans would have no need to examine our food production, policies, and distribution systems if these systems were delivering a healthy population, an unpolluted environment, and social benefits to consumers, producers, and taxpayers. As it is, food-related health problems are on the rise; antibiotic-resistance, environmental damage, soil degradation, and water pollution are persistent problems;[1] and, both urban and rural communities are suffering.[2]

Consumers have always faced risks from their food. However, the vast scale of today's food system amplifies age-old risks like bacterial contamination and parasites with new risks such as antibiotic-resistant pathogens, chemicals containing carcinogens, endocrine disruptors, and hormones. The scale of industrialized agriculture increases the safety risks because contaminants can affect more products in a single incident and thus reach more people than was ever the case in pre-industrial times. Industrialized agriculture, especially livestock production, also concentrates huge quantities of pollutants in a small area. Some new technologies like genetically modified organisms may have unintended side effects as substances are released into the food supply with little scrutiny given to their long-term impacts on human health, wildlife, animal health, soil, and water.

The scale of industrial farming also impacts our land, air, and water because it disrupts natural systems. Natural systems feature multiple species, complementing, competing, and cooperating in a cycle with checks and balances. Industrial farming replaces complex systems with simplified monocultures of one species, which fails to fulfill all the functions needed for healthy soil, nutrient cycling, and pest limitation.[3] When farming relies on a single strategy, nature adapts, creating pathogens, weeds, and insects that become resistant to the poisons we devise for them. Antibiotic-resistant bacteria, herbicide-resistant weeds, and pesticide-resistant bugs have emerged, putting us in a race to find even stronger substances to eliminate pests – or revise the way we farm.

The Interconnection of Pesticide Use, Pesticide-Resistant Pests, and Genetically Modified Seed Use

The problem of scale begins in the field. In order to achieve economies of scale, industrial farmers plant hundreds or thousands of acres of a single crop. Many farmers plant the same crop in the same field, year after year. Such monocultures provide ideal habitat for pests – whether they are insects, fungi, bacteria, or weeds that prefer that crop or those crop conditions. Because of these prime growing conditions coupled with little competition and predation to control a pest species' population, pests can thrive. In response, industrialized agriculture turns to pesticide to protect crops, but these chemicals are unable to evicerate all pests. Instead, a select few survive through natural selection to breed a new pesticide-resistant population. Moreover, the use of pesticide can also harm the predators of these pests, furthering the pest population's ability to adapt and repopulate.[4]

How Herbicides Kill Weeds "Some vital metabolic plant processes include photosynthesis (capture of light energy and carbohydrate synthesis), amino acid and protein synthesis, fat (lipid) synthesis, pigment synthesis, nucleic acid synthesis (RNA - DNA essential to information storage and transfer), respiration (oxidation of carbohydrate to provide CO2 and usable energy), energy transfer (nucleic acids) and maintenance of membrane integrity. Other vital processes include growth and differentiation, mitosis (cell division) in plant meristems, meiosis (division resulting in gamete and seed formation), uptake of ions and molecules, translocation of ions and molecules, and transpiration. One or more of the vital processes must be disrupted in order for a herbicide to kill a weed."[5]

Escalating Pest Wars

In this vicious cycle of pesticide use and pest adaptation, farm workshops and farm chemical marketing campaigns are now dedicated to addressing the crisis of "super-weeds" and "super-bugs."[6] As farmers have adopted genetically-engineered crops (or genetically modified "GM") that withstand and survive herbicide applications like Roundup® (generically known as glyphosate), herbicide-resistant weed populations have developed alongside, as many ecologists predicted. In 1992, herbicide-resistant weeds were unknown in Missouri.[7] In recent years, glyphosate-resistant weed populations that have been found in Missouri, including Giant Ragweed, Hoseweed/Marestail, Common Ragweed, Palmer Amaranth, and Waterhemp (in the Pigweed family).[8] In neighboring Arkansas, resistant Johnsongrass populations have developed.[9]

Moreover, as the use of genetically-engineered seeds climbs, so does the use of the herbicides these plants are designed to withstand. By 2011, nearly 94% of soybean crop acreage planted in the U.S was "Roundup Ready" or glyphosate-resistant; nearly 88% of America's corn crop acreage was "Roundup Ready."[10] A recent study refuted the "often-repeated claims that today's genetically-engineered crops have, and are reducing pesticide use" based on assessments of USDA pesticide application data.[11] In fact, the study found "[t]he estimated overall increase of . . . 404 million pounds applied over the past 16 years represents about a 7% increase in total pesticide use."[12] In Missouri, 64% of corn acreage in 2010 was glyphosate-resistant,[13] increasing the odds that glyphosate-resistant weeds would follow.

With continued pesticide resistance comes the pressure to find new methods to protect crops against pests. Chemical companies have developed new herbicides that work differently than glyphosate to kill weeds. One of these is glufosinate which decreases essential amino acids in plants causing their death.[14] Trade names include Ignite, Rely, Finale, and Liberty.[15] However, herbicide-resistant weeds have developed to withstand a wide range of common farm herbicides and researchers are also documenting weeds with "cross-resistance" that withstand multiple herbicides.[16] Changing farming practices, like planting different crops in the field from year to year (crop rotation), and preventing weeds from going to seed, can curb resistance and reduce the future need and expense for new herbicides.[17] Chemical company representatives have an interest in steering farmers toward chemical controls; however, re-thinking how to farm with fewer chemicals might be a better long-term investment in Missouri's and Illinois's land and soil.

Nevertheless, rather than re-think farming methods, chemical companies are seeking approval for new ways to dole out old pesticides. Recently Dow Chemical sought approval for the launch of 2,4-D- (2,4-dichlorophenoxyacetic acid) tolerant genetically engineered seed and a new pesticide that combines glyphosate (aka Roundup herbicide) and 2,4-D.[18] Dow calls the new pesticide, "Enlist." 2,4-D gained notoriety as an ingredient in the herbicide Agent Orange, which was used to kill vegetation in combat operations in thick jungle (veterans later won compensation for health effects from exposures including birth defects in their children).[19]

In order to more fully understand these industrialized agriculture inputs others, the following sections illustrate how the U.S. agriculture system has changed over time with increased use of different inputs and the environmental and public health costs experienced as a result.

IMAGE. 7-1

PHOTOGRAPHS OF THE HERBICIDE-RESISTANT WEED POPULATIONS IN MISSOURI

Giant Ragweed[A]

Hoseweed/Marestail[B]

Common Ragweed[C]

Palmer Amaranth[D]

Waterhemp[E]

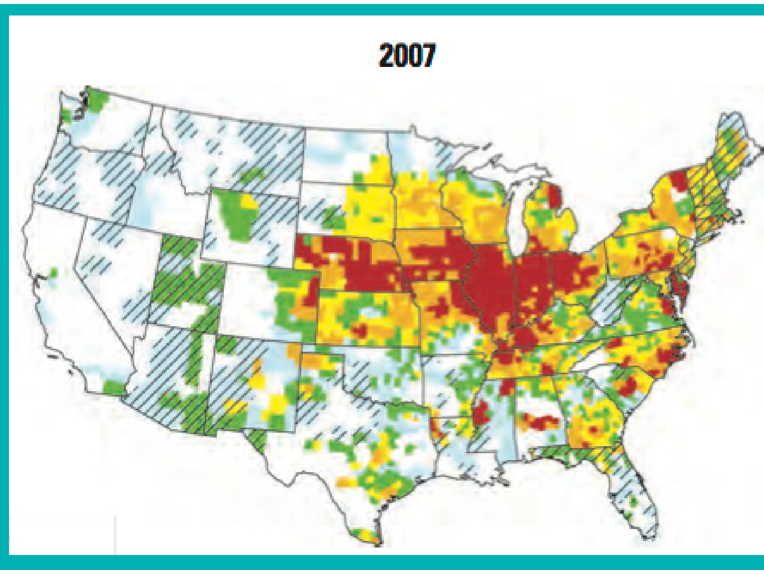
[A] *Giant Ragweed, Horseweed, Great Ragweed*, Missouri State University, https://courses.missouristate.edu/pbtrewatha/giant_ragweed.htm (last visited May 4, 2017).
[B] *Horseweed, Mare's tail, Canada Horseweed*, Missouri State University, https://courses.missouristate.edu/pbtrewatha/horseweed.htm (last visited May 4, 2017).
[C] *Common Ragweed*, Missouri State University, https://courses.missouristate.edu/pbtrewatha/common_ragweed.htm (last visited May 4, 2017).
[D] *Palmer Amaranth*, Missouri State University, https://courses.missouristate.edu/pbtrewatha/palmer_amaranth.htm (last visited May 4, 2017).
[E] *Waterhemp (Tall or Common)*, Missouri State University, https://courses.missouristate.edu/pbtrewatha/tall_waterhemp.htm (last visited May 4, 2017).

MAP. 7-1

ATRAZINE USE IN INTENSITY ON CORN FIELDS, 2007[32]

Estimated atrazine use intensity on corn, in pounds per a square mile per a square year. Quintiles were calculated on the basis of 2007 atrazine use on corn.

- > 0-4
- > 4-24
- > 24-59
- >59-167
- >167
- >Tier 1 or 2 or EPest rate



Pesticides

Pesticides are considered to be any material intended to "kill, repel, or control certain forms of plant or animal life" that are deemed pests.[20] They include chemicals such as herbicides (for killing weeds and vegetation), insecticides (for getting rid of destructive insects), fungicides (for stopping molds and mildew from growing), disinfectants (for blocking the growth of bacteria), and substances used to prevent mice and rat infestations.[21]

Over the course of the last half-century, the use of chemical pesticides has skyrocketed in conjunction with the adoption of industrial agriculture methods.[22] The USDA Economic Research Service (ERS) studied pesticide use for 21 selected crops between 1960 and 2008 and found that total pesticide use increased from 157.68 million pounds to 516.11 million pounds of active ingredient.[23] The popularity of genetically engineered (or genetically modified "GM") or "transgenic" crops has increased because GM crops' ability to withstand the lethal effects of the pesticide applications. Since the widespread adoption of particular GM crops in the 1990s, ERS noted a decrease insecticide use[24] and an increase in herbicide use.[25] Herbicide use alone for the 21 selected crops increased from 35.18 million pounds in 1960 to 393.88 million pounds in 2008.[26] The abundant use of herbicides is just one risk to the environment and human health that results from our food production processes.

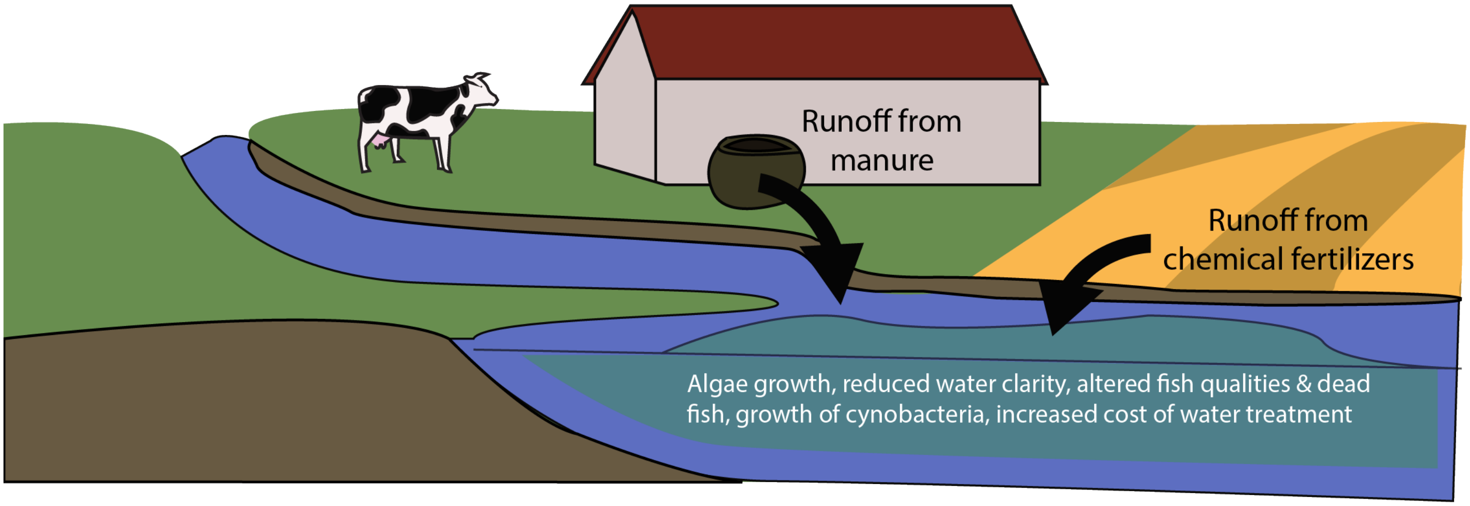
According to Damalas and Eleftherohorinos, "[e]xposure of the general population to pesticides occurs mainly through eating food and drinking water contaminated with pesticides, whereas substantial exposure to pesticides can also occur when living close to a workplace that uses pesticides or even when workers bring home contaminated articles."[27] Long-term health effects can range from higher risk of cancer to the "disruption of the body's reproductive, immune, endocrine, and nervous systems."[28]

The two pesticides used most frequently on U.S. corn and soybean fields (the two leading crops grown in the Saint Louis Regional Foodshed), atrazine and alachlor, are "suspected endocrine disruptors."[29] Map 7-1 illustrates the amount of atrazine used in 2007 on corn alone (in pounds per square mile), and reveals that much of our region, especially the region's counties in Illinois, applied more than 167 pounds per square mile of atrazine on cropland for corn in 2007.[30] While atrazine is sprayed predominantly on corn, it is also used on many other crops in large amounts as well, including sorghum and sugar cane.[31]

Pesticides can reach consumers through residual amounts on or in fruits, vegetables, and meat, in contaminated drinking water, and in air from pesticide spraying.[33] Pesticides can also "bioaccumulate" or concentrate in organisms as they travel up the food chain because the chemicals remain in the organisms that eat them.[34] By eating greater amounts of foods "found higher on the food chain (more meat, milk, cheese, and eggs and fewer plant foods)," Horrigan et al. note we are increasing our consumption of pesticides and the risks associated with them.[35]

David Pimentel, a Cornell University entomologist, estimates that roughly "0.1% of applied pesticides reach the target pests, leaving the bulk of the pesticides (99.9%) to impact the environment."[36] Various fauna and flora, including bird and insect populations which have important and advantageous roles within the ecosystem, suffer pesticide impacts.[37] One specific example of this is the drastic decrease in nature's vital pollinators, honeybees, in the last two to three decades due to the direct and indirect effects of pesticides.[38] Researchers have explored a possible correlation between pesticides and developmental abnormalities in amphibians.[39] When studying this, researchers discovered "frogs with extra legs growing from their abdomens and backs, stumps for hind legs, or fused hind legs."[40] Further, many species, both insect and plant, are becoming resistant to the chemicals sprayed on them.[41]

The possible risks of pesticides are farther-reaching than we know or understand. The known health and environmental impacts alone levy a high price for killing "pests" on our low-nutrient yielding, monocropped fields. Further, new risks associated with pesticide use are increasingly common. Right now, scientists cannot tell us every harm that people risk by eating from the current food supply. As new pesticides are introduced, scientific knowledge will continue to lag behind. By shifting to an agricultural system that does not heavily rely on harmful chemicals, we can alleviate costs for farmers while making safer food and avoiding the known and unknown risks of pesticides.



Organic and Chemical Fertilizers

Industrialized farming has removed animals from the fields, which is contrary to nature's system. When animals are on the land, they eat plants for nutrition, and leave their manure behind to nourish plants for new growth. With manure absent on most cropland today, fields need chemical or manure fertilizers because they have a deficit of nutrients. With nearly all livestock animals now in feedlots or confined indoors, the animals have no access to pasture and require feed.[42] They also require waste collection systems, are at more risk for spreading disease,[43] and are well-poised to breed antibiotic-resistance.[44] Animals confined in massive numbers indoors or in feedlots create a surplus of waste in that often becomes a disposal problem rather than a farm asset.[45] In contrast, safe and environmentally conservative food production only uses "(least toxic) chemical pesticides as a last resort," and applies only as much fertilizer as can be absorbed by soil and vegetation.[46]

Plants need several macronutrients and micronutrients in order to survive. The three most important macronutrients for plant health are nitrogen (N), phosphorus (P), and potassium (K), and livestock manure is a source of all three.[47] Depending on the type of livestock manure, the amount of N, P, and K in the manure varies and the N:P:K ratio needed for plant health varies based on the type of crop grown.[48] As John Lory of the University of Missouri Extension explains,

> [T]he nutrient ratios of manure are fixed. If manure is applied to meet the crop need for one nutrient (e.g., nitrogen shown as N), a fixed amount of all the other nutrients is applied as well (e.g., phosphorus shown as P and potassium shown as K). These nutrients come with the manure whether they are needed or not.[49]

Furthermore, Lory points out, "[m]anure nitrogen-to-phosphate ratios are typically less than crop needs. . . . In some cases such as pastures, the differences are dramatic. More phosphorus is applied than the crop can remove in one year with nitrogen-based manure application strategies."[50] Phosphorus can accumulate in soils far beyond crop needs, while the demand for nitrogen persists, increasing the risk of excess phosphorus running off and polluting surface waters. Balancing the needs of the crop with the nutrients available in manure and other crop amendments requires careful attention to soil.

Livestock in confined operations produce quantities of manure in amounts far greater than can be regularly applied on cropland. When producers apply more manure on cropland fields than crops will use, they also risk water contamination.[51] Excessive nutrients can become water pollutants if crop fields cannot use the over-abundant manure fast enough because precipitation and wind may carry manure into nearby water bodies. This manure contamination can harm drinking water quality for livestock and the animals that rely on those water bodies, while also risking fish kills and algal blooms.[52]

> Increasing the amount of nutrients entering a stream or lake will increase the growth of aquatic plants and other organisms. Although these nutrients are necessary, excessive levels overstimulate the lake or stream, reducing the quality of the water. Excessive amounts of nutrients lead to increased algae growth, reduced water clarity, increased water treatment costs, altered fisheries and fish kills, and in the most extremely degraded water, growth of cyanobacteria (blue-green algae) capable of producing human and animal toxins.[53]

> "Despite fewer farm acres today than in years past, chemical fertilizer use has nearly doubled in Missouri and Illinois since the 1960s"

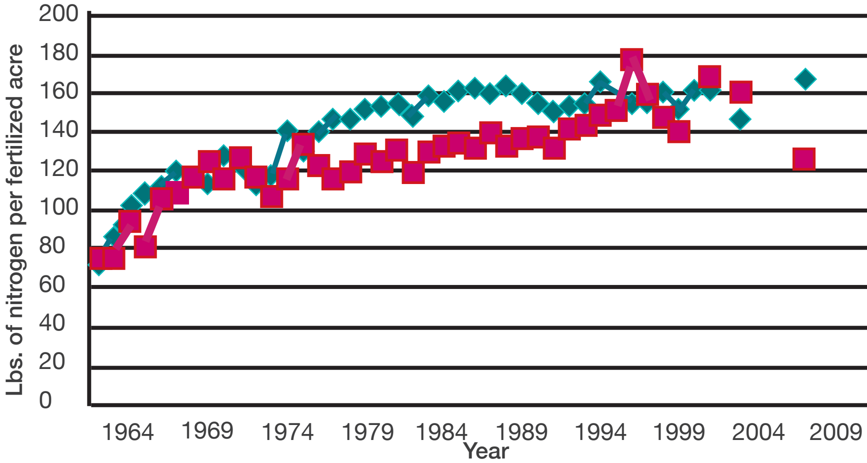
According to Horrigan and his colleagues, in addition to the harm caused to water bodies, "[e] xcess nitrogen in soil can lead to less diversity of plant species, as well as reduced production of biomass. Additionally, some ecologists contend that this decrease in diversity makes the ecosystem more susceptible to drought, although this issue has been controversial."[54]

On industrial farms, particularly hog and dairy operations, farmers often employ lagoons to collect and store manure, which create additional risks of nutrient pollution in water bodies. Lagoons can fail, resulting in contamination of drinking and irrigation water sources. When manure lagoons leak, millions of gallons of manure can leak onto cropland and can reach nearby waters.[55] Manure can also leach through the lagoons and contaminate groundwater sources that are used for human drinking water.[56] Pipes can leak. Containers can spill. Monitoring wells are rarely required around lagoons to detect groundwater contamination.[57] Even when lagoons do not fail, the amount of NPK in manure decreases overtime as it sits in storage because "[l]agoons volatilize N and precipitate phosphorus and potassium so that the effluent pumped onto cropland has few nutrients."[58]

Unlike manure, chemical fertilizers can be "custom blended to match the exact needs of [a farmer's] crop" and "[c]ommercial fertilizer applications based on results of soil testing are unlikely to raise soil test phosphorus and potassium to excessive levels."[59] However, over-application of chemical fertilizer poses the same threats as manure because it can run off into nearby water bodies and cause harm to water quality and ecosystem health. Appropriate formulations and applications depend on timely soil tests. The USDA is now promoting the "4 Rs" to guide fertilizer applications – right source, right rate, right time, and right place.[60]

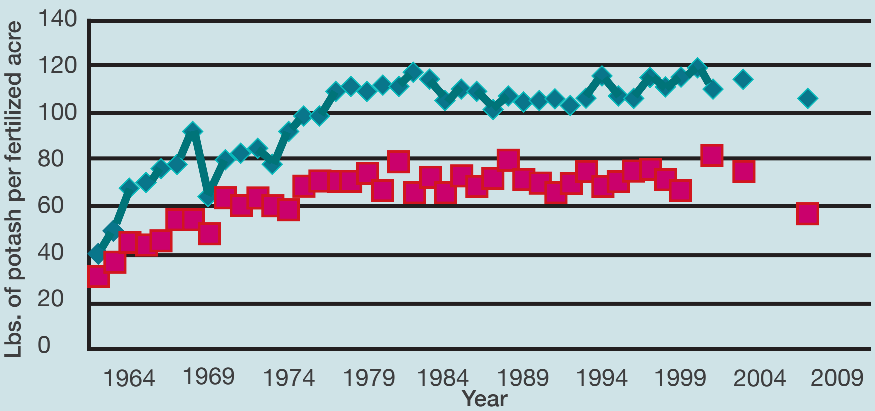
Fertilizer also poses other, lesser-known threats. As Horrigan et al. explains, "[c]hemical fertilizers can gradually increase [soil acidity] until it begins to impede plant growth. Chemically fertilized plots also show less biologic activity in the soil food web (the microscopic organisms that make up the soil ecosystem) than do plots fertilized organically with manure or other biologic sources of fertility."[61] In Missouri and Illinois the data show increased application of nitrogen fertilizer per acre over the last half-century, as illustrated by Graphs 7-1 to 7-4.[62]

Despite fewer farm acres today than in years past, chemical fertilizer use has nearly doubled in Missouri and Illinois since the 1960s, suggesting a need for the 4Rs. Note that even for organic growers who cannot use chemical fertilizers, and must rely on other nutrient sources like manures or crop rotations with nitrogen-fixing legume crops for their crops' needs, the need for the 4R's remains. Are farmers in the Saint Louis Regional Foodshed applying the right fertilizers in the right amount, at the right time, in the right place? Are Foodshed farmers too reliant on chemical fertilizers? What is the long-term impact on soil health and the organisms that keep soil healthy? How can farmers feed their crops and their soil? These questions can only be answered by research outside the scope of this report.



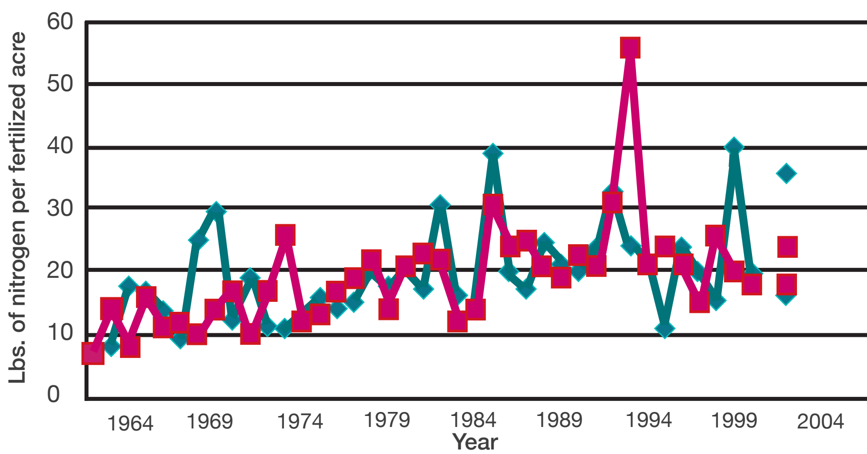
GRAPH. 7-1

APPLICATION RATE OF NITROGEN (N) ON ACRES OF CORN RECIEVING NITROGEN FERTILIZER IN MISSOURI AND ILLINOIS, 1964-2010



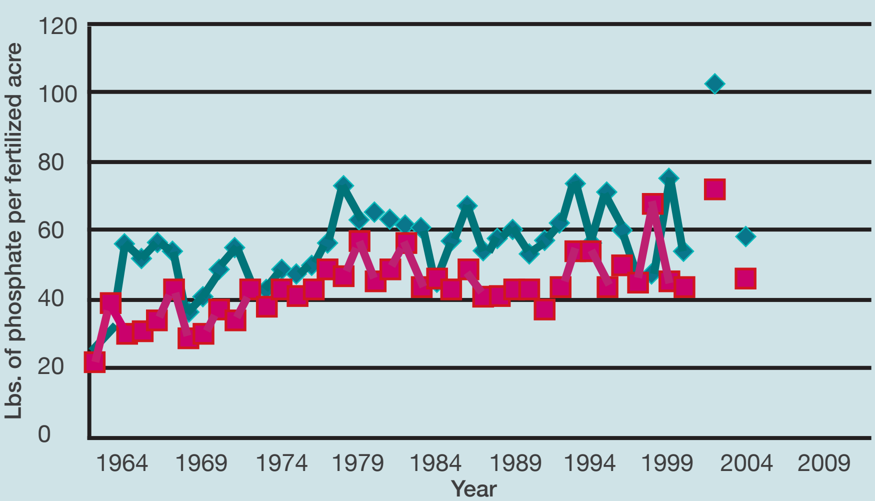
GRAPH. 7-2

APPLICATION RATE OF POTASH (POTASSIUM OR K) ON ACRES OF CORN RECIEVING POTASH FERTILIZER IN MISSOURI AND ILLINOIS, 1964-2010



GRAPH. 7-3

APPLICATION RATE OF NITROGEN (N) ON ACRES OF SOYBEANS RECIEVING NITROGEN FERTILIZER IN MISSOURI AND ILLINOIS, 1964-2007



GRAPH. 7-3

APPLICATION RATE OF PHOSPHATE (P) ON ACRES OF SOYBEANS RECIEVING PHOSPHATE FERTILIZER IN MISSOURI AND ILLINOIS, 1964-2006

> [T]oday approximately 85% of American corn and 91% of American soybeans are genetically engineered and estimations conclude that roughly 75% of all processed foods are comprised of genetically engineered products.[78]

Genetically Modified Organisms

Genetic engineering (GE) allows scientists to combine individual genes from different organisms (virus, bacterium, plant, or animals), put them together in a gene construct, and then introduce them into a target organism.[63] The result of such engineering is known as a genetically modified or "transgenic" organism creating a combination that would be unlikely to occur in nature through normal reproductive or plant breeding processes, such transgenic engineering as genes from soil bacteria inserted into corn.[64] Genetic engineering is used to gain "some perceived advantage either to the producer or consumer of these foods," including protection from plant diseases, an increase of "tolerance towards herbicides," tolerance of cold, and insect and virus resistance.[65]

Genetic engineering in America's food supplies has created a number of crops, most of which are designed to withstand chemical herbicides or to produce their own pesticide. The GE industry is a subset of the field labeled "biotechnology." However biotechnology is a term encompassing a vast area of the interface between biological organisms and technology.

The multi-national agriculture biotechnology company, Monsanto, originally a chemical company, is now a leader in the crop biotech industry.[66] The GE agriculture industry profits greatly from the modification of two main characteristics within an organism: Bacillus thuringiensis (Bt), which allows for insect resistance, and herbicide tolerance (HT).[67] Bt and HT are predominantly engineered into corn, cotton, soybeans, and canola.[68]

Monsanto has gone one step more with its Bt Corn and, through genetic engineering (GE), has inserted genes from the Bacillus thuringiensis (Bt) bacteria directly into the corn plant.[69] Bt is a natural soil bacteria that produces a protein called the Bt delta endotoxin that erodes the intestinal lining of corn borers that eat it.[70] In Bt corn, sweet corn, and potatoes, the pesticide - the Bt bacteria – is manufactured by the plant itself, in every cell. Farmers who want the protection are committed by contracts to purchase only Monsanto Bt seed. Under current regulations, consumers that want to avoid ingesting tortilla chips, potato chips, or corn syrup produced from crops that create their own Bt bacteria can only do so by buying certified organic food because food with GE ingredients is not labeled[71] and GE ingredients are in almost all processed foods (through ingredients hidden in processed food like canola, soy, corn, and beet sugar).[72]

> In 1990 Congress passed the Organics Foods Production Act (OFPA) [7 U.S.C.A. § 6501], which authorized National Organics Program. . . Under [these] standards, foods labeled "organic" cannot include bioengineered ingredients or be irradiated to kill bacteria and lengthen shelf life. Meats sold as organic cannot be produced from animals that receive antibiotics.[73]

Consumers can identify these foods by looking for USDA certified organic labels on food products.

Conveniently, Monsanto also produces the chemicals that are sprayed on genetically engineered HT crops, making Monsanto the industry leader. Roundup Ready® (or Roundup® resistant) crops can be sprayed with Monsanto's chemical, Roundup® (glyphosate), from the time the crop pokes through the soil until the crop begins to flower.[74] Today, over 90% of soybeans produced in the U.S. are Roundup Ready® soybeans carrying the Roundup Ready® gene.[75] Farmers seeking soybean seed that are not genetically modified often have difficulty finding the non-GE seed at their local seed store.

GM products have infiltrated our food system without action from Congress or federal regulatory bodies accounting for their management and release into the environment.[76] According to Thom Hartmann in his book Unequal Protection: The Rise of Corporate Dominance and the Theft of Human Rights, as a result of Monsanto lobbying efforts beginning in 1986 and weak regulations governing GM organisms,

> the dangers of genetically modified foods would be determined by the manufacturers, not the government, and testing would occur only when the companies wanted. No long-term studies have been conducted in the U.S. on the safety of consuming GM foods. And consumers were not to be notified if their food contained genetically modified organisms.[77]

As a result, today approximately 85% of American corn and 91% of American soybeans are genetically engineered and estimations conclude that roughly 75% of all processed foods are comprised of genetically engineered products.[78] In fact, USDA Economic Research Service reports that as of July 2014, 91% of all corn and 93% of all soybean planted in Missouri and 91% of both corn and soybean in Illinois are GE varieties.[79]

Since GM foods have only recently been integrated into the food supply, health risks, such as new food allergens, are not completely understood and can arise quickly without warning.[80] These allergens can occur because the genetic material in GM foods may have come from organisms not previously part of the human diet.[81] GM food poses other serious and unevaluated risks to animals, the environment, and specifically to humans, including higher risks of toxicity, allergenicity, antibiotic resistance, and immune-suppression.[82] Additional concerns are decreased nutrient content in food items and elevating toxins to hazardous levels in foods that normally have none or innocuous amounts.[83]

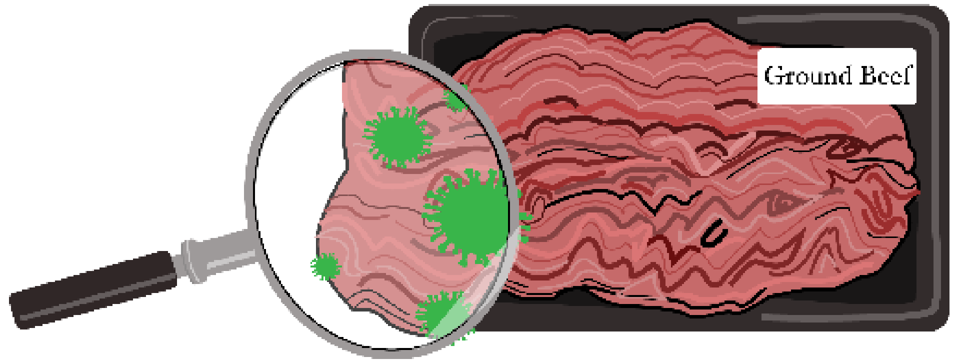
One environmental concern arising from the use of GM organisms is the risk of GM gene contamination of wild varieties.[84] As Horrigan et al. state, genes in plants engineered for herbicide resistance can "spread to wild relatives of those crops," which, as the Food and Agriculture Organization of the United Nations has concluded, could lead to superweed formation and increased difficulty in weed management.[85] A related concern over insect resistant crops specifically is the risk of insects building resistance to Bt, thereby destroying a naturally occurring pest management option.[86] Genetically engineered crops can also affect the larger ecosystem in unprecedented and unexpected ways, such as in the 2000 study that found one variety of Bt corn pollen "could kill the larvae of monarch butterflies in laboratory studies," after "over 20 million acres of Bt corn were planted in the United States."[87]

GM seeds also pose concerns for the farmers. Under the contract that GMO-using farmers must sign with their seed company, such as Monsanto, there is almost always a clause that bans farmers from saving their seeds to plant in the next planting season.[88] Unable to save seeds, farmers are forced to buy new seed every year,[89] forcing a relationship solely driven by profit between the farmer and the seed company.[90]

Overall, the risks associated with the consumption of genetically engineered organisms are not fully understood. However, financial and contractual risks associated with purchasing genetically engineered organisms are clear and substantial. While U.S. policy continues to allow these organisms to infiltrate our food system and does not require GM-containing food to be labeled, numerous countries have recognized the risks of GMOs and have taken action to restrict their use. These steps include mandatory labeling requirements and approval of far fewer GM varieties than the United States.[91]

Foodborne Pathogens

In addition to the water quality impacts of manure and chemical fertilizers, industrial food production is linked to high numbers of food-borne illnesses annually. "CDC estimates that each year roughly 1 in 6 Americans (or 48 million people) get sick, 128,000 are hospitalized, and 3,000 die of foodborne diseases."[92] CDC also states that four of the top five pathogens



that contribute to domestically-acquired foodborne illnesses resulting in hospitalization are most commonly transmitted to humans by consumption or ingestion of contaminated meat.[93] However, vegetables and fruits can be contaminated as well.

Two of the most common food borne-illness-related bacteria are Escherichia coli (E. coli) and Salmonella, which are well known to most Americans and enter the food system repeatedly, causing numerous food recalls annually.[94] Recent examples of E. coli-related disasters include the 2006 Dole baby spinach recall from a Natural Selections Foods processing plant that sickened 205 people and killed three[95] and more than 130,000 pounds of Tyson Fresh Meats Inc. ground beef recalled from nearly 20 states after four children were sickened and one hospitalized in Ohio (2011).[96] Salmonella-related recalls include "29,300 pounds of [Cargill's] 85-percent-lean ground beef" (2012),[97] nine brands of Diamond Pet Food manufactured across 16 states (2012),[98] 756 cases of Dole Seven Lettuces salad in 15 states (2012),[99] and over 380 million eggs that caused several hundred Americans to fall ill (2010).[100]

Foodborne pathogens usually originate in animals' stomachs and transfer to meat products by way of contact with an infected animal's stomach contents or manure.[101] Before the meat is wrapped in its Styrofoam tray, it can come in contact with bacteria on the high-speed production lines in slaughter houses and processing plants, where manure can drop from an animal's hide onto just-cut meat if the hide was improperly cleaned or where improper removal exposes intestines to meat.[102] Because of the massive quantities of meat in industrial scale processing plants, a single animal infected with E. coli O157:H7 can contaminate 32,000 pounds of ground beef.[103] Furthermore, the environment of CAFOs makes it easy for manure to get onto animal hides and spread to other animals because, as Michael Pollan points out, they "stand around in their manure all day long, eating a diet of grain that . . . turn[s] a cow's rumen into an ideal habitat for E. coli O157:H7."[104] Exposed animals can put livestock water at risk, increasing the risk of transferring bacteria.

A more localized food system would create more accountability in the food system and could help reduce large scale food contamination issues. When local consumers have a relationship with local producers, the incentives to focus on quality and to avoid shortcuts that would compromise safety are greater. In these more personal relationships, the producer's reputation is essential to securing consumer confidence.

By minimizing the conditions in which harmful bacteria thrive (such as industrialized feedlots) and reducing the speed and scale of the assembly line processing and manufacture of food, fewer consumers would be at risk for food-borne pathogen exposure from any single incident.[105] Further, the geographical distribution of outbreaks would significantly decrease if one contaminated product was not processed with millions of similar products and then distributed throughout the globe.[106]

An additional concern is the FDA's inability to regulate the safety of imported food. Internationally grown and processed food barely gets the FDA's attention.[107] As imports increase in the nation's food supply, the FDA has been able to inspect only about 1% of the imported food it regulates.[108] This leaves consumers vulnerable to health risks every day from imported foods which, as shown in Chapter 5, are an increasing share of the market.[109]

Antibiotics and Growth Hormones

Antibiotic use in livestock production is another issue prompting greater concern as its effects become more widely recognized. Antibiotics have long been used in sickened animals. However, as early as a half century ago, farmers began using penicillin and tetracycline in livestock to promote growth.[110] The livestock industry began to add the drugs to feed and water, even when there were no prescriptions or signs of sickness in the animals.[111] Today, approximately 80% of antibiotics made in the U.S. are used in animal production to boost growth,[112] even though studies show that their use allows for growth of resistant strains of microbes.[113] Further, as several studies have suggested, "nonmedical use[114] of antibiotics in animal agriculture may be threatening the effectiveness of antibiotics in treating human disease by creating selective pressure for the emergence of antibiotic-resistant bacteria."[115] In the spring of 2013, Representative Louise McIntosh Slaughter introduced HR 1150, the Preservation of Antibiotics for Medical Treatment Act to limit the use of antibiotics in livestock,[116] the fifth attempt since 2003 to pass a law to limit the use of antibiotics in healthy animals.[117] The bill has not moved forward in the House since its introduction and referral to the Committee on Energy and Commerce's Subcommittee on Health;[118] however, its existence illustrates the continued concern over antibiotic use in livestock and the need for new legislation.

In addition to antibiotics, growth hormone use in livestock production also raises health concerns. Consumers have taken notice of the use of recombinant bovine growth hormone (rBGH). The synthetic hormone, which is the man-made version of the naturally-occurring Bovine growth hormone or *bovine somatotropin (BST)*,[119] is used in dairy cattle to boost milk production.[120] Although U.S. dairy farms have used this synthetic hormone since the FDA first sanctioned it in 1993,[121] many countries forbid its use because of the possibility for adverse human health effects.[122] While rBGH use can increase milk production by approximately 10%, concern arises over the health of the cow,[123] such as increased occurrence of "bacterial udder infections in cows by 25 percent, thereby increasing the need for antibiotics to treat the infections."[124]

Possible human health risks exist as a result of increased levels of hormones in milk products as well.[125] A 1999 European Union study of growth hormone use in cattle found that residues in meat from injected animals could affect the hormonal balance of humans, causing reproductive issues and breast, prostate or colon cancer.[126] With about 22% of all U.S. dairy cows and 54% of large herds (500 animals or more) being treated with rBGH,[127] it appears American dairy consumers, including those in the Saint Louis Regional Foodshed, are exposed to this hormone on a regular basis.

Consumers who carefully read labels and seek rBGH-free dairy products do have options. A growing number of organic milk suppliers are now on supermarket shelves while some conventional dairies seek commitments from their producers to be "rBGH-free". Consumers also have the option of avoiding cow's milk altogether. Saint Louis Regional Foodshed consumers even have appealing cow-free cheese options. A growing number of farms are producing cheese from sheep or goat's milk. One of those, Baetje Farms, is found at regional farmers' markets. Baetje Farms, a regional farm located in Bloomsdale, Missouri, took home the "SuperGold" at the World Cheese Awards in 2011.[128]

Safeguarding Diversity: Heirloom Seeds

As defined by Seed Savers Exchange, an heirloom plant is "any garden plant that has a history of being passed down within a family."[129] Heirloom seeds are defined by some "as anything older than 50 years."[130] Small local farmers often use heirloom seeds with a history of success in the local environment.[131] While not all table crops can be produced in the Saint Louis Regional Foodshed, there are table crops that thrive in the region's local micro-climate and among those, certain varieties that perform particularly well. Heirloom are not hybrids, which means that heirlooms will produce offspring like the parent plant. Hybrids are bred from different parents, resulting in unpredictable offspring that may not resemble the hybrid parent. Planting heirloom seeds from the local area is one way to boost crop success.

Heirloom seeds are beneficial to the local food supply because "[p]lant breeders use the old varieties to breed resistance into modern crops that are constantly being attacked by rapidly evolving diseases and pests."[132] Maintaining the genetic diversity found in multiple varieties of plants safeguards genetic traits that can help improve plant vigor and resist pests and disease without dependence on chemicals. Growers and consumers who avoid chemically-treated food have options for their farms and their kitchens with heirlooms In addition, the flavor of heirloom crops is often better than industrialized agricultural products.

MAP. 7-2
DISTANCE TRAVELED BY COMMON FOOD ITEMS BEFORE REACHING ST. LOUIS REGIONAL FOODSHED

Fossil Fuels

Much of the Saint Louis Regional Foodshed's produce comes from national and international sources. For example, common fruit found in Saint Louis County grocery stores include Sunnyridge blueberries from Winter Haven, Florida (over 1,000 miles away); Driscoll's organic raspberries and Driscoll's strawberries from Watsonville, California (1,700 miles away);Suntreat summer navel from San Joaquin Valley, California (1,900 miles away); and Bluevalley blueberries from Abbotsford, British Columbia, Canada (3,600 miles away) (Map 7-2).

According to TheTruckersReport.com, semi-trucks average six miles per gallon of diesel fuel.[133] Assuming that one truck carried both the Driscoll raspberries and strawberries, 1,366.67 gallons of fuel were expended in order for these five fruits to reach the Saint Louis Regional Foodshed. These fruits as well as most other produce are shipped off multiple times each week to grocery stores across the nation. A portion of our food supply, especially produce, comes from other countries, as previously reflected in Graphs 5-10 and 5-11, requiring even more fuel. Even though most of the produce consumed in the United States is grown in the United States, those fruits and vegetables travel an average 1500 miles before reaching the supermarket.[134] Thus, fossil fuel consumption for food transportation is significant.

Producing and consuming food locally decreases the food sector's energy use simply by limiting the supply chain to local farmers and merchants. With fewer miles to travel and less need for packaging, the food industry consumes less energy while subsequently reducing the price mark-ups associated with the energy use of middlemen industries, which puts more money directly into the pockets of farmers and producers.[135]

In addition to all the miles traveled, our food system depends on fossil fuels in every step of the food supply chain from the field to the table. As Heller and Keoleian present in Life Cycle-Based Sustainability Indicators for Assessment of the U.S. Food System, "[a]griculture is ultimately a process of energy conversion: converting solar energy, along with various chemical and fossil energy inputs, into food energy that will sustain a human population."[136] As in much of modern society, fossil fuel has replaced human and animal labor. As farmers employ machinery, fertilizer, and pesticides, they reduce labor inputs per acre, allowing them to increase the acreage they can plant, cultivate, and harvest in many crops - especially the commodity crops of wheat, cotton, soybeans, corn, and rice.[137] Vegetable and fruit crops are often the exception, requiring hand picking at the peak of the season by farm laborers.[138]

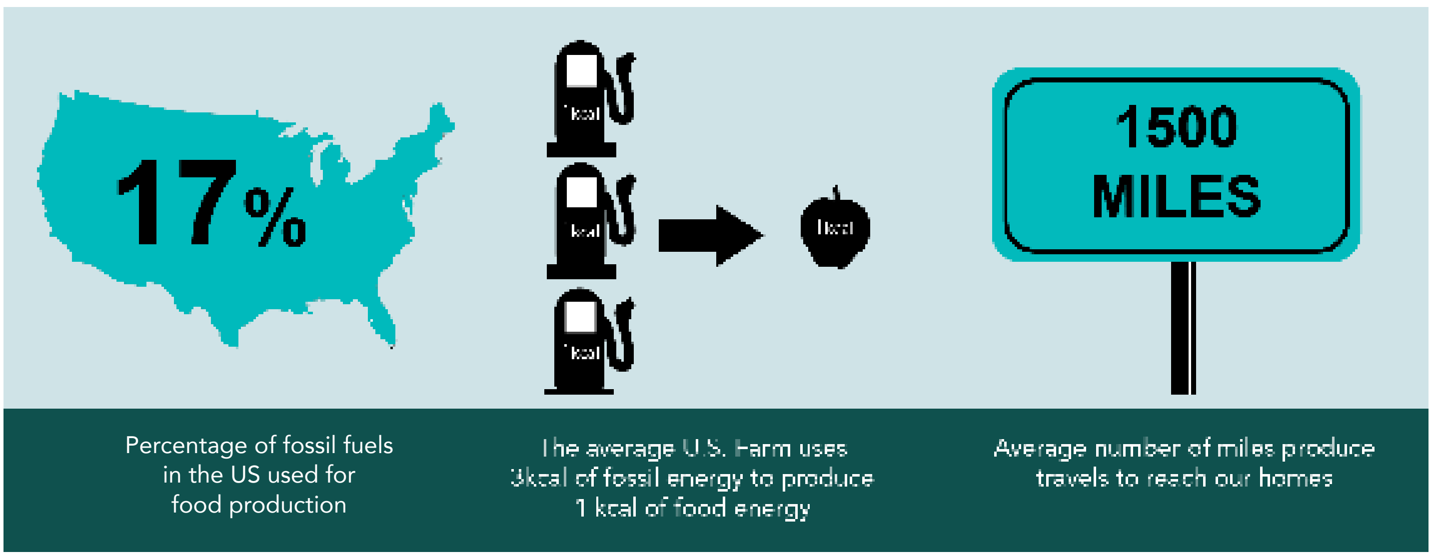
While the use of technological advances in agriculture "has allowed [for] greater yields in terms of bushels per acre as well as bushels per man-hour of labor," Heller and Keoleian argue "the energy conversion process has lengthened with the added step of "industrial (largely fossil) energy."[139] Fossil fuels power farm equipment, trucks, rail cars, processing plants, factories, and equipment. Fossil fuels still provide the bulk of fuel needed for America's electricity use, which we rely on to process, store, advertise, refrigerate, and prepare our food.[140] Pesticides and fertilizers are fossil fuel-based, produced from hydrocarbons by chemical manufacturing companies.[141] How long can Americans continue to rely on fossil fuels to such a degree for our food? How much of our national security and food security should depend on fuels that come with an increasingly higher political and environmental price?

Climate Impacts

Among the impacts to consider is climate change due to increased levels of carbon in the atmosphere. Factoring in the amount of land used solely to produce livestock feed, as Anna Lappé notes in The Climate Crisis at the End of Our Fork, it becomes clearer that

> [t]he more consolidation in the livestock industry[,] . . . the more land will be turned over to feed production. This production is dependent on fossil fuel-intensive farming, from synthesizing the human-made nitrogen fertilizer to using fossil fuel-based chemicals on feed crops. Each of these production steps cost in emissions contributing to the escalating greenhouse effect undermining our planet's ecological balance.[142]

The transportation system that provides the world with the food produced on industrial fields requires a significant amount of fossil fuels. The food production system accounts for 17% of all fossil fuel use in the United States, note Horrigan et al., and the average U.S. farm "uses 3 kcal of fossil energy in producing 1 kcal of food energy."[143] All this energy expense is for little gain when "produce can travel an average of 1500 miles just to reach our homes, only to lose its flavor and be quick to mold."[144]



Conclusion

By transitioning to a locally based, low-chemical food system, present industrial agriculture could be transformed into farming that creates a healthier environment, safer food, and a food system less vulnerable to distribution disruptions. Environmental benefits include biodiversity – pollinators, birds, reptiles and amphibians regaining their role in farm ecosystems. A local food system would provide another level of defense against food-borne illness. A local producer would avoid shortcuts or risks in his farming methods if he was selling directly to his consumers. Consumers have more influence (i.e. if a community does not want genetically engineered food or pesticides, they can influence their local grower to provide non-genetically engineered or organic food). This provides a safety net for consumers that is unavailable within the industrialized system, since consumers in industrialized agriculture are currently disconnected from most aspects of food production. By shifting the Saint Louis Regional Foodshed's agricultural framework to a local system in which farmers minimize chemical inputs and employ crop rotation, cover crops, and more diversified operations, and deliver food that is fresher and more nutrient-dense, the health risks associated with industrial food production may decrease.

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125. Recombinant Bovine Growth Hormone, supra note 119.
126. Food & Water Watch, supra note 124.
127. Id.
128. Baetje Farms LLC Bloomsdale Cheese, Baetje Farms; see also Our Story, Baetje Farms LLC (2009), http://baetjefarms.com/story.html.
129. Saving Heirlooms, Seed Savers Exchange, http://www.seedsavers.org/Education/Saving-Heirlooms/ (last visited Aug. 6, 2014).
130. Id.
131. Thies Farm is a small farm in the Saint Louis Regional Foodshed that produces heirloom tomatoes. See Plant List, Thies Farms, http://www.thiesfarm.com/plant-list (last visited Aug. 6, 2014).
132. Saving Heirlooms, supra note 129.
133. Making Semi-Trucks More Efficient, TheTruckersReport.com (2011), http://www.thetruckersreport.com/making-semi-trucks-more-efficient/
134. See Martin C. Heller & Gregory A. Keoleian, The Center for Sustainable Systems, Life Cycle-Based Sustainability Indicators for Assessment of the U.S. Food System 40-41 (2000) http://css.snre.umich.edu/css_doc/CSS00-04.pdf ("Fresh produce in the U.S. travels an estimated 1500 miles, primarily because 90% of all fresh vegetables consumed in the U.S. are grown in the San Juaquin Valley of California.").
135. Incorporating organic practices into local food systems further reduces fossil fuel dependency by eliminating the hidden fossil fuel costs of transporting and packaging of pesticides and chemical fertilizers. Further, chemical fertilizers contain nitrate, a by-product of natural gas and an important compound for increasing production.
136. Heller & Keoleian, supra note 134, at 39 & n.143.
137. See G. Miller & Scott Spoolman, Living in the Environment: Principles, Connections, and Solutions 282 (2009), http://books.google.com/books?id=5gC9Dy1YWfkC&dq.
138. See Linda Calvin & Philip Martin, U.S. Dep't of Agric., Econ. Research Serv., Labor-Intensive U.S. Fruit and Vegetable Industry Competes in a Global Market, Amber Waves, Dec. 1, 2010, http://www.ers.usda.gov/amber-waves/2010-december/labor-intensive-us-fruit-and-vegetable-industry-competes-in-a-global-market.aspx#.U-LbQlaChT4 (stating that the fruit and vegetable industry is labor intensive and discussing the significant impact of cost and availability of labor on a grower's profit).
139. Heller & Keoleian, supra note 134.
140. Frequently Asked Questions - What is U.S. Electricity Generation by Energy Source?, U.S. Energy Info. Admin., http://www.eia.gov/tools/faqs/faq.cfm?id=427&t=3 (last updated May 9, 2013). In 2013, Americans depended 39% on coal, 30% on natural gas, and 1% on petroleum for electricity generation. Id.
141. Howard Frumkin, Jeremy Hess, & Stephen Vindigni, Energy and Public Health: The Challenge of Peak Petroleum, 124 Public Health Rep. 5, 13 (2009), http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2602925/pdf/phr124000005.pdf.
142. Anna Lappé, The Climate Crisis at the End of Our Fork, in Food, Inc. 105, 111 (Karl Weber ed., 2009).
143. Horrigan et al., supra note 3, at 448.
144. Gateway Greening, http://www.gatewaygreening.org (last visited Aug. 6, 2014); see GatewayGreening: Building a Community Garden, YouTube (Sept. 9, 2012) http://www.youtube.com/watch?feature=player_embedded&v=Gwpx_FTqI80#!.